

Article

A Systematic Review of the Business Contingencies Influencing Broader Adoption: Modern Methods of Construction (MMC)

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Abstract: The existing body of knowledge on the Modern Methods of Construction (MMC) reflects their benefits and relative advantages, particularly in addressing contemporary construction challenges. However, the uptake of such methods is minimal, particularly in the public construction sector. The low uptake has led MMC firms to liquidation due to the lack of an economy of scale. Studies, particularly recently, explain that the low adoption rates are linked to the inappropriateness of existing business models responsible for driving broader demand. This paper assumes that the lag in MMC adoption could be related to the ability of supply business models to communicate confidence to demand. Public clients are foreseen as important target customers, acquiring influential status across the industry, with an expected potential to drive innovation adoption across the sector. A systematic review method allows scholars to assess existing literature by critically locating and analysing relative publications to approach the study's aim. Through utilising this method, the study classifies the arguments against the Business Model Canvas (BMC), and argues the results with respect to contingency theory, and in turn, synthesizing a new meaning that reveals the considerations needed to boost business model performance when penetrating the public sector. Hence, the critical analyses of 70 studies relative to MMC, led to proposing the contingencies that are believed to better structure business models. Results suggest that MMC firms can embrace specific reforms and gain more momentum when communicating confidence to public client organisations; however, a guideline that conceptualises the interactions between the elements and their influence on the decision-making does not exist, and this may be inhibiting coherency on how MMC businesses drive broader demand. To the authors' knowledge, this is the first study to utilise the contingency theory as an attempt to disseminate previous efforts to explain the low adoption of MMC in the UK public sector.

Keywords: modern methods of construction; business models; public sector



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1. Introduction

The construction industry is being pressured to evolve and sustain an acceptable level of enhancements, particularly in speed [1], cost [2], and environmental considerations [3]. However, such enhancements are not deemed possible in an overly fragmented industry that is mostly dominated by traditional ways involving vast onsite activities [4]. To address this, researchers focus on introducing broader control as a considerable gateway [5]. The Modern Methods of Construction (MMC), over the years, transpired to offer research and practice a controlled environment when delivering building, domestic and non-domestic, construction projects. However, albeit the governmental “presumption in favour” stance [6], MMC uptake is still very limited [7]. The academic body is developing interest in explaining the low adoption rates, such as studying its complexity [8], digitalisation capability [9,10], historical origin [11], supply chains [12], and market demand [7]. However, less attention is being given to study firms offering these building solutions.

The shift from a longstanding way of construction to one that demands a fundamental transformation is associated with a change in the relative business models, a reality that is described as not yet realised [13]. The significance of appropriate business models has been described as the first condition for better MMC adoption [14]. The literature herewith emphasises the importance of improving currently utilised models, yet the needed improvements remain uncaptured. Knowing that MMC uptake is low in the public sector [15,16], public clients attain characteristics that can be argued to drive innovation adoption in the whole construction industry due to their unique nature and demand [16,17]. In the construction context, these clients have been described as the ‘gatekeepers’ in promoting innovation across the industry [18]. Enhancing MMC uptake among public clients would therefore influence less dependency from the public sector on conventional methods currently dominating over 70% of all new developments in the United Kingdom [19]. If these influential organisations adopt MMC as a practical solution, other organisations will follow, thereby accelerating innovation adoption across the construction sector [20]. Studies focusing on the public sector described public clients as ‘a change-restraining force’ for MMC diffusion, calling for research in the same direction [21]. However, although influential in their procurement power, Gustavsson [22] underlines that change among public clients are not easily achieved. To address this, identifying the non-technical inhibitors that are undermining wider MMC adoption in the public sector is described as imperative [23]. Therefore, a knowledge gap presents itself amidst the lack of efforts to justify the low adoption rates of MMC despite the demonstrated benefits, driving the aim of this study to explore the contingencies that can enable MMC organisations to broaden their business prospects in the public construction sector.

Terminologies overlap to describe the Modern Methods of Construction as Prefabrication [24], Offsite Production (OSP) [25], Industrialised Construction [26], Modular Construction [27], and Modern Methods of Construction [28]. It is acknowledged that the variety of terms used means that confusion could arise [13,29]. This paper, though, is mainly focusing on the public sector, and thus adopts a relative definition by the UK Cabinet Office [30]; “MMC is a wide term, covering a range of offsite manufacturing and onsite techniques. MMC provides alternatives to traditional methods and has the potential to deliver significant improvements in productivity, efficiency and quality for both the construction industry and public sector”, where authors use the term MMC exclusively and interchangeably throughout this paper. This study perceives the term ‘MMC’ from the same view of Green [31], who states that “it is here that the research community has a responsibility to act as an institutional memory” when looking at the issue of definition and conceptualization of the terminology. Therefore, this paper adopts MMC as a cluster of new ideas rather than only one new idea, aligning with Rogers [32], who states that innovations “maybe perceived as an interrelated bundle of new ideas. The adoption of one new idea may trigger the adoption of several others.”. The clustering of the UK government included defining MMC by categorising it to seven different categories [33]. These are as follow:

- *Category 1: Pre-Manufacturing—3D primary structural systems*
- *Category 2: Pre-Manufacturing—2D primary structural systems*
- *Category 3: Pre-Manufacturing—Non-systemised structural components*
- *Category 4: Pre-Manufacturing—Additive Manufacturing*
- *Category 5: Pre-Manufacturing—Non-structural assemblies and sub-assemblies*
- *Category 6: Traditional building product-led site labour reduction/productivity improvements*
- *Category 7: Site process-led labour reduction/productivity improvements*

This study classifies, and reveals, how MMC organisations can drive broader MMC uptake in the public sector by reinventing their business models to better communicate confidence. The following sections sequentially detail the theoretical underpinnings (Section 2), the method substantiating the use of a systematic review of past literature (Section 3), the characteristics of the included articles (Section 4), the critical analysis of the included articles

(Section 5), and finally, the discussions and conclusions of the findings in accordance with the utilised theory, respectively (Sections 6 and 7).

2. Theoretical Underpinning

2.1. Business Models

The literature argues that contractor business models may be a potential inhibitor to wider MMC adoption. The development of suitable business models is increasingly becoming a necessity to ensure that the benefits of MMC are effectively exploited [34]. This development should include deliberations when approaching the new and changing requirements of modern processes [35]. Darlow [36] reports the potential of business models to steer the market toward an MMC's direction, through effective communication of clear commitments, such as justifying the use of these methods. Goulding [37] reports the need to find alternative business models to communicate the values that can lead to better diffusion of MMC. Existing literature surpasses the importance of developing MMC-suitable business models to drive industry behaviour and reports that the role of business models could be of far more significance in creating a market rather than only influencing it [14]. The same study provides a variety of examples where MMC providers are deemed successful when tweaking their models to better approach demand. Hence, the existing body of knowledge supports the reasoning behind changing business models to drive the industry toward better MMC uptake [14].

The study adopts the Business Model Canvas (BMC) by Osterwalder [38]. This model helps categorise and extract improvements needed to reinvent a robust MMC business model with a particular focus on the public construction market. The term 'Business Model' evolved from being initially a buzzword to dominating a significant portion of business research [39]. It is foreseen to dominate as a unit of analysis to systematically determine how value could be captured [40]. Teece [41] underlines delivering value through the critical understanding of customers and converting this value into profit. One of the most popular tools that can aid in forming a robust business model is BMC, which offers a representation of the components considered critical in building a successful business model [42]. Nine elements, hence, define a firm's fundamental business approaches toward its relevant market (see Figure 1).

