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Implementing IBS Technology of Reducing Costs Problems for Affordable Housing Project

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Abstract

Industrialised Building System (IBS) technology has long been introduced in Malaysia since early 1960 and now its use is growing as it gives many advantages in construction especially in saving time and cost. This technology is able to address the issue of affordable housing which is a hot topic at the moment due to the rise of demand and need as well as the issue of widespread use of IBS technology in the housing construction sector is the increasing cost of building materials that led to an incremental increase in housing costs. Therefore, the objectives of this research are to identify the main problems of implementing IBS technology of reducing costs for affordable housing project, to identify the main solutions of implementing IBS technology of reducing costs for affordable housing project and to examine the relationship between the main problems with main solutions of implementing IBS technology of reducing costs for affordable housing project. This research used a quantitative method by distributing questionnaire to developers via online media or physically face-to-face in Seberang Prai Utara (SPU) district in Penang in order to gather the data and achieve the objectives. This research focused on developers in Seberang Prai Utara (SPU) district in Penang as respondent and this study surveys 103 perceptions of developers and a total of 80 (77.7%) respondents had given feedback in the questionnaire. Frequency analysis, descriptive statistic with frequency and crosstabs by SPSS software was used to analyse the data for all objectives. This research found that the main problems and main solutions respectively massive expenditure on capital and proper planning recorded as the highest frequency. Meanwhile, the strongest relationship between the main problems with the main solutions was allocation of total cost for foreign labour with digital technology in IBS. This study may help the developers can successfully adopt IBS technology in achieving affordable housing project, which could help the Malaysian construction industry in achieving affordable housing projects by implementing the solutions given to reduce the costs of IBS technology.

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1. Introduction

Housing affordability is always a major issue in Malaysia, particularly for those who live in major cities (Hassan, Ahmad & Hashim, 2021). According to the New Straits Times' Financial Surveillance Department (2019), 73% of unsold properties in Malaysia were unaffordable, with Johor recording the highest number of unsold houses in 2019, followed by Pulau Pinang, Selangor, Kuala Lumpur, and Perak (Hassan, Ahmad & Hashim, 2021).

Housing should be available to the general public regardless of income level. Access to housing could imply owning or renting a dwelling. In the field of housing provision, both the public and private sectors play their respective roles in meeting the needs and demands of all levels of society, depending on whether the housing is owned or rented (Masram & Misnan, 2019). Hence, housing policy and programmes must evolve to meet public expectations and respond to current housing sector issues, particularly house ownership (Shatar *et al.,* 2017). These are reflected in the implementation of various housing development programmes involving all levels of society. Developers played an important role in housing provision in Malaysia, including low-income housing (Bujang, 2008).

2. Literature Review

Many interchangeable terms can be used to describe Industrialised Building Systems at the international level, including 'off-site,' 'prefabricated components,' and 'modern methods of construction' (Goulding *et al.,* 2014). Although different terms are used to describe IBS implementation, the goals remain the same: to ensure high-quality, cost-effective products and to shorten the completion time (CIDB, 2016). Prefabrication technology has been used in many countries to meet a sudden demand spike in the market, such as in Malaysia, where there was a high demand for affordable houses and a large supply-demand gap (CIDB, 2016). Therefore, it was assumed that implementing IBS would fill the void (Aris, 2020). When compared to traditional building techniques, IBS is more efficient and faster and the adoption of the Industrialised Building System (IBS) can result in faster construction and design consistency (CIDB, 2020). As a result, a standard reference for affordable housing design must be developed to assist the government in applying IBS to shorten construction time and produce quality results (CIDB, 2020). Furthermore, it will aid the construction industry in making extensive use of IBS to build affordable homes (CIDB, 2020).

Minister of Housing and Local Government, stated that the IBS method is currently used to build only 30% of affordable housing, or 19,000 units per year, and that an additional 4,000 units could be built if an additional factory was built to manufacture the various IBS components (The Sun Daily, 2019). Furthermore, as said that the technology can reduce the cost of building affordable houses without sacrificing quality, and that it can also lead to a 49% reduction in labour costs (The Sun Daily, 2019). PR1MA Corporation Malaysia is relying on Industrialised Building System (IBS) technology to build more affordable homes in the country by lowering construction costs while increasing building speed and quality (Kaur, 2023).

2.1 The Practice of Reducing Costs Problems in IBS Affordable Housing Project

IBS is considered a threat to traditional techniques in Malaysia, but in reality, there are many IBS techniques such as block work in combination with standard practices and it will work closely with the construction industry to support best practices while ultimately displacing traditional industries (Nawi *et al.*, 2018). However, IBS implementation has improved significantly in recent years, allowing them to compete with traditional construction methods. IBS quality can sometimes be improved compared to conventional techniques (CIDB, 2020). Growing awareness of IBS is being seen across the country, with good practices and initiatives being developed in the UK construction industry, for example. While in Denmark, about 80% of the detachable houses are used IBS and it has been done via a panelised system and in Sweden with 90% of single-family houses were constructed using IBS (Pan, Gibb & Dainty, 2008).

IBS offers better cash flow for developers as it can claim cash flow from buyers as little as two weeks after building construction (Nawi *et al.,* 2007). In addition, the prefabrication method under controlled conditions reduces material waste and consumes less building materials, resulting in cost savings (Idrus, Hui & Utomo, 2008).

Currently, the Malaysian construction industry is very adept at adapting and adopting IBS technology from foreign practices. Many private companies in Malaysia are now partnering with foreign experts to provide solutions for IBS projects (Nawi *et al.*, 2018). Choose and implement the right technology in IBS project is probably the key to IBS success (Nawi *et al.,* 2018). Regardless of the issues that persist, the importance of IBS

adoption in construction projects is expected to grow as the industry moves into the Industrial Revolution (I.R) 4.0, as outlined in the Construction 4.0 Strategic Plan 2021-2025 and Dasar Pembinaan Negara 2030 (CIDB, 2021).

2.2 The Main Problems of Implementing IBS Technology of Reducing Costs Problems for Affordable Housing Project.

When it comes to IBS, people frequently have misconceptions. Many people have strong feelings about low-cost, mass-produced homes and prohibitively expensive custom homes (CIDB, 2020). In reality, IBS buildings are the more common and accessible option for a wide range of budget levels. In fact, there are numerous reasons to prefer IBS over traditional construction methods (CIDB, 2020).

The IBS application claimed to provide a faster, higher-quality, less-expensive, cleaner, and safer construction site (Jabar & Ismail, 2018). Various studies in the past have revealed that IBS implementation may result in significantly shorter project duration and ultimately lead to cost savings for construction projects - given the potential for repetitive use of various machineries and equipment for different types of projects - to the benefit of construction players, particularly builders, real estate developers, and contractors, who are major IBS users apart from other participants in the construction industry (CIDB, 2018). Researchers did, however, identify several management challenges during the construction phase (Jabar & Ismail, 2018). The identified challenges and issues can be divided into three categories: pre-construction, construction, and post-construction. Categorising the challenges and issues will help to increase the contractor's understanding and prepare them to handle any situation that may arise during the project phases (Jabar & Ismail, 2018).

(a) Massive expenditure on capital

One of the challenges in managing IBS construction projects in order to achieve affordable housing is higher capital costs. This enormous capital cost is due to the large investment required to set up the plant, supply machinery and moulds, and consider engineering (Qays *et al.*, 2010). Adopting a new system necessitates a substantial and ongoing budget, as well as time set aside for human resource training and the purchase of specialised equipment and machinery (Kamar *et al.*, 2009). Besides, it also requires a large volume of work to break even on the investment, implying that IBS requires mass production to achieve economic viability (Alinaitwe, Mwakali & Hansson, 2011). This also includes the installation of prefabricated building components at the construction site after the initial installation of wood or plywood formwork, reinforcement steel and metal. It becomes more expensive as the cost of labour, raw materials, transportation, and the construction period lengthens (CIDB, 2020). The shortcomings include a high initial IBS setup cost, aversion to change, a lack of standardisation of IBS components, a lack of human capital development, and the availability of cheap labour (Hee, 2023).

