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# Are the characteristics of public clients influencing their uptake of the Modern Methods of Construction? A thematic analysis

## **Abstract**

**Purpose** – Construction research comprises quality contributions to the Modern Methods of Construction (MMC) context in terms of their benefits and relative advantages. However, the uptake of MMC is yet deemed very low in the public sector. Knowing that public clients acquire the purchasing power and the influential status to drive industry change, understanding their low MMC uptake is necessary.

**Design/methodology/approach** – A systematic review of literature has been chosen to extract the key variables contributing to the limited adoption of MMC across the public sector, reinforced by a qualitative semi-structured interview with twelve industry leaders and public clients. This methodology enables the authors to explore works from the past decade, paving a direction for an adequate empirical investigation by reviewing and critically analysing forty-nine academic articles and interviewing twelve industry leaders and public clients.

**Findings** – The study captured and argued the characteristics that have an influence on public clients' decision, inhibiting the extraction of values associated with greater MMC deployment. A critical analysis resulted in identifying 13 characteristics under 4 main themes, providing a new argument to existing knowledge by calling on the need to better understand public clients and the influence of their own characteristics on their MMC uptake.

**Originality/value** – This paper utilises the Diffusion of Innovation theory (DOI) which offers constructs that help explain the influence of the characteristics of a decision-making unit. Our knowledge on public construction clients is limited, and more research in this direction may help in better aggregating construction demand. Overall, arguments provided in this paper enable relative improvements in contractors' business models when approaching the public market. The study is believed to be in support of the relative governmental efforts to shape effective policies that can enhance innovation uptake among public bodies.

**Keywords** Modern Methods of Construction, Public Clients, Diffusion of Innovation

**Paper type** Research paper

## **Introduction**

### ***Background***

As emerging innovations, the Modern Methods of Construction (MMC) are being featured by the UK government due to their potential to address the critical industry needs in terms of sufficient supply of efficient housing (Švajlenka and Kozlovská, 2018), certainty (Yang *et al.*, 2021), and sustainability perspectives (Ofori-Kuragu and Osei-Kyei, 2021). However, the uptake of such methods is still very primitive (Taylor, 2020), particularly in the public sector (Charlson and Dimka, 2021). Among other critical contemporary challenges in the construction industry, MMC has its generous share in the Construction Playbook, a document that aims to impose policies on the public body to facilitate the adoption of construction innovations (HM Government, 2022). In addition, extensive research exists on validating the benefits associated with such methods in areas like carbon reduction (Tavares, Lacerda and Freire, 2019), enhanced productivity (Gbadamosi *et al.*, 2020), risk reduction (Rausch *et al.*, 2019), digitalisation (Martinez *et al.*, 2021), and adequate planning (Liew, Chua and Dai, 2019). Nevertheless, limited studies focus on understanding and explaining the low adoption rates among public clients. This limited focus on public clients motivates the authors to explore and identify a gap within research to better study such key construction client type and unravel the reasoning behind the low uptake within the public sector. To approach this, Ågren and Wing (2014) discuss the need to look beyond the technical challenges and barriers of MMC when researching its adoption, treating it as a complex reality of political, economic, and sociological constraints.

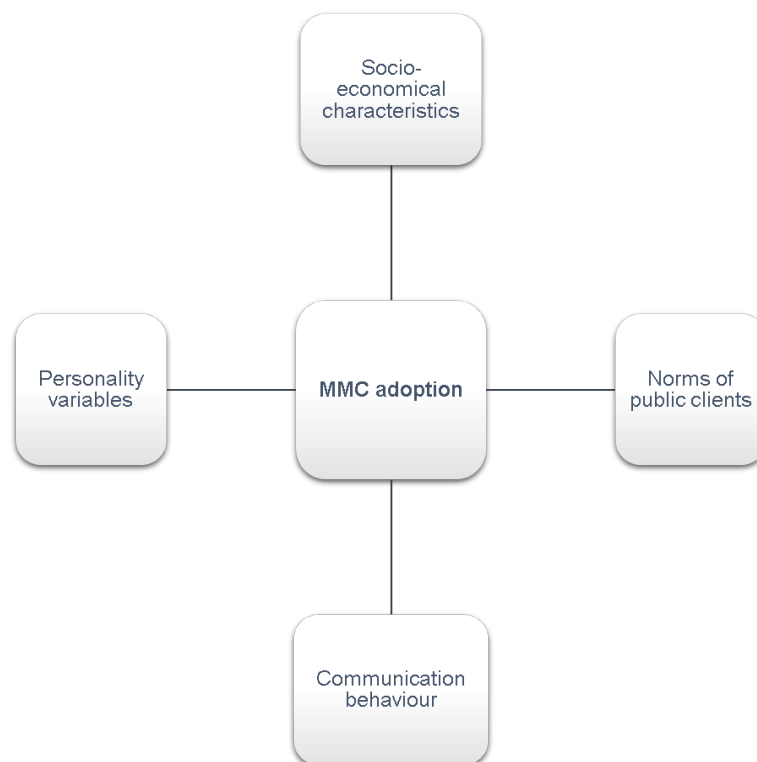
### ***Importance of Public Clients***

Public clients acquire a unique position in the construction sector due to their magnitude, represented by dominating over 70% of new developments in the UK (Agapiou, 2021). They obtain change-triggering importance through their purchasing power that can influence and encourage companies to improve their business models in supporting an innovation adoption (Pellegrini *et al.*, 2021). Such importance has been acknowledged by construction literature referring to public clients as "change agents" in promoting innovation (Lindblad, 2019, p. 33), and the 'biggest' construction clients across many countries (Guribie *et al.*, 2022). In the construction sector, organisations are being led by public clients, particularly in adopting innovation, as firms tend to "follow the lead" of these organisations (Tezel, Koskela and Tzortzopoulos, 2021, p. 5). Literature is indirectly linking the characteristics of clients with the outcomes of construction projects (Rahmani, 2021), with a particular focus on public clients' ability to drive innovation (Lindblad and Karrbom Gustavsson, 2021). One critical element that may better explain the importance of the public sector can be traced to the reputation enhancements of the firms that are demonstrating their ability to effectively meet public client demands (Warland and Mayer, 2017). Hence, public clients are superior to private clients in driving the industry's change, however, limited studies relate the dynamics between their characteristics and their decision-making.