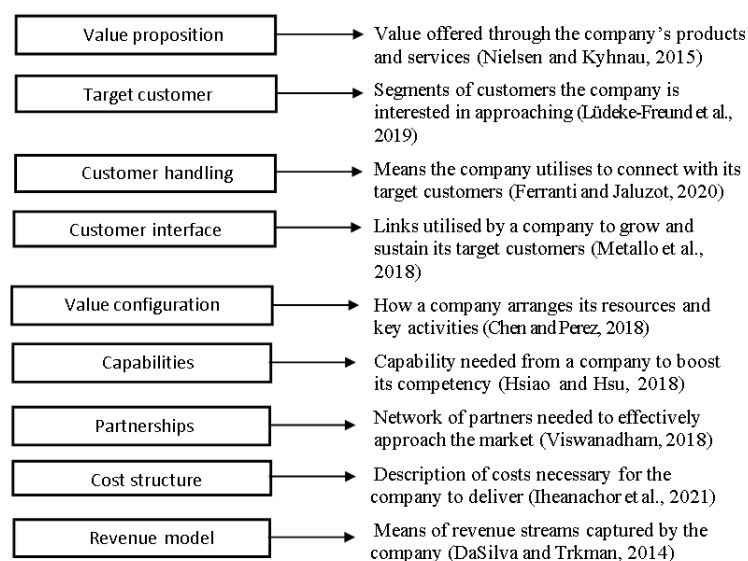


Figure 1. Nine business model elements—modified from Osterwalder [38]. **Note(s):** Nielsen 2015 [43], Lüdeke-Freund 2019 [44], Ferranti 2020 [45], Metallo 2018 [46], Chen 2018 [47], Hsiao 2018 [48], Viswanadham 2018 [49], Iheanachor 2021 [50], DaSilva 2014 [39].

2.2. Communicating Confidence

Confidence is a key intention determinant for an individual or an organisation toward a specific choice [51]. In a client context, practitioners have been argued to attain the ability to influence clients' confidence [52]. The perception that specific goals can be pursued, and reached, would drive higher confidence irrespective of other influencing elements [53]. Such change in confidence is nurtured by the ability of businesses to advise clients, as the transmittal of reliable information would drive motivation [51]. The matter of building client confidence, therefore, is linked to the responsibilities of supply by their competency to influence demand. This is supported by scholars such as Price and Stone [54], who link the communication of confidence, in the lack of information, to their confidence in the provider, which influences their overall judgement. This research task, hereby, disassembles the supply's business model elements to reveal the most significant indicators that are driving public clients' confidence in the MMC market.

2.3. Contingency Theory

Contingency theory can reflect the influence of combining parameters to achieve a fit between a concept and its environment [55]. This fit, once internally achieved, would yield external congruence [56]. In the context of business models, a consensus among scholars emerges on the importance of achieving a level of consistency among the business model elements [41,57]. Such consistency would indicate alignment between internal business model processes, which is critical for external success [58], and a key influence on a firm's competitive advantage [59]. Overall, the matter of business model consistency has been described as powerful, but also as the most "neglected aspect" [60]. This research, therefore, aims to reveal how such a fit can be internal through the relationships between the nine business model elements, and external through the impact of the business model elements on influencing greater levels of MMC business in the public sector i.e., congruence with the number of delivered public projects.

Linking contingency with business survival, Drazin and de Ven [61] assume that fit reflects the best-performing businesses, whereas, in contrast, organisations that don't achieve such a fit are assumed to fail. Gimeno et al. [62] state an argumentative statement of "survival of the fittest" when exploring the reasons behind firms that succeed and others that fail, although vast similarities exist. A recent report by Atradius, a global insurance company, predicts that the current market conditions would mean that the UK construction industry is inbound to witness as high as a 25% increase in insolvencies in 2022 alone. The report, meant to study big-name construction firms, did not distinguish between traditional and MMC firms, which understandably, would accommodate the more vulnerable MMC businesses due to the lag in achieving an economy of scale [9]. The Company Insolvency Statistics 2022 rates, for the last quarter are confirming the prediction as the UK construction industry witnessed 4143 insolvencies constituting alone, 19% of all national insolvencies (see Figure 2). To link the statistics with recent news, different resources were cited to reflect the impact of the current situation on MMC businesses (see Table 1).

This paper, therefore, aims to explore sufficient reasoning, through qualitative means of reviewing past research efforts, to identify the indicators that differentiate between low-performing and high-performing MMC organisations when penetrating the public construction sector, and explain both the influence and significance of the interactions between business model elements to achieve fit through contingency and congruence. The research question of this paper is:

RQ1. What are the contingencies that may enable MMC businesses to communicate better confidence by achieving fit?

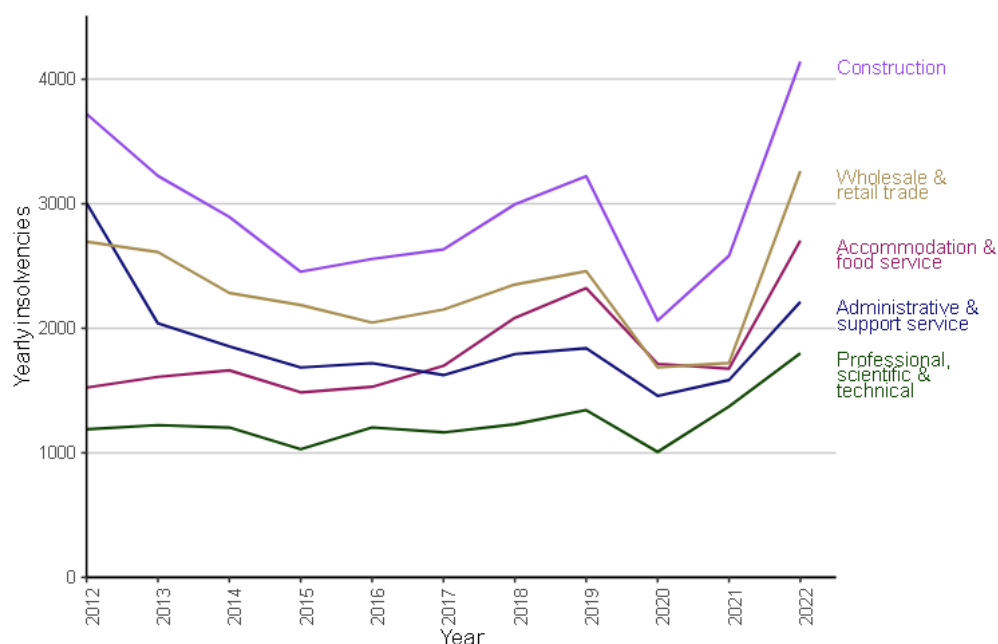


Figure 2. Company Insolvency Statistics—October to December 2022 (from The Insolvency Service [63]).

Table 1. News coverage mentioning MMC businesses.

Source	Title
Business Sale Report [64]	Administrators exploring sale as modular builder collapses
Gerrard [65]	Collapsed offsite business sold to timber frame specialist
Churcher [66]	Ex-employees poised to take legal action over the collapse of Caledonian Modular
Building [67]	Problems at modular factory caused collapse of Urban Splash House
Gardiner [68]	Ideal Modular undergoes pre-pack administration
Clark [69]	Collapsed Homes England-backed modular housing firm owed creditors £19m

3. Materials and Methods

Despite that a systematic review methodology can be used to satisfy quantitative methods, it also allows scholars and researchers to qualitatively collect and assess existing works [70,71]. The process is initiated through an extensive review of the literature and the choice of a suitable database [72]. Scopus offers coverage of vast peer-reviewed journals and is considered the most extensive database globally [73]. Due to its reach of relevant publications, the search resulted in a broad exposure of recent Q1 papers, leading to the inclusion of 70 quality papers from peer-reviewed journals, whilst eliminating the need to consider other databases. Overall, the use of comparable qualitative methods has been described as limited in past MMC-related publications [74].

Articles have been included based on their relevancy and suitability to the aim of this study [75], such as publishing date being in the last decade, the inclusion of empirical data, corresponding to quality journals, and comprising insights that can feed into the nature of this study. Keywords are formed on the firm base to include as many research papers as possible from the last decade, restricting the extensive search to the terms most used referring to MMC. The search set is formed as “Modern Methods of Construction (MMC)” or “Offsite Construction (OSC)” or “Modular Integrated Construction (MiC)” or “Industrialized Building Systems (IBS)” or “Prefabricated Construction”. The first search on Scopus has been initiated in May 2022, enabling the inclusion of recently published studies, which adds the new outline advantage to the overall search, providing readers with an overview and discussion of new publications. As shown in Figure 3, there is a

spike in publications in 2021, informing emerging interest in research relative to MMC, particularly in the last five years.