(b) Human barriers

IBS is not well-liked by architects and designers. Meanwhile, according to users, the IBS building is a fragile and impermanent structure (Jabar & Ismail, 2018). Besides, contractors prefer not to use IBS because it is easier for them to stick to the traditional construction method (Nawi *et al.*, 2007). Furthermore, due to historical failure, it is difficult to change mindset (CIDB, 2010) and they are hesitant to adopt the new construction method because it requires them to adopt new ways of thinking and working (Nadim & Goulding, 2010). Despite the undeniable benefits of IBS, some industry players are sceptical of its practical implementation in Malaysia Tan Sri Teo Chiang Kok, believes that IBS adoption must be carried out in accordance with the efficiency and effectiveness of property development processes (Hee, 2023). The Government, CIDB, MIDA, and other government-related organisations have taken a variety of measures and initiatives to overcome these human barriers to IBS adoption, such as restructuring IBS training programmes and conducting IBS research and development. The proposed measures are expected to boost industry players' confidence in actively participating in IBS adoption, eventually leading to 100% adoption of IBS in the construction and building industry (Hee, 2023).

(c) IBS design as mass construction method

According to Hofman, Voordijk & Halman (2009), housing developers face many challenges when implementing innovation in their construction methods such as IBS, one of which is that customers are sceptical of design that they believe will limit architectural freedom and make this new method vulnerable to design errors. For instance, there have been numerous cases where the use of IBS has resulted in such side effects as an example, consider Pekeliling Flats in Kuala Lumpur and Taman Tun Sardon in Gelugor, Pulau Pinang (Rahman & Omar, 2006). These two early pre-fabricated flats were mass-produced to provide low-cost housing for lower-income groups. In the case of Taman Tun Sardon, the British Research Establishment, UK designed the IBS

precast system for low-cost housing in tropical countries (Rahman & Omar, 2006). Furthermore, in many cases, low-cost housing is not properly maintained, contributing to the negative image of IBS buildings. Therefore, many housing developers are hesitant to take the risk of using IBS because if their projects must be stopped or suspended, they cannot easily stop the construction as they might in a conventional method, but they must still proceed with payment to IBS manufacturers and are obligated for other costs such as transportation and storage (Lovell & Smith 2010).

(d) Insufficient knowledge and poor skill

Construction technology knowledge is also essential. There have been instances where building projects have been awarded and constructed using the IBS system, but have been fraught with difficulties (Rahman & Omar, 2006). This is because, IBS necessitates a high level of construction precision. Previous research has found that the majority of local professionals and contractors lack technical knowledge and experience in the IBS (Kamar *et al.*, 2009). Furthermore, many local governments are unfamiliar with the modular co-ordination and standardisation concepts associated with IBS design and assembly procedures (Hamid *et al.,* 2011). One of the reasons for the delay in IBS implementation is a lack of knowledge among the consultants, the client of the project, and the contractors (Onyeizu, Hassan & Bakar, 2011). Due to a lack of knowledge and exposure to IBS, poor structural analysis and design resulted in problems such as cracks, leakage, and other defects (Rahman & Omar, 2006) and lack of educational courses in university academic curricular, industry players have tended to choose familiar conventional construction methods (Qays *et al.*, 2010). Moreover, lack of knowledge capability in designing the details of ties and connections of prefabricated components, particularly in precast concrete construction, is another related technical issue (Musa *et al.,* 2021). Poor connection systems can impede site work by preventing connections from being properly joined due to poor construction details (Musa *et al.*, 2021).

(e) Missing Logistic Information

Housing developers and builders will face challenges from companies that supply and manufacture traditional building materials data, as these companies will continue to lobby clients to use traditional methods in order to keep their businesses afloat (Lovell & Smith 2010). Furthermore, many traditional building contractors educate the public on the information that traditional design can only be achieved through traditional methods, and IBS is only appropriate for modern design projects (Hofman *et al.*, 2019). Furthermore, the perfect of logistic data of IBS cannot guarantee cost savings and a good return on investment (Aburas 2011). The reason for this is that IBS requires a significant initial investment, such as skilled workers, mechanised equipment, and automated machines to fabricate the components (Lovell & Smith 2010). Because there are few IBS manufacturers and suppliers, housing developers are concerned that their demand for IBS components will not be met because they require large quantities of components at once (Elnaas, Ashton & Gidado, 2009).

(f) Transportation and coordination elements

One of the most important aspects of handling and managing modular construction is transporting or delivering it to site. Because of the large size of the component, transportation may necessitate the use of large machinery and equipment to transport and move the component from the manufacturer to the site. Some routes have become difficult to navigate, and improvised improvements are required (Ang & Kasim, 2013). Furthermore, the cost of maintenance and operation will skyrocket (Azman, 2012). This is one of the problems and reasons why contractors are hesitant to work with IBS construction budgeting rather than traditional construction (Azman, 2012). Aside from the cost of routinely transporting components from the IBS factory to the site, there is also the issue of carrying heavy and large IBS panels, which may endanger other road users and local residents near the site (Jabar & Ismail, 2018). Detail inspection and supervision should be performed during the transportation and unloading processes to avoid component defects and to ensure that all components are calculated in the correct parts to avoid double analysis (Jalil *et al.,* 2016).

(g) Allocation of low-cost foreign labour

Because low labour rates are easily obtained, contractors are hesitant to move into other construction method solutions that require higher capital costs and make IBS investment riskier (Hashim & Kamar, 2011). This is due to the fact that the allocation of total cost for foreign labour is higher than for local skilled labour, which has the effect of achieving affordable housing (Musa *et al.*, 2021). This situation was exacerbated by some irresponsible contractors who hired illegal foreign workers, who can be obtained at very low rates (Kamar & Lou, 2012). Besides many small local contractors are hesitant to adopt the IBS system and prefer to continue using the traditional method of construction (Rahman & Omar, 2006). This is due to small contractors lack financial backing and are unable to establish their own manufacturing plants due to the high capital investment required. In this case, financial concerns become the primary impediment to small contractors implementing the IBS system (Rahman & Omar, 2016).

(h) Imperfect Calculation on IBS Cost than Conventional Method

Currently, the use of IBS can cost 6% to 10% more than conventional construction, which is deemed economically inappropriate for developers in their projects (Foo, 2020). When compared to traditional construction materials, damage to IBS components on-site has a greater impact on cost, time, and process (Pasquire & Gibb, 2002). The initial capital cost, which the contractor must allocate and organise properly, is a significant challenge (Pasquire & Gibb, 2002). The contractor must consider investments in specialised equipment and machinery, human resource training, transportation, and the establishment of a prefabrication yard (Nawi Lee & Nor, 2011). The Covid-19 outbreak however, on the other hand, is said to have presented an opportunity for greater adoption of IBS, as the cost of conventional construction may be higher than before, due to a shortage of foreign labour and rising material costs (Foo, 2020). This is proven by some researchers, using the conventional construction method will cost more in the overall construction project in terms of labour, raw materials, and transportation, as well as slowing down the overall time duration for the project (Rahim, Syazwan & Haron, 2013).

2.3 The Main Solutions of Implementing IBS Technology of Reducing Costs Problems for Affordable Housing Project.

(a) Government incentives and policy

The Malaysian government has made numerous significant efforts to bring the IBS to all professionals involved in the construction industry (Kamar *et al.*, 2010). One of these significant efforts has been the creation of the IBS Roadmap 2003-2010, which has been approved by the government as the blueprint document for the industrialization of the Malaysian construction sector (Kamar *et al.*, 2010). Government incentives to encourage the use of IBS can help to increase the use of this prefabrication concept (Aburas, 2011). Incentives that successfully attract builders include exemptions from building fees when using prefabricated materials and tax breaks on capital invested in IBS factories (Din *et al.*, 2012). These incentives have encouraged IBS fabricators and contractors to investigate IBS without jeopardising their profit margins (Din *et al.*, 2012).

