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The challenges of implementing evidence-based strategies to inform building and urban design decisions: a view from current practice

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Abstract

Purpose: This study aims to raise awareness of the key challenges, opportunities, and priorities for evidence-based strategies' application to inform building and urban design decisions.

Design/methodology/approach: This study uses deductive qualitative content and manifest analysis, using semi-structured interviews undertaken with building and urban design professionals who represent a UK-based organisation.

Findings: The challenges associated with the practical implementation of frameworks, potential application areas and perceived areas of concern have been identified. These not only include the need to practically test their use, but also to identify the most appropriate forums for their use. Participant responses indicate the need to further develop engagement strategies for their practical implementation, clearly communicating the benefits and efficiencies to all stakeholders.

Research limitations/implications: Implications/ limitations of this study come with the fact that some of the respondents may possess inadequate professional experience in properly evaluating all the questions. Additionally, the information gathered is restricted to the UK geographical context, as well as coming from one organisation, because of data accessibility.

Practical implications: The findings of the study can be adopted by designers in the strategic definition level to overcome the key challenges associated with the use of evidence-based strategies, enhancing their decision-making processes.

Originality/value: As a theoretical contribution to knowledge, this study enhances the body of knowledge by identifying the challenges associated with the practical implementation of evidence-based strategies to inform building and urban design decisions. In practice, the findings aid urban planners, designers and academics in embedding and adopting strategies that enhance decision-making processes.

Keywords: Evidence-based strategies; Design decisions; Challenges; Opportunities; Big data

1. Introduction and theoretical background

Building and urban design hold the prospect of enhancing the quality of life for its users while also helping address global issues found in urban systems (Imants, et al., 2021; Chang, et al., 2020). The design process is considered as a creative problem, where its solution includes a series of steps or sequenced activities that can eventually lead from the initial concept to realisation (Koberg & Bagnall, 1981; Ledbury, 2018). There are several interpretations as to what design process means, and several models have been proposed to divide the design process into steps, such as the "*Double Diamond Model*" or "*Design Thinking Theory*" (Ledbury, 2018; Meinel & Leifer, 2011). In practice, the stages of a design project are defined to help organise the process of briefing, design, and construction. These stages are described in the Royal Institute of British Architects Plan of Work (RIBA PoW) (RIBA, 2020).

Contemporary practice in building and urban design industry still relies on belief rather than evidence (Brown & Corry, 2011). However, these sources do not clearly articulate relevant planning and design research, nor does research heavily impact on practice. Both the profession and the discipline follow the culture of "non-reporting", missing the opportunity of monitoring build projects to identify whether they have achieved their stated objectives, and thus, avoid mistakes while introducing design efficiencies (Ahern, 1999). Medicine is one of the first disciplines that has transitioned from using "theoretical foundations" to practicing evidence-based approaches (Rosenberg & Donald, 1995). However, several difficulties have already been identified in implementing evidence- based approaches, such as practitioner resistance in embracing this, a lack of communication between stakeholders and academics or a clear definition of what counts as evidence (Abruzzini & Abrishami, 2021; Stanitsas & Kirytopoulos, 2021).

Implementing and disseminating an innovative idea (innovation process) in building and urban design require substantial resources and the role of private development (Forsyth, 2007). The innovation process can be defined as an iterative process aimed at the creation of new products, processes, knowledge or services using new or even existing knowledge (Kusiak, 2009). Emergent technologies and new trends can create new opportunities and help in overcoming such challenges, but they also pose new challenges to designers (Semeraro, et al., 2021). More specifically, "Big Data" tools are recognised as a new generation of technologies, designed to extract value from enormous volumes and varieties of data, enabling capturing, analysis and knowledge-discovery in high velocities (Esteves & Curto, 2013). The evolving trend of big data-driven innovation is leading towards the development of data-driven commodities and services and can empower data-driven planning (Gahm, 2020). Big Data Approaches (BDAs) refer to the combination of diverse data sets and related technologies to extract insights on complex systems via novel organisational and analytical capabilities (Pollard, et al., 2018). Data-driven innovation (DDI) entails exploitation of any type of data in the innovation process to generate positive economic and social impacts (Jetzek, et al., 2014). Nevertheless, the lack of a systematic definition, a

unified meaning of what "Big Data" is, shared amongst academia, industry, business and media, is adding a mystery around its concept (Ward & Barker, 2013; Chen, et al., 2014). Because of the ambiguity of what it represents, its meaning has been converted into a "buzz" word (Power, 2014). The solution (final design product) should be based on evidence and knowledge, increasing the trustworthiness in decision-making (Fredriksson, 2017; Power, et al., 2019). To achieve this, practitioners should be allowed to use research results and evidence as a basis for their designs. Thus, there is a need for developing their own frameworks of reporting evidence in design.

This paper aims to raise awareness of the key challenges, opportunities and priorities for evidence-based strategies' application to inform building and urban design decisions. The study uses deductive qualitative content and manifest analysis, using semi-structured interviews undertaken with building and urban design professionals who represent a UK- based organisation. The originality of this study lies in the contribution to new knowledge by reviewing existing literature and revealing building and urban design professionals' views on the challenges associated with the practical implementation of frameworks. The significance of the findings is reflected in the highlighted potential application areas and perceived areas of concern for future development. The outcomes present opportunities for effective evidence-based strategies to be followed by designers.

2. Research Methodology

2.1. Data collection via semi-structured interviews

Design professionals from a design, engineering and project management consultancy in UK were interviewed via a semi-structured approach. The study followed a deductive qualitative content analysis, where the interview guide was predefined based on previous research and the desire to explore topics based on these findings (Barton, et al., 2021). The research that Stanitsa et al. (2021a; 2021b) conducted defined the structure of the data framework presented in Figure 3, while it informed the selection of participants, as described in Section 2.2.

