

The perceived barriers and drivers to sustainable design as a sustainable construction method between UK rural and urban locations

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Abstract: As governments increase their commitment to fight climate change, the construction industry is a major contributor to carbon emissions, responsible for approximately 40%. This paper aims to understand the perceptions of architectural designers on the drivers and barriers to sustainable design, comparing rural and urban UK locations, as a method that has historically for improved occupant comfort. In this study, perceptions were collected through surveys based on barriers and drivers identified through the literature review. Cost and legislation were noted as key barriers, and legislation and increasing incentives were noted as the best solutions. The barriers were typically aligned with literature, which advised cost being the top barrier to sustainability, followed by legislation. This may indicate a budget-led approach to the brief. The study could be expanded upon to reach a wider or different population, study specific sustainable design measures or strategy effectiveness.

Keywords: Sustainable construction, architecture, sustainable design, barriers, drivers

1. Introduction

Global initiatives are increasing demand to combat climate change affecting health and morbidity (Costello et al, 2023). Governments are under pressure to report progress in global conferences, which currently does not meet targets (IEA, 2023). Between rural and urban locations, there are differences including local culture, opinion, demographic, and occupation (Williams, 2023). Rural areas tend to have lower population density, more agricultural land and lack large infrastructure, urban areas, the opposite (Kang, 2009). Urban populations contribute 72.7% towards the UK's economic output, whilst rural areas contribute towards 15.8% (Scott, 2020). Due to new technologies, places have increasingly good connectivity (Furuholt & Kristiansen, 2007). In the UK, only 17.1% of the population lives in a rural location, however 71% of the UK's landmass is rural (DEFRA, 2024; Scott, 2020). Rural will be defined by settlements of 10,000 or less as dictated by the UK Government (Gov.Uk, 2017).

Sustainable Construction (SC) is the umbrella term for strategies such as retrofitting, low carbon design, and sustainable design (SD) (Hussin, et al, 2013). The concept of SC consists of three main pillars: environmental, social and economic value (Brownhill & Rao, 2002). SD utilises methods that minimise harm and CO₂ emissions, increase wellbeing and biodiversity (UKGBC, 2024). Though SD is reported to have good long-term benefits (Agwu, et al, 2024), it does not feature in briefs due to perceptions of increased costs, complexity, and difficulty monitoring. Table 1 highlights barriers/solutions taken from existing studies for comparison. Table 1 Barriers and drivers by impacting force (Amepey, et al 2015; Tokbolat, et al 2019; Durdyev et al, 2018, Pham, et al, 2018; Ahn, et al, 2013; Ali & Alkayed, 2019; Darko, et al 2017).

Force	Barrier	Drivers
Legislation	- Lack of mandatory legislation - Lack of enforcement	- Government regulations and policies - Knowledge and awareness, and information

	- Higher priority given to visual/ economic/ social needs	- Demand from clients/tenants - UK rating systems
Opinion/ Culture	- Lack of consideration in bid fee - Perception that sacrifices will be made - Lack of demand from client brief - Resistance to change - Lack of leadership - Lack of personal concern - Additional time required	- Corporate social responsibility - Corporate image, culture, and vision - Company policy - Moral imperative or social conscience - Integrated design approach or design quality - Competent team members
Physical/ Geographical	- Lack of consideration at planning stage - Potentially higher build cost - Poor cooperation of project team - Lack of sustainable products - Lack of testing of sustainable products - Cost of sustainable products - Lack of precedent for new technologies	- Improved indoor environmental quality - Waste reduction (materials and construction wastes)
Investment/ Infrastructure	- Lack of financial incentives - Lack of adequate training guidance - Lack of designer training/ awareness - Lack of contractor/ subcontractor awareness/ knowledge - Lack of experienced labour/labour cost - Lack of awareness of long-term benefits	- Incentive schemes - Marketing benefits - High return on investment - Education and training - Better ways to measure/ account for costs - Product and material certification - Reduced liability and risks - Proactive role of materials manufacturers - Improve reusable and recycle elements

The barriers/solutions have been taken from studies completed for other countries. Rural/urban divide studies focus on developing countries where the gap is more significant. The literature agrees that financial barriers are most significant (Tokbolat et al, 2019; Ahn et al, 2013). Legislation is also a significant barrier (Amepetey, et al, 2020; Durdyev et al, 2018; AlSanad, 2015). While previous research has largely focused on sustainable construction barriers in many countries, there is limited evidence on how these barriers and drivers differ between rural and urban contexts in the UK, highlighting the need for this study to examine regional variations in the adoption of SD. Rural and urban specific studies are often from before 2005, and opinions may have changed due to globalisation (Arellano & Roca, 2017).