### **Theoretical underpinning: Public clients as decision-makers**

To reinforce our understanding of the critical aspects behind the low MMC adoption across the public sector, utilising theories that can explain the decision-making process is essential. One of the critical theories that conceptualise the decision-making posture toward adopting innovations is the Diffusion of Innovation theory (DOI). Rogers (2003) introduces the innovation-decision process where the decision-making unit adopts or rejects an innovation influenced by multiple characteristics. A

set of those characteristics influencing the innovation decision is those attained by the decision-making unit itself. Rogers (2003) categorises those as socioeconomic characteristics, personality variables, and communication behaviour. Such characteristics are perceived to influence the decision of the decision-making unit towards an innovation (see **Figure 1**). This study utilises the DOI theory in an attempt to identify the various critical characteristics in shaping public clients' attitudes and potentially influencing their decision to adopt MMC as an innovative construction alternative.



**Figure 1:** The innovation-decision process (adapted from Rogers (2003))

Literature has been generous in providing studies that thread the key MMC arguments and emphasise the necessity of this paper. Clients are identified as main actors undermining wider MMC adoption (Larsson *et al.*, 2014; Saad, Zulu and

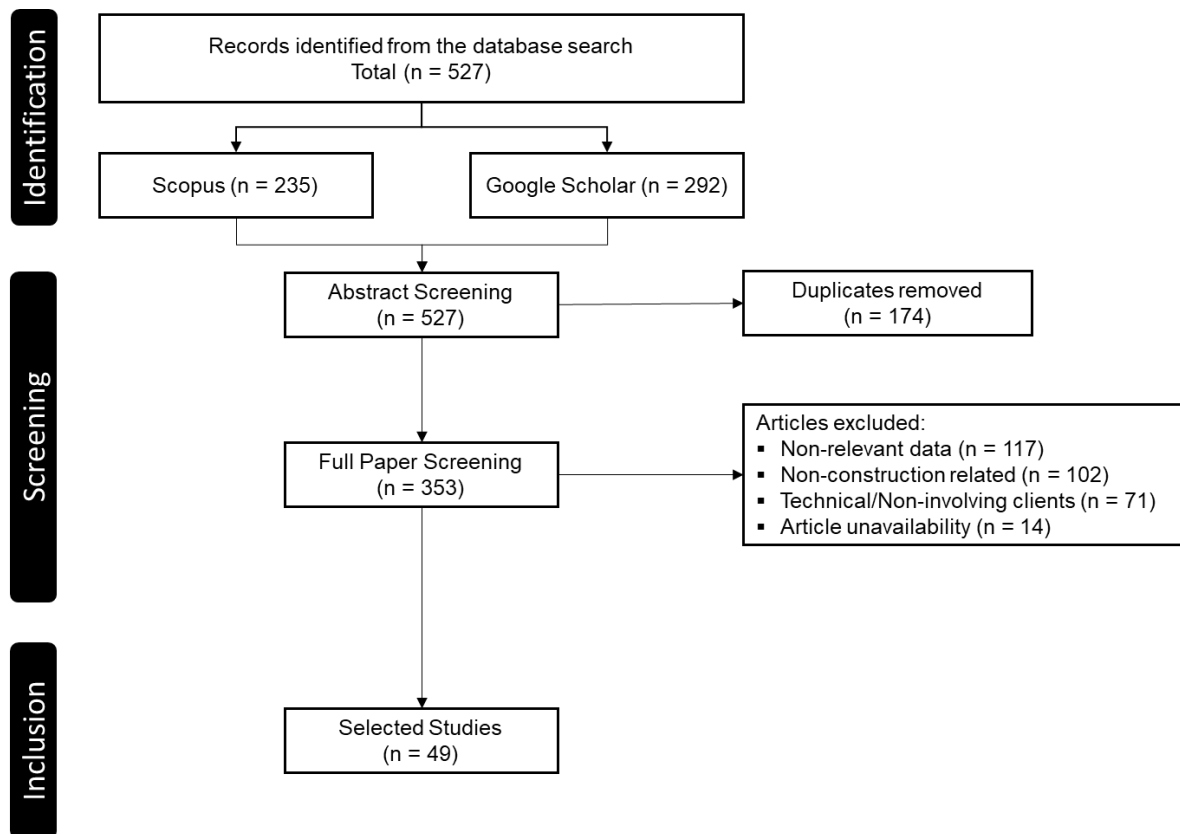
Dulaimi, 2023). Eriksson *et al.* (2014) report that a higher level of MMC could be incorporated if clients tend to accept the methods by minimising their conservative attitude towards innovation. Although public clients demand better cost control and waste reduction across their construction projects (Pellegrini *et al.*, 2020), such MMC advantages alone are yet to yield better adoption across the public sector. This phenomenon aligns with Rogers (2003), who reports that the benefits and effectiveness of the innovation alone may not form enough purpose for greater adoption. Despite being recognised as innovation change agents, research reports that the complex nature of public clients requires further research (Vass and Gustavsson, 2017; Lindblad, 2019). Studies looking at better explaining and understanding the influence of public clients' characteristics on the MMC adoption decision are limited in number and reach (Ali M Saad, Dulaimi and Zulu, 2023). Studies do, however, identify a variety of aspects that could feed into this research to underpin the critical public clients' characteristics, such as skills (Adam and Lindahl, 2017), education (Ofori-Kuragu and Osei-Kyei, 2021), and experience (Onubi, Yusof and Hassan, 2020). Oti-Sarpong *et al.* (2022) provide an interesting argument that aligns with the DOI theory by linking actors' characteristics with their MMC adaptive behaviour. This paper, thus, aims to address a gap in knowledge by systematically reviewing and critically analysing publications from the past decade to capture the characteristics attained by public clients and may be influencing their decision to enhance MMC uptake in the public sector. This aim is approached by the following research question (RQ):