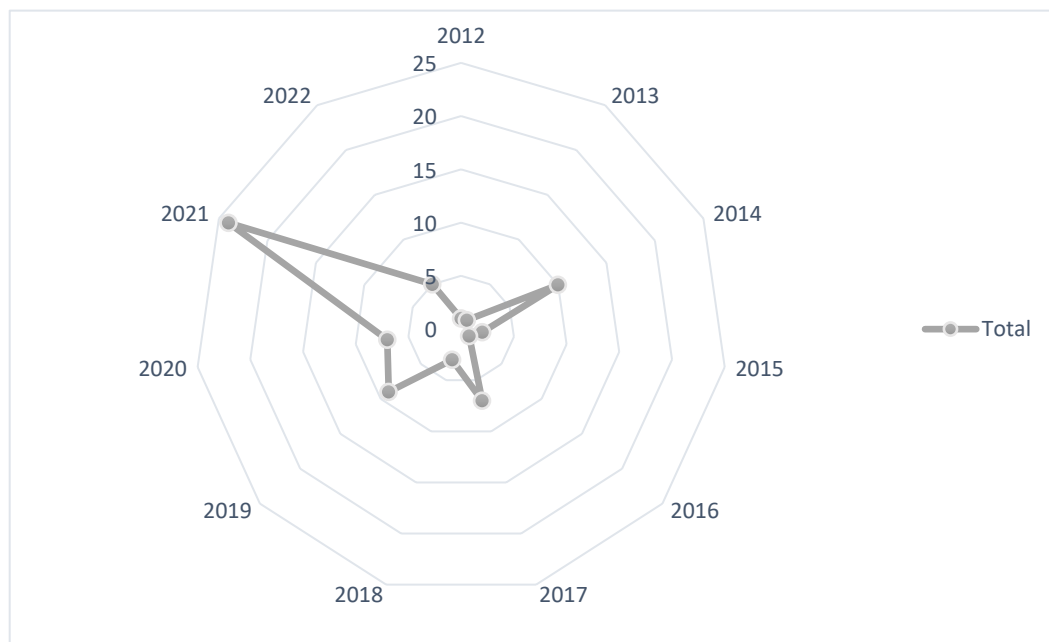


Figure 3. Count of articles against publication year.

A thematic approach has been adopted in this paper to critically analyse literature in line with the nine elements discussed in the BMC. It is designated as a criterion of structured analysis that extracts information from large quantities of literature [76]. This analysis choice allows researchers to derive patterns and trends to understand and explain the data set [77]. Braun [78] underlines a procedure in which a thematic analysis could be thoroughly applied. The process includes the alignment of codes and patterns, developing themes, categorising data to each corresponding theme, and finally reporting overall results and discussions (see Figure 4). Data are classified in isolation from their context, based on repetitive content, as patterns are clustered into themes that relate to the study's aim [78].

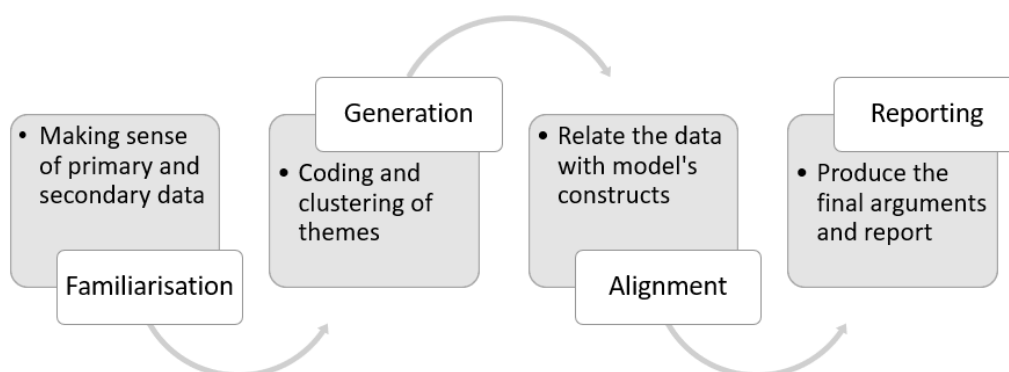


Figure 4. Thematic analysis process.

4. Results

The search includes 70 articles passing the inclusion–exclusion criteria of relevancy (see Table 2), nourishing the main aim of this study, across 13 Q1 ranked journals by SCImago (see Table 3), a novel instrument used to rank and evaluate the impacts of journals [79]. Wing [80] praised most of these journals, describing them as pioneers in leading the body of knowledge, particularly in Construction Management. Based on that, sustaining an

added value of a quality approach ensured the inclusion of the most recent studies while maintaining a high-rank stance.

Table 2. Inclusion–exclusion criteria of relevancy.

No.	Checklist
1	Is the article construction related?
2	Does the article include an MMC-related objective?
3	Is the methodology and methods used clearly defined?
4	Is there a clear contribution to knowledge?
5	Does the study depict clear and coherent results?
6	Can the findings be interpreted against the objectives of this study?
7	Can the findings be used to propose potential variables that can enhance MMC adoption?

Table 3. Number of articles against the peer-reviewed Journals.

Journal	Count of Articles
Automation in Construction	12
Construction Management and Economics	11
Journal of Cleaner Production	10
Construction Innovation	8
Engineering, Construction and Architectural Management	7
Sustainability (Switzerland)	6
Journal of Construction Engineering and Management	6
Architectural Engineering and Design Management	3
Sustainable Cities and Society	2
Journal of Architectural Engineering	2
Structures	1
Journal of Management in Engineering	1
Buildings	1
Total	70

Source: Authors' review data (February 2022).

5. Analysis

Our knowledge of how MMC firms are shaping their business models to effectively penetrate the public construction market is limited, and the complexity of the dynamics involved can explain the low uptake. To simplify associated complexities, this study utilises the Business Model Canvas to help extract and classify the critical business elements. As shown in Figure 5, the research process included a rigorous screening process and analysis.

Such factors, extracted through thematic analysis of the Business Model (BM) elements and extensive MMC research, would highlight the considerations needed to form a robust MMC business model and explain the relationship between the BMC elements in the MMC setting. To the authors' knowledge, no other research reports a similar relationship, neither in the MMC context nor in the public sector, aiding the novelty and originality of this work. This section argues the identified themes in line with the nine business elements of the BMC, providing a critical investigation of the contingencies believed to influence each element, and these are listed as subsections relative to the nine elements.

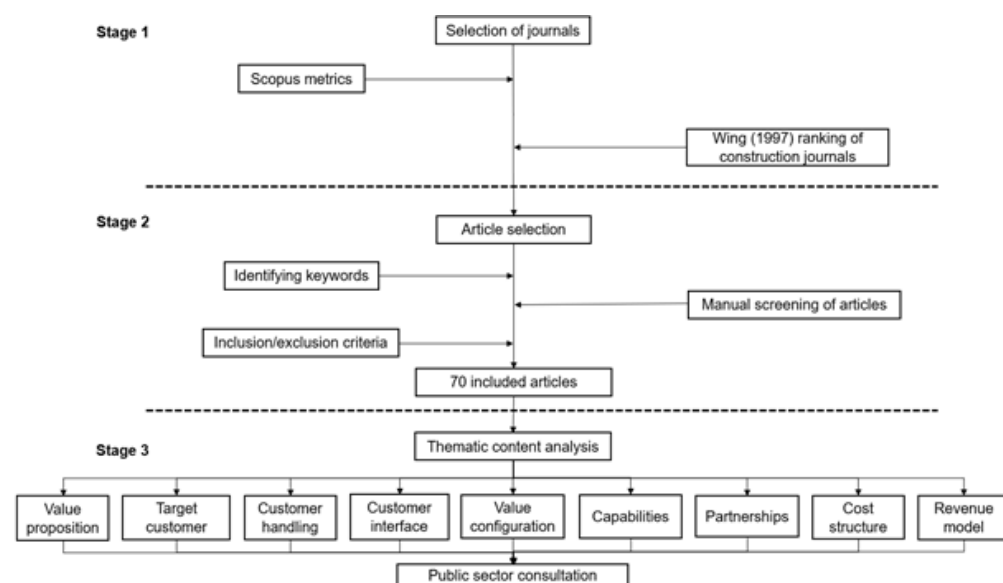


Figure 5. Research process.

5.1. Value Proposition

The value proposition element is where a company locates and offers the values customers want [81]. Hairstans [82] indicates that old-fashioned business models lag in achieving a compelling value proposition element by failing to demonstrate MMC benefits. Thus, this subsection extracts the subthemes of value propositions that can influence greater confidence by depicting values in cost, time, carbon, waste, and convenience.

