bidang
TEKNIK

INTELIGENT BUILDING SYSTEM (IBS) AS A GREEN AND SMART APPROACH IN INDONESIA: BENEFIT, PROBLEM, AND CHALLENGE

ANDI HARAPAN S
Program Studi Teknik Arsitektur, Fakultas Teknik dan Ilmu Komputer
Universitas Komputer Indonesia

Intelligent Building System (IBS) is a concept that elaborate architectural design, interior design, mechanical and electrical in order to provide the mobility and ease of control and access from any direction and any time. The system is highly related to automation, where all the utility system in the building still can be operating without any people's intervention, even if there are no people inside of the building, the system will run in accordance with the program that we have created.

IBS is not a new thing in Indonesia, it is a concept that has developed since a few years ago. The term of IBS is more popular as Smart Building System (SBS), where the concept has been applied in several buildings in Indonesia. But unfortunately, this concept was limited to office and commercial buildings, and only focused on a few major cities in Indonesia, such as Jakarta.

In general, the concept of IBS in Indonesia is to help customers create within their projects an environment that maximizes the efficiency of its occupants while at the same time allow effective management of resources with minimum lifetime cost. With the benefits: 1) Capex and Opex Cost Efficiency, 2) Interaction of Systems, 3) End User and System Management Benefits, 4) Streamlined Design and Construction.

But in reality, IBS is still rarely applied in Indonesia due to several factors, such as: 1) Lack of understanding of the importance of IBS system, 2) The high cost of IBS, 3) The system is still limited in big cities, especially Jakarta, 4) The operational method and maintenance which is hard to do, 5) IBS is viewed by many stakeholders as a tool of commercial use only.

Viewed from its benefits, the IBS is very useful and provides a high value, not only the matter of cost, but also environment and technology. These problems could be solved if the stakeholders of development sector in Indonesia can collaborate to implement this system. Those mentioned could be the building owners, tenants, government, design consultants (including architects), contractors, and others.

This paper discusses about the IBS within the context of green programs in Indonesia, also discusses about the benefits, problems and challenges throughout the implementation of this system in Indonesia.

Keywords : *Intelligent Building System, Smart Building System, Benefit, Problem, Challenge, Indonesia*

INTRODUCTION

Intelligent Building System (IBS) was developed in 1980s (Wong et al, 2005). Also in this era, this term was introduced in Indonesia, only in academics and researcher community, with a limited meaning for 'utility services in building that controlled automatically'. It is not a misused definition however, as Leifer (1988) stated that IBS is a system which two or more of its services systems are automatically controlled, guided by predictions based upon a knowledge of the building and usage, maintained in an integrated data base. While Stubbing (1988) defined IBS as 'system of building which totally control its own environment'.

In 1990s, definition of IBS was involving. This time, human being was the focal point (Yasuyoshi, in Ghaffarianhoseini, et all., 2016). Similar with Stubbing had stated, Powell (1990) defined Intelligent Building as being: 'a building which totally controls its own environment'. This seems to imply that it is the technical control of heating and air conditioning, lighting, security, fire protection, telecommunication and data services, lifts and other similar building operations that is important – a control typically given to a management computer system. Such a definition for a conventionally Intelligent Building does not suggest user interaction at all. While in that era, IBS definition in Indonesia was still a direct derivation from its definition in 1980s, it was seen as solely a technological device that control building utility services. On the other hand, there was building in Indonesia that used IBS comprehensively in Indonesia.

Until early 2000s, IBS in Indonesia was still being a discourse in academic and researcher community – mostly still using its limited definition from 1980s – and its application still rare. When Green Building Council Indonesia (GBCI) was established in 2008, IBS was started to be applied because the system is making building more efficient – substantial for green building. The rising popularity of green building in Indonesia which lead to government's regulation of green building implementation, particularly in metropolitan area such as Jakarta, made IBS was developed not specifically for building utility, but also an integral part of architectural design.

The challenge in implementing IBS today is how to engage building user get used to this system and how IBS can be adjusted to local costume in Indonesia so it can be implemented thoroughly.

INTELIGENT BUILDING SYSTEM (IBS), SMART BUILDING AND GREEN BUILDING PROGRAM IN INDONESIA

1. Intelligent Building System (IBS) and 'Smart Building' Development

Since its beginning, IBS was developed progressively. In 1988, Leifer explained that IBS is defined as a tool of information communication network through which two or more of its services systems that automatically controlled, guided by predictions based upon a knowledge of the building and usage, maintained in an integrated data base. IBS was consisting of control, networks, data processing equipment, automation, telecommunication, and building management systems (BMS) (Ghaffarianhoseini, et all., 2016).