The semi-structured interview approach was selected because of its benefits in encouraging participants to diverge and elaborate beyond a certain point, revealing additional information of relevance (Adams, 2015). There are several limitations when conducting semi-structured interviews, mainly associated with respondents fully comprehending the questions asked (Oltmann, 2016). Addressing this, the selected participants were practitioners with a depth of professional knowledge in the design of buildings and places. Furthermore, to avoid bias introduced by the interviewer, questions were asked in ways to avoid increased involvement in the discussion or further commenting (Adams, 2015; Ritchie, et al., 2003).

Interviews were recorded and transcribed with participants' consent obtained, and assurance of anonymity was provided. This study also uses manifest analysis, using direct quotation of participants

(Gopaldas, 2016), providing detailed understanding on a subject area (Bengtsson, 2016). Two pilot semi-structured interviews were completed prior the commencement on the main cohort of participants to validate the included questions, concepts and language and to determine suitability of research instruments (Malmqvist, et al., 2019). The collection of data via semi-structured interviews was undertaken between August and October 2021. Each interview was restricted to approximately 45 minutes to ensure willingness of participation, fatigue reduction and to achieve a higher response rate (Barton, et al., 2021).

2.2. Stakeholder group

The stakeholders' group was composed of practitioners with experience in the fields of design and construction of buildings and places. The collected sample included 15 participants from one UK-based organisation, which is within the acceptable range of interviewees as defined by the literature (Bengtsson, 2016; Galvin, 2015). The number of participants is determined based on the conclusive responses to the questions regarding the analysed themes, and the sample has reached the point of information saturation (Ritchie, et al., 2003; Fusch & Ness, 2015). The study followed a convenience sampling method through direct approach, targeting participants based on professional relativity and participation willingness (Brodaty, et al., 2014). This method was selected because of the benefits it presents, avoiding complications of dealing with a randomised sample and to obtain information and trends relevant to decision-making within the design process. Key criteria, as gathered from existing literature, were participant's different levels of hierarchy, sector focus and experience in DDI and BDAs (West, et al., 2008; Harris, 2012). The participant details are provided in Table I.

Table I: Participants of the semi-structured interviews

ID	Sector	Role	DDI or BDAs Experience
P1	Commercial & Workplace	Architect	Partial
P2	Education	Project/ Lead Architect	None
P3	Master planning & Urban Design	Technical Director	Beyond role
P4	Master planning & Urban Design	Associate Director	Partial
P5	Research & Innovation and Building information modelling	BIM Coordinator/ Digital Developer	Expert
P6	Rail	Associate Director	Beyond role
P7	Rail	Senior Architect	Partial
P8	Research & Innovation	Senior Design Researcher	Expert
P9	Commercial & Residential	Project Architect	Partial
P10	Building information modelling	Associate Director	Expert
P11	Master planning & Urban Design	Urban Designer	Partial
P12	Commercial & Residential	Architectural Assistant	None
P13	Education & Residential	Technical Director	Partial
P14	Rail	Architectural Assistant	Partial
P15	Education	Architect	None

2.3. Semi-structured interviews guide design

An interview protocol was developed, outlining the main questions, while several secondary questions occurred based on the initial responses to the main ones. These questions are structured based on the key themes outlined in Figure 1, divided further by sub-themes for a detailed understanding of the challenges and opportunities present in existing approaches and the future implementation of new frameworks. The key themes explored are Existing Design process investigation, DDI and BDAs potential, and Practical application and Framework validation.

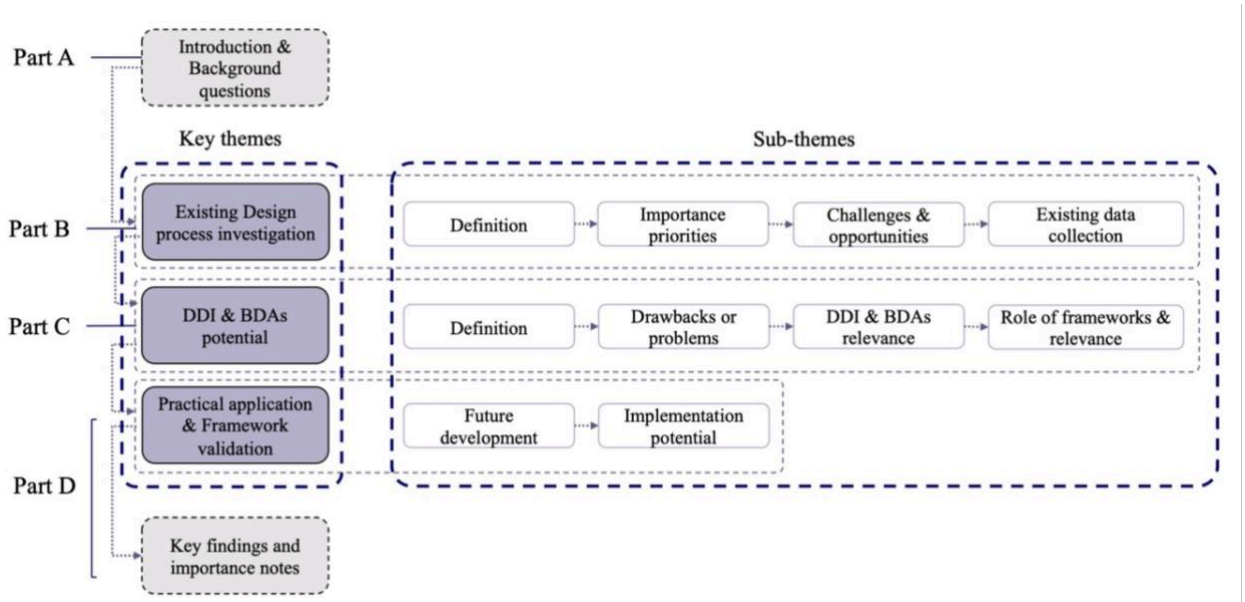

Figure 1 Systematic map of the key themes explored during the semi-structured interviews.