*RQ1.* What are the characteristics of public construction clients that are influencing their innovation-decision?

## Methods and results

This study utilises a systematic review method to extract and capture the characteristics and variables that are deemed critical in shaping public clients' innovation-decision process. To answer a specific question, a systematic review enables the authors to reduce bias in selecting relative studies that lead to an objective synthesis (Tranfield, Denyer and Smart, 2003). Such a methodology is becoming widely accepted among academics due to its transparent nature, allowing replication of data focused on one central research gap and enhancing the quality of a study (Crossan and Apaydin, 2010). Moreover, it aids authors in capturing and summarising results that align with the study's primary aim (Petticrew, 2001). The comprehensive search has been conducted between November 2021 and July 2022.

As a start, a robust review demands a database that aligns with the pursued academic contributions (Xiao and Watson, 2019; Saad, Ajayi and Alaka, 2022). Scopus database is described to hold substantial qualifications in providing wide-ranging coverage and evaluation metrics compared to the Web of Science (Pranckutė, 2021), and has been described as the "largest single abstract database in the world" (Boyle, Sherman and Boyle, 2008, p. 148). Similarly, Google Scholar has proven to be the most comprehensive among the top six scientific databases (Martín-Martín *et al.*, 2021). As a result, the search identified Scopus and Google Scholar as the two databases to extract and evaluate construction research included in this study (see **Figure 2**). Such an approach has led to the inclusion of scholarly metadata which are key for the overall reliability of the review (Zhu *et al.*, 2022).



**Figure 2:** PRISMA diagram detailing the selection of articles

The search has been performed through keywords 'construction clients', 'public clients', AND 'modern methods of construction' OR 'offsite construction' OR 'offsite manufacturing' OR 'modular' OR 'volumetric' OR 'construction innovation' OR 'industrialized' OR 'prefabrication'. All of these keywords have been used in the search, which led to retrieving articles that have at least one of these keywords in their description. The study includes only articles written in English, published within the last decade, and involving knowledge about construction clients regarding innovation. This approach results in maximising the inclusion of pertinent articles. Journals hosting the articles included were ranked as top journals in Construction Management in the famous ranking by Wing (1997), described as pioneers in construction research (see **Table 1**). **Figure 3** shows a chart of the distribution of the selected articles based on the publication year, depicting that the interest in research relevant to MMC is

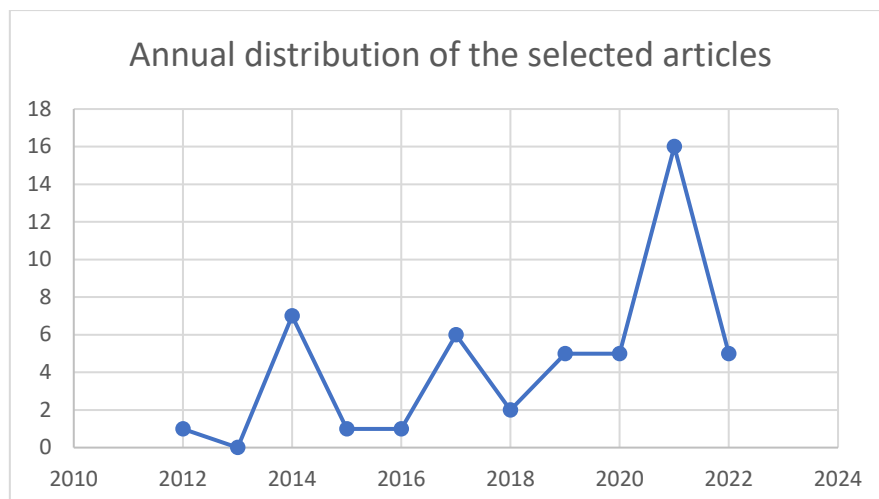


substantially growing in the past five years, which has been previously confirmed by past comparable research (Ehwi *et al.*, 2022; Ali M. Saad, Dulaimi and Zulu, 2023a).

