



Framing the Barriers to Construction Industry Transformation

Journal:	<i>Built Environment Project and Asset Management</i>
Manuscript ID	BEPAM-01-2022-0010.R2
Manuscript Type:	Research Paper
Keywords:	Supply Chain, Barriers, Carbon Footprint, Construction, Organizational Change, Strategy

SCHOLARONE™
Manuscripts

Framing the Barriers to Construction Industry Transformation

Greg Watts, University of Salford

Peter McDermott, University of Salford

Shaba Kolo, University of Salford

Abstract

Purpose:

'Transforming construction' is a wide-ranging strategic term, under which sit numerous initiatives. It is the latest, in a long line of strategies and reports introduced to with the intention of industry improvement. Arguably, many of these fail to achieve their aim. The barriers preventing the adoption of transforming construction initiatives are therefore limiting the potential benefits of the strategy. The aim of this research is to formally identify and understand how these barriers are framed and how these frames can be changed so that the barriers can be overcome, and the wider strategy benefits realised.

Design/methodology/approach:

A literature review is undertaken to identify 'transforming construction' initiatives. Fifteen semi-structured interviews are then undertaken with construction professionals and analysed via narrative analysis to identify and understand perceived barriers to these initiatives. Framing is utilised as a theoretical lens to categorise these barriers and understand how 'shifts' in the frames held can be achieved and the barriers overcome.

Findings:

Barriers to transforming construction initiatives are identified as wicked problems. This allows a new perspective on such initiatives to be gained. The results also reveal how construction professionals frame such barriers, viewing themselves as bystanders with initiatives and practices 'bigger' than themselves and their roles. How these frames can be 'shifted' from bystander to active participant is identified. Such a shift can serve as a blueprint for industry professionals so that the initiatives identified can be successfully implemented thereby increasing the success of the transforming construction strategy.

Originality:

1
2
3 This paper addresses a gap in current research around the perceptions held by construction
4 professionals of the initiatives that sit under the transforming construction strategy. Addressing this
5 gap allows the diagnosis of barriers that have previously served to prevent initiatives gaining
6 traction. The findings contribute to both the existing literature and current industry practice by
7 highlighting how the barriers are framed, and how such frames can be 'shifted' to support the
8 realisation of long promised strategy benefits.
9
10
11
12
13
14
15
16

17 1.0 Introduction

18
19
20 When it comes to publishing reports and introducing strategies on how to improve industry
21 practices and performance, the construction industry can be described as having 'form'.
22 Construction industry criticisms such as an uncaring and aggressive attitude to both clients and
23 society, and responsible for high waste and pollution levels are long standing but arguably still
24 applicable (Barthorpe, 2010). In the 1920's and 1930's the industry was criticised for its adversarial
25 attitude, cost overruns, time delays, and wasteful nature (Blossom, 1934). This report was published
26 in response to such criticisms and outlined a strategy advocating for a change in the way buildings
27 were constructed. on the same criticisms were then echoed thirty years later with attention also
28 drawn to the industry's contract and procurement practices (Banwell, 1964).
29
30
31
32
33
34
35

36 Over the next decade little changed in the industry with the publication of a further report which
37 again gave a series of recommendations and initiatives to address industry criticisms (Wood, 1975).
38 This report, like those that preceded it, were largely ignored. Acknowledging the failure of industry
39 to mobilise in response to previous reports, 'Constructing the Team' set out its own strategy for
40 change (Latham, 1994). Whilst the increasing use of the NEC (NBS, 2018) can be viewed as a success
41 resulting from the report, the failure of other recommendations to be implemented led to a second
42 major report of the decade (Egan, 1998). Whilst this report did highlight improvements the industry
43 had made, it again followed the familiar pattern of highlighting industry criticisms and responding
44 with a list of strategic recommendations for change. Unfortunately, such recommendations were not
45 met. The industry was described in the follow up report Never Waste a Good Crisis as still having a
46 long way to go to achieve the targets set by the Egan Report (Wolstenholme, 2009). Nearly a decade
47 later the report 'Modernise or Die' highlighted the same industry criticisms and again introduced a
48 strategy to address such criticisms (Farmer, 2016). Whilst it may be a little premature to judge the
49 success of this report's recommendations, recent research has found the pandemic has served to
50
51
52
53
54
55
56
57
58
59
60

1
2
3 remove some of the positive steps the industry has taken over recent years with aggressive and
4 bipartisan behaviours returning (Watts, 2020).
5
6

7 Reviewing industry reports a repeating pattern emerges of industry criticism, followed by
8 intervention in the form of strategic recommendations, a failure to adopt the recommendations
9 proposed, and so further criticism, appear to be an ongoing wheel on which the construction
10 industry is stuck. However, the industry appears, if nothing else, stubborn in its introduction of
11 strategies and initiatives to challenge its criticisms. A recent strategy introduced to continue this
12 optimistic push for improvement is 'transforming construction'. This strategy is an umbrella concept
13 under which sit several initiatives all with the purpose of improving the industry where other reports
14 and strategies have failed.
15
16
17
18
19
20

21 Under the 'transforming construction' strategy sit a range of ideas and initiatives. These include
22 recent initiatives intended to enhance industry productivity, reduce costs, increase project delivery
23 speed, encourage more environmentally and socially aware practices. Indeed, the strategy has been
24 described as growing in both breadth and depth (Clarke et al., 2020). Transforming construction
25 essentially refers to adopting practices that will serve to aid the industry over the long term to
26 become more efficient, resilient, and technology driven. For example, according to research funding
27 available under the 'transforming construction' banner, such initiatives include those focused on,
28 circular supply chains, digital twins, zero carbon, and Modern Methods of Construction (UKRI, 2022).
29 Extensive research has shown the potential (and often realised) benefits such initiatives can have
30 (Bui et al., 2021; Abbanejad et al., 2021). Such benefits can be experienced by both the industry
31 itself and the wider UK economy. However, for such benefits to be realised, the transforming
32 construction agenda will need to be fully embraced by the wider construction population at both an
33 operational and strategic level. Yet, the initiatives that sit under this strategy have been well known
34 for a significant amount of time, and their widescale adoption has still not occurred. Arguably,
35 therefore, barriers are preventing the construction industry from embracing these initiatives. In turn
36 these are serving to stifle realisation of the benefits the transforming construction strategy offers.
37
38
39
40
41
42
43
44
45
46
47
48