An initial introduction to the research and the format of the interview was involved and several background questions were posed (Figure 1. Part A). The purpose of the first part of the questions asked was to identify how involved the participants are with the design process and at which level they are using diverse types of data. Part A questions also allowed the later questions in Part B to be placed into the context of each participant's role (Figure 1. Part B). Furthermore, it allowed terminology used to be defined, ensuring participants fully acknowledge the content of the questions that will follow. The questions included in Part B, C and D were then used to explore the key themes and investigate the potential of new approaches to be implemented in practice, serving the aim of this paper. Further to this, some of the work produced as part of this research, was communicated via graphs, further explained in the next sections.

3. Results

3.1. Challenges and opportunities derived from existing design processes

The purpose of the semi-structured interviews in Part B was to reveal the challenges and opportunities designers face in addressing the existing design processes. Based on the responses received by the participants, the results indicated an in-depth understanding of what "design process" means to them, with a great majority referring to an "iterative" process. Nevertheless, it was suggested that there is not one single methodology to be followed, rather it is just a narrative or a set of guidance documents, often used as advice. When discussed with participants, several suggested that key steps exist when rationalising the design process, as noted below:

"So, it's really reflecting the work process that we traditionally follow in design. Well, in all the projects, it's data collection, then it's diagnostic, and then it's prototyping on the project and development to the project. Those are the four main steps. Nothing more specific." [P4].

However, participants who formed part of the Rail sector referred to "*a scientific and structured process in the early stages of the projects, to come down to a single preferred option*" ([P7]), or to a "*heavily standardised and very prescriptive process that needs to follow client's design standards"* ([P6]). Similar comments were received by those involved with the Building Information Modelling (BIM) service line, highlighting that the end-goal of their service line is to streamline the design process, enabling designers "*to be a lot more prescriptive and linear and record the process in which various stakeholders delivered and developed their design."* [P10]. Finally, one of the participants referred to the design process as "*pre-conceived*" and by further expanding "*There's a lot of repetition. There's not much flexibility in design.*" [P15].

Figure 2 describes the stages of design, research and development process, spanning from the generic design stages up to detailed design tasks, as identified in literature (Ledbury, 2018; Meinel & Leifer, 2011). RIBA stages are mapped against each step for ease of interpretation of the participants. Following the presentation of Figure 2 to the participants, they were then asked to highlight the important parts of the design process and identify the parts that are not aligned with their internal design methodologies. Three participants commented on the presented process, highlighting key differences, while the rest of the participants felt that Figure 2 accurately represents the steps usually followed when designing a building or a place.

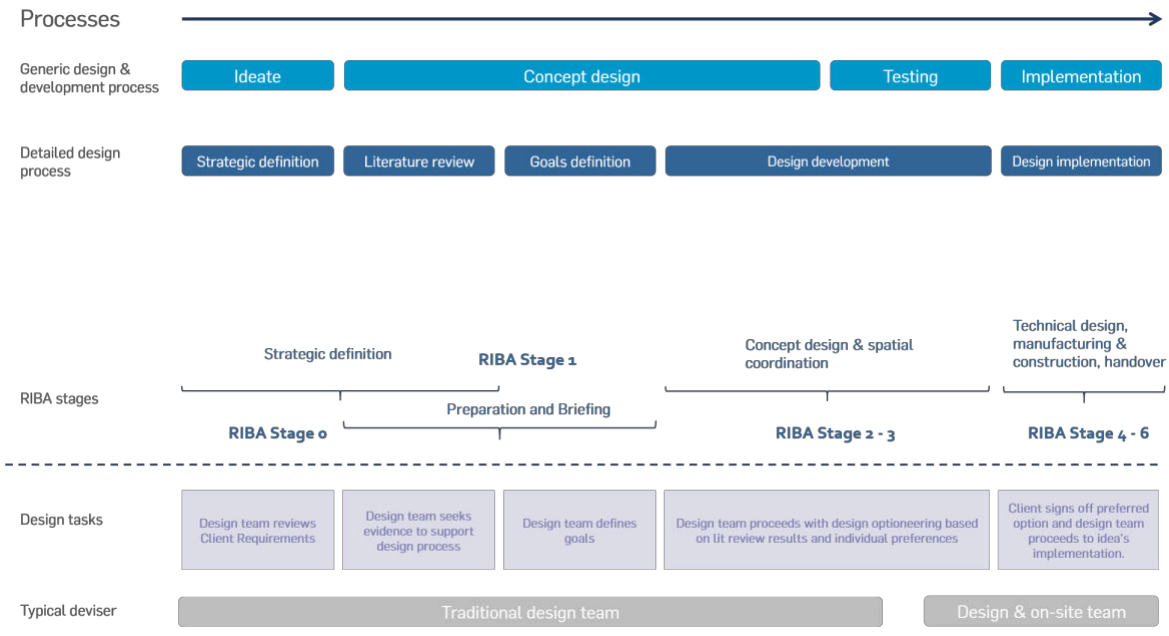

Figure 2 Design, research, and development stages.

More specifically, regarding the highlighted differences, [P3] felt that "*All the tasks fit within the strategic definition. Mini scheme on its own.",* highlighting the iterative nature of the design process. [P1] felt that "*testing comes in tandem with concept design. You will never do the testing after you develop a concept design.",* commenting on the need for a design validation process prior to a finalised concept design. Finally, [P4] identified a missing step in the beginning of that process; "*Understanding the context, understanding the client.*".

Majority of the participants felt that all the steps within the design process are equally important. However, a great majority of the participants indicated that the biggest impact of decision-making is in the initial stages of design. They highlighted its linear structure, indicating that the outcome of the first step (Figure 2- Ideate) will be carried on in the following stages of design, up to the implementation (Figure 2 – Implementation). Others identified important aspects of the design process in need to be considered, rather than important steps. These can be divided into three themes: Resourcing, Information and Understanding, as noted by several participants:

"In strategic definition and briefing, there is sometimes a lack of knowledge of where you would get information or what type of information will be useful at that stage outside of people's experience". [P8]

"Client requirements. I think it's really important to have a very clear understanding of the brief." [P11].