**Table 1:** Selected Articles allocation across Academic Journals

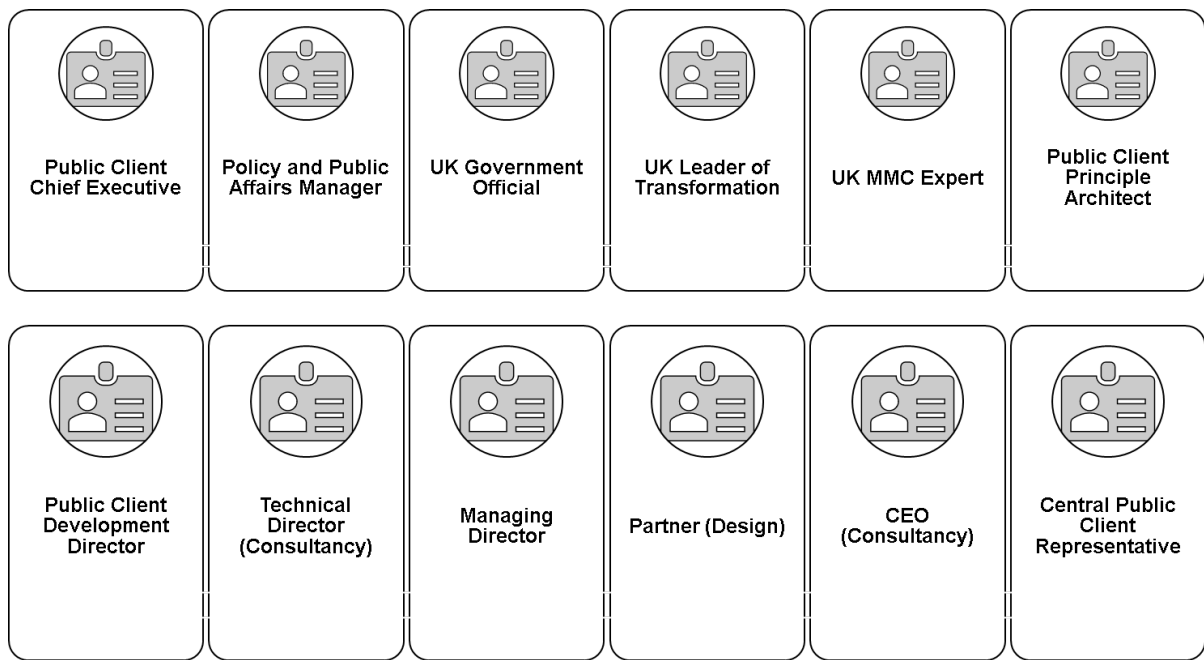
Journal	Number of Articles
Construction Management and Economics	14
Journal of Cleaner Production	8
Construction Innovation	6
Sustainability (Switzerland)	5
Journal of Construction	3
Engineering and Management	
Architectural Engineering and Design Management	2
Engineering, Construction and Architectural Management	2
Safety Science	1
Journal of Purchasing and Supply Management	1
Production Planning and Control	1
Service Industries Journal	1
Sustainable Cities and Society	1
Journal of Architectural Engineering	1
Journal of Management in Engineering	1
Automation in Construction	1
Frontiers in Energy Research	1
<b>Total</b>	<b>49</b>

Source: Authors' review data (November 2021)



### **Figure 3:** Annual distribution of the selected articles

In addition to the secondary data from the systematic review, the authors reinforced each of the variables by qualitative data from a set of interviews with industry leaders and public construction clients. In total, twelve key participants have provided their views that align to each of the identified variables (see **Figure 4**), a sample size that has been described as sufficient to achieve saturation in qualitative studies (Galvin, 2015), as saturation is the key indicator of the reliability of qualitative research (O'Reilly and Parker, 2013). The authors choice to include qualitative data to support the main arguments is motivated by the exploratory nature of this study, and further to the systematic review of MMC methodologies by Ehwi *et al.* (2022), who infer the lag of qualitative and theoretical studies in previous MMC research efforts. Interviewees have been invited based on their characteristics predominantly believed to being decision-makers and industry leaders in the field of this study. Participants have been approached after being purposively selected to meet the criteria set in this paper. A purposive sampling approach is not random but is rather highly non-probabilistic, allowing the authors to selectively choose participants with characteristics that best suit the study's aim (Tongco, 2007). All the interviewees have been asked questions that would enable them to meet the aim of this study through answers they see fit (Diefenbach, 2009). This approach led to building a meaning from the non-restricted and semi nature of the interviews, allowing each participant to amplify their perceptions and opinions accordingly (Cooper, D. R., Schindler, P. S., & Sun, 2006).



**Figure 4: Interviewees' roles**

Large quantities of qualitative data has been argued to be suited for a thematic analysis (Finfgeld-Connett, 2014). Such an approach enables researchers to identify the patterns responsible to explaining the relationships among information (Braun and Clarke, 2012). The criteria involves isolating data from its context and capturing a repetitive nature across a spectrum of multiple sources, which leads to the formation of patterns that are then clustered into respective themes (Braun, Clarke and Hayfield, 2022). This study, hereby, adopts a thematic analysis approach to both primary and secondary data to meet its key aim and objectives.

## **Discussion**

Collected studies have been manually screened for critical analysis in line with the main research question of this paper. Based on the nature of the study in utilising the DOI theory, themes have been accordingly set and analysed through a thematic analysis criterion. Aided by qualitative analysis software, NVivo has been chosen as a reliable tool to code the different variables emerging from the analysis, following the

guide detailed by Allsop (2022). Thirteen (13) variables have been argued as critical for empirical investigation under the four main themes.

### ***Socioeconomic characteristics***

Rogers (2003) identifies a relation between innovativeness and the socioeconomic status of the decision-making unit. For instance, adopters tend to be more educated and specialised than late adopters. However, in the MMC context, literature is discreet in reporting this relationship, and relative themes emerge as education and previous commercial experience that aim to identify the socioeconomic characteristics of public clients better.