49 The barriers to transforming construction initiatives have been explored in the literature from many
50 perspectives but how the barriers are framed by construction professionals remains largely
51 underexplored. The aim of this research is to formally identify and understand how these barriers
52 are framed. This will then support a process of frame shifting to occur, so that barriers can be
53 potentially overcome. Overcoming such barriers is key to helping the construction industry achieve
54 the benefits Transforming Construction can bring.
55
56
57
58
59
60

1
2
3 First, the initiatives that sit under Transforming Construction are highlighted and the barriers to
4 adoption outlined. Framing is then presented as a theoretical lens through which to understand how
5 and why construction industry professionals perceive and frame transforming construction
6 initiatives. The concept of wicked problems is then introduced, before the ontological position of this
7 paper and selected research method outlined. The findings of this analysis are then presented and
8 discussed before the originality of the research, and the contributions to contemporary research and
9 practice, are described.
10
11
12
13
14
15
16
17
18

19 2.0 The Barriers to Transforming Construction Initiatives

20
21
22 The Construction Sector Deal is a partnership between the UK government and construction industry
23 aiming to support a more efficient, productive, cost effective industry, that is safer, smarter, and
24 more environmentally focused (HM Government, 2018). Transforming construction has been
25 described as an essential part of the Construction Sector Deal. It's aim is *"to accelerate the shift in*
26 *construction towards manufacturing and digital processes and a value outcome approach"* and
27 improve the industry's historical poor performance of (UKRI, 2022). Transforming construction has
28 specific targets of a 50% decrease in the delivery time of projects, a reduction of 33% for whole life
29 cycle costs, lifetime emissions reduced by 50%, and a 15% increase in productivity (UKRI, 2022).
30
31
32
33
34
35

36 The strategy has been gaining increasing traction and recognition for its importance in the
37 construction industry (Clarke et al., 2020). It is a broad strategy under which sit numerous initiatives,
38 each of which look to contribute to the achievement of one or more of the set targets. As it is
39 impractical for all applicable initiatives to be reviewed, , one for each of the four strategy targets
40 were selected (table I). Once selected, the initiatives were reviewed and any barriers to their
41 implementation identified.
42
43
44
45
46
47
48

49 [Insert 'Table I: Transforming Construction Targets and Industry Initiatives' Here]
50
51
52
53

54 2.1 Barriers to Circular supply chains

55 It has been argued that historically society has engaged in what can be classed as a 'linear' supply
56 chain. In that organisations, individuals, and wider society, have engaged in, used, and then disposed
57 of, resources (Patwa et al., 2021). However, such models are now considered outdated due to their
58
59
60

1
2
3 unsustainable nature leading to high costs, a shortage of raw materials, and environmental
4 degradation (Nandi et al., 2021). A circular economy is therefore one in which waste is utilised at the
5 raw materials stage to help produce new products and reduce the need for raw material extraction.
6
7

8
9 In an overview of seventy-five previously published research papers Luthra et al., (2022) summarised
10 the barriers to circular supply chains. This includes misaligned interests of individuals across sectors,
11 lack of trust and collaboration, the absence of integrated planning and management, existing
12 organisational structures focused on self-interest, a lack of a common vision, and limited knowledge
13 and experience of engaging with circular economy practices (Luthra et al., 2022). Such barriers can
14 be categorised as operational, contextual, perceptual, strategic and management, and governance.
15 A framework is proposed illustrating how collaboration can help overcome these barriers, but such
16 quantitative research only reveals patterns and trends in existing data, and fails to explore the
17 interpretations and perceptions construction professionals hold regarding the barriers to why
18 circular economy practices are not widely adopted. This is essential to understand how the barriers
19 are framed, so steps can be taken to re-frame such perceptions. It is argued without this,
20 frameworks, and statements on the benefit of collaboration to overcome barriers, will only go so far.
21
22
23
24
25
26
27
28
29
30
31

32 2.2 Barriers to Digital twins

33
34 There has been a general movement of digitisation of construction information in an effort to
35 optimise the flow of information, reduce waste, and augment operation procedures (Al-Saeed et al.,
36 2020). The creation of a digital twin is a manifestation of this process and is essentially a digital
37 duplicate of a physical environment (Stojanovic et al., 2018). Digital twins can be used to monitor
38 existing building stock, as well as offering the ability to simulate and analyse different building
39 options with wider applications in public health, air pollution and the tracking of material chains
40 (Steadman et al., 2020). It is more than simply a Building Information Model that contains historic
41 and current data, as a digital twin will need to forecast future environments and outcomes
42 (Stojanovic et al., 2018). The benefits of wide scale digital twin adoption are reported to include a
43 more productive, sustainable, intelligent, quality focused construction industry that is more time and
44 cost effective throughout the entire project life cycle (Kamble et al., 2022).
45
46
47
48
49
50
51

52
53 One barrier to implementing digital twins has been described as a need for a fundamental shift in
54 current industry operations and processes (Hyre, 2022). Another barrier is the current limit in the
55 knowledge surrounding the process and benefits the role digital twins play in design, planning, and
56 ongoing management (Solman, 2022). Via a comprehensive literature review the barriers to
57 implementation have been categorised. (1) there are no national standards available, (2) the high
58
59
60

1
2
3 initial cost of application, (3) the lack of skilled professionals, (4) organisational issues, and (5) legal
4 issues (Lui et al., 2015). It is also argued the wider barriers to technological implementation include
5 the attitudes of those tasked with implementing the technology, the attitudes of those who will be
6 directly and indirectly impacted, the difficulty experienced in application, and organisational cultural
7 resistance to change (Lui et al, 2015). Confusion over definitions of digital twins, which can serve to
8 limit people's awareness of the true benefits digital twins offer has also been described as a barrier
9 to adoption (Solman, 2022).