(b) Non-cash incentives to consider

Measures aimed at improving the project development process, such as providing fast-track approval for IBS projects or eliminating onerous building requirements, will, for example, go a long way towards both advancing development costs and meeting existing housing demands on time (Foo, 2020). Furthermore, any "non-cash incentives," such as a higher plot ratio for affordable housing projects that use IBS construction or a reduction in compliance costs, are seen as more appealing and motivating, as they directly benefit the developers (Foo, 2020). Given the importance of "demand-side" incentives in increasing demand for IBS among private developers and the fact that these "demand-side" incentives are beyond the jurisdiction of CIDB or MIDA, and can only be achieved by involving the Ministry of Housing and Local Government, state governments, and local authorities of establishing a functional IBS ecosystem is no longer a construction industry-only issue, but a component of a larger picture (Foo, 2020).

(c) Direct incentives to builders

Direct incentives, such as tax holidays, that can either help sustain their mass volume production or upskill their IBS manufacturing facilities, as well as lower their production costs through duty import exemptions for machinery, equipment, and technology, are most welcome in this case (Foo, 2020). Most Malaysian developers are only involved in property development and investment, leaving building and construction to third parties. It would be able to lay out and improve the entire incentive package for the IBS industry with a coherent and structured IBS agenda that better reflects the overall industry needs and the potential for long-term growth and competitiveness, and maps out each segment with the nation's affordability (CIDB, 2018). Fewer new foreign hires, on the other hand, as a result of lower labour requirements in the construction sector with widespread IBS adoption (CIDB, 2018).

(d) Monitoring throughout installation

IBS necessitates the use of laser surveys, automation scales, and other high-tech tools. As a result, the contractor must ensure that their employees use the necessary equipment because the space to locate each component must be within 0.5mm tolerance (Jalil & Shaari, 2021). Otherwise, the building's load may be jeopardised and deformed (Jalil & Shaari, 2021). Not only IBS manufacturers, but also C&S consultants, must participate in the installation work and provide supervision on-site. This is necessary because the C&S consultant is responsible for the overall safety of the building, whereas IBS manufacturers are only responsible for IBS components (Jalil & Shaari, 2021). This is to ensure that no conflicts arise between the installation of the IBS components and the standard operations that will lead to increase the cost of the project. This is also to prevent the IBS manufacturer from focusing solely on his IBS work while C&S focuses solely on his part (Jalil & Shaari, 2021).

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(e) Proper planning

IBS is perceived to be cost effective however, there are still incidents that may raise the cost, such as material mishandling, in which large IBS components must be replaced at the correct location, which will require time, cranes, and machines (Dainty & Brooke 2004). All IBS manufacturers must provide contractors with precise and clear instructions. As a result, before placing the components, the project site must pay special attention to avoid double handling from the start and to evade the cost (Jalil & Shaari, 2021). This is to ensure that there is no mishandling, component cracking, bending, or mis-positioning (Jalil & Shaari, 2021). This double handling of components causes cost overestimation and savings underestimation because moving the components requires large cranes, skilled operators, and time thus, proper planning is needing in return to decrease the cost of the project (Blismas, Christine & Alistair, 2006).

(f) Integration of BIM in support of IBS implementation

The increased use of technology and modern practises in the construction industry has become a game changer in resolving fragmentation issues and improving the efficiency of construction project completion. Through a series of technological developments such as Building Information Modelling (BIM) and advanced modelling, the adoption of IBS serves as a paradigm shift in the construction industry (CIDB, 2019). Kamar *et al.* (2009) proposed collaboration among various parties through the implementation of an integrated approach in the construction supply chain to support the implementation of IBS and BIM-based technology facilitates the integration process, which aids in resolving the IBS crisis and achieving affordable housing. Hence, Building Information Modelling (BIM) tools were used to discover that the implementation of IBS was proven to reduce building costs (Aris *et al.*, 2020).

(g) Digital technology in IBS

To meet the demand for affordable housing, innovation and digital technology will be essential (Aziz, 2019). Digital construction technology such as cloud computing used in the Industrialised Building System (IBS) method will aid the government's push to build more affordable housing (Othman, 2019). Government stated that digital IBS, which included the use of robotics, would not only benefit the housing sector but would also help to upskill the local workforce (Othman, 2019). The next-generation digital IBS, which leverages today's digital design tools and robotic construction, means flexibility in design, quick construction, and superior quality finish, with the goal of achieving affordable housing (Gamuda, 2023). Therefore, that the technology had the potential to reduce the country's reliance on foreign workers, thereby preventing the yearly outflow of capital. To meet the demand for affordable housing, innovation and digital technology will be essential (Othman, 2019).

2.4 The Relationship Between the Main Problems with the Main Solutions of Implementing IBS Technology of Reducing Costs for Affordable Housing Project

For years, the Construction Industry Development Board (CIDB) has advocated for the use of IBS, claiming that it will reduce costs, improve quality, reduce the construction industry's environmental impact, eliminate the need for foreign labour, accelerate construction timelines, and simplify on-site management and safety (Aris *et al.*, 2020). Based on the studies mentioned, no analysis of the relationship between the main problems with the main solutions of implementing IBS technology of reducing costs problems for affordable housing project has been done. Researchers completed the results of this study because there is still no study that analyses the relationship of the issues.

3. Research Methodology

3.1 Research Design

(a) Procedure of Research

Appendix A shows the research procedure that used to conduct this study. This study was divided into five phases. In general, each phase represented an overall process in the research.

(b) Research Method

This study employed a quantitative approach to achieve all of its goals. Quantitative research was a research method that uses numbers to explain its findings. Quantitative research was carried out by designing questions and surveys relevant to the study's objectives in the form of structured questions.

(c) Respondent

The sample size for this study was determined using Krejcie and Morgan's (1970) Table. Furthermore, the population in this research was the developers, and the population size was estimated to be around 140 respondents in Penang's Seberang Prai Utara (SPU) district. As a result, the sample size is approximately 103 (see Appendix B).

(d) Research Instrument

The questionnaire was primarily used to assess developers' agreement with the impact of the main problems of implementing IBS technology of reducing costs for affordable housing project, the main solutions of implementing IBS technology of reducing costs for affordable housing project, and the relationship between the main problems and the main solutions of implementing IBS technology of reducing costs for affordable housing project. As contexts for questions, Likert five-point scales ranging from strongly agree to strongly disagree are used. Section A, Section B, Section C, and Section D were the three sections. Section A discusses the respondents' backgrounds. Section B is about the main problems of implementing IBS technology of reducing costs problems for affordable housing project. And section C is regarding the main solutions of implementing IBS technology of reducing costs problems for affordable housing project (Refer to Appendix C for questionnaire form).

3.2 Pilot Study

Before conducting the full study and distributing an online questionnaire to the respondents, the researcher conducted a pilot study. In the pilot study, ten people from Penang's Seberang Prai Utara (SPU) district filled out an online questionnaire. Bullen (2021) states that after the survey questionnaire design is completed, 5 to 10 respondents from the target population are chosen.

(a) Reliability Analysis

The reliability of multiple-question Likert scale surveys was determined using Cronbach's alpha. These questions assess hidden or unobservable variables such as a person's conscientiousness, neurosis, or openness (Glen, 2021). The general rule of thumb is as follows: "$\alpha > 0.9$ - Excellent, $\alpha > 0.8$ - Good, $\alpha > 0.7$ - Acceptable, $\alpha > 0.6$ - Questionable, $\alpha > 0.5$ - Poor, and $\alpha < 0.5$ – Unacceptable". The Cronbach's Alpha for the data gathered is 0.978, as shown in Table 1, indicating that the questionnaire is reliable and the items have reasonably high internal consistency.

Table 1 *Reliability test*

Number of Questions	Number of Respondents	Alpha Cronbach's Value
129	10	0.978

3.3 Data Collection

All of the data was gathered through an online questionnaire distributed to 103 developers in Seberang Prai Utara (SPU) district in Penang. The questionnaire was created both manually (at a face-to-face meeting) and online (via Google Forms). The Google Forms link was shared on platforms such as WhatsApp and Email.