#### ***Education***

Vass and Gustavsson (2017) report the need to provide adequate education to public client staff which would encourage their decision towards innovation adoption. Education could assist decision-makers in perceiving innovation as an opportunity. Such knowledge gained in construction would require an interoperable mindset on how processes could connect, which would subsequently support the appetite for more controlled conditions (Langston and Zhang, 2021). Alwan *et al.* (2017, p. 357) report that "behind every good project is an educated client", a statement that emphasises the role education could play in enhancing the decision of clients to capture the benefits of innovation. The willingness alone is being described as insufficient for MMC adoption with the lack of education, which deviated from the decision of adoption (Charlson and Dimka, 2021). The same has been reported by O'Connor *et al.* (2014) on the need for modules that can help educate clients, which could change their perceptions of MMC. These studies raise the question of the current level of education in public clients' organisations and whether there is a

difference between those who have adopted MMC and those who are yet to accept these methods in their public procurement.

*“it's all about education, it's been about education for a long time.”*

(MMC expert, 22 years industry experience)

### *Experience*

Rogers (2003) reports that adopters acquiring previous commercial experience could support their decision to receive the innovation more than the decision-makers who lack such experience. Lack of experience in MMC could be associated with fear, which influences adopters' attitude compared to those more familiar with the methods (Rahman, 2014). This could be described by the ability of previous experience to encourage the adoption of innovation since the decision-maker would develop a capability to share realistic needs. Salama *et al.* (2021) report a case study where clients had previous experience with MMC, and this has enabled them to specify their explicit needs. In contrast, Charlson and Dimka (2021) describe a situation where the lack of experience influenced the perception, which resulted in unrealistic expectations leading to missing on MMC values. Generally, the low adoption rates would be the central aspect limiting MMC experience, thus, leading the industry to favour more familiar methods (Lou and Kamar, 2012). In the public client context, lessons learnt reflect the dependency on external actors to manage and implement an innovation in construction, resulting in the need for more experience as a priority for better adoption (Vass and Gustavsson, 2017). Similarly, Adam and Lindahl (2017) recommend that public clients apply a strict hiring criterion that would help funnel candidates with better commercial experience. A better experience would result from this, supporting a better judgement and expectations leading to better adoption (Havenvid *et al.*, 2016). Hence,

identifying the level of MMC experience among public clients and the approaches being taken to study these methods could help better understand and explain the low MMC adoption rates.

*“the past experience is a massive factor that we have to overcome, and the only way we're going to do that is by having some force. And also we need some good exemplars and we need some commitment. But, I don't know how to do that, Otherwise I'd wave my magic wand and it all worked.”*

(Public Client Chief Executive, 35 years industry experience)

### ***Personality variables***

The second construct by Rogers (2003) theory is about the personality traits of the decision-makers. Despite that research is limited on the influence of such variables on the innovation-decision process, the theory does offer attributes that could differentiate adopters from late or non-adopters, adding to the knowledge on the characteristics of the decision-making unit influencing their decision. This section offers the themes that emerge from the critical analysis of the selected studies, extracting various variables that characterise public clients' personalities, potentially undermining their MMC adoption.

### ***Controlling***

Viking and Lidelöw (2015, p. 491) reflect this personality in public clients' tendency to control the early designs and "lock" their requirements before considering any innovation. Similarly, clients require their teams to be more involved in the process, which is being perceived by the industry as risky (Charlson and Dimka, 2021). The

controlling personality of clients is emerging, yet discreetly discussed, a potential variable limiting the broader adoption within the public sector. Järvenpää *et al.* (2022, p. 62) report a study where all respondents agree on the control imposed, referring to this client's personality as "bureaucratic". Lessons learnt are that such a control tends to intensify when innovations in construction are involved (Lindblad, 2019). Eriksson *et al.* (2014) report that clients tend to be controlling since they perceive it as a 'necessity' to ensure their preferences are being met. This knowledge has been acknowledged by Vestin *et al.* (2021), reporting that businesses are becoming aware of this personality and, in return, are aiming to enhance their competitive advantage by offering easily customisable products. However, this adjustment is imposing challenges on contractors to offer products that align with the controlling personality but sustain the benefits of repetition, a key advantage of MMC. Similarly, a controlling personality is being reported to exceed normal perceptions, such as the regular evaluation of contractors' capability (Boadu *et al.*, 2022), towards clients taking over the role of driving developments rather than contractors, which implies and confirms the undermining influence of such a personality on the adoption of an innovation (Hedgren and Stehn, 2014; Kuitert, Volker and Hermans, 2019). Hence, studying and underpinning the controlling personality of public clients may aid the overall research to explain the low MMC adoption among public clients.

*"it enables a much more balanced approach and much more confidence in certain outcomes. You got the opportunity to have much more visibility and control over what you're buying. Where the traditional project, What's happening is the tier one contractor will be putting out loads of subcontract tenders and trying to get those various different subcontractors to coordinate with each other and the*

*complexity of trying to audit the performance of all those different subcontractors is massive. So, you know, effectively what you get is less certainty.”*

(Leader of industry transformation, 20 years industry experience)

### *Conventional*

The term ‘conventionality’, referring to the tendency to reject new ideas and practices, is being used by literature to describe clients' personalities (Rahman, 2014). Eriksson *et al.* (2014) imply the existence of such a personality trait by reporting the dependency of clients' consultants on offering unique and bespoke traditional solutions to make money, being adverse to the concept of repetition and innovation overall. The same arguments are supported by an empirical study which has identified the resistance to change as the most critical factor limiting wider MMC adoption among clients (Charlson and Dimka, 2021). Guribie *et al.* (2022) discuss adoption among clients, reporting that adoption of innovations is directly influenced by the benefits associated with this innovation compared to conventional methods, where clients' nature repels adoption based on perception rather than proven data. This is also described as hindering negotiation when it comes to innovative ideas (Havenvid *et al.*, 2016; Rahmani, 2021). In contrast, Ling *et al.* (2015) describe public clients' flexible mindset to have yielded a positive innovation adoption. Moreover, this adoption relies on public clients' willingness to accept an innovation (Warland and Mayer, 2017). A conventional personality may not limit the adoption of innovation directly, as some public clients do have the ambition to consider innovation. The conventionality, however, is said to emerge when the public procurement of the innovation conflicts, which is when the actual decision of adoption is made, favouring more traditional methods (Viking and



