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THE 13<sup>TH</sup> INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

**EXTENDED ABSTRACTS**  
e-BOOK

# EXTENDED ABSTRACTS e-BOOK

THE 13th INTERNATIONAL  
INNOVATION, INVENTION &  
DESIGN COMPETITION 2024



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## TOOLSTIBS: A DECISION-MAKING TOOL FOR IBS PRODUCT SELECTION

Mohd Rofdzi Abdullah<sup>1,a</sup>, Mohamad Ezad Hafez Mohd Pahroraji<sup>1,b</sup>, Mohd Najib Abd  
Rashid<sup>1,c</sup>, Wan Nur Syazwani Wan Mohammad<sup>1,d</sup>

<sup>1</sup>College of Built Environment, Universiti Teknologi MARA Perak Branch, Seri  
Iskandar Campus, 32610 Seri Iskandar, Perak

<sup>a</sup>Rofdzi159@uitm.edu.my, <sup>b</sup>ezad@uitm.edu.my, <sup>c</sup>mohdn613@uitm.edu.my, <sup>d</sup>wannur956@uitm.edu.my

### ABSTRACT

The Malaysian construction industry is often associated with the infamous problems of being Dirty, Difficult and Dangerous (3D). To support efforts in providing solutions to the issues, an innovative strategy known as the Industrial Building System (IBS) was successfully developed. Presently, the manufacturers and producers of IBS have incorporated a multitude of advantages and benefits into their products. However, selecting the appropriate type of IBS product for construction projects was identified as a critical issue in the decision-making process at the conceptual stage. It could be overwhelming for the decision maker to decide on an IBS product due to the vast selection criteria that need to be considered. Therefore, a tool is required to facilitate and assist in the efficient decision-making associated with selecting the type of IBS product. The consideration criteria are structure and materials' design, site orientation, safety, client perspectives, environmental issues and sustainability, organisational issues, and risk. To overcome this issue, a tool known as TOOLSTIBS was developed using prominent Microsoft Excel. The tool has the capability to determine priority for product selection, provide quantitative analysis in suggestions when two equally weighting factors are involved, and facilitate the person in charge of the decision-making process. The advantages of TOOLSTIBS include serving as an alternative to existing expert choice apps in the current market, incorporating forty main criteria related to IBS systems, and comparing three IBS products for recommendations.

**Keyword:** TOOLSTIB, Decision Making, Industrialised Building System, Product Selection, Construction

### 1. INTRODUCTION

In the rapidly evolving landscape of construction technology, the selection of appropriate Industrialised Building System (IBS) products stands as a critical decision-making process that significantly impacts project efficiency, cost, and sustainability (Abdullah & Egbu, 2010). TOOLSTIBS emerges as a decision-support tool designed to streamline the IBS product selection process, with the potential to revolutionise the IBS industry. By integrating multi-criteria decision-making algorithms with a user-friendly interface, TOOLSTIBS aims to empower decision-makers to make informed, data-driven choices that align with project-specific goals and industry best practices.

The use of IBS in Malaysia has seen significant growth. As of 2021, the implementation of IBS in government projects increased to 84%, up from 79.5% in 2020. In private projects, the adoption of IBS also rose substantially to 60% in 2021, compared to 41% in the previous year. This

indicates a strong trend towards adopting IBS in the country's public and private sectors. In construction, the IBS is a benchmark of innovation, promising efficiency, sustainability, and quality. However, the journey to reap these benefits is not without its challenges. One significant hurdle that decision-makers face is the selection of the appropriate IBS products (Abdullah & Egbu, 2011). It is a task that is complex and multifaceted. The lack of a dedicated tool for this purpose compounds the issue, leading to indecision and potential project delays. The selection process involves numerous criteria, including structure and materials design, site orientation, safety, client perspectives, environmental issues and sustainability, organisational issues, and risk (Abdullah & Egbu, 2011). Without a specialised tool, decision-makers must rely on fragmented information and intuition, which can result in suboptimal choices.