3.4 Data Analysis

The data was analysed with the Statistical Package for Social Sciences (SPSS) software. In this study, frequency analysis was used to explain the fundamental characteristics of the data. A simple descriptive analysis using the mean technique was used, and a relationship analysis was performed using crosstab analysis. The researcher used frequency to analyse the data in Sections A (respondent background), Sections B (the main problems of implementing IBS technology of reducing costs for affordable housing project), and Sections C (the main solutions of implementing IBS technology of reducing costs for affordable housing project). The researcher used the same Likert Scale in Sections B and C of this study. The Grade 7 contractors' agreement level was evaluated using a 5-point Likert Scale in these sections. The results, as well as the average response (mean), were derived from the 5-point Likert scale by the researcher. Cross-tabulation (Crosstab) was used to analyse objective 3, which is to assess the strength of the relationship between the main problems and the main solutions of implementing IBS technology of reducing costs for affordable housing project. Crosstab analysis is appropriate

because this study used ordinal data to identify the main problems of LC practices in construction project management and the main solutions of implementing IBS technology of reducing costs for affordable housing project. The researcher can obtain estimates of an event's relative risk in the presence or absence of specific characteristics, as well as test for significant differences in the column proportions in the crosstab (IBM, 2014).

4. Result and Discussion

4.1 Survey Response Rate

The data and analysis from the study are presented in the results and discussion section. A total of 103 questionnaire sets were distributed to respondents. A total of 80 sets of questionnaires were returned with answers among the 103, and all of the returned questionnaires were used for data analysis. As a result (Table 2), the study's response rate is 77.7% of the total questionnaires were distributed to the developers in Seberang Prai Utara (SPU) district in Penang. It is valid to do the analysis as a result, the study's response rate is 77.7%, well above the average response rate of 60% or so for questionnaires of this type (Pharm, 2008). And it is involving developers because they are an organization that managing house construction.

Table 2 *Survey return rate*

Sample Size	Questionnaire Distributed	Returned Questionnaire	Percent (%)
103	103	80	77.7

4.2 Reliability Analysis

A pilot study was carried out to ensure that the questionnaire items were valid and reliable. The results of the pilot study's reliability test are shown in Table 3. The respondents were from the Penang population.

Table 3 *Reliability test*

Number of Questions	Number of Respondents	Alpha Cronbach's Value
129	10	0.978

4.3 Assessment Level Based on Mean Score

Table 3 categorizes and interprets the mean average score into three levels. A mean score of 1.00 to 2.33 indicates a low mean value, a score of 2.34 to 3.66 indicates a moderate mean value, and a score of 3.67 to 5.00 indicates a high mean value.

Table 4 *Assessment Level Based on Mean Score (Ibrahim, 2013)*

Mean Score Range	Mean Score Level	
1.00-2.33	Low	(Not Agree/ Not Helpful/ Unsatisfied/ None/ Sometimes/ Not Sure)
2.34-3.66	Moderate	(Agree/ Helpful/ Satisfied)
3.67-5.00	High	(Strongly Agree/ Fully Satisfied/ Really Helpful)

4.4 Crosstabs Analysis

Table 5 shows the approximate significance for the variable's must < 0.05 and value must < 0.5 to show there is a relationship between the variables and there is a strong or a weak relationship. The approximate significance is related to variables. There are two types of hypotheses in this study which is H0 and H1. H0: The main problems of implementing IBS technology of reducing costs for affordable housing project is not significant with the main solutions of implementing IBS technology of reducing costs for affordable housing project. H1: The

main problems of implementing IBS technology of reducing costs for affordable housing project is significant with the main solutions of implementing IBS technology of reducing costs for affordable housing project.

Table 5 *Crosstab Analysis (DeFranzo, 2010)*

Appr. Significant	Value	Explanation
< 0.05	< 0.5	There is a relationship between the variables and the relationship is strong (H_1 is accepted)
> 0.05	> 0.5	There is no association between the variables and the relationship is weak (H_0 is accepted)

Table 6 *Relationship Analysis for Main Problems with Main Solutions*

Main Problems	Main Solutions	Approximate Significant	Value	Hypothesis	Ranking
Massive Expenditure - Purchasing of specialised equipment	Proper Planning - IBS manufacturer provided detailed written - Project site must pay special attention to evade cost - IBS manufacturers provide contractors clear instruction	0.0258 (Yes) 0.0605 (No) 0.0139 (Yes)	0.2584 (Strong) 0.2209 (Strong) 0.2778 (Strong)	H_1 H_0 H_1	51 - 68
	Integration of BIM in Support of IBS Implementation - BIM allows for adequate data analysis - Improves practitioners communication - Improves practitioners visualisation	0.0371 (Yes) 0.0599 (No) 0.0466 (Yes)	0.2386 (Strong) 0.2222 (Strong) 0.2174 (Strong)	H_1 H_0 H_1	31 - 15
	Digital Technology in IBS - Reduce cuts waste - Flexibility in quick construction - Flexibility in design	0.0755 (No) 0.0746 (No) 0.0272 (Yes)	0.2250 (Strong) 0.2045 (Strong) 0.2771 (Strong)	H_0 H_0 H_1	- - 67
	Monitoring Throughout Installation - Ensure employees use the necessary equipment by the procedures - Ensure employees use the necessary machinery by the procedures - C&S provide supervision on-site	0.0342 (Yes) 0.1259 (No) 0.0118 (Yes)	0.2418 (Strong) 0.1868 (Strong) 0.2637 (Strong)	H_1 H_0 H_1	36 - 53
	Direct Incentives to Builder - More intensive training	0.2292	0.1529	H_0	-

	programs	(No)	(Strong		
		0.0946	)	H_0	-
	- Education training of IBS in	(No)	0.2045		
	universities	0.4218	(Strong	H_0	-
	- Lower the production costs	(No)	)		
	exemptions for machinery		0.0930		
			(Strong		
			)		
	Non-Cash Incentives to				
	Consider	0.0122	0.3023	H_1	84
	- Measures improving the	(Yes)	(Strong		
	project development process	0.0214	)	H_1	63
	- Providing fast-track	(Yes)	0.2759		
	approval for IBS projects	0.0193	(Strong	H_1	6
	- Higher plot ratio for	(Yes)	)		
	affordable housing projects		0.1548		
			(Strong		
			)		
	Government Incentives and				
	Policy	0.0011	0.3191	H_1	91
	- Tax breaks on capital	(Yes)	(Strong		
	invested in IBS	0.0177	)	H_1	75
		(Yes)	0.2841		
	- Implement better policies	0.0157	(Strong	H_1	83
	through contract terms	(Yes)	)		
	- Cooperation between		0.3012		
	industry and higher		(Strong		
	education		)		
Insufficient Knowledge and Poor Skills - Lack of Exposure of IBS	Proper Planning				
	- IBS manufacturer provided	0.0012	0.3587	H_1	102
	detailed written	(Yes)	(Strong		
	- Project site must pay	0.0004	)	H_1	101
	special attention to evade	(Yes)	0.3483		
	cost	0.0030	(Strong	H_1	97
	- IBS manufacturers provide	(Yes)	)		
	contractors clear instruction		0.3333		
			(Strong		
			)		
	Integration of BIM in Support of IBS Implementation				
	- BIM allows for adequate	0.0056	0.3077	H_1	85
	data analysis	(Yes)	(Strong		
		0.0052	)	H_1	82
	- Improves practitioners	(Yes)	0.3011		
	communication	0.0176	(Strong	H_1	28
		(Yes)	)		
	- Improves practitioners		0.2316		
	visualisation		(Strong		
			)		
	Digital Technology in IBS				
	- Reduce cuts waste	0.1488	0.1928	H_0	-
		(No)	(Strong		
	- Flexibility in quick	0.0423	)	H_1	18
	construction	(Yes)	0.2198		
		0.0345	(Strong	H_1	57
	- Flexibility in design	(Yes)	)		
			0.2674		
			(Strong		
			)		
	Monitoring Throughout Installation	0.0002	0.3830	H_1	106
	- Ensure employees use the	(Yes)	(Strong		
	necessary equipment by the	0.0002	)	H_0	-
	procedures	(Yes)	0.3723		
	- Ensure employees use the	0.0028	(Strong	H_1	64
	necessary machinery by the	(Yes)	)		