18 2.3 Barriers to Modern Methods of Construction

20 Modern Methods of Construction (MMC) has been described as a universal term covering any
21 method of building construction that does not adopt the traditional brick, block, and cavity approach
22 (Boothman et al., 2014). Such methods are predominantly completed off site (Lovell, 2012).

23 Reported benefits include enhanced customer satisfaction, increased predictability in programme,
24 more efficient processes, a higher quality of construction, improved health and safety practices, and
25 improved sustainability credentials (Nadim and Goulding, 2010). Production of MMC elements also
26 have reduced labour requirements, and so therefore appears an ideal solution to the projected
27 downward trend in construction industry labour availability (Lovell, 2012). It has been reported that
28 investment in MMC has been increasing, with Alazzaz and Whyte (2014) finding that the value of
29 MMC increased from £2.2billion in 1998 to £5.8billion in 2008. Whilst the same exponential growth
30 has not been a continuing trend, studies have shown the value of MMC to be nearly £7billion in
31 2018 (Taylor, 2020). Nevertheless, widescale adoption of MMC practices have not taken hold across
32 the construction industry.

33 It has been argued that numerous definitions are used interchangeably, such as modern methods of
34 construction, manufactured construction, offsite construction, offsite manufacturing, offsite
35 production, and pre-assembly fabrication, which further perpetuates difficulties of understanding
36 (Goulding and Rahimian, 2019). The high upfront investment costs, lack of current factory capacity
37 to meet any large-scale demands and the fluctuating demand for housing stock are also considered
38 potential barriers to MMC adoption (Lovell, 2012). As are the fact there are limited proven case
39 studies and recorded benefits, and a lack in public appetite for methods that are often viewed as
40 untested (Lovell, 2012).

2.4 Barriers to Zero carbon

Being responsible for more than 40% of energy used internationally and over one third of greenhouse gas emissions globally the construction industry has a significant impact on the climate (Lucon et al., 2014). In the UK, buildings have been considered to generate up to 49% of greenhouse gas emissions resulting in the UK Government target of achieving net zero carbon emissions by 2050 (Gillespie and Mcllwaine, 2021). Having zero carbon buildings is viewed as one way in which the industry can contribute to this target, respond to any criticism, and reduce its negative climate impact (Bui et al., 2021).

Despite all the associated benefits and increased awareness around targeting zero carbon, Bui et al (2021) found that ambiguity exists around the many terms often used to describe the zero-carbon concept which serves as a barrier to engagement. One study finds a lack of investment in workforce training and education has also resulted in a lack of trained professionals to aid in supporting achieve the zero carbon target (Clarke et al., 2020). The focus primarily on a zero-carbon construction process at the expense of a whole life cycle focus is another barrier that has been discussed, as well as the often-confused way in which reductions can be calculated due to the plethora of tools in existence (Gillespie and Mcllwaine, 2021). Combine these barriers with the lack of clear Government legislation or guidance, and the sluggish nature of the industry in adopting zero carbon principles can be explained (Gillespie and Mcllwaine, 2021).

Whilst numerous barriers have been identified for all Transforming Construction initiatives reviewed, how these barriers are 'framed' by construction industry professionals is an overlooked focus in the literature. However, it is crucial this gap is explored. By understanding the 'frames' held by construction professionals this research seeks to explore and understand how the 'frames' can be 'shifted' to help the barriers be overcome. Table II collates and categorises the barriers to adoption identified in the literature for all four initiatives.

[Insert 'Table II: Summary of barriers to Transforming Construction Initiatives' Here]

3.0 Framing of Wicked Problems

Framing is essentially the social perspectives held by an individual. It is how social reality is shaped (Goffman, 1974). The shifting of these frames, or 'frame shifts' is the process whereby a frame held by one individual or organisation changes from one social perspective to another, or even across

1
2
3 several different perspectives as part of a wider transformative journey. Reinecke and Ansari (2016)
4 describe how organisations can start from a position of denial on certain issues before shifting their
5 frame to one of acceptance, and then again to a frame of active involvement. According to Snow and
6 Benford (1992) there are three core framing tasks required to generate collective action for an issue:
7 diagnosis, prognosis, and motivation. All of which are arguably more difficult to achieve when
8 complicated by wicked problems (Reinecke and Ansari, 2016).
9

10
11
12
13
14 Wicked problems can be described as large-scale challenges “*caught in casual webs of interlinking*
15 *variables*” (Reinecke and Ansari, 2016, p299). They do not have clear definitions and solutions, with
16 no definitive formulation of the problem, with good or bad solutions as opposed to true or false,
17 with no opportunity to immediately test solutions, and can often be considered symptoms of other
18 problems (Klasche, 2021). The multiple barriers to the diverse range of initiatives under the
19 transforming construction agenda fulfil the criteria of a wicked problem. The transforming
20 construction concept also satisfies the three categories of being a wicked problem as outlined by
21 Reinecke and Ansari (2016). Firstly, it is difficult to identify the root cause or ‘central villains’, with
22 transforming construction a complex set of initiatives and practices proposed to tackle a wide range
23 of societal and environmental problems. Secondly, solutions are difficult to arrive at due to the
24 ambiguity of the concept, which is true given the multitude of initiatives that exist each with their
25 respective barriers Thirdly, setting targets and gaining wider support to achieve such targets is
26 difficult to mobilise. This again is true for transforming construction initiatives as widescale support
27 across the construction industry has proved difficult to mobilise for previous strategies. This paper
28 therefore posits that transforming construction is a wicked problem. As stakeholders are likely to
29 clash over causes of wicked problems, their proposed solutions are also likely to differ resulting in
30 wicked problems being unable to be ‘solved’ in the traditional sense (Reinecke and Ansari, 2016).
31 Due to the difficulties and challenges associated with wicked problems, the shifting of frames held
32 for transforming construction initiatives can potentially prove problematic. This paper seeks to
33 identify and understand how current barriers are framed, and how a process of frame shifting can
34 occur to enable these barriers to potentially be overcome.
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52

53 4.0 Methodology

54
55
56 The ontological position adopted within this research is one of constructivism. This derives from
57 socially constructed understandings and the belief that meanings are essentially agreed between
58 actors on an ongoing basis, are subject to change, and so are therefore best understood though
59
60

1
2
3 qualitative data (Bryman, 2021). This research seeks to understand the perceptions of construction
4 professionals with regards to barriers to implementing initiatives under the transforming
5 construction strategy. A constructivist ontological position is therefore adopted to help reveal the
6 insights required. The epistemological position adopted is one of interpretivism. This is concerned
7 with establishing the subjective meanings of social action as a method of inquiry (Bryman, 2021).
8 Such ontological and epistemological approaches dictate a qualitative research strategy. Qualitative
9 research methods allow for the exploration of deeper meanings that are not easily expressed by
10 reductionary techniques involving numbers and graphs, and are instead concerned with an
11 individual's personal experience, insight, and ideals.