"We all make assumptions; we form our viewpoint depending on precedent and what we've seen before. Understanding the opportunity that data can bring us up, because sometimes it surprises us." [P13].

The majority of the participants highlighted the fact that in initial stages of design, they follow a two-stage approach to collect the required information. Designers rely mainly on the client to provide information, which is then followed by a desktop study from the design team, a site visit or by direct commission of external consultants to obtain missing information. Therefore, design teams consider that "the only source of information is from the client and standard policies" [P1] or "Personal education" [P15]. According to the authors' understanding, this implies that in the initial stages of design, publicly accessible information is not used, indicating designers' over-reliance to the client's brief and policies, which can be linked to several associated factors, e.g. competence and skills, experience, project budget, areas of interest, etc. This is further supported by one of the participants:

"*Publicly accessible information at the RIBA stage Zero, but I think design teams tend to maybe kind of rush that and will do things like just use Google Maps. Will take an image of like a street pattern and then just infer on top of that. And I think that that is a challenge because you're not using accurate information necessarily*." [P8].

The radical alteration of the designer's practice has been identified as a continuous challenge since the early 90s. Schön (1991) claimed that professionals are expected to solve tasks they are not educated to handle, and are required to generate technological change to be aligned with the expectations and demands that technology itself has generated. Contemporary practices still struggle to accommodate change, as the complex and time-consuming processing involved with "new ways of working" force designers to rely on existing approaches and workarounds to accelerate their work.

Furthermore, participants discussed the key challenges and opportunities of the approaches they use, summarised in Table II. To highlight the important aspects of the discussion in existing design approaches, the key findings are separated in four categories: Data, People, Tools and Brief. Table II also summarises the priorities for future efforts to be focused on, to improve the existing design processes.

Table II: Summary of key findings including challenges and opportunities in existing design approaches of buildings and places

Challenges	**Opportunities**	**Findings & priorities for future efforts to improve design processes**
Data		
Data management Data analysis Data sourcing Data accuracy Lack of information	Open-source data Data availability Feedback collection	• A consistent approach on how to collect the data first. • Validate the data from a quality perspective, not just from what it has been produced against the contractual, but against a set of requirements in terms of what the data means for the success of the project. • Encouraging conversation at the beginning of the process to leverage data that exist or the client to get information from other parts of the local authorities.
People		
Designer's (users) culture Client familiarity Understanding of client's business model Data Literacy	Centralised clients	• Choosing the right methodology for the clients, not necessarily changing the design process. • Putting in a broader context the nature of the problem, so it becomes clearer and with the breadth of the solutions. • Depends on the geographical context - introduce the benefits of sharing the data. • Having people with the experience of bringing that data or information into those different stages. • Bring people in with enough experience around construction and design, and data literate.

		• Robust leadership and a robust set of stakeholders that can supervise and sit across. • Validation at every single stage against all the stakeholders. • Design methodology captured in a way that could be audited.
Tools		
Multiple forms of communication Limited software experience Resources and skills	Open-source tools Design validation	• Tools with successful interface interaction with the client. • Low cost and effective tools and information, freely accessible geospatial information, and platform to use. • Reduction of manual processing. • Reduction of data sizes or training on how to utilise heavy files of information.
Brief		
Restricted budgets Time Complex stakeholder and procurement route	Future potential	• In the long run, a data driven approach would be more efficient in the design process - therefore encouraging implementation in early stages. • Utilizing what is produced out of expensive requirements into contracts and scope in a meaningful way. • Digitize the construction process and the design. • Aligning stakeholders' expectations. • Sharing of information to avoid abortive work. • Asking the intelligent questions early on.

The results indicated the lack of a monitoring process of existing design approaches. More specifically, participants highlighted the need for the design process to be defined and communicated, including any potential methodologies. This can enable the designers to choose amongst a range of methodologies and identify the most suitable one for their projects. This can further help in articulating the benefits of the diverse methodologies, which can then be communicated to the clients, encouraging conversation at the beginning of the process.

3.2. Perceived drawbacks and priorities in DDI and BDAs implementation

The purpose of the semi structured interviews in Part C was to identify participant experience in DDI and BDAs implementation, followed by a discussion of the perceived drawbacks and priorities of such approaches. Several participants felt that "*it does not mean anything specific*" [P2] or that "*Big data is a fuzzy name – very abstract.*" [P3]. Participants with a wider knowledge around the use of data,

classified as "*Experts*" in Table I, also received this concept with various interpretations, as noted below:

"*These very large repositories, having more data all in one place and sort of timestamped."* [P5].

"*A really large number of data points, over 10,000, that provides you with a much more granular understanding of something*." [P8].

"*From my perspective, means anything that doesn't sit specifically to a direct input, but it's more related to a pattern and it's modern drive out of a series of other datasets that are trying to connect. But it's the connectivity of data for other purposes than what it was intended for*." [P10].

Other interpretations included "*A system that stores raw data. which cannot necessarily be handled manually*." [P12], or "*Access to the large and open variety of information that can be extracted from a multiple from a variety of sources. Although they are not coordinated*." [P4].

As identified from the literature, contemporary practices assume of having an in-depth appreciation of people's point of view on "Big data," as it forms a big part of the industry's agenda. However, the lack of a systematic understanding of how people perceive data results in the missed opportunity for stakeholders to express their opinion on data, how can these be embedded in their processes and what their impressions and challenges are.

One of the key findings includes that even though participants had a general understanding of what "*Big Data*" is, all of them felt that DDIs and BDAs are "*definitely relevant*" [P2] to their work. The reasoning behind that positive response was explained by several participants, as noted below:

"*It's important to have an overall view of the bigger picture of things before you start designing, so it's just another facet that feeds into the design process."* [P7].