	procedures - C&S provide supervision on-site		0.2766 (Strong)		
	Direct Incentives to Builder - More intensive training programs - Education training of IBS in universities - Lower the production costs exemptions for machinery	0.0326 (Yes) 0.0006 (Yes) 0.1259 (No)	0.2500 (Strong) 0.3736 (Strong) 0.1889 (Strong)	H_1 H_1 H_0	42 104 -
	Non-Cash Incentives to Consider - Measures improving the project development process - Providing fast-track approval for IBS projects - Higher plot ratio for affordable housing projects	0.0645 (No) 0.1031 (No) 0.0330 (Yes)	0.2247 (Strong) 0.2000 (Strong) 0.2644 (Strong)	H_0 H_0 H_1	- - 54
	Government Incentives and Policy - Tax breaks on capital invested in IBS - Implement better policies through contract terms - Cooperation between industry and higher education	0.0029 (Yes) 0.0114 (Yes) 0.0231 (Yes)	0.2990 (Strong) 0.2967 (Strong) 0.2907 (Strong)	H_0 H_0 H_0	- - -
Imperfect Calculation on IBS Cost than Conventional Method - Damage to IBS components on-site has greater impact on cost	Proper Planning - IBS manufacturer provided detailed written - Project site must pay special attention to evade cost - IBS manufacturers provide contractors clear instruction	0.0334 (Yes) 0.1434 (No) 0.1567 (No)	0.2258 (Strong) 0.1556 (Strong) 0.1596 (Strong)	H_1 H_0 H_0	21 - -
	Integration of BIM in Support of IBS Implementation - BIM allows for adequate data analysis - Improves practitioners communication - Improves practitioners visualisation	0.2501 (No) 0.0088 (Yes) 0.0424 (Yes)	0.1196 (Strong) 0.2660 (Strong) 0.2396 (Strong)	H_0 H_1 H_1	- 55 32
	Digital Technology in IBS - Reduce cuts waste - Flexibility in quick construction - Flexibility in design	0.0857 (No) 0.2163 (No) 0.0522 (No)	0.1786 (Strong) 0.1304 (Strong) 0.2069 (Strong)	H_0 H_0 H_0	- - -
	Monitoring Throughout Installation	0.1995	0.1124	H_0	-

	- Ensure employees use the necessary equipment by the procedures - Ensure employees use the necessary machinery by the procedures - C&S provide supervision on-site	(No) 0.1250 (No) 0.0605 (No)	(Strong) 0.1739 (Strong) 0.2022 (Strong)	H_0 H_0	- -
	Direct Incentives to Builder - More intensive training programs - Education training of IBS in universities - Lower the production costs exemptions for machinery	0.0326 (Yes) 0.0006 (Yes) 0.1259 (No)	0.2500 (Strong) 0.3736 (Strong) 0.1889 (Strong)	H_1 H_1 H_0	43 103 -
	Non-Cash Incentives to Consider - Measures improving the project development process - Providing fast-track approval for IBS projects - Higher plot ratio for affordable housing projects	0.1165 (No) 0.0361 (Yes) 0.2211 (No)	0.1556 (Strong) 0.2527 (Strong) 0.1477 (Strong)	H_0 H_1 H_0	- 45 -
	Government Incentives and Policy - Tax breaks on capital invested in IBS - Implement better policies through contract terms - Cooperation between industry and higher education	0.0029 (Yes) 0.0193 (Yes) 0.0281 (Yes)	0.2449 (Strong) 0.2826 (Strong) 0.2299 (Strong)	H_1 H_1 H_1	38 73 25
Human Barrier - Additional Human Capital Investment	Proper Planning - IBS manufacturer provided detailed written - Project site must pay special attention to evade cost - IBS manufacturers provide contractors clear instruction	0.1744 (No) 0.2212 (No) 0.0028 (Yes)	0.1413 (Strong) 0.1348 (Strong) 0.1398 (Strong)	H_0 H_0 H_1	- - 3
	Integration of BIM in Support of IBS Implementation - BIM allows for adequate data analysis - Improves practitioners communication - Improves practitioners visualisation	0.2306 (No) 0.0732 (No) 0.0293 (Yes)	0.1319 (Strong) 0.2043 (Strong) 0.2316 (Strong)	H_0 H_0 H_1	- - 29
	Digital Technology in IBS - Reduce cuts waste - Flexibility in quick construction - Flexibility in design	0.1748 (No) 0.2652 (No) 0.1689 (No)	0.1084 (Strong) 0.1209 (Strong)	H_0 H_0 H_0	- - -

			0.1628 (Strong)		
	Monitoring Throughout Installation	0.0556 (No)	0.1124 (Strong)	H_0	-
	- Ensure employees use the necessary equipment by the procedures	0.0466 (Yes)	0.1739 (Strong)	H_0	-
	- Ensure employees use the necessary machinery by the procedures	0.0605 (No)	0.2022 (Strong)	H_0	-
	- C&S provide supervision on-site				
	Direct Incentives to Builder				
	- More intensive training programs	0.0549 (No)	0.2045 (Strong)	H_0	-
	- Education training of IBS in universities	0.0895 (No)	0.1758 (Strong)	H_0	-
	- Lower the production costs exemptions for machinery	0.2292 (No)	0.1461 (Strong)	H_0	-
	Non-Cash Incentives to Consider	0.1165 (No)	0.1011 (Strong)	H_0	-
	- Measures improving the project development process	0.2573 (No)	0.1333 (Strong)	H_0	-
	- Providing fast-track approval for IBS projects	0.0793 (No)	0.1494 (Strong)	H_0	-
	- Higher plot ratio for affordable housing projects				
	Government Incentives and Policy	0.0099 (Yes)	0.2680 (Strong)	H_1	60
	- Tax breaks on capital invested in IBS	0.0458 (Yes)	0.1628 (Strong)	H_1	7
	- Implement better policies through contract terms	0.1850 (No)	0.2088 (Strong)	H_0	-
	- Cooperation between industry and higher education				
Transportation and Coordination Elements - Detail Inspection During the Unloading Processes	Proper Planning				
	- IBS manufacturer provided detailed written	0.0012 (Yes)	0.2000 (Strong)	H_1	12
	- Project site must pay special attention to evade cost	0.0029 (Yes)	0.1957 (Strong)	H_1	9
	- IBS manufacturers provide contractors clear instruction	0.0327 (Yes)	0.1977 (Strong)	H_1	11
	Integration of BIM in Support of IBS Implementation				
	- BIM allows for adequate data analysis	0.2143 (No)	0.0495 (Strong)	H_0	-
	- Improves practitioners communication	0.0860 (No)	0.2093 (Strong)	H_0	-
	- Improves practitioners visualisation	0.0547 (No)	0.2386 (Strong)	H_0	-
	Digital Technology in IBS				
	- Reduce cuts waste	0.0413	0.2237	H_1	19