Lidelöw, 2015). In the construction market, contractors are being driven to address this conventionality by offering services that could easily "fall back" on a traditional method when the innovation did not meet the expectations (Lenderink *et al.*, 2022, p. 7). A conventional personality trait is thus another personality variable that can limit wider MMC adoption among public clients, which requires more investigation.

*"Go from the more traditional design point of view that we consult our end user, we know what we want, and we include that within the design. And I don't think they could quite get their head around that, so I think that's where the inconsistency has been."*

(Public client principle architecture, 24 years industry experience)

#### *Risk avoidant*

It has been noted that early adopters differ from late and non-adopters in their personality traits to accept risks rather than being risk-avoidant (Hedgren and Stehn, 2014). Literature is implying the existence of a low-risk attitude among clients towards MMC. Charlson and Dimka (2021) report a case study where clients forced suppliers to work with developers they were familiar with, an approach made to minimise risks. Public clients ranking MMC, an innovation, as a challenge was identified as one of the critical aspects in Langston and Zhang (2021) investigation of adoption challenges. Adopters from public clients usually mitigate such risks by adding specific conditions to contracts (Boadu *et al.*, 2022). Academia is generous in offering innovative studies to try to explain this phenomenon. Lenderink *et al.* (2022) report that public clients avoid radical innovations, perceiving them as highly risky. The extensive existence of a personality that rejects taking risks is another implication of the meagre adoption rates of the innovation, as Luo *et al.* (2020) describe this implication as inversely

proportional, as the higher the adoption rate, the lower the risk perception among clients towards MMC. However, a risk perception toward innovation could be influenced by the competency of contractors, which is described as a critical aspect that can aid clients' trust in the process (Ling *et al.*, 2015). With this, public clients are perceived to have less tendency to take risks which is a personality variable that can potentially limit the adoption of MMC across the public sector.

*"I think there is a risk here, which is that if you if you apply MMC at any cost on all projects, just because you've been told to, there clearly will be projects where it isn't appropriate. So we we're on a bit of a knife edge where clients are constantly told that it's the right thing to do without that sort of context of a given project."*

(Consultancy Technical Director, 10 years industry experience)

### *Abstraction Capability*

Rogers (2003) discusses that early adopters tend to adopt ideas received from media compared to later adopters who adopt innovations upon observing their peers; this is described as the abstraction capability. In the construction context, clients tend to be heavily dependent on others when it comes to change and innovation adoption (Vass and Gustavsson, 2017); moreover, Xu *et al.* (2021, p. 2) imply that clients have an "out of sight, out of mind" philosophy when it comes to innovations in construction. Similarly, clients tend to mimic their peers and adopt what is already accepted, especially those superior to them, rather than being more flexible towards uncertainty (Oti-Sarpong *et al.*, 2022). The same argument was acknowledged by Hedgren and Stehn (2014), who report findings where clients clearly express their reluctance to try anything new and ideas that are yet fully adopted by others. Hairstans and Smith

(2018) report the critical role that media can play in enhancing the adoption of MMC. Nevertheless, the overall approach is sophisticated and must improve clients' understanding of such innovations. Similarly, Guribie *et al.* (2022) report that construction clients are not well communicated concerning innovations, and this raises questions about the suitable media strategies that can exist to enhance the perception of innovation. Hence, the abstraction capability within public client organisations is another personality trait described by the DOI theory generally but is being proven by construction literature to exist among clients and may influence their decision to adopt MMC.

*“the real benefit of MMC is not just in the construction phase. what we really need to do to contribute to the big societal challenges around decarbonisation energy security, energy self-sufficiency are minimised. Environmental impact promoting human well-being in the broadest sense, which the built environment requires. We need to see how these buildings are actually performing and being able to measure that effectively and learn the lessons from that so we can keep refining and improving the designs and just demonstrating that over time these buildings deliver better than buildings produced using traditional techniques, which theoretically they should. But we need to prove that in practice.”*

(Government official, 20 years industry experience)

### **Communication behaviour**

Rogers (2003) notes the importance of an enhanced communication attitude within organisations to gain knowledge about an innovation, reflecting differences between

adopters and later or non-adopters in their communication behaviour. This section critically analyses the selected articles to pursue themes that can include variables linked to this characteristic reported by the theory to influence the innovation-decision process.

### *Connectiveness*

Rogers (2003) reports that adopters differ from late or non-adopters in their connectiveness with other social system members, which is deemed a variable within the communication behaviour characteristic. Such connectiveness is described to aid construction clients in being aware of previous experiences and building upon lessons learnt (Shafiee *et al.*, 2020). Havenvid *et al.* (2016) discuss that clients acting alone is an "impossible" approach, emphasising the need for connectiveness and communication with peers, supported by Ling *et al.* (2015) in the public sector. In the public client context, being better connected with other divisions in the public sector means better knowledge exchange (Warland and Mayer, 2017). Public clients, however, are delicate in their approachability, seeking relationships based on shared values (Kuitert, Volker and Hermans, 2019). Arguably, Adam and Lindahl (2017) discuss that connectivity of public clients exclusively in the public sector may be limiting their exposure to the processes done in the private sector, limiting their ability to track potential changes that would widen their perspectives. Connectiveness with other client departments is being recognised to significantly enhance the communication maturity among these organisations (Johannes *et al.*, 2021). Literature supports further research to explore the connectiveness among construction clients as an understudied area (Hedborg and Karrbom Gustavsson, 2020). Hence, connectiveness among public clients can act as a critical variable within their communication behaviour characteristic influencing their innovation-decision process.