"*Yes, because I know there could be a lot of more efficient ways that big data and digital emphasis could sort of improve efficiency on a project. So, I do think it's got a part of it. I just think a lot of people struggle to understand what big data is and what digital is on the railway."* [P6].

Because of the challenges identified in existing processes around people and skillsets, as summarised in Table II, participants highlighted the fact that in many cases there are specific people with specialised roles responsible for the incorporation of diverse data sources and their findings within the design, as a separate team within the organisation. Nevertheless, based on participants' commentary, this barrier is now recognised by the organisation and moving towards a "*more integrated approach. The team is separated from the people who analyse the data – and keep feeding this information. But because they are also trained architects in most cases, it would be way easier to do it as part of the team."* [P1]. This has been recognised as a key challenge within the organisation, stating that: "*Needs to be part of the design team. The design team might not be experts in that, but they need to have sufficient understanding*

to identify the need. It is difficult to keep up with the emergent technologies and they need to educate themselves." [P3].

Participants felt positive towards the implementation and adoption of new "data frameworks," while they recognised the value of such evidence-based strategies as part of the wider planning and design process, rather than just the project design. By example, "*A series of frameworks might help identifying different clients.*" [P1] or "*It doesn't necessarily need to relate to design information, but it really could relate to things like program or fees or resources or skills before design."* [P9].

Participants were presented with the framework in Figure 3, enabling further discussion on the implementation challenges of similar evidence-based strategies in the design process. The proposed framework describes the steps to be undertaken on the top, with detailed information for each step described below. It recognises the importance of three distinct layers of information that are pre-processed and analysed using DDI and BDAs, leading to the extraction of insights. These can then be fed to the design team, enabling the definition of the design indicators and success factors at the end of this framework, which are then implemented directly in the traditional design process.

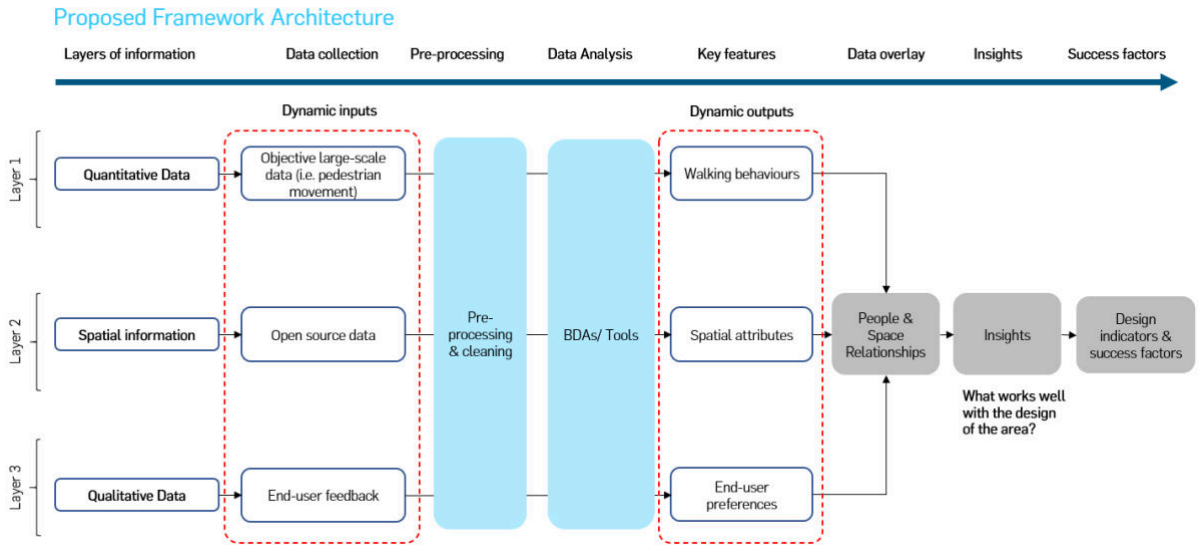

Figure 3 Proposed framework architecture example, as presented to the semi-structured interviews.

Participants expressed a positive feeling overall in the presented example or to similar evidence-based strategies potential as part of their design process. Participants did not alter their initial views around frameworks, following their exposure on Figure 3. On the contrary, the presentation of a framework example enabled some of the participants with no familiarity of DDIs and BDAs to materialise what the role of such evidence-based strategies could be and express their views towards potential drawbacks or problems in their future implementation. A summary of the findings and overall discussion is presented in Table III. The same structure in the categories of Data, People, Tools and Brief is followed.

Table III: Summary of drawbacks or problems participants foresee with evidence-based strategies implementation.

Drawbacks or problems	Findings & priorities for future efforts for evidence-based strategies implementation
Data	
Key Performance Indicators (KPIs) should be in place Data accessibility	• Data that can be turned into modelling. • Use the findings to review and analyse. • Consider it as an additional source of useful information for designers. • Centralise the repository of the information that is produced from a design stage through to construction and beyond.
People	
Complexity of implementation Fit in clients' aspirations Specialised roles required Evidence the benefits Culture of users: nervousness around the use	• Needs to be used intelligently, not just applied to a project. • It can serve as evidence when pitching to the clients. • Useful as an overall view of the bigger picture. • Has to be dealt by someone who knows how to extrapolate but has to be also someone who understands the project needs. • Finding a common language that can be shared.
Tools	
Bias in the analysis	• Improve efficiency. • Bring predictability in what designers do.
Brief	
Be organic, not solid, and linear Increased budget Time constraints Communicate relevance to projects	• Applied in the early stages of design- crucial decisions early in the process. • Informs the general agenda. • Potential in minimizing error and changes. • Everybody working in this environment has to have the ability or picking up that data in the shortest time possible. • Use lessons learnt to speed up the process. • Produce findings against a series of criteria

Participants highlighted the need for specialised skills and roles for the effective implementation of such approaches, while they have also referred to the need of clearly communicating any potential benefits of such approaches. DDI and BDAs have been perceived as an opportunity to inform the

general agenda of their work and to access insights which have been previously hidden or required extensive manual work. In general, participants expressed their positive views towards new approaches, indicating that the application of such frameworks reveals opportunities and potential benefits.