5.1.1. Cost Values

Cost reduction was described as a primary reason for real-life scenarios where clients chose to adopt MMC [83,84]. Langston [85] reports an expert opinion for which MMC could be deemed valuable for customers since it can prevent additional and uncounted costs imposed by contractors that are usually easier made onsite but minimised offsite. However, cost savings might not always be the value outcome clients seek by using MMC, discouraging more adoption [86]. To address this, Iuorio [87] reports that MMC can be associated with considerable cost savings. However, the issue is how firms propose a value, not emphasising how such savings are made, such as lower energy consumption. Hence, compared to traditional methods, cost reduction is being described as a significant influencer needed to be explicitly applied by firms through clear commitments while developing the value proposition element in their business models.

5.1.2. Time Values

Time is described as a vital aspect that influences clients' adoption of MMC [83]. A case study of two multi-story residential buildings reports a 30% reduction in time than traditional methods in both projects [85]. Nevertheless, the time aspect is occasionally neglected as a significant value drawn by MMC and, in exceptional cases, crucial to accommodating strict deadlines. For instance, relevant to education developments, MMC could fit well in completing major construction projects on tight schedules such as school holidays [88]. However, MMC does not mean that construction will be quicker unless processes are managed to ensure that the work is not slowed down, keeping the production line continuous [15]. Hence, companies may provide strict deadline commitments while reflecting the value of their services and products to emphasise the ability of MMC to be immensely quicker than conventional methods.

5.1.3. Carbon Values

There is a growing tendency to follow sustainability codes and regulations in newly built developments, where unsurprisingly, MMC is more compatible than traditional construction. Clients are leaning towards greener construction and long-term sustainable outcomes [89]. MMC can attain far greater sustainability values offered by monitoring the material production phase, which accounts for over 95% of the environmental impacts [90]. In addition, firms are pressured to provide sustainability certifications for their products and materials to underpin these environmental values [91]. Sustainability, indeed, transpires as a vital MMC advantage over conventional methods, substantiated by offering proof of compliance followed by firms to develop a robust value proposition in their business models. However, this remains a tentative assumption due to the discreteness of literature in providing empirical data that pinpoint how sustainable advantages are being communicated.

5.1.4. Waste Values

Reducing waste in construction projects may not be an exciting aspect in line with regular client preferences, yet achieving such reduction could be associated with vital values. MMC provides an ability to better track waste and improves recycling prospects [15]. Iuorio [87] reports that MMC adoption is attributed to 90% more waste minimisation than conventional methods, acting as a vital value and commitment for customers. Another study indicates that MMC could reduce material waste to less than 3% of the overall material usage [92]. However, Ayinla [93] argues that MMC does not necessarily reduce waste as many perceive it unless lean approaches such as repetition and automation are effectively adopted. Hence, for MMC providers to achieve an adequate value proposition to their customers, substantiating their ability to minimise waste and the values associated with the client, particularly from such reduction, is deemed vital.

5.1.5. Convenience Values

A common occurrence in traditionally constructed projects is the disruption caused to the surroundings fuelled by the uncontrolled nature of such methods. Dowsett [94] reports that the choice of MMC in a case study reflected less dependency on having multiple accesses to the site, which is deemed significant, especially in congested areas, reflecting another value of MMC. Moreover, convenience is reported to expand to MMC project stakeholders through more minor requirements for storage spaces, fewer errors, and enhanced safety [95]. Similarly, the greater the utilisation of MMC, the less requirement for onsite labour, achieving minor inconveniences for all stakeholders [17,96]. Hence, this value means that construction would not jeopardise clients' relationships with the surroundings but also achieve considerable convenience for everyone directly and indirectly involved.

5.2. Target Customer

As highlighted in the introductory section, this study focuses mainly on public clients. The reason behind this focus is drawn from the ability of public clients to drive the adoption of innovation [97], as well as being considered the most prominent construction clients [85]. Clients, in general, show resistance to adopting MMC despite its benefits [15]. Hence, understanding how supply is targeting the public sector may aid our understanding of the flow of confidence.

5.2.1. Experience in the Public Sector

Although MMC's factors align with public clients' needs, driving public clients to adopt such methods is not a straightforward process. They discourage new approaches by nature, preferring traditional norms and practices [84]. In their decision-making processes, studies reflect that often public clients issue the design early and lock their requirements which halt the gateway to adopting MMC [98], making it difficult for MMC contractors to drive the decision while sustaining the benefits. Nevertheless, Chen [47] discusses

that contractors' capability to provide an impressive portfolio could attract public clients. However, the same study reports that these clients would strictly require their requirements to be met and may not be as flexible as regular clients. Hence, experience with public clients and well-regard for their characteristics may enhance the target customer factor within a business model. The level of past experience of a firm in public sector works, hereby, would reflect the level of readiness that can better communicate confidence.

5.2.2. Awareness of Public Sector Needs

In approaching a unique target customer, it is necessary to understand the clients' needs and interests. MMC is merely excelling by ensuring that such skills are well-regarded, allowing the workforce to focus on their specialities rather than getting involved in physical activities, as is usually the case in conventional methods [99]. Moreover, ref. [87] reported a case where Leeds City Council (LCC), in West Yorkshire, had an interest in energy efficiency and the environment, leading to their development of a Leeds Standard specifying relevant sustainability requirements for new build houses, and MMC was a gateway to meet the developed standard. Public clients recognise such benefits in significant developments due to the sole commitment to pursuing net-zero goals. For instance, the Department for Education (DfE) initiated a £4m MMC project called GenZero to harvest the environmental values offered in delivering 200 schools each year [88]. Hence, public clients differ from private ones in terms of needs, attaining an expanded set of interests, and the comprehension of these needs may aid the development of a target customer element that communicates confidence.

5.2.3. Customer Handling

In the Business Model Canvas, the customer handling element presents the strategy of a company to reach and communicate with its target customers [45]. In other words, it is how a company relates its offerings and businesses to the targeted market. Hairstans and Smith [82] report that marketing in the case of MMC is not a simple task with existing media options, where channels that ensure and govern the company's exposure to approach suitable audiences are deemed significant. This subsection, therefore, includes the subthemes that may indicate the effectiveness of a customer-handling element of a business model.

5.2.4. Admittable to Public Procurement Agreements

Public procurement agreements are argued to be an effective communication channel that promotes MMC in the public sector [15]. Oti-Sarpong [20] described how leveraging MMC projects through Public Procurement Frameworks would facilitate better adoption. For instance, such agreements have been described as key communication channels between stakeholders [86]. Hairstans [82] discusses the importance of public procurement frameworks in facilitating vital local knowledge exchange that can influence MMC market growth. The knowledge exchange in MMC projects influences decision-making processes by paving avenues for constructive debates toward combining different experiences and domains into one solution. As a result, public procurement channels form a potential entry for contractors into the public sector, allowing direct communication with public clients. Such channels also minimise the dependency on media that is not perceived as effective [100]. Based on the need for guidance to drive clients' MMC adoption [88], thus, public procurement can act as a potential avenue where public clients are approached. Hence, public procurement agreements could act as communication channels when communicating confidence in the customer-handling element of a business model.

5.2.5. Alignment with Public Sector Policies

Gaining the public sector's confidence would require a level of alignment with the policies expected by contractors approaching the public sector. Public clients may not acquire detailed construction experience and knowledge, but they trust the Public Pro-

curement Act and the processes imposed by public procurement frameworks [98]. In that sense, respective policies exist in the public client context and are vital for contractors to meet when communicating confidence [83]. Contractors could approach such policies as a critical strategy within their customer handling development which would facilitate their admission to public procurement agreements. However, Eiksson [84] conveys that contractors tend to misalign with the same by following a quick profit short-term strategy. Hence, understanding and complying with the policies imposed on public clients is a strategy that is being deemed vital in better reaching public client organisations.

5.3. Customer Interface/Relationship

The customer interface is a business model element that describes strategies adopted by firms to grow and sustain healthy relationships with their customers [46]. Innovation research indicates that if a process is changed from a traditional practice, this would require a change in the customer interface element [101]. MMC companies have yet to build upon this support by effectively managing their customers through achieving brand awareness and loyalty [14]. Hence, an effective customer interface could influence a substantial MMC business model that communicates confidence.

5.3.1. Confidence through Public Client Relationships

Public procurement offers an opportunity for long-term relationships, which are vital in influencing a stronger “pull-mechanism” toward the market’s MMC adoption [14]. The existing body of knowledge emphasises the need to study the potential avenues where MMC could be directed to a more collaborative environment [102]. In the case of MMC, early collaboration is described as a vital condition for the effective implementation of MMC projects [103]. Similarly, Larsson [8] reported that MMC reflects a long-term stance (processes) rather than shorter terms (projects), which implies that the longer the relationship is when adopting MMC, the better the results are to capture its values altogether. In addition, the absence of such long-term relationships means that costs are subject to increase [104]. Thus, developing a customer interface element that sustains relationships with public clients would better exploit MMC characteristics and drive more adoption.