*“typically, public sector is more conservative. Whilst a lot of innovations come from the public sector. I think it's still quite slow to be pioneering. often it likes to see what other people have done. so I think that for me the difficulty probably is in getting the right information from consultants that compares quality costs and time and performance.”*

(MD of Wholly Owned Local Housing firm, 25 years industry experience)

### *Seek Information*

Rogers (2003) reports that adopters differ from late or non-adopters by their tendency to seek and search for information actively. Clients' trait to seek, locate, and understand information around MMC is a communication behaviour deemed critical in MMC adoption and implementation (Zhang *et al.*, 2021). Literature focusing on the market dimension calls the industry to support clients in their pursuit of adequate information. Guribie *et al.* (2022) report that poor communication was the most critical factor influencing construction clients' informed decision about an innovation. Shafiee *et al.* (2020) describe that MMC companies should support construction clients in easing the reach of the required adequate information. Similarly, Gbadamosi *et al.* (2020) discuss that in order to enhance the possibility of clients acquiring information about MMC, data is yet lagging to exist, limiting better assessments. The same argument has been reported by Dowsett *et al.* (2019) on the importance of making information accessible and available with an intent to communicate MMC processes. Hence, the tendency of public clients to seek information about innovation would aid our understanding of their communication behaviour and the external influences limiting them from accessing such information from the market.

*“It's about public clients doing more market intelligence research, going out and doing market engagement, meeting MMC manufacturers, meeting specialists, understanding the products, going and seeing them in the factory and seeing completed schemes and potentially, you know, wouldn't it be great if some public clients spoke to each other?”*

(Government advisor, 30 years industry experience)

### *Innovation knowledge*

Rogers (2003) reports that communication behaviour influences knowledge and that early adopters have more excellent knowledge of innovations than late or non-adopters. In other words, the ability of clients to acquire innovation knowledge would reflect an enhanced communication behaviour that, in return, influences their innovation-decision. In the MMC context, literature proves a reality of unawareness among clients on the benefits of such innovations, highlighting a lag in MMC knowledge among construction clients (Brege, Stehn and Nord, 2014; Ezzeddine and García de Soto, 2021; Ali M. Saad, Dulaimi and Zulu, 2023b). This variable is described as influencing clients' decision to adopt MMC and making it challenging for firms to gather information and build an adequate procedure due to the lack of clients knowledge of MMC (Barkokebas *et al.*, 2021). A lack of knowledge of the critical processes of MMC would subsequently impact the development of a viable methodology to deliver projects (Sutrisna, Ramanayaka and Goulding, 2018). Thus, despite literature being discreet on the level of knowledge attained by construction clients on MMC, such knowledge is being reported as critical within the communication behaviour characteristic of public clients, influencing their MMC adoption-decision.

*“I actually don't think they fully understand it, that's one of the issues. I think although the government is pushing modern methods of construction as the preferred route for public frameworks, I still think there's a misconception. They don't understand the benefits of standardisation of what they could actually do.”*

(Technical Director, 38 years industry experience)

### *Collaborative attitude*

Rogers (2003) reports that adopters belonging to well-integrated systems share ideas better and faster, enhancing their exposure to new ideas. Goh and Loosemore (2017) discuss that early adopters of MMC tend to learn from builders and attend trade shows, focusing on long-term return on value rather than expecting immediate profits. Moreover, the interaction with the network can shape clients' requirements (Havenvid *et al.*, 2016; Gluch and Svensson, 2018). Construction clients are driven by literature in the direction where they should be open to collaboration and accept the expert opinion. O'Connor *et al.* (2014) aid this argument and emphasise the need for construction clients to work closely with experts who can help them define and reinforce their adoption decision. One of the critical aspects that drove an interdependency within the project between the initial design and final production has been the clients' attitude to welcome collaboration (Lingegård, Havenvid and Eriksson, 2021). Similarly, Rahmani (2021) reports a critical success factor of the benefits associated with establishing early collaboration between clients and contractors. This has extended in magnitude where clients are reported to procure their projects while demanding collaboration to be at the forefront of their decision-making (Johannes *et al.*, 2021). In the public client context, Lenderink *et al.* (2022) report a case study where the collaboration characteristic enabled the successful promotion of innovation in

construction. Thus, public clients' collaborative attitude may be a key variable within the communication behaviour characteristic of their MMC decision process.

*“The answer is through aggregating demand, I think that we have a real problem, that we have 300 local authorities, for instance, in the UK, all interested in housing, many with an interest in MMC, and they're all trying to procure it and procured slightly different things in an immature marketplace. The marketplace is confused and actually largely unable to bid for things because they're not really engaged in frameworks and so on, and you tend to get the wrong people on frameworks because of that. You get people that understand frameworks and can bid for it and they frontend manufacturers and that's just putting another layer in the way. So I think the best way is to change procurements to be longer than four or five years.”*

(Partner, 40 years industry experience)

### ***Public clients' norms***

Due to the unique nature of public clients, being influenced by external social pressures, governmental policies, and regional legislations, looking at their preferences is a key aspect for an adequate study of the characteristics that are influencing their decision to adopt MMC. Therefore, this section presents the themes that emerge from the critical analysis of the variables within the special public client preferences characteristic.