The results further disclose the underlying concern for a lacking part of the stakeholder basic knowledge of general principles and methods around DDI and BDAs. More specifically, the findings imply that the human component can be underestimated as a part of the design process. Design processes can become of increased complexity and by having multiple owners and leads creates challenges. The lack of a robust leadership in the initial stages of design results is a missed opportunity to introduce a set of requirements to define the role of "data" from a quality perspective. Furthermore, the absence of a clear definition of how information can be used in a meaningful way, embedded in an already complex procurement route, may lead to the introduction of additional costs as part of contracts and design scope. Therefore, the human aspect becomes a crucial factor when introducing novel approaches in design.

3.3. Strengths, opportunities, and future development of evidence-based strategies

Although evidence-based strategies' research potential in addressing design and planning issues is promising, technical and knowledge discovery challenges slow down their practical implementation, as indicated in Table II and Table III. Nevertheless, all participants stated a willingness to test and adopt the presented framework or other similar ones. Participants noted that "*it is important to test things before you judge"* [P1] to "*get a clear understanding*" [P4]. However, few of the participants were hesitant to confirm that they would adopt such frameworks as part of their traditional approaches before comprehending what its role might be, as noted below:

"*Depends on how it would fit in. If you can demonstrate where the time saving is or where the efficiencies are, I have no reasons to say no."* [P2]

"*So, adopting it, it depends. If you are delivering a project and you're trying to test that on a project, that might be a challenge. A parallel thing where we test project that we have delivered, and we know already what's the performance in doing a traditional in going through traditional approach versus unimproved approach. That is something that is more realistic."* [P4].

Other participants felt that the role of evidence-based strategies application lies with the ones defining the overall design process, such as the clients themselves or the client facing roles within the organisation, as noted below:

"*I can personally test it, but I don't think that I can make a call for how big the project is in terms of tests. For example, testing a new framework when it's the process of how we go about things is quite set in stone."* [P14]

"*It depends on the dynamics. So, depends on how your client is going to drive the collection of your data. That's where you're going to make the decision of which framework and which approach, you're going to use."* [P1]

Several participants indicated that the overall presented framework "*is quite robust*." [P14] while they highlighted the parts that they see as its strengths and opportunities. However, participants commented on additional features they would like to see added in future evidence-based strategies. The information is summarised in Table IV.

Table IV: Summary of strengths & opportunities and additional detail to be considered added in future evidence-based strategies as expressed by the participants

Strengths and opportunities
• *"The distinction of quantitative data, spatial information, and qualitative data"*
• *"The data overlay and the insights' part, to understand that is an evolving process, rather than a single solution"*
• *"Thinking about people, space, and relationship as a whole"*
• *"The headings work really well as a general overview"*
• *"Areas of innovation, especially ones that can help us communicate better"*
Future development/ Missing detail
• *"Site visits and collection of observational data"*
• *"Allow for input and feedback from other disciplines and factors that would be part of the scheme"*
• *"A good definition of what's a success factor"*
• *"Evidencing if finding has a positive or a negative impact"*
• *"The story should be at the beginning"*
• *"Between layers of information and data collection, there needs to be an input of existing KPI's"*
• *"Elements of predictability"*
• *"Clear step, in which validation of information happens"*
• *"Data sources step for documentation"*
• *"Links to the building regulations and contractual requirements"*

Participants highlighted the importance of having such frameworks in place, however, there needs to be a strategy also in place, if this is to be presented back to the organisation. More specifically, the main concern voiced by one interviewee regarded a cultural issue often observed when introducing new workflows or methodologies, aimed to replace or add to existing ones:

"*I think people are just fixated on using that, but it will be hard to shift away from their habits that people use just. I think people find it hard to visualize something else that kind of does the same thing. It might be hard to either explain people why this sort of thing might be relevant in addition to the plan of work or something that might replace it.*" [P15].

In a similar context, this was mentioned by another participant, however, highlighting an additional challenge; the level of experience in using such frameworks within the design process, as indicated below:

"*I don't think there's anything missing from the framework as such, but I don't know whether if you were going to do this in practice, whether you would almost need like a story at the bottom, where beforehand to be like this is the challenge. If people don't have previous experience of working with data, they sometimes find it abstract. How do you introduce people and design teams to this?"* [P8].

Several future development concepts were suggested by the participants; however, results indicate that the most critical one remains the stakeholder engagement. The development of evidence-based strategies is closely dependent to the end-users, and without their proper involvement in this process, frameworks can endlessly be altered to meet project needs. Instead, the focus should be turned on creating practical application examples to be tested, as the requirement of achieving specific outputs can highlight missing key features and enable users with no previous experience on such strategies to provide constructive feedback.

3.4. Potential areas of application and prioritised areas of concern

The results of the interviews indicate that designers feel that frameworks have a potential role in their existing design process. Throughout the interviews, several parts of the design process, which could provide potential areas of application for the frameworks, were identified. However, several areas of concern associated with their practical implementation were also raised. This section discusses the key areas of concern as prioritised by the interviewees and possible ways of overcoming them.

In terms of design and planning, the optioneering development process present difficulties associated with creating evidence against each option tested and it is currently limiting their application at the strategic level (Figure 2- Strategic Level). Were the limitations as identified in Table II to be overcome, then frameworks could be applicable at the strategic level, re-enforcing what design process is already doing. Some interesting responses to arise from the interviews are noted below:

"*I think that this is a framework that sits in a stage rather than across all the stages. I guess you could use it in different ways at those different stages. Test your options against those, so you might come back to this at those later stages. In the rail sector in particular, they already do that kind of approach.*" [P8].