2. Methodology

A questionnaire was chosen for quantitative and qualitative data to both understand significance and allow for ranking. Online surveys allow participants to respond in their own time and was used in similar studies (Amepetey, et al, 2020; Zulu et al, 2022; Durdyev et al, 2018), using Likert ('strongly disagree to strongly agree' and '1-5') ranking for easy graph representation. The survey was designed to be intuitive, avoiding low-frequency and technical terms and acronyms to make it accessible, reduce drop-out rate and survey time to under 10 minutes (Krosnick, 1991). The survey structure includes demographics; use of SD to establish experience; barriers and solutions (including drivers which could increase the likelihood of adopting SD) to rank on a Likert scale of 1-5 (5 being most significant); asked to provide a justification for their top choice; perceptions and comments. The survey was designed to collect some basic information on the respondent to understand their existing knowledge on the topic such as job title and experience with strategies. Following that it asks them to give their perspectives on the existing barriers and solutions. The survey was issued out as a pilot study to 10 individuals for comment and then after comments were action, it was issued officially via email to a 40/60 split of rural and urban based individuals and social

media, using the easier, more cost-effective snowballing method, a survey being sent to one individual with the intention of it being sent on to other potential responders (Ting, et al, 2025), as this study did not have access to the population. Similar methods, purposive and convenient sampling were used by other studies (AlSanad, 2015; Zulu et al, 2022). The general largest typical sample size is 50 for qualitative research (Creswell & Creswell, 2018).

36 responses were received after distribution to an unknown number of architecture industry professionals who have experience preparing drawings for construction and informing design decisions, including architects, architectural assistants, architectural technologists, design managers, and directors of architecture practices. This was deemed suitable for qualitative research to allow time for analysis. No respondents work on rural only.

3. Data Analysis

Data analysis was completed in Excel after exporting the results from Google Forms. Linear analysis was used to identify trends and then multi-variable to identify further patterns.

84% of respondents actioned SD on 50% or less of their projects. The most common type of strategy includes solar panels/collectors and green roofs/walls used by just under 70%. Wind walls (projecting walls designed to direct and channel prevailing winds to interior spaces for ventilation and cooling) were the only unused strategy. Most respondents were architecture industry company directors, with the intention that the survey would be sent to their employees. Most worked on 'mostly urban' projects and none noting that they work in exclusively rural architecture. Figure 1 below shows the ranking of the barriers overall. Each respondent rated each of the barriers on a Likert scale between 1 and 5 (5 being most significant). The average was taken of all these ratings.