### ***Public clients' Acceptability***

Knowledge about acceptability would enable a better understanding of public clients' decision-making. Their expectations, however, reflect a lack of understanding of MMC



among construction clients (Sutrisna and Goulding, 2019). Järvenpää *et al.* (2022, p. 64) reports that public clients have "unrealistic expectations" of innovation in construction beyond the actual outcomes. Such expectations result in ambiguous goals and different results. Similarly, Rahmani (2021) discusses the need for clients to clarify their expectations early about the innovation, this would also aid a proper evaluation criterion in public clients' assessment of contractor suitability in public procurement (Boadu *et al.*, 2022). Hence, there is a need to better understand public clients' acceptability with regards to MMC and the relation between these expectations and their influence on their preferences impacting their innovation-decision.

*"in our in a traditional development will acquire the land, we will then pay for the works and stages that everybody can go and see and gets validated. Obviously, here we might buy the land and then we are paying for product being built in a factory. So those upfront financing and security elements are definitely more complex."*

(Public Client Development Director, 15 years industry experience)

### *Public clients' interests*

Literature focuses on the customisation aspect as a significant advantage that may enhance construction clients' engagement in the MMC market. The perception of having maximum input and their ability to influence "a unique house" is described as a vital client interest (Vestin, Säfsten and Löfving, 2021). This interest, however, is creating a conflict with the standardisation process through clients' demand for maximum uniqueness and flexibility (Isaac, Bock and Stoliar, 2016). Nevertheless, contractors tend to align their business models to better attract construction clients by considering such interests to gain a competitive advantage. For instance, public clients

would prefer more emphasis on environmental performance than the private sector, where contractors tend to meet those interests and enhance their competitiveness in the market (Onubi, Yusof and Hassan, 2020). An informed interest would mean that public clients would acknowledge innovation and be interested in its benefits, a stance that enabled public clients to adopt an innovation in construction (Vass and Gustavsson, 2017). In contrast, an uninformed client interest would limit the adoption of an innovation (Lingegård, Havenvid and Eriksson, 2021). Overall, public clients' interests are discreet within the literature, mainly driven by the political and social scrutinise (Onubi, Yusof and Hassan, 2020) and public procurement laws and regulations (Kuitert, Volker and Hermans, 2019). Hence, an adequate understanding of the interests of public clients and their influence on the innovation-decision process concerning MMC adoption is required.

*“public sector’s perception of value has changed dramatically, especially since COP 26, where we’re more focused on achieving outcomes like net zero or inclusive place development or issues around kind of the ESG agenda.”*

(Policy and Public Affairs Manager, 13 years industry experience)

### *Public clients’ priorities*

One of the emerging pressures described by luorio *et al.* (2019) is the staggering rates of housing shortages. Moreover, Kuitert *et al.* (2019) report that public clients are expected to balance their legal obligations and procedural values that may be forcing pressure on their ability to overtake new tasks. However, such a burden to adopt an innovation would ease with time once the intuitional pressure is minimised upon the innovation reaching a broader scale of adoption, shifting from being an option to a

factor for legitimacy and significance (Oti-Sarpong *et al.*, 2022). In the public context, the pressure differs from private or commercial sectors through not being a business challenge but rather the ability of the organisation to fulfil governmental instructions and abide by changing policies (Lindblad and Karrbom Gustavsson, 2021). Hence, the knowledge of the various pressure dimensions exerted on public clients would enable a more robust study to explain the influence of their characteristics on their decision-making process to adopt MMC.

*“net zero carbon in operation, all of our schools now are delivered to net zero carbon in operation. All the projects which are being designed and will be built now as of a certain date, the requirement from that point onwards was for all future procurements to be net zero carbon in operation. So again, that signals to the market, you know, government is serious about net zero.”*

(Department for Education Representative, 30 years industry experience)

## **Conclusion**

This paper aims to support research efforts engaged in accelerating innovation in construction by extracting the characteristics that may exist in public clients and are influencing their innovation-decision towards MMC. Through screening literature from peer-reviewed journals from the last decade, 49 articles have been selected and included in this study for a critical analysis. A systematic review methodology determines that various characteristics exist and are being deemed critical by research as attained construction clients and are responsible for undermining the broader uptake of MMC across the sector. The same were reinforced by primary data of arguments from twelve industry leaders and public clients. The characteristics vary

between a) socio-economical characteristics; at education and experience levels, b) personality variables; in attaining traits like controlling, conventional, risk-avoidant, and lower abstraction capability, and finally, c) communication behaviour; in being open to connecting with peers, tendency to seek information, greater knowledge on MMC, and their collaborative attitude. Moreover, this study reveals the need to better understand public clients' norms by aggregating their demands through investigating their acceptability, interests, and the exerted external pressure.

Overall, the critical analysis of these characteristics results in identifying 13 variables that are considered essential influencers in the decision-making of public clients and can be argued to directly impact their innovation adoption. Hereby, this paper paves the direction for future trends of quantitative empirical assessments, informing both research and practice of a research gap, and offering key variables that would enhance the knowledge about this special type of client and, in return, could aid the government, practitioners, and researchers on the pressure points that influence public clients' decision, triggering further adoption of innovation across the public sector. Therefore, future research that can quantitatively assess the influence of each variable under the four key clusters from the DOI theory on the overall MMC uptake among public client organisations would be highly favourable to illuminate the variables of high significance as a key extension of the exploratory nature of this paper.

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