"*Yes, I think it could probably go feed into all stages actually. I think this would be brilliant. in the early stages of a project in feeding into the design process for the rail sector.*" [P6]

"*I would find these more useful during the early stages of the of the design process maybe. When you define what the concept is and what the dynamics of the project is."* [P9]

Furthermore, the results of the interviews articulate that designers feel that frameworks have a potential role in participatory design, hence acting as communication tools when design processes vary as much as identified in the organisation. As [P12] noted, offer a means to open dialogue between different disciplines by helping to explain and communicate in a "*language that everyone uses*". In that way it can help to overcome issues arising from not using "*a common template… Same approach or same tools. Then the information and the data can easily be connected afterwards.*" [P12]. Similarly, such frameworks have also a role to play in communicating project goals in the strategic level. The design process is very complex, and in many cases, designers feel overwhelmed from the breadth of information defined in a client brief. [P13] highlighted the importance of frameworks as communication tools defining what is needed, as noted below:

"*To look at a site when you can't see the context, if you look at the brief, if you just had the site plan without the context, then you're not going to understand how you actually respond to that site. To be able to make it easier for people is what you essentially need."* [P13].

Another participant felt that frameworks have a role to play in the management of the design process, rather than the process itself. More specifically, [P10] notes that "*It doesn't necessarily need to relate to design information, but it really could relate to things like program or fees or resources or skills before design.*". Their potential is as visualisation tools to understand "*progress in your project*" [P15]. The participant further elaborated on the lack of interactive tools to ensure the efficient management of the project itself, noting that "*Buildings are so complex, you can't remember everything, and you need a database on every project to make sure you ticked off every box. And that currently doesn't really exist. It exists as a document, like a piece of literature."*

Participants were asked to close the interview by prioritising the most important point from the overall discussion (Table V). It is worth mentioning that the general concerns raised by the interviewees were similar throughout the semi-structured interviews. However, in terms of prioritising them, participants raised different points as being of high priority. Results indicated that the variety of design methodologies undertaken, the challenges present in each role and sector, as well as the diversity in

experiences and knowledge in big organisations, heavily affect the decision-making in design processes. This highlights the importance of framework implementation to streamline and enhance innovation in the design process of buildings and places. Further to this, 7 out of 12 interviewees' concerns were related to the "People" category, emphasising the key role that the end user holds in the effective implementation of evidence-based approaches in the design of buildings and places.

Table V: Conclusion points and high importance priorities as perceived by the interviewees (key elements have been highlighted)

ID	Overarching Theme	Category	**Conclusion points and priorities** (as extracted via direct quotation)
P1	People/ Skillset	People	*"The whole process is important – every part is important. As a broader skill that everyone needs to have in the level of design and operation of a project is **to be able to understand and analyze data**".*
P2	Data management	Data	***"Management of data and how it is shared**. What changes it would make in knowledge sharing".*
P3	Integrated process	Brief	*"This process needs to be into the design process in a way that recognizes that **it's not distinct** and separate off from it".*
P4	Seamless process	People & Tools	***"It needs to be seamless**, but the fact how it's seamless and easy is to access the framework and use it".*
P5	Data availability/ analysis efficiency	Data & Brief	***"Availability of the data**, finding methods or people that can **analyse the data quickly** and make it available to decision makers".*
P6	Data sources	Data	*"It's **where you get your information from** because that forms your argument. Or your evidence".*
P7	Software	People & Tools	***"Having the right software** to work with just on the very basic level. This is shaping what we can achieve as well, and if they're restrictive, that just restricts the whole process and leads to. I think it probably leads to innovation being stifled by being hammered with delivering in a certain way".*
P8	Success factors definition	Tools	*"The endpoints, the **design indicators**, and **Success Factors**. How do we do that and then test our designs against it. Indicate like what the benefit of this is. You know it's to have the like this evidence-based data driven design".*
P9	Feedback loop	Tools	***"Feedback.** Present your data and then have feedback and rethink about the whole cycle and how it works".*
P10	Big data perception	People	*"Probably the most important one is one of the first questions, which is under **understanding other people's point of view on big data**. There is an assumption because data is such a big part of what we do, whether in the industry or globally".*

P11	Process as a communication tool	People	*"This very **well-structured process** and it makes it more **clear and easier for everybody in the team to understand**".*
P12	Framework's importance as part of the design process	People	***"The importance of frameworks.** Because if frameworks mean achieving a level of organization, it can be either in projects or analysis or anything, and this can automate processes, save time, and produce more money for a company for example".*
P13	Timeframes	Brief	*"Making our teams understand the **importance of this data** and allowing them **the time** and the space to access it, beginning of project. Particularly on projects which are very fast track and where we might only have a week or so to do this at the beginning".*
P14	Transformation of existing design process	People	***"The use of data**, the use of big data or for being like heavily part of the design process; because otherwise I don't see how anything can work".*
P15	Efficiency of design process	Brief	*"Frameworks may give you an answer to a question that normally takes about four weeks to decide".*

4. Discussion

The design process contains a series of activities that may vary from one type of a building or a discipline to another (Ledbury, 2018). Early in the process, designers take crucial decisions, which often, these are not supported by evidence (Brown & Corry, 2011). Findings revealed that halfway through, designers may realise that the assumptions or questions asked in the beginning of the process do not adequately reflect the requirements of the client brief, or the process becomes "top-heavy" by analysing all available data in the first stages of design, wasting time and effort.