12
13
14
15
16
17
18
19 In this research the views of construction industry professionals are required, and so participants
20 were selected based on their knowledge and positions within the industry. Semi-structured
21 interviews were then selected as the most appropriate method by which such insights can be
22 ascertained. Interviews are essentially conversations that allow a participant's values,
23 interpretations, and insights to be gained (Bryne, 2012). Employing a semi-structured nature to the
24 interviews allowed for the interview conversations to be anchored around a set of core questions
25 yet the flexibility to pursue any interesting avenues that may arise and be applicable to the research
26 (Bryman, 2021).

27
28
29
30
31
32
33 Fifteen interviews were conducted in total across eight different main contractor organisations. To
34 identify the most suited participants for the research a process of purposive sampling was utilised
35 whereby participants are selected as they satisfy the research needs and are likely to give informed
36 and relevant contributions (Robson and McCartan, 2017). An online search was conducted to
37 identify UK main contractors with the highest turnover in 2020. Once identified Linked In was
38 searched for professionals who belonged to these organisations, and those professionals who
39 appeared to be able to inform the research based on their job roles contacted. In total 32 messages
40 were sent requesting interviews, with 23 positive responses received. From these positive
41 responses, interviews were arranged with fifteen. The breakdown of participants can be seen in
42 table III. Research by Guest et al (2020) confirmed that in most research projects that adopt a <5%
43 new information threshold, seven interviews will capture most of the relevant information required,
44 with full data saturation usually occurring after eleven interviews. Therefore, with fifteen
45 participants it was felt that a robust understanding was achieved. The participants were selected as
46 they broadly represent different hierarchal levels of main contractor organisations. Large main
47 contractors are those organisations most notably in the public eye when delivering construction
48 projects, and so arguably are more inclined to adopt innovative initiatives. The construction
49
50
51
52
53
54
55
56
57
58
59
60

professionals who participated should therefore have broad knowledge regarding the initiatives undertaken by their respective organisations.

[Insert 'Table III: Interview Participants' Here]

The interviews consisted of questions relating to the concept of transforming construction as well as broader topic areas that would serve to inform the research. Such questions were structured around understanding current frames, the perceptions of existing barriers, and exploring the required actions to shift such frames.

Narrative analysis is adopted as a method to both structure the semi-structured interviews and analyse the responses received. It is the process by which interpretations, insights and understandings are gained from the perspective of the interviewee (Ebiega-Oselebe et al, 2021). Essentially, it is a method of accessing an individual's knowledge through their retelling of stories allowing key information to be extracted (Sandelowski, 1991). It doesn't attempt to create quantitative variables with any reductionary techniques but instead summarises interviewee responses based on the core points they discussed (Loosemore and Bridgeman, 2018). It has been increasingly used in the construction management literature (see Loosemore and Bridgeman, 2018; Ebiega-Oselebe et al, 2021) and is adopted in this research as a means of understanding the interviewee's perceptions, reflections, and experience.

5.0 Findings and Discussion

Analysis of the data collected revealed the following key findings:

5.1 Transforming Construction can be identified as a wicked problem

The narrative analysis of all interviewees revealed the actions required to successfully implement each transforming construction initiative can be identified as a wicked problem. Therefore, by extension, the transforming construction strategy itself could be classed as a wicked problem. The barriers discussed by all interviewees for circular supply chains for example, mirrored those of the literature. All three Quantity Surveyors interviewed agreed the barriers to fully implementing the

1
2
3 principles of a circular supply chain included a general lack of trust that resulted in a failure to
4 collaborate across organisations reinforcing findings by Luthra et al., (2020). However, building on
5 these findings the interviews revealed that a lack of a common vision was perhaps one of the biggest
6 barriers facing circular supply chain adoption. As the Commercial Manager interviewed revealed that
7 whilst some circular supply chain initiatives were embraced (such as having specially designated
8 plasterboard skips to return all plasterboard waste to the manufacturer), the pressure to deliver the
9 lowest cost projects was the primary focus. If the quality and programme were achieved, then the
10 primary goals of the main contractor were met for the project, with other initiatives regarded with
11 lower importance. Whilst circular economy initiatives were described as having importance in the
12 broader construction industry, on a project-by-project basis they were only adopted if the primary
13 aims of the project were met first. As the Commercial Manager stated, *“we’re happy to do our bit
14 and return waste and materials to the supply chain, but the ball is in their court to lead the process,
15 we are just too busy on site to meet what the client wants for budget and quality, to start paying out
16 for more...that ultimately won’t make a difference to the project”*.

17
18
19
20
21
22
23
24
25
26
27 Analysis of the interviews also revealed that the barriers to adopting zero carbon initiatives echoed
28 those of the literature (Gillespie and McIlwaine, 2021) in that a lack of clear regulation and
29 government policy were described by both the Commercial Manager and the Regional Director as
30 barriers to their organisation’s wider uptake of zero carbon action. This was echoed by the
31 Operations Manager who believed it was a lack of client drive in substantially enforcing any policies
32 that did exist, with clients focusing instead on their core criteria such as overall cost and time to
33 compete. All interviewees were aware of the target to be zero carbon by 2050, and all stated their
34 respective main contracting organisations had their own zero carbon target in place, but many of the
35 interviewee’s (PM3, PM5, QS3, DM1, and DM2) were unaware of any specific organisational
36 initiatives to achieve the target set. Both the Regional Director and Commercial Manager however,
37 felt that the current level of education and training regarding zero carbon was sufficient to meet
38 current demands, contradicting findings in the literature (Clarke et al., 2020). This highlighted a
39 difference across organisational hierarchies in that those of management level believed training
40 regarding zero carbon to be sufficient for purpose, as the process should be client led. However,
41 those staff who could be classed as intermediate management or site based operational
42 professionals felt the training offered was not sufficient to meet the needs of clients.