		(Yes)	(Strong		
	- Flexibility in quick	0.1866	)	H_0	-
	construction	(No)	0.1548		
		0.0019	(Strong	H_1	100
	- Flexibility in design	(Yes)	)		
			0.3418		
			(Strong		
			)		
	Monitoring Throughout				
	Installation	0.1066	0.1494	H_0	-
	- Ensure employees use the	(No)	(Strong		
	necessary equipment by the	0.0065	)	H_1	35
	procedures	(Yes)	0.2414		
	- Ensure employees use the	0.0458	(Strong	H_1	16
	necessary machinery by the	(Yes)	)		
	procedures		0.2184		
	- C&S provide supervision		(Strong		
	on-site		)		
	Direct Incentives to Builder				
	- More intensive training	0.1104	0.1358	H_0	-
	programs	(No)	(Strong		
		0.2068	)	H_0	-
	- Education training of IBS in	(No)	0.1190		
	universities	0.2931	(Strong	H_0	-
	- Lower the production costs	(No)	)		
	exemptions for machinery		0.1341		
			(Strong		
			)		
	Non-Cash Incentives to				
	Consider	0.0487	0.2561	H_1	49
	- Measures improving the	(Yes)	(Strong		
	project development process	0.0290	)	H_1	77
	- Providing fast-track	(Yes)	0.2892		
	approval for IBS projects	0.0147	(Strong	H_1	92
	- Higher plot ratio for	(Yes)	)		
	affordable housing projects		0.3250		
			(Strong		
			)		
	Government Incentives and				
	Policy	0.0025	0.3000	H_1	81
	- Tax breaks on capital	(Yes)	(Strong		
	invested in IBS	0.1000	)	H_0	-
		(No)	0.2857		
	- Implement better policies	0.0192	(Strong	H_1	47
	through contract terms	(Yes)	)		
	- Cooperation between		0.2532		
	industry and higher		(Strong		
	education		)		
Allocation of Total Cost for Foreign Labor - Lacking of skilled workers	Proper Planning				
	- IBS manufacturer provided	0.0109	0.2143	H_1	14
	detailed written	(Yes)	(Strong		
	- Project site must pay	0.0029	)	H_1	10
	special attention to evade	(Yes)	0.1975		
	cost	0.0389	(Strong	H_1	13
	- IBS manufacturers provide	(Yes)	)		
	contractors clear instruction		0.2118		
			(Strong		
			)		
	Integration of BIM in Support of IBS Implementation				
	- BIM allows for adequate	0.0263	0.2410	H_1	34
	data analysis	(Yes)	(Yes)		
		0.0190	0.1412	H_1	4
	- Improves practitioners	(Yes)	(Strong		
	communication	0.0109	)	H_1	2
		(Yes)	0.1379		

	- Improves practitioners visualisation		(Strong)		
	Digital Technology in IBS				
	- Reduce cuts waste	0.1119 (No)	0.1867 (Strong)	H_0	-
	- Flexibility in quick construction	0.0209 (Yes)	0.1205 (Strong)	H_1	1
	- Flexibility in design	0.0342 (Yes)	0.3258 (Strong)	H_1	93
	Monitoring Throughout Installation				
	- Ensure employees use the necessary equipment by the procedures	0.0793 (No)	0.1512 (Strong)	H_0	-
	- Ensure employees use the necessary machinery by the procedures	0.0330 (Yes)	0.2674 (Strong)	H_1	58
	- C&S provide supervision on-site	0.0063 (Yes)	0.3372 (Strong)	H_1	98
	Direct Incentives to Builder				
	- More intensive training programs	0.1748 (No)	0.1125 (Strong)	H_0	-
	- Education training of IBS in universities	0.1011 (No)	0.1566 (Strong)	H_0	-
	- Lower the production costs exemptions for machinery	0.2278 (No)	0.1235 (Strong)	H_0	-
	Non-Cash Incentives to Consider				
	- Measures improving the project development process	0.0487 (Yes)	0.1728 (Strong)	H_1	8
	- Providing fast-track approval for IBS projects	0.0114 (Yes)	0.3293 (Strong)	H_1	95
	- Higher plot ratio for affordable housing projects	0.0146 (Yes)	0.2532 (Strong)	H_1	48
	Government Incentives and Policy				
	- Tax breaks on capital invested in IBS	0.0209 (Yes)	0.2247 (Strong)	H_1	20
	- Implement better policies through contract terms	0.0690 (No)	0.2048 (Strong)	H_0	-
	- Cooperation between industry and higher education	0.0320 (Yes)	0.2436 (Strong)	H_1	37
Missing Logistic Information - Lack of Awareness of the IBS Advantages	Proper Planning				
	- IBS manufacturer provided detailed written	0.0015 (Yes)	0.3158 (Strong)	H_1	90
	- Project site must pay special attention to evade cost	0.0036 (Yes)	0.2935 (Strong)	H_1	79
	- IBS manufacturers provide contractors clear instruction	0.0058 (Yes)	0.2813 (Strong)	H_1	71
	Integration of BIM in Support of IBS Implementation				
	- BIM allows for adequate data analysis	0.0049 (Yes)	0.2766 (Strong	H_1	65

		0.1000 (Yes)	) 0.2813	H_1	72
	- Improves practitioners communication	0.0290 (Yes)	(Strong)	H_1	41
	- Improves practitioners visualisation		0.2449 (Strong)		
	Digital Technology in IBS				
	- Reduce cuts waste	0.0168 (Yes)	0.2791 (Strong	H_1	69
	- Flexibility in quick construction	0.1003 (No)	) 0.1702	H_0	-
	- Flexibility in design	0.0049 (Yes)	(Strong) 0.3258 (Strong)	H_1	94
	Monitoring Throughout Installation	0.0054 (Yes)	0.2990 (Strong	H_1	80
	- Ensure employees use the necessary equipment by the procedures	0.0026 (Yes)	) 0.2809	H_1	70
	- Ensure employees use the necessary machinery by the procedures	0.0026 (Yes)	(Strong) 0.2887	H_1	76
	- C&S provide supervision on-site		(Strong)		
	Direct Incentives to Builder				
	- More intensive training programs	0.1104 (No)	0.1358 (Strong	H_0	-
	- Education training of IBS in universities	0.2068 (No)	) 0.1190	H_0	-
	- Lower the production costs exemptions for machinery	0.2931 (No)	(Strong) 0.1341 (Strong)	H_0	-
	Non-Cash Incentives to Consider	0.0428 (Yes)	0.2308 (Strong	H_1	27
	- Measures improving the project development process	0.0009 (Yes)	) 0.3404	H_1	99
	- Providing fast-track approval for IBS projects	0.0860 (No)	(Strong) 0.1957 (Strong)	H_0	-
	- Higher plot ratio for affordable housing projects				
	Government Incentives and Policy	0.0010 (Yes)	0.3100 (Strong	H_1	87
	- Tax breaks on capital invested in IBS	0.0165 (Yes)	) 0.2766	H_1	66
	- Implement better policies through contract terms	0.0123 (Yes)	(Strong) 0.2584 (Strong)	H_1	52
	- Cooperation between industry and higher education				
IBS Design as Mass Construction Method - IBS Methods Applied More Concrete	Proper Planning				
	- IBS manufacturer provided detailed written	0.0895 (No)	0.1684 (Strong	H_0	-
	- Project site must pay special attention to evade cost	0.0264 (Yes)	) 0.2283	H_1	24
	- IBS manufacturers provide contractors clear instruction	0.1013 (No)	(Strong) 0.1979 (Strong	H_0	-

			)		
	Integration of BIM in Support of IBS Implementation				
	- BIM allows for adequate data analysis	0.0627 (No)	0.1809 (Strong	H_0	-
		0.0248	)	H_1	17
	- Improves practitioners communication	(Yes) 0.0454	0.2188 (Strong	H_1	5
		(Yes)	)		
	- Improves practitioners visualisation		0.1531 (Strong)		
	Digital Technology in IBS				
	- Reduce cuts waste	0.0340 (Yes)	0.2326 (Strong	H_1	30
	- Flexibility in quick construction	0.2749 (No)	) 0.1170	H_0	-
		0.0029	(Strong	H_1	89
	- Flexibility in design	(Yes)	) 0.3146 (Strong)		
	Monitoring Throughout Installation	0.0754	0.1753	H_0	-
	- Ensure employees use the necessary equipment by the procedures	(No) 0.0293 (Yes)	(Strong) 0.2268	H_1	23
	- Ensure employees use the necessary machinery by the procedures	0.0147 (Yes)	(Strong) 0.2474	H_1	40
	- C&S provide supervision on-site		(Strong)		
	Direct Incentives to Builder				
	- More intensive training programs	0.1910 (No)	0.1319 (Strong	H_0	-
		0.0577	)	H_0	-
	- Education training of IBS in universities	(No) 0.0859	0.1915 (Strong	H_0	-
	- Lower the production costs exemptions for machinery	(No)	) 0.1739 (Strong)		
	Non-Cash Incentives to Consider	0.0055	0.2717	H_1	62
	- Measures improving the project development process	(Yes) 0.0076	(Strong)	H_1	50
	- Providing fast-track approval for IBS projects	(Yes) 0.0076	0.2581 (Strong	H_1	59
	- Higher plot ratio for affordable housing projects	(Yes)	) 0.2677 (Strong)		
	Digital Technology in IBS				
	- Reduces cuts waste	0.0042 (Yes)	0.3100 (Strong	H_1	88
	- Flexibility in quick construction	0.0042 (Yes)	) 0.3085	H_1	86
		0.0100	(Strong	H_1	61
	- Flexibility in design	(Yes)	) 0.2697 (Strong)		
Imperfect Calculation on IBS Cost than	Proper Planning				
	- IBS manufacturer provided detailed written	0.0334 (Yes)	0.2258 (Strong	H_1	22
	- Project site must pay	0.1434	)	H_0	-