The availability of information and the synthesis of research findings to inform decisions in the early stages of design are needed to support the evolving complexity of design and construction practice. This study revealed that "Big data" approaches are relevant to the decision makers in design, promising to tackle the lack of information and bring predictability in their work. However, they are not yet effectively implemented in their existing approaches. Because of the technological changes, the collection of data becomes easier; however, challenges around their analysis and interpretation arise (Reddy, et al., 2020). The analysis suggests that the design and construction sector has already started the transition from document-based to model-based data by embedding specialised roles in the design processes. Nevertheless, the change to digital ways of working has been slow, with users still conditioned to work with traditional sources of information, such as portable document formats and drawings, and limited to what it is provided by the client. The complexity and long processing times involved with evidence-based strategies force users to shift back to existing approaches and

workarounds to expedite their work. Findings indicate that current practice does not have policies in place to monitor existing approaches, missing the opportunity to identify issues and save a significant amount of capital throughout the stages and minimise error and changes. Thus, the development of frameworks to report evidence in design becomes a prerequisite.

A common misconception is the fact that having access to a plethora of data means that an in-depth understanding and visibility of the problems in a project can be easily acquired, and subsequently, decision makers can resolve any issues before they arise. Potentially the problem is "Big data" itself, and the fact that data in isolation does not replace the human element of behaviour nor communicates elements that are culturally ingrained around how people behave. Monitoring and capturing the relationship of people's engagement with the evidence-based approaches and understanding their point of view on data is the key priority, as people hold the prospect for the effective implementation of such strategies in practice.

Dossick and Neff (2010) indicated the importance of cultural differences among the diverse stakeholders, stifling collaborative work, caused by the existence of multiple design processes, domain-specific tools and modelling practices. However, the findings of this research indicate that, although the design process can vary significantly, it responds to an overarching structure that defines the diverse steps to be undertaken. Results also highlight the individuality of each project, and the way client requirements can be analysed under several different points of view. Accordingly, following the participants' views, frameworks have the capacity to define the design process steps, while introducing efficiencies throughout the process. Nonetheless, for the efficient framework implementation in policy and practice, there is a need for two distinct approaches: initially, the introduction of a general framework responding to the overarching structure of the design process, and secondly, via multiple adopted frameworks in accordance with the needs of the diverse stages, activities or steps, responding to the uniqueness of each project. To achieve this, it requires the practical testing of frameworks within the design approaches, via which the most appropriate forums for their use can surface. A set of common practices and a larger vision for the identified challenges around data creation, management, use and interpretation should be laid out in the beginning of each project, ensuring that every decision-making step is recorded and conducted without loss of information in between.

Gaining understanding of human behaviour is a highly complex challenge, requiring the inclusion of the wider group of decision makers involved in the design of buildings and places (Stanitsas & Kirytopoulos, 2021). By adopting such an approach, a broader cross section of stakeholder groups and individuals can be consulted, incorporating their greater knowledge and experience as decision makers in all stages of design. The development of engagement strategies for the practical implementation of evidence-based approaches is an essential component unlocking their potential to be effectively used by designers.

The opportunity to test and monitor the framework implementation lies in the strategic definition level, where the benefit of adopting new approaches can be identified and communicated to the diverse stakeholders. Practitioners should focus beyond the individual scope of their organisations towards the common goals of the project. Initially, there needs to be a focus on data collection, and communicate the importance of the data and continuous data capture as part of this process.

The study's distinctiveness resides in its contribution to new knowledge by presenting the perceptions of building and urban design experts on the challenges involved with the application of frameworks. Furthermore, designers gain insights into the effective implementation of evidence-based strategies as a result of the findings.

5. Conclusion

This paper aims to raise awareness of the key challenges, opportunities and priorities for evidence-based strategies' application to inform building and urban design decisions. The study uses deductive qualitative content and manifest analysis, using semi-structured interviews undertaken with building and urban design professionals who represent a UK-based organisation. Participant responses indicate that whilst evidence-based strategies potentially have a wide range of uses in the building and urban design industry, there remains a need to further develop engagement strategies for their practical implementation, clearly communicating the benefits and efficiencies to all stakeholders.

Together with the challenges associated with the practical implementation of frameworks, several potential application areas, and perceived areas of concern of high priority for future development have been identified, which need to be resolved for the evidence-based strategies to be effectively used by designers. These not only include the need to practically test their implementation, but also to identify the most appropriate forums for their use. The collection of data and use of modern analytics and methods in early stages of design offers opportunities to improve existing design approaches, helping building and urban design organisations make more informed and efficient decisions, considering future demands in ever-changing environments. The recipients of the findings will be the urban planners, designers and academics who are interested in delivering urban environments aligned to the end user needs, using evidence-based strategies in their decision-making processes.

Implications/limitations of this study come with the fact that some of the respondents may possess inadequate professional experience in properly evaluating all the questions. Additionally, although participants were selected with different levels of experience in DDI or BDAs, the initial questions were exploring their understanding, identifying areas of concern regarding their responses, or further explanation of concepts where necessary. Finally, the information gathered is restricted to the UK geographical context, as well as coming from one organisation, because of data accessibility. Therefore, they are not generalisable and future research should explore gathering information from a wider

audience in a global geographical context that could fine-tune the results for specific contexts. Another line of inquiry for future research could be the analysis of the applicability of these frameworks before and during the implementation of a project. Further research should be conducted on the identified approaches for different types of projects to validate their usage as generic or project and sector specific.

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Author contributions

The final manuscript has been approved by all three authors. Avgousta Stanitsa conceived of the presented idea and compiled the manuscript. Stephen H. Hallett and Simon Jude supervised this work, verified the methods used, and provided substantial inputs to the text. All three authors discussed the results and contributed to the final manuscript.

Conflicts of Interest

The author(s) declare no conflict of interest with respect to the research, authorship and/or publication of this article.

Data statement

Due to the sensitive nature of the questions asked in this study, survey respondents were assured raw data would remain confidential and would not be shared.

Ethical Approval

An ethical approval was obtained for the collection and use of the questionnaire data via the Cranfield University Research Ethics System (CURES). Reference: CURES/14449/2021.

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The challenges of implementing evidence-based strategies to inform building and urban design decisions: a view from current practice

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