43
44
45
46
47
48
49
50
51
52
53
54
55 When barriers to the transforming construction initiatives were discussed, the majority of
56 interviewees immediately reported obstacles and threats faced. For example, when asked about
57 barriers to implementing MMC practices, QS2 responded by stating *“it is the high costs”*. When
58 faced with the same question one PM1 stated *“there is no demand from clients”* with PM3 arguing

1
2
3 the confusion over the types of MMC available leads to a lack of action and a PM4 being personally
4 “not sold” on the benefits MMC proposes to offer. When asked which initiatives could potentially
5 make the biggest contribution to the goals of the transforming construction strategy, the
6 Operational Manager replied “*there is no single practice we can undertake that will make a*
7 *difference to any of the transforming construction initiatives. It will take many initiatives*
8 *simultaneously by many contractors*”.

9
10 From the interview responses it become apparent transforming construction initiatives can be
11 described as a wicked problem. The barriers (and potential solutions) are in webs of interlinking
12 variables (Reinecke and Ansari, 2016) with no clear consensus over definitions, solutions, or even an
13 accurate description of the problems the initiatives are aiming to tackle (Klasche, 2021). The findings
14 reiterated that the transforming construction agenda satisfies the three categories of being a wicked
15 problem as outlined in table IV which compares the three criteria proposed by Reinecke and Ansari
16 (2016) against the findings from the interviews.

17
18
19
20
21
22
23
24
25
26
27
28
29 [Insert ‘Table IV: Transforming Construction as a Wicked Problem’ Here]

30
31
32
33 The interview responses categorised in table IV reinforce the argument that through trying to solve
34 many contemporary issues simultaneously under one umbrella strategy, transforming construction
35 has itself become a wicked problem. This is potentially very problematic as it is reported
36 stakeholders are likely to clash over any solutions to wicked problems and traditional approaches to
37 solutions are likely to fail (Reinecke and Ansari, 2016).

38 39 40 41 42 43 44 45 5.2 Framing wicked problems

46 Utilising the theoretical lens of framing, the interviews also revealed that all interviewees who could
47 be classed as intermediate or site-based management held a ‘frame’ of bystander. They viewed
48 themselves as not able to take any personal action to positively contribute on a wide scale to the
49 issues transforming construction sets out to address. They framed the actions, practices, and
50 responsibility required to substantially engage with the initiatives as bigger than their role and
51 current level of responsibility. For example, when asked how they viewed their role in achieving the
52 zero-carbon target, QS1 reported that “*we [the wider site team] just do as we’re told, the*
53 *management set all the targets and we have to try and manage them on site, but we can only*
54
55
56
57
58
59
60

1
2
3 *achieve so much*". With regards to adopting and embracing digital twins, PM2 believed that *"it is a*
4 *good idea in theory, and we have started to use BIM on our projects...whenever the client asks for it"*.

5
6 This was built upon further with a response from DM3 who stated *"we [design managers at this*
7 *contractor] are fully trained on how to deliver to BIM level 3, but most of the clients aren't this*
8 *advanced...even our public sector projects don't ask for BIM to levels we are supposed to deliver"*.
9

10
11
12 The intermediate and site-based management were more likely to focus on the immediate,
13 localised, and negative implications of any actions any requirements. The barriers were often
14 described and categorised as too vast, too complex, and requiring the involvement of too many
15 people to be effectively addressed by individual construction professionals alone. Indeed, there was
16 also a consensus that a single construction main contractor would be inefficient in its sole quest to
17 tackle such barriers and would need the whole industry and wider stakeholders (clients,
18 government, end users) to all have the same single aim.
19
20
21
22
23

24
25 The Regional Director and Operational Manager interviewed however, both claimed to adopt a more
26 'active participant' frame in that they believed a main contractor could make a difference. They
27 believed it would take the full industry to pull together, but this could be successfully started with a
28 single main contractor showing their willingness to adopt transforming construction initiatives and
29 setting clear targets to achieve. However, they also both believed staff had the current levels of
30 awareness and training to deliver against the requirements of the respective transforming
31 construction initiatives. The majority of the intermediate management roles did not agree, revealing
32 a disconnect amongst the main contractor hierarchal levels regarding how the requirements for
33 transforming construction were framed. Higher management believed intermediate management
34 framed the requirements as achievable based on their training and upper management support.
35 Intermediate management actually framed the requirements as difficult if not impossible to achieve
36 without further upper management support. It appears the frame adopted by upper management
37 was not one of active participant, but of failed enabler.
38
39
40
41
42
43
44
45
46
47
48
49

50 5.3 Shifting frames as a method of overcoming barriers

51 Those who reported feeling like 'bystanders' also discussed how they saw the organisational targets
52 set to achieve the initiatives as ones for the future. For example, PM3, PM4, QS2, and QS3 all stated
53 they had little working knowledge of BIM and did not trust it to provide the benefits stated, with no
54 intention of adopting BIM principles on their current and upcoming projects. PM3 believed *"I'll be*
55 *finished [in the construction industry] before BIM takes off...so there's no point me spending time*
56 *learning it now"*. Essentially, those who framed themselves as bystanders framed the problems
57
58
59
60

1
2
3 faced as ones that had no immediate urgency and required little immediate action. This can be
4 illustrated by the responses of QS3 who believed *“MMC is a good idea, and maybe in the future*
5 *when construction prices are too high or people want buildings finished even quicker we might start*
6 *using [MMC]”* and by PM1 who stated *“If we are told to use MMC by the client then we will, but if we*
7 *have the choice we’ll usually just stick to what we’re good at”*.
8
9
10