5.3.2. Confidence through Public Client Involvement

Clients are described as ineffective in providing their exact preferences due to their irrelevant backgrounds, which may influence the company’s ability to understand the required needs [5]. In the MMC context, many approaches could be perceived as potential opportunities that supply could adopt to help sustain and grow the demand through collaboration [105]. Digitalisation could minimise clients’ concerns, allowing the firm to capture the exact needs and sustain a practical customer interface element. For instance, the ability to harmonise a “common language” among stakeholders from different disciplines through visual controls proves effective [99]. The benefits of visualisation extend from placing the owner in the centre of the construction process to post-completion such as maintenance [87]. The importance of such a strategy is justified by the cognitive nature of humans to process complexities better when visualised [100]. Thus, visualisation would drive clients’ engagement and enhance the customer interface element of a business model.

5.3.3. Confidence through Consultation

There is a need to aid informed decisions toward the appropriate choice of methods [93]. Literature reflects that construction clients would require help in choosing the system or method [106]. Uncertainty and lack of proven usage of MMC could act as a vital influence on clients’ decision-making processes [8]. Therefore, it is paramount to offer an “evolutionary” manner where clients could perceive and observe the successful outcomes, over time, prior to their actual adoption [102], p. 564. Moreover, utilising digitalisation to aid clients in confirming options based on their optimisation in line with the required preferences [107,108], emphasising feedback [94], and early client involvement, which

would provide a comprehensive understanding of their needs [88,109]. Hence, advising clients towards the optimum substantiated MMC type through understanding their needs would sustain a practical customer interface element of a business model.

5.4. Value Configuration

Value configuration elements of a BMC reflect the key activities and resources required for the firm to conduct business [47]. A company's value configuration element is to approach value by ensuring activities and resources favour the other elements [110]. This section provides a critical analysis of the literature to reflect the practices that can enhance the handling of resources toward better-approaching demand.

5.4.1. Confidence through Competent Human Resources

Trades and experiences have been discussed differently across the literature. Goh [111] describes that multi-trade skills are usually perceived as beneficial due to their flexibility in tackling various tasks. However, due to work being on an hourly basis and not on cycles, issues with resource allocation may lead to critical delays [112]. Meiling [113] reports the significant need to change the work culture by enhancing internal communication; this could be approached by hiring exceptional "problem-solving" managers. For instance, Yu [114] reports that supervisors with quality management backgrounds played essential roles in identifying defects. Dowsett [94] reported that the success of practices and processes within MMC projects relies heavily on the skilled awareness of MMC concepts. Hence, attaining the critical skills would influence effective human resource management that can feed into the value configuration element of an MMC business model.

5.4.2. Confidence through Logistics

Challenges within transportation can expand to jeopardise the overall benefits of MMC in terms of time and cost reductions [115,116]. Yang [117], p. 96 described the term "last mile", reflecting the importance of transportation in ensuring schedules are strictly abided by, as early arrival could even be more problematic than a late arrival. This interprets the importance of the location where an "economic transport distance" option could influence the choice of contractors [109]. In order to optimise the transportation phase, the required considerations include weight capacity, truck orientation, truck dimensions, and site storage space [118]. Moreover, Lin [119] reports further essential requirements to acquire all necessary permits and align the transportation with the availability of cranes, as any issue during this crucial phase could be associated with additional costs. Permits and approvals from regulatory bodies such as the Road and Bridge Authority, Police, and Highway England Special Order would depend on the dimensions and loads of the modules [83]. Hence, the transportation phase dictates various improvements to the value configuration element within a business model.

5.4.3. Confidence through Repetition and Standardisation

Repetition is the process where value can be achieved through supporting mass production. Standardisation is maximised when the reuse of similar components is facilitated, which captures the values of repetition [120]. Salama [121] emphasises that repetition should consider works beyond production to ensure work continuity and strict compatibility with offsite and onsite activities. In addition, Ayinla [93] reports that automating processes to support repetition is crucial for capturing MMC values. However, a repetition stance is not always viable due to the unique nature of building projects and customer preferences [122]. Hence, it is logical to state that ensuring repetition when configuring value within a business model shape and support the overall stance of MMC, however, studies are discreet in detailing how firms are ensuring effective repetition without conflicting with clients' bespoke requirements and needs.

5.5. Capability and Core Competency

MMC businesses' capability and core competency form a critical business model element [86]. This element details how companies develop abilities to compete against their peers [48]. The ability of an MMC firm to capture potential values that would feed into its core competency is significant and guarantees growth in both its vision and strategy [13]. Hence, a business model's capability and core competency element would enable a company to develop attributes important for its development.

5.5.1. Architectural Capability

Values surrounding the ability of MMC to cope with modern and flexible requirements are being described as vague by the literature. For example, Langston [85] reports that customers may perceive MMC developments as boxes with nearly null architectural capability. However, MMC is demonstrating engineering capabilities through the ability to configure such developments with robust connections flexibly and in line with circular procedures [123]. Moreover, Ofori-Kuragu [96] describes the ability of MMC to meet clients' requirements by appearing "less modular". Hence, including aspects that would enable clients to sense the values associated with adopting MMC could be a vital addition to the value proposition element of an effective MMC business model.

5.5.2. Customisation Capability

Offering a strategic approach that includes options for clients to meet their preferences through customisation is being described as significant [124]. Research proves that clients prefer "unique" homes based on their customisation [91]. However, client requirements might impact the benefits of standardisation and limit contractor's abilities to sustain value [125], by interfering with the engineering aspects [98]. To address this issue, studies investigate how customisation could be met without halting MMC benefits. For instance, Said [126] reports a web-based solution that enables customers to flexibly configure their buildings, intensifying MMC contractors' competitive advantage. In a mass-construction approach, less customisation would mean a higher standardisation level [108]. However, contractors' capabilities to offer customisation opportunities that would still be within the boundaries of mass construction and repetition would provide a significant core competency to their market approach.

5.5.3. Automation and Digitalisation Capability

Automation is being discussed to provide a competitive advantage for contractors over others [127]; automating repetitive and straightforward tasks allows using the workforce in more complex processes [128]. Moreover, automation is proving effective in using digital information to simplify tasks [91]. BIM has been described as effective in enhancing the collaboration between key stakeholders [129] and improving process transparency [105]. Barkokebas [5] reports up to a 47% reduction in the duration of total tasks because of digitalisation. Such digital technologies also considerably reduce time and costs in MMC projects [130]. Moon [128] reports that digitalisation can be effective beyond enhancing productivity to the level where digital solutions have replaced an entire team of designers and draftsmen. Similarly, Tidhar [108] reports that digitalisation could improve efficiency in managing drawings more than humans. In the BIM context, and despite its ability to effectively exploit MMC benefits through its digitalisation abilities [131], its implementation is yet limited in MMC projects [130]. Hence, automation and digitalisation have an adequate ability to drive critical improvements to the capabilities and competence of MMC businesses.

5.5.4. Turnkey Solution Capability

Brege [14] reports the popularity of turnkey solutions, where over 80% of the clients prefer a turnkey solution in MMC developments. Such a solution provides clients with a single-point responsibility, providing them with all work from groundworks to final

delivery [15]. Sutrisna [132] reports case studies where successful delivery was linked to the ability of MMC businesses to perform the role of leading contractors and offer projects with complete packages. Moreover, studies focus on having the onsite experience to complete work beyond factories. Despite that MMC is associated with fewer major onsite activities, the knowledge of onsite methods may be required, and this potential may aid the contractor's competency [17]. The knowledge and interpretation of site conditions such as accesses, manoeuvring space, and logistics are significant considerations for a successful MMC project [83]. Hence, the capability of MMC contractors to handle projects from concept to completion can act as a competitive advantage for their business model development.