Conventional Method - Damage to IBS components on-site has greater impact on cost	special attention to evade cost - IBS manufacturers provide contractors clear instruction	(No) 0.1567 (No)	0.1556 (Strong) 0.1596 (Strong)	H_0	-
	Integration of BIM in Support of IBS Implementation - BIM allows for adequate data analysis - Improves practitioners communication - Improves practitioners visualisation	0.2501 (No) 0.0088 (Yes) 0.0424 (Yes)	0.1196 (Strong) 0.2660 (Strong) 0.2396 (Strong)	H_0 H_1 H_1	- 56 33
	Digital Technology in IBS - Reduce cuts waste - Flexibility in quick construction - Flexibility in design	0.0857 (No) 0.2163 (No) 0.0522 (No)	0.1786 (Strong) 0.1304 (Strong) 0.2069 (Strong)	H_0 H_0 H_0	- - -
	Monitoring Throughout Installation - Ensure employees use the necessary equipment by the procedures - Ensure employees use the necessary machinery by the procedures - C&S provide supervision on-site	0.1995 (No) 0.1250 (No) 0.0605 (No)	0.1124 (Strong) 0.1739 (Strong) 0.2022 (Strong)	H_0 H_0 H_0	- - -
	Direct Incentives to Builder - More intensive training programs - Education training of IBS in universities - Lower the production costs exemptions for machinery	0.0326 (Yes) 0.0006 (Yes) 0.1259 (No)	0.2500 (Strong) 0.3736 (Strong) 0.1889 (Strong)	H_1 H_1 H_0	44 105 -
	Non-Cash Incentives to Consider - Measures improving the project development process - Providing fast-track approval for IBS projects - Higher plot ratio for affordable housing projects	0.1165 (No) 0.0361 (Yes) 0.2211 (No)	0.1556 (Strong) 0.2527 (Strong) 0.1477 (Strong)	H_0 H_1 H_0	- 46 -
	Government Incentives and Policy - Tax breaks on capital invested in IBS - Implement better policies through contract terms - Cooperation between industry and higher	0.0029 (Yes) 0.0193 (Yes) 0.0281 (Yes)	0.2449 (Strong) 0.2826 (Strong) 0.2299	H_1 H_1 H_1	39 74 26

education	(Strong)

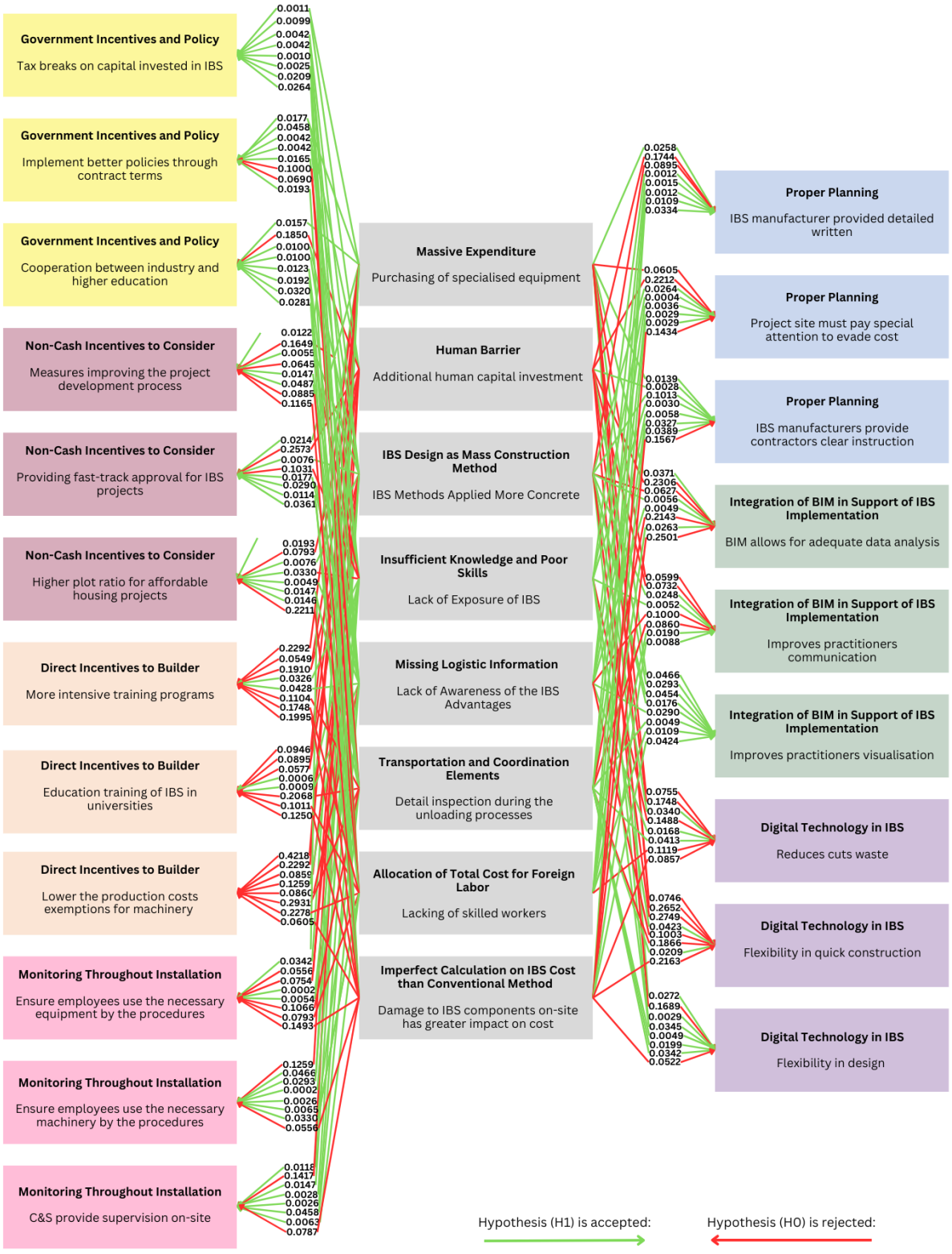

Fig. 1 *Relationship Analysis Diagram for Main Problems with Main Solution*

5. Conclusion

The findings of this research show that all of the objectives of this research were met by utilizing the results of the data analysis obtained from the returned questionnaires. The achievement of the objectives is critical to the research's success. Accordant with the research that has been done, the researcher found that the main problems are "Massive expenditure capital" and main solutions is "Proper planning" of implementing IBS technology of reducing costs for affordable housing project were agreed upon by the developers. Researchers also found that the main problems were correlating 106 out of 189 with the main solutions. The strongest relationship (H1) is "Digital Technology in IBS – Flexibility in quick construction) while the weakest relationship (H0) is "Monitoring throughout installation – Ensure employees use the necessary equipment by the procedures). As a result of the research findings (refer to Figure 2), it is hoped that the parties involved and responsible for addressing the problems will do so by implementing the solutions provided. If the construction industry is conducted in this manner, it has the potential to enjoy increased levels of prosperity and success.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Nurina Batrisyia Mohd Nizam, Rozlin Zainal;* ***data collection:*** *Nurina Batrisyia Mohd Nizam;* ***analysis and interpretation of results:*** *Nurina Batrisyia Mohd Nizam;* ***draft manuscript preparation:*** *Nurina Batrisyia Mohd Nizam, Rozlin Zainal, Mohd Hilmi Izwan Abd Rahim, & Sr Zarina Shamsudin. All authors reviewed the results and approved the final version of the manuscript.*