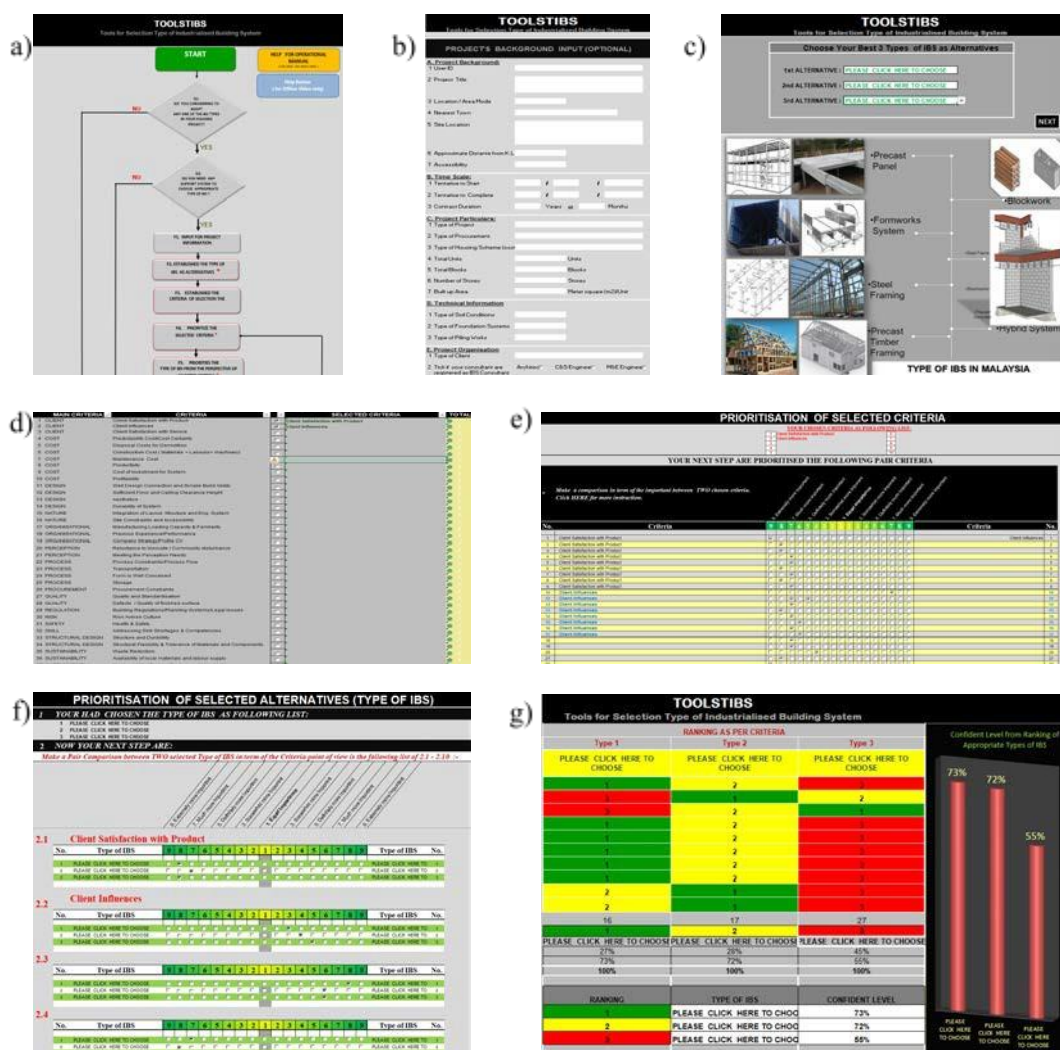
This indicates a clear need for a comprehensive and user-friendly tool (Omar et al., 2016). A tool that not only simplifies the selection process but also ensures that the decisions align with the project's goals and constraints. Therefore, TOOLSTIBS was created to address the intricacies of IBS product selection and the pressing need for a tailored decision-making tool. It highlights the experiences of industry professionals who grapple with these decisions and underscores the potential impact of such a tool on the future of construction. As the industry moves forward, developing a decision-making tool for IBS product selection is not just a convenience but imperative.

## **2. METHODOLOGY**

TOOLSTIBS was developed using Microsoft Excel. The tool is a decision support system (DSS) designed to aid in selecting IBS products. Upon launching the system, users are welcomed by a FlowChart interface in the First Tab (Figure 1a). This visual guide is crucial as it presents the overall workflow and interconnectivity of the system's components, allowing users to understand the sequence of operations and how data flows from one module to another. It serves as a navigational aid and a high-level overview, setting the stage for a structured decision-making process. The second Tab interface is named Project Background (Figure 1b). In this step, users input essential details about their project, including the project's background, time scale, specific particulars, technical specifications, and organisational structure. By capturing this information, the system contextualises the decision-making process, tailoring subsequent steps to the unique aspects of the project at hand. The third Tab interface is named Alternative (Figure 1c). Users are prompted to select three types of IBS that they consider as viable alternatives for their project.

The system may provide a comprehensive list or database of IBS options, from which the user can choose based on preliminary assessments or preferences. This step narrows down the field of choices to a manageable number for detailed analysis. The fourth Tab interface is named Criteria (Figure 1d). From a list of 40 main criteria, users select those relevant to their project's needs. These criteria could span various aspects such as cost, sustainability, time efficiency, labour requirements, and more. The chosen criteria will form the basis for evaluating the selected IBS alternatives. The fifth Tab interface is named Pairwise Criteria (Figure 1e). The system facilitates a pairwise comparison method, asking users to weigh the importance of each criterion against the others. This step employs a systematic approach to determine the relative priority of each criterion, which is essential for making balanced and informed decisions. The sixth Tab interface is named Pairwise Alternatives (Figure 1f). Like in the previous step, users compare the selected IBS types pairwise, focusing on how they measure against each criterion.

This detailed analysis helps understand each alternative's strengths and weaknesses in the context of the project's specific requirements. The seventh and final Tab interface is named Recommendation (Figure 1g). The system processes the input data and user preferences to generate three ranked recommendations. Each recommendation is accompanied by a percentage indicator, reflecting the degree to which it meets the established criteria. This output gives users a clear, quantified basis for making a final selection. This output gives users a clear, quantified basis for making a final selection. The system's functionality is designed to streamline the decision-making process by providing a structured framework for evaluating complex alternatives. By guiding users through a series of logical steps and facilitating a methodical analysis of options, the system helps in arriving at a well-informed, data-driven decision. The use of pairwise comparisons ensures that each decision factor is carefully considered and the final recommendations are presented in a clear, actionable format. This DSS is particularly valuable in the construction industry, where selecting IBS can significantly affect the project's success.



**Figure 1** Flow Chart (a), Project Background (b), Alternative (c), Criteria (d), Pairwise Criteria (e), Pairwise Alternatives (f), Recommendation (g).

### **3. CONCLUSION**

TOOLSTIBS marks a transformative step in construction, offering a decision-support system that revolutionises IBS selection with its multi-criteria algorithms and user-friendly interface. It empowers informed choices, aligning with project goals and best practices. As Malaysia adopts IBS, TOOLSTIBS exemplifies the shift towards efficient, sustainable construction, reflecting the country's modernisation efforts. The rise in IBS use, notably in government and private projects, underscores a commitment to innovative, eco-friendly construction methods. TOOLSTIBS is set to become a vital tool, driving excellence and sustainable development in the global construction industry.

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