5.5.5. Confidence through Regularity Alignment

Literature reflects the need for specific certifications and licences as indispensable by MMC businesses, reflecting their capability to conduct MMC work. At the design level, a Buildoffsite Property Assurance Scheme (BOPAS) requires designers to substantiate adequate MMC knowledge [15]. In addition, warranties and risk assurances are to be provided for all components, especially if any are ordered overseas, which are MMC contractors' responsibility [119]. Assaad [133] discusses the importance of having warranties for goods and services, as both are equally important to eliminate any dispute arising from the blurriness of whether an issue is material or labour related. Nevertheless, knowledge and experience with local building codes and standards are essential [109]. Hence, providing professional assurances through certifications and compliance can communicate better confidence to the public sector.

5.6. Cost Structure

The cost structure is one of the most significant elements of a firm's survival, as operational efficiency is dictated by how costs are structured [50]. Cost is the most critical factor influencing clients' adoption of MMC [15]. As a result, this section reflects a variety of arguments by literature that can help develop a robust cost structure element that communicates better confidence.

5.6.1. Cost Certainty

Heedlessness in the design stage would increase overall costs [129]. Such influence by the design phase could be driven to cost reduction if more focus minimises as much material as possible [92]. Dowsett [94] reports a case study where a misalignment occurred between the architect's specifications and existing services which required a rerouting solution, resulting in cost additions. Another consideration emerges as Salama [125] discusses that the connections in modules are usually discarded, where such costs are distributed into the material, installation, and maintenance, influencing the cost structure of a business model. The same study discusses that fewer connections would mean fewer costs due to less material and activities needed, particularly logistics and lifting. Hence, MMC is associated with separate costs across different stages that may influence the development of a robust cost structure element of a business model.

5.6.2. Transportation Costs

Transportation emerges as a critical subtheme that influences the cost structure element, constituting a substantial portion of the overall module cost [125]. Moreover, transportation costs expand from moving panels and modules to include other transportation costs such as cranes and other associated arrangements [119]. To address this, Koronaki [88] reports the applicability of critically reducing such costs by efficient planning of the assembly process, which in turn, reduces cranes and heavy equipment. Moreover, this is said to be influenced by the location, requiring an "economic transport distance" governance to ensure that logistics would not substantially impact the cost structure [109]. Nevertheless, Almashaqbeh [118] reports that module optimisation planning applications exist to reduce

transportation costs effectively. Hence, transportation costs count as an essential attribute within the cost structure element of an MMC business model.

5.6.3. Cost Savings

Hedgren [21] shared that the decision to adopt MMC by a client was due to its cost-effectiveness. The lack of an adequate and fair comparison that includes MMC benefits within the reduction gained due to their challenging quantifiable nature [17]. Such comparison enables traditional contractors to offer solutions with considerable cost savings, driving the industry away from MMC [7]. The inadequate determination to reduce waste could influence the overall cost of single units and, subsequently, the overall project [93]. Reducing waste enhances efficiency and influences the overall process duration [105]. In addition, O'Connor [134] indicates a variety of cost savings that are being discarded in MMC due to the lack of benchmarking data when developing the cost structure, which in return is feeding into the perception of the high initial costs of MMC. Hence, a robust cost structure element that ensures well-documented value for money which substantiates cost savings is, tentatively, another critical aspect when communicating confidence.

5.7. Partnership Network

Effective partnerships to utilise embedded values are characteristics of an innovative business model [135]; having a robust network would enable firms to fill institutional voids [136]. In the MMC context, Lou [86] indicates the weakness of the partnership network element, discussing that the “partnering concept” is yet to be understood by all stakeholders. Similarly, Goh [13] reports that MMC contractors need to focus on supply and demand partnerships that can enable them to gain knowledge, connections, and better access to resources. This section, therefore, argues the development of a robust partnership network element within an effective MMC business model.

5.7.1. Attaining Essential Partners

Ensuring a partnership network with the needed skill and experience is crucial for a compelling business element to transfer risks across specialisations. Early partnerships with suitable suppliers would ensure services and components are effectively delivered and adopt a risk-transfer approach to reduce associated risks [86]. Such an ability provided by ensuring informed partnerships would enable firms to transfer risks to those more experienced, capturing values beyond their current ability [104]. However, it is noted that despite the benefits of outsourcing, it could be associated with mismatches and communication issues [137]. Hence, an adequate understanding of the approaches taken by firms to address risk through partnerships.

5.7.2. Upskilling Partnerships

Studies report the importance of achieving the right partnerships for better upskilling potential. Langston [85] indicates that MMC principles would mean the replacement of traditional jobs, and that could lead to clashes with construction unions and can, overall, influence adoption. Arguably, London [138] reports a case study where MMC firms recruit actants from the car industry, providing a compelling approach to benefit from their repetitive production experience. Having diverse disciplines aids sharing of knowledge and skills across MMC firms [104]. Moreover, Zhang [139] suggests the involvement of an academic-industry partnership that can address skill gaps through education, resulting in more experts in the sector. Similarly, Wuni [109] discusses the need for competent teams and skilled experts, and Luo [12] discusses the need for training MMC contractors to reduce risks. Hence, a partnership network that embraces innovation would have to comprise a variety of binding actors to approach a constructive upskilling approach.

5.7.3. Local Partnerships

Developing a network of local partners can result in fast and reliable support, being described as forming a “just-in-time” approach [94]. Lin [119] indicates the benefits of dealing directly with local suppliers importing goods overseas. Such a process is associated with considerable risks; this would lessen the jeopardy while gaining benefits such as training and guidance on installation and maintenance. High risks are associated with shipments, and it is the buyer’s responsibility to bear all losses [133]; this may lead to fewer risks through local partnerships. Moreover, Goh [13] reports that subcontractors are following the direction of partnering with established manufacturers due to the expensive nature of procuring all tools, equipment, and preparations needed for a fully functional MMC providing the facility. Hence, partnerships with local firms are driven by the modern, risky, and expensive nature of initiating an MMC business, requiring the necessary knowledge, collaboration, and coordination.

5.8. Revenue Model

A revenue model is one of the most important elements within any firm’s business model that shapes how goods and services are offered [39]. It is logical to state that the more “visibility” clients have on MMC, the more selling opportunities for MMC businesses, which would enable more “profitability” [9]. Hence, this section argues for developing a revenue model that would represent a robust key element within an MMC business model.

5.8.1. Convenient Payment Collection

Developing a revenue model that would support a convenient payment collection is critical when communicating confidence. Charlson [15] discusses the case where 80% of overall payment is required before any delivery is made to the site, which means that clients would radically change how they pay for construction upon completion to paying prior to having anything yet executed or delivered. Such initial costs are not always possible to secure through regular mortgages, and customers are obliged to apply for expensive short-term loans [85]. The same study reports that clients’ decision not to adopt MMC as a construction option was the collection of the cost compared to conventional methods. As a result, upfront payments challenge clients to secure finance and loans [96]. Such an issue demands MMC contractors improve how initial payments are collected, which would enable a more robust approach when penetrating the public sector and sustaining revenue.

5.8.2. Diversification of Revenue Streams

As the current widespread adoption is not enough to support core revenues, a change is required in business models for better diversification [17]. MMC businesses may not be able to conquer the whole market, but they can indeed support enhancing the post-completion phase of MMC developments. Sánchez-Garrido [95] discusses data presenting a 20% variation of the maintenance costs against the design reference across ten years, with issues such as waterproofing, anti-rust, and other maintenance concerns. Firms need to produce quality materials to minimise maintenance costs in the long run. However, cases requiring maintenance may help utilise a new revenue stream for MMC contractors to utilise their experiences [140]. Hence, the approaches taken by firms are limited in the literature on the potential revenue streams that can feed into a robust revenue model; nevertheless, some avenues could be of significance, such as maintenance and customisation.

6. Discussion

This study responds to the calls by Brege et al. [14], Lessing and Brege [141], and Goh and Loosemore [13] on the need for research to critically analyse and argue the importance of improving supply business models to facilitate the uptake of MMC. Our main assumption links the low MMC uptake in the public sector to the ability of business models to achieve internal and external fit. In that sense, this paper pinpoints the problematic and complex process of developing a business model in construction firms to influence demand [142,143].

Our findings suggest multiple indicators identified from analysing previous research, reflecting different firms with distinct business features, as it is rather rational to build upon the unequivocal successes achieved in the past [141]. The following subsections serve the study by providing key discussions that pinpoint this paper's theoretical standing, and in turn, illuminate the potential influence of the business model elements on penetrating a specific construction market (see Figure 6).