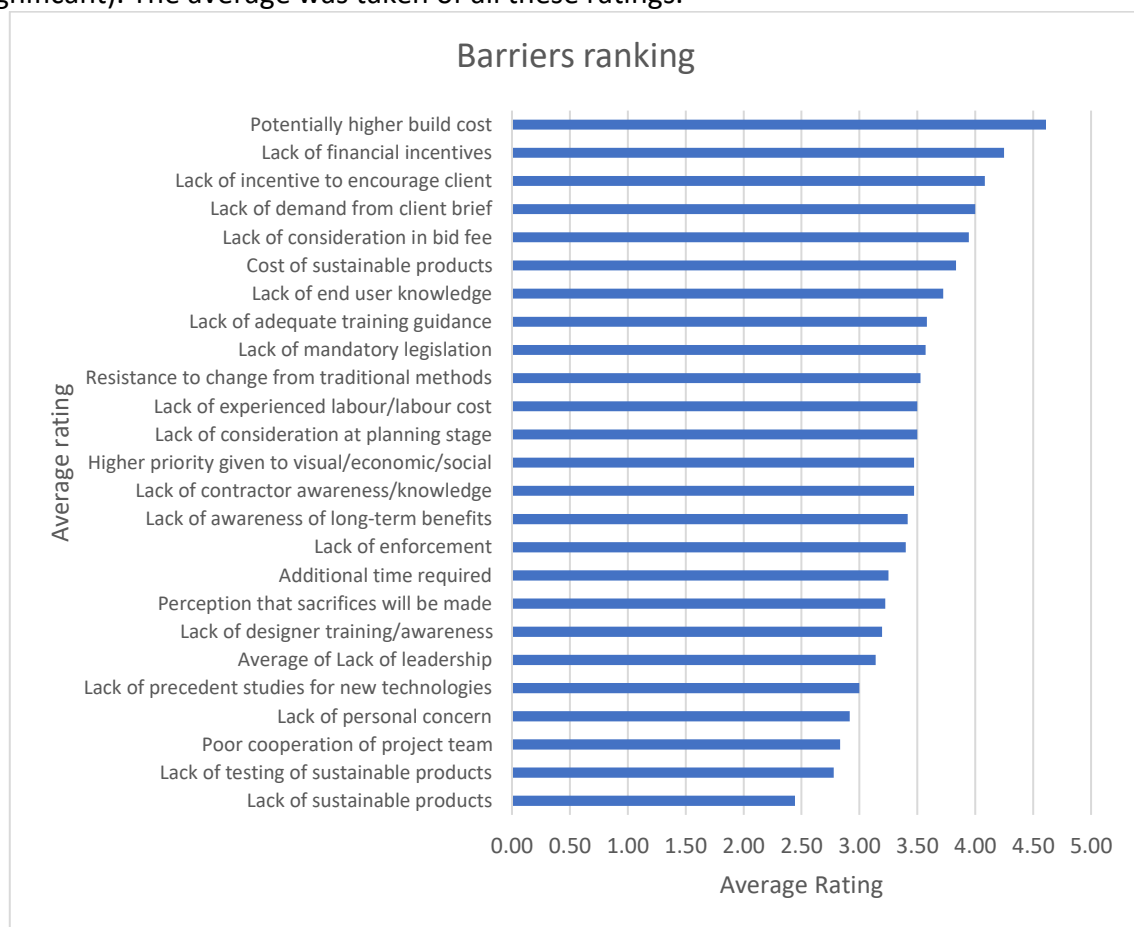


Figure 1. Barriers to SD by Location

Figure 1 suggests lack of products, testing, personal concern and poor co-operation of design team are rated lowest significance. Higher build cost rated highly in all areas whereas, lack of personal concern and precedent studies for new technologies had lower rural ratings. When asked to choose their top barrier over 50% of the respondents chose 'cost' as their top barrier (3.5x more likely than the following 'lack of demand from client brief').

Figure 2 below shows the solutions by location. The same method of determining the mean was used for the solutions as for the barriers.