11
12 Narrative analysis of the interviews allowed for categorisation of the responses. In table V these
13 were then plotted against the three core framing tasks required to generate collective action for an
14 issue: diagnosis, prognosis, and motivation (Snow and Benford, 1992).
15
16
17
18
19

20 [Insert ‘Table V: How Frames can be Shifted’ Here]
21
22
23
24

25 Table V illustrates the current frame held by those who consider themselves ‘bystanders’ in regard
26 to each of the barrier categories. This is classed as the diagnosis of the framed wicked problem. To
27 move to a state of positive prognosis the next frame required is one of engaging (for intermediate
28 management staff) or enabler (for upper management staff). This frame is based upon interviewee
29 responses regarding what each recipient would like to see or would assist in shifting their current
30 frame. For example, when the zero-carbon agenda was discussed with the question *“What would*
31 *your organisation need to do to achieve this goal in the next ten years?”*, the Operational Manager
32 began to evidence the engager/enabler frame. OM1’s responses started to focus on the longer-term
33 impacts of the strategy, and how goals would need to be set for each of the next ten years, with a
34 strategy enforced by the business owners. This would represent a shift away from a frame where
35 initiatives and problems are viewed as ‘bigger’ than themselves and their roles to a frame where
36 they feel empowered to personally engage with issues and to act as enablers for others to do the
37 same.
38
39
40
41
42
43
44
45
46

47 The final frame identified is one of active participant. This is the motivational stage that helps
48 generate collective action. When possessing this frame interviewees were fully motivated to help
49 achieve the transforming construction targets set to overcome any identified barriers. For example,
50 when this was further explored with OM1 with the follow up question *“What can you to do to*
51 *achieve this goal in the next ten years?”*, the consideration appeared to facilitate a shift to that of
52 active participant, with elements starting to be discussed such as encouraging collaboration and
53 consistent values between supply chain partners and internal employees, with co-created goals and
54 targets being implemented. They believed this would help *“reduce any supply chain barriers”* and
55
56
57
58
59
60

1
2
3 “help staff ‘buy-in’ to the strategy” to further aid its success. This frame can only be achieved via the
4 engaging / enabler stage, but once a construction professional holds this frame, they are more likely
5 to positively contribute to the transforming construction initiative and less likely to be prevented by
6 any pre-existing barrier. Table V shows the frame shifts required for a construction professional to
7 overcome the barriers to the wicked problem of transforming construction. Such a frame shift can
8 facilitate positive contribution to the transforming construction strategy. Therefore, enabling and
9 accelerating any associated benefits to be realised.
10
11
12
13
14
15
16
17
18

19 6.0 Conclusions and Implications of Findings

20
21
22 Transforming construction is the latest UK government backed strategy to address long standing
23 performance issues within the construction industry. For this strategy to succeed where numerous
24 others have failed, long-standing barriers need to be identified and overcome. Whilst previous
25 research has identified these barriers, there is a gap in knowledge around how these barriers are
26 framed by construction professionals. This research identified transforming construction as a wicked
27 problem in that it is large in scale with no clear definitions or solutions. The initiatives that sit within
28 this strategy have a range of barriers to their success that can be categorised as operational,
29 contextual, perceptual, strategic, management, and governance.
30
31
32
33
34
35

36 Semi-structured interviews with fifteen construction professionals revealed the perception of these
37 barriers was one of ‘bystander’ in that the barriers were bigger than any professional could likely
38 influence on their own. However, the results of this research identify how such frames can be
39 ‘shifted’ from one of bystander, to one of engager/enabler, and then onto one of active participant.
40 When barriers are framed from the perspective of active participant, such barriers are more likely to
41 be overcome. These findings address a gap in current research around how barriers are framed, and
42 how by framing barriers they can be overcome with a process of frame shifting. Such findings
43 contribute to research by furthering the debate on failed construction strategies by understanding
44 them as wicked problems. The findings contribute to the construction industry by offering a
45 proposed method by which the perspectives of barriers held by construction professionals can be
46 ‘shifted’ from bystander to active participant. This can potentially help mobilise both responsibility
47 and action to help overcome the barriers identified. This could lead to more successful strategy
48 implementations for the construction industry in future, including increasing the success of the
49 transforming construction strategy.
50
51
52
53
54
55
56
57
58
59
60

7.0 References

- Alazzaz, F., & Whyte, A. (2014). Uptake of Off-site Construction: Benefit and Future Application. *International Journal of Civil, Architectural, Structural and Construction Engineering*, 8(12), 1148-1152
- Al-Saeed, Y, Edwards, D, and Scaysbrook, S. (2020). Automating construction manufacturing procedures using BIM digital objects (BDOs) Case study of knowledge transfer partnership project in UK. *Construction Innovation*. 20(3), pp345-377.
- Barthorpe, S. (2010) Implementing corporate social responsibility in the UK construction industry. *Property Management*, 28(1), pp.4–17
- Boothman, C, Higham, A and Scott, A (2014) Delivering school buildings using off- site construction: Stakeholders perceptions In: Raiden, A B and Aboagye-Nimo, E (Eds) Procs 30th Annual ARCOM Conference, 1-3 September 2014, Portsmouth, UK, Association of Researchers in Construction Management, 1017-1026.
- Byrne, B. (2012). *Qualitative Interviewing*. In, Seale, C, *Researching Society and Culture*. 3rd Ed. Sage Publications. London.
- Bui, P, Wilkinson, S, Domingo, N and MacGregor, C (2021) Towards Zero Carbon Building Refurbishment: A New Conceptual Framework for Decision Support Tools In: Scott, L and Neilson, C J (Eds) *Proceedings of the 37th Annual ARCOM Conference*, 6-7 September 2021, UK, Association of Researchers in Construction Management, 594-603
- Clarke, L, Sahin-Dikmen, Winch, C. (2020). Transforming vocational education and training for nearly zero-energy building. *Buildings and Cities*, 1(1), 650–661
- Ebiega-Oselebe, O, Watts, G, and Higham, A. (2021). Construction Project Success as a Wicked Problem: The role of the local community in Ebonyi, Nigeria. *Construction and Human Settlements Management Journal*. 1(2) p49-66
- Gillespie, D and McIlwaine, S (2021) Reducing Embodied Carbon in the Construction Sector In: Scott, L and Neilson, C J (Eds) *Proceedings of the 37th Annual ARCOM Conference*, 6-7 September 2021, UK, Association of Researchers in Construction Management, 744-753
- Goulding, J. S., & Rahimian, F. P. (2019). *Offsite Manufacturing: Envisioning the Future Agenda*. In J. S. Goulding & F. P. Rahimian (Eds.), *Offsite Production and Manufacturing for Innovative Construction: People, Process and Technology*. Oxon, UK and New York, USA: Routledge.