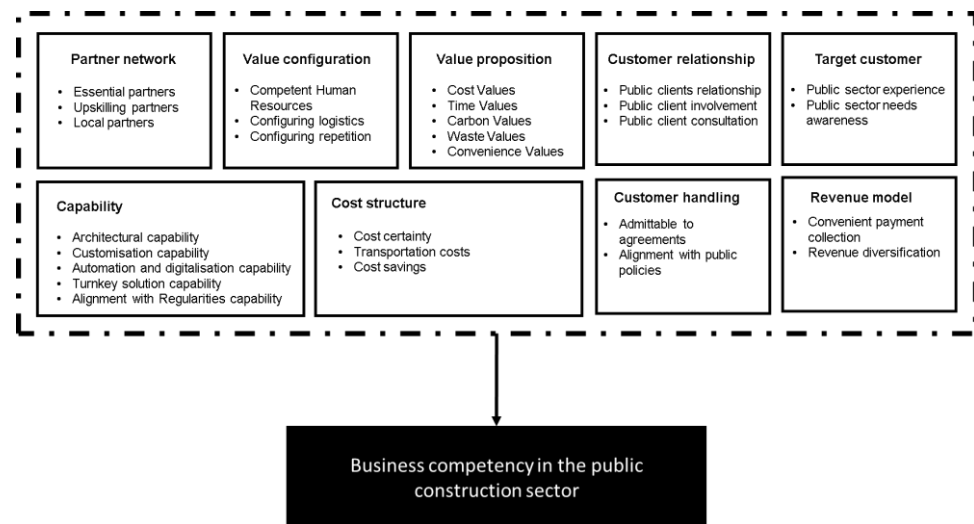


Figure 6. Business model elements influencing demand.

6.1. Identification of the Contingencies

Our findings propose that MMC organisations substantiating cost, time, carbon, waste, and convenience values may achieve a higher share of public business than those who lag in achieving these public values. Arguably, it is the formation of a meaning of customer values being proposed and the ability for supply to identify and measure this flow of meaning when communicating confidence. Results do not suggest a radical change in the strategic processes of supply but establish a common and measured sense of what they are offering while aligning with what is appreciated by demand.

Results suggest a logical stance in which prior experience with similar social systems can aid a more favourable attitude towards MMC compared to those without any experience with public clients. Such experience is discussed as important in gaining an insight into the needs and felt problems that lurk in the public sector, this knowledge can be aligned to how MMC meets customer needs and address their felt problems, thus, dictating contractor's strategies to consider and acknowledge directions that are, tentatively, more effective when communicating confidence. Moreover, results confirm the discreteness of literature in studying public client organisations in the construction context. Our lack of knowledge on how these special clients think, decide, and interact with innovations limits the potential to detail business models that communicate confidence. Hence, we may question the ability of MMC contractors to better know their customers amidst the lack of an adequate understanding of the decision-making processes of public clients.

Public procurement agreements have been underlined by literature as, tentatively, the most effective communication channel to reach public client organisations. Such evidence is not surprising, in fact, it is logical that contractors proving knowledgeable of the public sector's norms would gain the attention of cautious public clients seeking reliable business. The reasoning here is that supply organisations are encouraged to develop their business models to embrace public procurement. This would mean gaining the qualifications needed to be included or having no grounds to be excluded when applying to public procurement agreements. Sensibly, results suggest that extending capabilities to qualify for admission in

public procurement agreements would not only enhance their prospects of working with public clients but also pinpoint their core competency when communicating confidence.

Helping clients by advancing confidence towards an option best suited for them through more engagement and involvement is proving essential. Deploying new types of methods and options radically different from what clients are traditionally utilising for tens of years is associated with hesitance. An involvement approach would be a positive incentive to accommodating clients' concerns and addressing empirically invalid perceptions. Encouraging clients' engagement would not only enable contractors to support their choice and option that meets clients' needs but also motivate interaction deemed critical to aid clients' sensemaking of the values offered. Contractors utilising advanced and contemporary means of involvement are sustaining effective customer relationships than those lagging in offering the same. An archetypical business model, thus, would formulate a regular stance on client interaction.

Evidence suggests that the key internal considerations are the people, logistics, and repetition of processes. To start with, the first segment includes the employment of competent human resources. The hypothesis, reasonably, is that organisations that have experienced and competent human resources would attract more public sector business than those who are otherwise. Moreover, transportation constitutes a phase by itself in an MMC project, and its complexity is dependent on a variety of external elements that either facilitate its delivery or act as an uncontrollable event that hinders the overall choice of MMC, i.e., road appropriateness, site location, etc. Findings suggest that the transportation phase is where uncertainty lurks, and our knowledge of how MMC firms are managing this phase is limited.

Results emphasised the importance of achieving and ensuring repetition and standardisation. Reasonably, a repetitive activity would require fewer costs and would help raise the revenue margin. However, construction is driven by its uniqueness and history has proven the reluctance of construction clients to easily accept standard products compared to other industries, i.e., mobile phones, automobiles, etc. [144]. Encouraging clients to embrace the standardisation mindset has been discussed to significantly enhance contractors' standing compared to shifting away from repetition to align with customers' needs. Hence, a stance in which contractors could sustain a repetitive process to exploit MMC values but also meet the uniqueness preference of their clients would enable effective management and exploitation of MMC in the business sense.

Findings highlight that architectural, customisation, and digitalisation capabilities are facilitating the communication of confidence. To start with, it has been noticed that external designs that are explicitly reflecting the difference between an MMC project and a traditional one are not preferred, whereas the ability of a contractor to align the designs with what clients envision as normal, or less MMC recognisable, is encouraged. Moreover, and as previously stated, customisation was also highlighted as a capability for contractors to gain better grounds in attracting clients. To achieve this, contractors are developing innovative approaches by offering multiple options and designs to widen their ability to meet the needs of multiple customers without the complete annihilation of MMC's key advantages. Furthermore, contractors embracing digitalisation are proving operative advantages in their business processes that are, in return, aiding their competitive advantage in penetrating the market. In addition, it is worth noting that a single point of responsibility of offering a turnkey solution is proving to be a popular and preferred core competency by clients which is critically distinguishing contractors from others offering limited services. Finally, the ability of contractors to comply and offer certificates and warranties is said to equip firms with the necessary means to reflect their readiness and adherence. It is reasonable to state that contractors acquiring the needed compliances and certificates, i.e., schemes and warranties such as Buildoffsite Property Assurance Scheme (BOPAS), are lessening the burden on clients, inclusively, acting as another key aspect when communicating confidence [145], sustaining the link between customer handling and capabilities.

A variety of variables exist to dictate how contractors should shape their cost structure. Findings were more generous in how transportation costs supersede other phases, per se, manufacturing and assembly. Nevertheless, contractors are proving the potential to achieve cost savings and cost control across all the key phases, which would enhance their ability to recover from the gap widened by not achieving an economy of scale [28]. Results suggest that the ability of contractors to control and save costs would be through relying on the competence and value configuration elements in their business models, to respectively utilise their capabilities and ensure adequate management of resources and repetition that aids in achieving considerable savings.

Partnerships with experienced firms, undoubtedly, enhance the prospects of contractors to deliver services and products beyond their own capabilities [146]. However, it is worth noting that the process being adopted by traditional contractors to outsource services and identify themselves as MMC businesses are proving ineffective and are associated with misalignments [147], feeding into the growing perception of the expensiveness of MMC compared to traditional methods. Nevertheless, local partnerships that support a business rather than outsource it are proving effective and reliable networks in developing a shared logic that reinforces confidence [148], pinpointing the importance of such partnerships in the MMC context [13]. Moreover, partnerships are also proving effective in upskilling existing workforces, shifting from the traditional norms of doing business to embracing MMC-friendly skills. This is highlighting a link between the value configuration of human resources and the ability of partnerships to address the gaps in relevant skills.

Making a profit is what drives business and is the key vehicle for MMC contractors to survive and thrive. Results suggest that revenue streams could be achieved by the ability of contractors to invest in their customers' convenience [149]. Revenue, sensibly, would require alterations to ensure streams are not only sustained but nurtured [39]. To start with, results suggest that nourishing revenue streams would be offered through a convenient payment criterion that aligns with clients' funding and financial potentials. The change in how payments are being requested is influencing clients' confidence; being charged for value due, rather than for value completed, fundamentally differs from what is accustomed in traditional construction. Altering how revenue streams are achieved, thus, may influence how payments are collected, which can better communicate confidence to public clients. Moreover, harvesting opportunities beyond the completion phase could lead to capturing new and unprompted revenue streams [147], for example, servitisation [150]. Hence, evidence suggests that contractors can invest in their customer convenience to facilitate the communication of confidence financially as well as capture opportunities beyond project delivery.