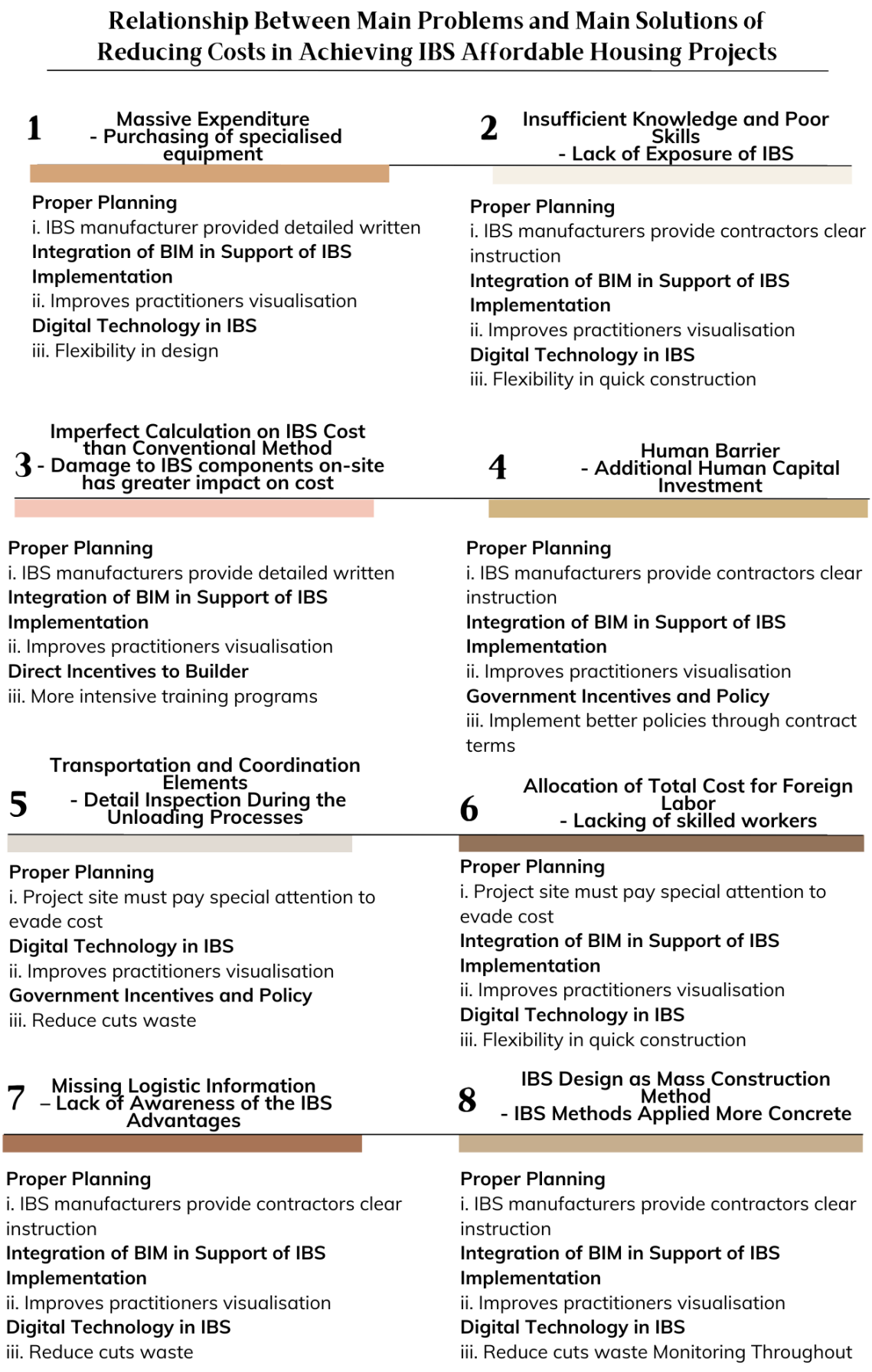

Fig. 2 *Relationship Framework for Main Problems with Main Solutions of Reducing Costs in Achieving IBS Affordable Housing Projects*

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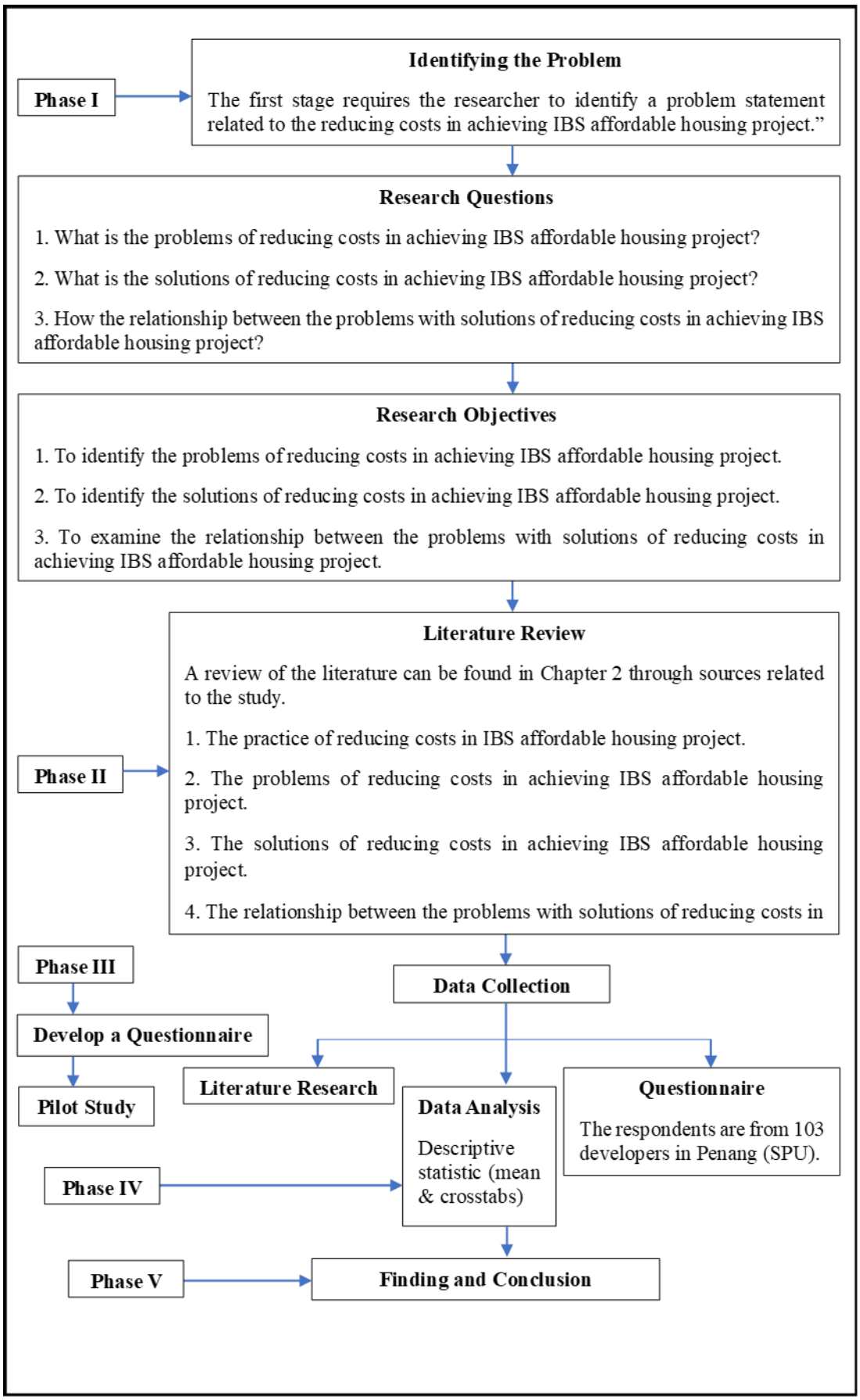
Appendix A: Procedure of Research



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