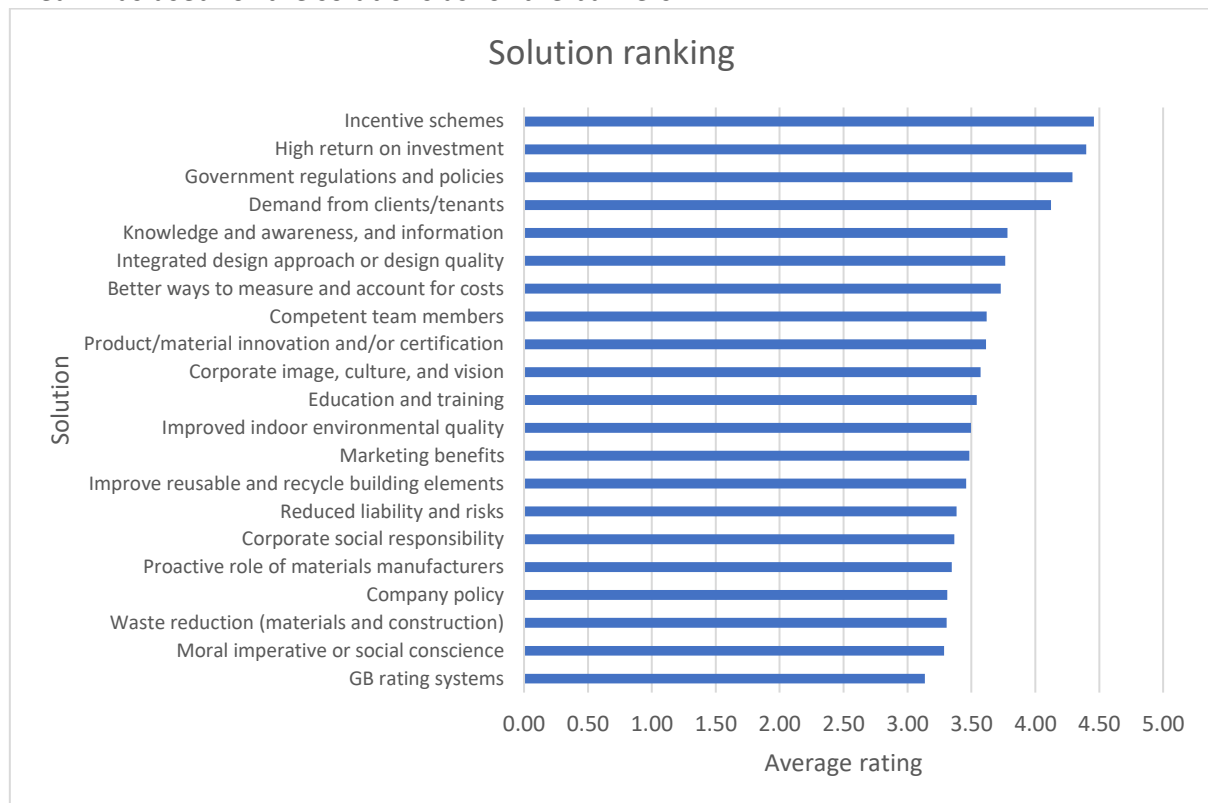


Figure 2. Solutions to SD by Location

Figure 2 suggests the most significant solutions are incentives schemes, high return on investment, and government regulations and policies. The least significant were UK-based rating systems, moral imperative/social conscience and waste reduction. Despite not being rated the most significant on average, the top-rated solution was legislation at 28% respondents, followed by cost at 15% of respondents.

The 'evenly mixed' location category had the most strategy variety. The 'mostly rural' location category has mostly residential and the least variation. The 'mostly urban' location category has mostly commercial projects and the most variety, covering all sectors. For the perception statement 'The projects I work on exceed mandatory legislation' just over 40% are neutral, just under 40% agree. More disagree towards the 'urban' areas. For the perception 'I feel motivated to improve sustainability in my projects' none strongly disagreed, 5% disagreed and 20% neutral. Motivation increased towards the 'mostly rural' category. For the perception 'I feel confident to specify new technologies in my designs' 53% agree, 25% neutral and 22% disagreed. There are no major differences between rural and urban locations.

4. Discussion

Whilst cost is the most significant barrier, there is a more diverse range of solutions. This is expected as many projects rely on investment with an expectation of high returns. As most respondents adopt SD on <50% of projects, there is opportunity for increased

implementation. Popular strategies were those that have least effect on the form of the architecture or 'bolt-on' strategies (e.g. green roofs), and the least popular, trombe walls or wind towers. This may also be due to cost or geographic suitability.

Many responses came from directors, although not unusual as they were contacted with the intention of sending onto employees, this may result in a bias. In addition, a greater proportion worked on urban or mostly urban projects, a result of greater investment in city infrastructure in cities. This meant that a 'rural only' category could not be studied. Rural/urban trends indicated 'product' being increasingly significant for rural locations, which may be due to accessibility. Product was rated higher in literature, however this may be due to the literature studies being in developing countries and where rural/urban divides are greater or where landscape may affect access to materials and new technologies or infrastructure. Those in 'mostly urban' and 'urban' had lower confidence in their project exceeding legislation. It was originally predicted that urban projects may have to meet higher legislation due to stricter enforcement, however it is possible that due to stricter local councils, rural properties may receive harsher regulatory enforcement. Individuals felt positive but noted a lack of confidence, which could be improved with awareness training, however, upskilling is mandatory for registered professionals and not for clients setting briefs. Overall, the results agree with literature that cost, and legislation are key factors.

5. Conclusions

Climate change and increasing fuel costs increase the need for SD to avoid damage to health. After identifying barriers and solutions through existing literature, a questionnaire issued to the UK industry professionals. The highest rated barrier was cost, followed by lack of financial incentives and client demand. The lowest rated barriers include lack of sustainable products, testing, and poor co-operation of project team. Cost was highly significant in all areas whereas lack of personal concern and precedent studies had lower ratings for rural areas. The highest rated solution is incentives schemes, followed by high return on investment, legislation, demand from clients, knowledge and awareness, and information. The lowest rated solutions include UK rating systems, moral imperative or social conscience, waste reduction, company policy, and proactive role of materials manufacturers. Rural respondents placed more emphasis on product-related challenges, while financial barriers were more prominent in urban areas and all areas highly rated 'legislation' as a barrier and solution.

Whilst the study did not achieve a comprehensive sample of the existing population of architectural professionals and could be repeated to expand the reach, this study achieves a basic understanding of the barriers and solutions to sustainable design. Further studies could include other countries; different stakeholder perceptions; SD at different RIBA stages or use on different building. This work could be used by those looking to understand how best to target SD such as policy makers, SD groups, and architectural practices and help understand where regional barriers may exist towards the adoption of SD, to target specific barriers, or to compare UK results with other countries. Legislation being noted as a leading solution, paired with the fact that governments have a responsibility to reduce the carbon emissions across national industry, mean that governments could take initiative to target building regulations and increase enforcement to increase the adoption of SC.

6. References

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7. Abbreviation

SC – Sustainable Construction

SD – Sustainable Design