6.2. Relations between Business Model Elements: Achieving Fit

When arguing contingency with business model development, no universal set of specific guidelines exists toward an optimal model for all businesses [151]. Nevertheless, a consensus exists that a change in a business model element may lead to changes in the other elements. Our findings suggest that business models may be enhanced to achieve internal fit (consistency) between the business model elements as each element overlaps with others [14]. Moreover, elements should have a good fit with the external business environment, for example, the public sector, by achieving external fit (congruence). Therefore, a change in any of the business model elements would mean a change in the overall fit of capabilities to deliver value, both inside-out and outside-in. However, the differences that can inform us where MMC businesses succeed in penetrating the public sector are lagging in current research efforts. For instance, businesses are different in their production systems, value compositions, and supply-chain partners, all of which imply different stances to achieve fit in contingency and congruence. For MMC businesses, therefore, communication of confidence flows from the internal successful fit that extends to an external successful fit which then attains more business in the public sector. Such success is achieved by the special attention on what is appreciated by the public sector, and what would influence

their decision-making to favour an unusual construction approach supported by the effectiveness of MMC to deliver value. Reaching fit, therefore, could be through revealing the internal relations between business model elements, derived by an empirical assessment of firms that are excelling in the public sector, which would enable better understanding of the complex dynamics and interactions with the external environment.

To formulate enough basis that justifies subsequent quantitative assessment and validation, and due to this paper being the first to shed light on these interactions, no empirical foundation yet exists to support the overall conjectures. Therefore, this study proposes a generic set of relationships that are argued to achieve internal fit. Understanding the relations between business model elements would enable research to articulate the influence and impact of each change needed to reach internal fit, and successively reach external fit [152]. Relationships shown in Figure 7, hereby, are derived from the arguments of these discussions and are in line with past literature as adapted from Mokhlesian [142] and the contingency theory. Such basic relationships are, nevertheless, tentative and inductively based on reasoning and rational from theories, past research efforts, and the development procedures provided by studies such as Teece [153]. The proposed relationships intend to offer a readily available conceptualisation of the assumed influences between the nine business model elements as an attempt to facilitate and encourage future empirical validation.

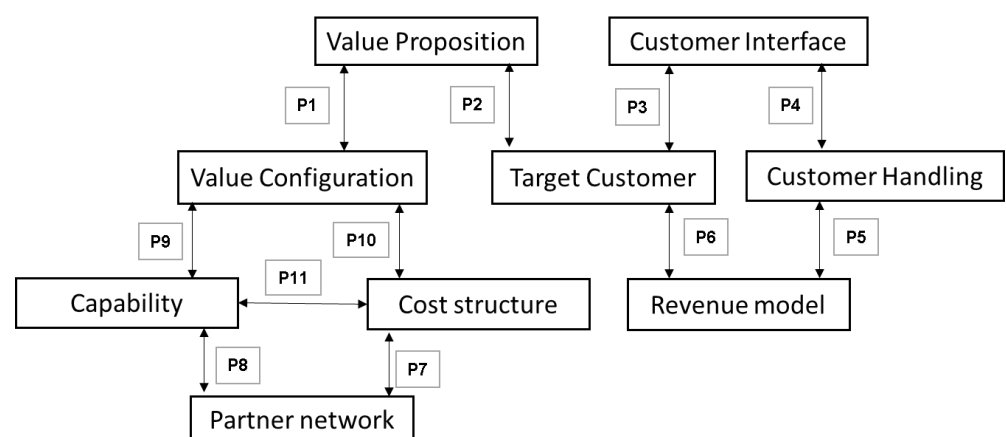


Figure 7. Proposed relationships among each of the business model elements (adapted from Mokhlesian [142]).

Overall, this study achieves two key contributions to both theory and practice. The results of this study benefit theory by being the first to apply the contingency theory in a systematic review of previous efforts concerning the MMC setting, an approach that led to a spectrum of new assumptions and arguments that can be seen to justify the low adoption rates of MMC in the public construction sector. Moreover, the use of this methodology led to deducing that literature is scarce in offering empirical evidence that can equip scholars with effective means to conceptualise the complex interactions when developing compelling business models, which in turn, may be inhibiting MMC businesses from driving wider demand. In practice, this study provides managerial insights to decision-makers, informing them that each change in one of the nine BMC elements has an internal influence on all other elements, and accordingly, on the overall congruence of an organisation with its targeted market. Decision-makers are, therefore, called to understand these contingencies and relations between the elements in an attempt to achieve highly informed decisions and positive influence on their competency in the public sector. Overall, the results of this paper depict broader areas where change at an organisational level can accelerate the adoption of MMC in the public sector.

7. Conclusions

The aim of this paper was to capture the potential business model indicators that may enable MMC businesses to communicate better confidence to public client organisations by reaching contingency. Classifying secondary data from articles published in the top journals against the nine business elements of the BMC, in isolation of vast literature, enabled us to conduct a more focused and clear exploration. Discussions shed light on the relationships between the business model elements, distinguishing the MMC setting from other pragmatic and innovation settings in construction, to formulate a stance on its own. Existing literature lacks a similar systematic review and analysis, with limited focus on qualitative and theoretical arguments, making this the first study to detail the dynamic and complex nature associated with developing a business model to foster innovation in the construction industry.

This study details the importance of firms seeking business in the public sector to acknowledge business model alterations and extend their ability to communicate confidence. First and foremost, there is a consensus in improving how firms are proposing values associated with MMC to their clients, emphasising the need to offer values that matter, rather than values by default, while ensuring that adequate measurements exist to substantiate their delivery. Moreover, boarding public procurement agreements may critically aid firms to reach public clients. Addressing false perceptions is encouraged through fostering client involvement and engagement that can yield a more favourable decision compared to detaching clients from the key processes. Public clients' perceptions of MMC, albeit deemed critical, are yet understudied in previous research efforts, providing little scope for research to guide practice on the effective focus points to sustain a robust customer interface element in a business model.

In contrast, literature is more generous when providing insights into the configurations needed for supply to better manage their resources. Workforce skills, logistics, and process repetition emerge as the key main considerations firms may focus on to steer their business process to communicate better confidence to the public sector. Core competency is linked by literature to the ability of supply to attain the attributes needed to gain admission to public procurement, as well as attain the certificates and qualifications needed to communicate confidence and assurance. Firms offering a single point of responsibility option of a turnkey solution are influencing a more favourable attitude compared to those with lesser capabilities. Moreover, decision-makers were encouraged to re-structure cost as an element to be developed in line with cost control and saving measures to support the supply's ability to mitigate losses and offer more financially attractive options. In that sense, capabilities are said to be extended through initiating and sustaining long-term alliances with reliable partners that would not outsource work but support it. Finally, investing in clients' convenience is emerging as a key approach that directs firms to change how they are capturing revenue by changing how they are demanding payments for work due, rather than work completed, which would aid the formation of a revenue model that communicates better confidence.

To this end, findings suggest that business models would always differ among firms seeking to penetrate the public construction sector. Differences that are proving competence are not yet recognisable and validated as pinpointed in the extensive secondary data exploration. Future research is extremely needed to assess the significance of each business model element in driving more business with public client organisations. The difference in how firms operate would provide insights into the characteristics that are of utmost effectiveness when developing business models. Moreover, future research is encouraged to investigate the decision-making process of public clients, such knowledge has been indicated as of critical importance amidst the lack of studies to research the public sector exclusively in the same context. Finally, some may argue that the proposed relationships between the business model elements are of a generic nature due to basing the hypothesis on explorations, which is, undoubtedly, a valid vindication that encourages empirical vali-

dation in the same direction, where findings of this paper can be the theoretical foundation for future research.

Limitations of this study are the choice of wordings to describe MMC, using other keywords to describe MMC by regarding wordings adopted in different countries would have, undoubtedly, yielded a variety of additional studies. Moreover, another limitation would be the exclusion of papers from other journals and top conferences, a limitation that was solely due to the inability to include vast MMC literature in one academic paper. The study focused on public clients as a unified target customer but authors do acknowledge that even within the same social system, organisations would differ and hereby developing a standard business model may not be possible and is driven by the heterogenous nature of MMC organisations to meet clients' needs.

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