1
2
3 Guest, G., Namey, E. and Chen, M. (2020) A simple method to access and report thematic saturation
4 in qualitative research. PLoS ONE, 15(5).
5

6
7 HM Government (2018). Industrial Strategy Construction Sector Deal. Available via:
8 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731871/construction-sector-deal-print-single.pdf)
9 [/731871/construction-sector-deal-print-single.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731871/construction-sector-deal-print-single.pdf)
10
11

12
13 Hyre, A, Harris, G, Osho, J, Pantelidakis, M, Mykoniatis, K, and Liu, J. (2022). Digital twins:
14 Representation, Replication, Reality, and Relational (4Rs). Manufacturing Letters. 32, pp20-23.
15

16
17 Kamble, A, Gunasekaran, A, Parekh, H, Mani, V, Belhadi, A, and Sharma, R (2022). Digital twin for
18 sustainable manufacturing supply chains: Current trends, future perspectives, and an
19 implementation framework Technological Forecasting & Social Change/ 176. 121448.
20
21

22
23 Klasche, B (2021). After COVID-19: What can we learn about wicked problem governance? Social
24 Science and Humanities Open. (4).
25

26
27 Lang, V. (2020). Increasing offsite housing construction in Scotland: An evidence base to support new
28 policy and systems.
29

30
31 Liu, S, Xie, B, Tivendal, L, and Liu, C (2015). Critical Barriers to BIM Implementation in the AEC
32 Industry. International Journal of Marketing Studies. 7(6).
33

34
35 Loosemore, M, and Bridgeman, J (2018). Corporate volunteering in the construction industry:
36 motivations, costs and benefits. Construction Management and Economics. 35(10), pp641-653.
37

38
39 Lovell, H. (2012). Modern Methods of Construction. International Encyclopaedia of Housing Home,
40 pp312-316.
41

42
43 Lucon, O, Üрге-Vorsatz, D, Zain Ahmed, A, Akbari, H, Bertoldi, P, Cabeza, L F, Eyre, N, Gadgil, A,
44 Harvey, L D D, Jiang, Y, Liphoto, E, Mirasgedis, S, Murakami, S, Parikh, J, Pyke, C and Vilariño, M V
45 (2014) Buildings, In: Climate Change 2014: Mitigation of Climate Change, Contribution of Working
46 Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change
47 Cambridge: University Press.
48
49

50
51 Luthra, S, Sharma, M, Kumar, A, Joshi, S, Collins, E, and Mangla, S (2022). Overcoming barriers to
52 cross-sector collaboration in circular supply chain management: a multi-method approach.
53 Transportation Research Part E. 157. 102582.
54
55

56
57 Nadim, W., & Goulding, J. (2010). Offsite Production in the UK: The Way Forward? A UK Construction
58 Industry Perspective. Construction Innovation: Information, Process, Management, 10(2), 181 - 202
59
60

1
2
3 Nandi, S, Sarkis, J, Hervani, A, and Helms, M. (2021). Redesigning supply chains using blockchain
4 enabled circular economy and Covid-19 experiences. *Sustainable Production and Consumption*. 27,
5 pp10-22.
6
7

8
9 Patwa, N, Sivarajah, U, Seetharamann, A, Sarkar, S, Maiti, K, and Hingorani, K (2021). Towards a
10 circular economy: An emerging economies context. *Journal of Business Research*. 122. pp 725-735.
11
12

13 Reinecke, J and Ansari, S. (2016) Taming Wicked Problems: The Role of Framing in the Construction
14 of Corporate Social Responsibility. *Journal of Management Studies*. 53(3) pp299-329.
15
16

17 Robson, C, and, McCartan, K. (2017). *Real World Research*. 4th Edition. John Wiley and Sons. London.
18

19 Sandelowski, M. (1991). Telling stories: Narrative Approaches in Qualitative Research. *The Journal of*
20 *Nursing Scholarship*. 23(3), p161-166.
21
22

23 Snow, D.A., and Benford, R.D. (1992) Master frames and cycles of protest. In: Morris, A.D., and
24 Mueller, C.M. (eds), *Frontiers in Social Movement Theory*. Yale University Press, New Haven, CT, pp.
25 133–155.
26
27

28
29 Solan, H, Kirkegaard, J, Smits, M, Vliet, B, and Bush, S (2022). Digital twinning as an act of governance
30 in the wind energy sector. *Environmental Science and Policy*. 127, pp272-279.
31
32

33 Steadman, P, Evans, S, Liddiard, R, Godoy-Shimizu, D, Ruyssevelt, P, and Humphrey, D. (2020).
34 Building stock energy modelling in the UK: the 3DStock method and the London Building Stock
35 Model. *Buildings and Cities*, 1(1), pp. 100–119.
36
37

38
39 Stojanovic, V, Trapp, M, Richter, R, Hagedorn, B and Döllner, J (2018) Towards the Generation of
40 Digital Twins for Facility Management Based on 3D Point Clouds In: Gorse, C and Neilson, C J (Eds)
41 *Proceeding of the 34th Annual ARCOM Conference, 3-5 September 2018, Belfast, UK, Association of*
42 *Researchers in Construction Management*, 270-279.
43
44

45
46 Taylor, M. D. (2020). A Definition and Valuation of the UK Offsite Construction Sector: Ten Years On.
47 *International Journal of Construction Management*, 1-9
48
49

50 UKRI (2022). Transforming construction challenge. Available at: [https://www.ukri.org/what-we-](https://www.ukri.org/what-we-offer/our-main-funds/industrial-strategy-challenge-fund/clean-growth/transforming-construction-challenge/)
51 [offer/our-main-funds/industrial-strategy-challenge-fund/clean-growth/transforming-construction-](https://www.ukri.org/what-we-offer/our-main-funds/industrial-strategy-challenge-fund/clean-growth/transforming-construction-challenge/)
52 [challenge/](https://www.ukri.org/what-we-offer/our-main-funds/industrial-strategy-challenge-fund/clean-growth/transforming-construction-challenge/)
53
54

55
56 Watts, G. (2020). Forgetting social value and other good practices in construction supply chains:
57 Procurement in pandemics. *International Journal of Construction Supply Chain Management*. 10 (4),
58 p221-233
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Watts, G., Fernie, S. and Dainty, A. (2019) Paradox and legitimacy in construction: how CSR reports restrict CSR practice. International Journal of Building Pathology and Adaptation, Vol. 37 No. 2, pp. 231-246.



Table I: Transforming Construction Targets and Industry Initiatives

Transforming Construction Target	Construction Industry Initiative
50% decrease in the delivery time of projects	Modern Methods of Construction
33% reduction for whole life cycle costs	Circular supply chains
50% reduction in lifetime emissions	Zero carbon
15% increase in productivity	Digital twins

Table II: Summary of barriers to Transforming Construction Initiatives

Transforming Construction Initiative	Barriers					
	Operational	Contextual	Perceptual	Strategic	Management	Governance
Circular Supply Chains	Limited knowledge and experience		Lack of trust and collaboration	A lack of a common vision	The absence of integrated planning and management Existing organisational structures focused on self-interest	Misaligned interests of individuals across sectors
Digital Twins	Limited knowledge and skills	High initial cost of application	Attitudes of those implementing the technology Confusion over definitions of digital twins	The need for a fundamental shift in current industry operations and processes	Organisational and cultural issues	No national standards available Legal issues
Modern Methods of Construction	Lack of current factory capacity to meet any large-scale demands	High upfront investment costs A lack in public appetite for methods that are often viewed as untested	Numerous definitions perpetuating difficulties of understanding A lack of proven case studies and recorded benefits			The fluctuating demand for housing stock
Zero Carbon	Lack of current skillsets	Confusions over how reductions are calculated	Ambiguity around zero-carbon terms	The focus on zero-carbon construction over whole life cycle		Lack of clear Government legislation

Table III: Interview Participants

Interviewee Code	Job Role	Experience in Industry	Organisation Type
PM1	Project Manager	10 years	Main Contractor A
PM2	Project Manager	7 years	Main Contractor B
PM3	Project Manager	22 years	Main Contractor C
PM4	Project Manager	10 years	Main Contractor D
PM5	Project Manager	12 years	Main Contractor E
QS1	Quantity Surveyor	19 years	Main Contractor B
QS2	Quantity Surveyor	5 years	Main Contractor E
QS3	Quantity Surveyor	10 years	Main Contractor G
DM1	Design Manager	13 years	Main Contractor D
DM2	Design Manager	15 years	Main Contractor E
DM3	Design Manager	20 years	Main Contractor F
CM1	Commercial Manager	11 years	Main Contractor B
OM1	Operational Manager	13 years	Main Contractor F
RD1	Regional Director	25 years	Main Contractor H

Table IV: Transforming Construction as a Wicked Problem

Wicked Problem Criteria (Reinecke and Ansari, 2016)	Interviewee Responses Regarding Transforming Construction (TC)
(1) it is difficult to identify the root cause or 'central villains.	<p><i>"TC requires a multi-pronged approach as it is a multi-pronged problem"</i> (Regional Director)</p> <p><i>"It's [TC] trying to tackle everything at once.... but I think there's too many problems for our company to make a difference, or even the entire [construction] industry"</i> (PM1)</p> <p><i>"It's everything we've [society] done for the last hundred years that needs to change really, all of it has caused the problems we have now...there's not a single cause..."</i> (QS2)</p>
(2) solutions are difficult to arrive at due to the ambiguity of the concept.	<p>[when describing what MMC is]: <i>"I think it means using new technology, BIM and all that"</i> (QS1)</p> <p><i>"We have actually tried a few different approaches over the past few years, all with different levels of success...but it's difficult as what one client wants you to do to tackle it [zero carbon] another client disagrees with and wants a different approach"</i> (CM1)</p>
(3) setting targets and gaining wider support to achieve such targets is difficult to mobilise.	<p><i>"We do have targets set for local spend, carbon reductions on plant and travel to site...but everyone knows these are not as important as actually making money and getting the job done"</i> (QS2)</p> <p><i>"I think we generally good buy in to the targets we set as an organisation, but it is sometimes a challenge to get all of the employees to buy into them, especially some of the older ones"</i> (RD1)</p>

Table V: How frames can be shifted

Barriers	Frames		
	Bystander (Diagnosis)	Engaging / Enabler (Positive Prognosis)	Active Participant (Motivation)
Operational	Limited skills and knowledge	Starting to identify gaps in knowledge and addressing	Up to date knowledge of problems, and all available technology and solutions across all supply chain
Contextual	A focus on immediate short-term localised negative impacts	Consideration of longer-term wider impacts	Evidence of the positive differences experienced shared amongst those involved / wider industry with a clear link to benefits for all
Perceptual	Lack of trust, confusion over terminology	Explanations over exact requirements and the part each individual / organisation can play	Industry and supply chain partners collaborating openly with shared goals and clear, widely agreed definitions
Strategic	No common vision	The development of an organisational and industry wide vision	A clear strategic vision with fixed goals and regular updates on progress
Management	Self-interested organisational structures	Shared values amongst all operatives aligned with wider industry requirements	Co-creation and evolution of values with wider industry collaboration
Governance	Lack of standards Little / unenforced legislation	Clear authentic and appropriate legal and management requirements in place	All requirements fully and equally applied across all contracts and by all clients