In 1995, CIBSE (quoted by Everett, 2008) defined Intelligent Building as a dynamic and responsive architecture that provides every occupant with productive, cost effective and environmentally approved conditions through continuous interaction among its four basic elements: places (fabric; structure; facilities); processes (automation; control; systems) people (services; users) and management (maintenance; performance) and the interrelation between them.

Following the advancement of communication/information technology and construction industry, IBS was getting comprehensively defined. Wong et al. (2005) show in their review of Intelligent Building research that most of the early definitions revolved around minimizing the human interaction with the building. The early definitions of Intelligent Buildings are what would be expected, since at that time architects and building engineers were progressing from what can now be seen to be automated buildings. Ghaffarianhoseini, et al. (2016) depicts the progressive evolution of IBS development in following diagram.

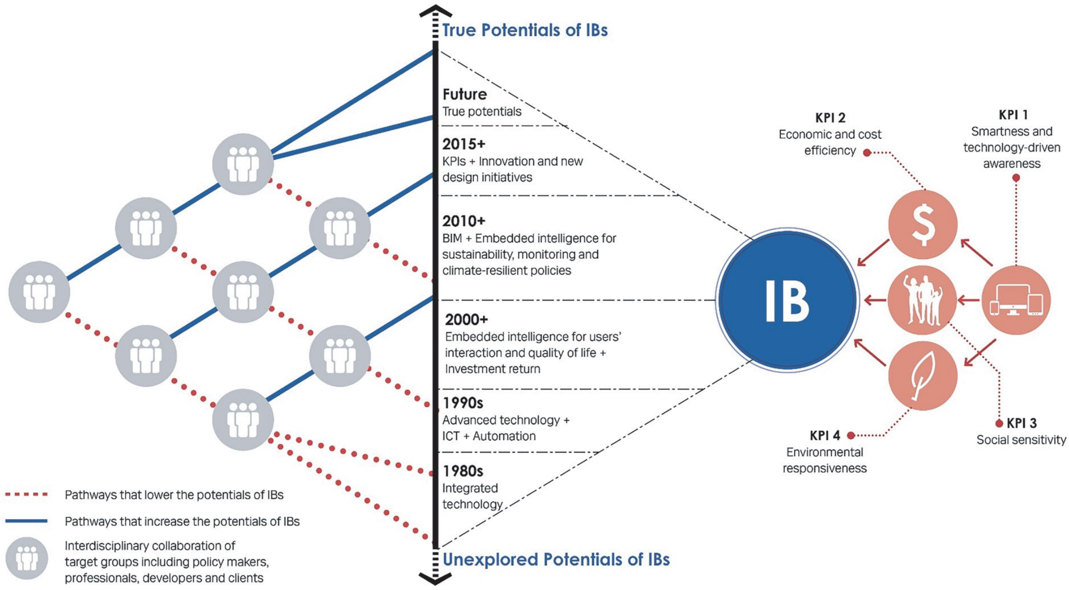

Diagram 1: Evolution of Intelligent Building System (IBS) definition.
Source: Ghaffarianhoseini, et al. (2016)

Following table summarizes the IBS definition development made by Ghaffarianhoseini, et al. (2016).

Table 1. Key features and components of IBs based on available definitions
Source: Ghaffarianhoseini, et al. (2016)

Period	Key features and components
1980s	Maximizing return on investment Information communication network and automatically controlled system Productive and cost-effective
1990s	Application of sophisticated operational systems to lifecycle cost efficiency, and ecological performance Human as the focal point Dynamic and responsive The emergence of information and communication technology (ICT) and automated systems Maximizing the technical performance, investment and operating cost savings, and flexibility Responding to the social and technological changes Maximizing the effectiveness of the building's occupants and efficient management of resources
2000–2005	Responding to user expectations and quality of life The role of user interactions and social changes Responding to the changing demands of the owner, the occupier and the environment Flexibility and adaptability
2005–2010	The efficiency aspect, the cost aspect, the environmental aspect, the health aspect and the security aspect Safer, more productive and more operationally efficient for the owners Communicating between building systems and with their owners Energy-saving features Incorporation of smart active features and passive design techniques Eco-intelligent
2010–2015	People, products, and processes User involvement in sustainable energy performance of buildings Considering the users' interactions and even the social values of users Ecologically sustainable design Embedded sensors, automation Innovation as an enabler and new products such as cloud computing, embedded sensors, and smart materials Responding to the needs and social well-being of the occupants and of society Suitability for their planned use and success at fulfilling the brief Energy-intelligent concept Satisfying occupants' need with high energy efficiency Sensory design Buildings management systems (BMS) Intelligent control strategies, including smart grids, smart metering, demand response control Adaptability of buildings to climate change Added values based on technology, function, and economy Learning capability, self-adjustability, and the relationship between occupants and environment Energy-saving strategies

2. Intelligent Building System (IBS) and Smart Building in Indonesia

Although the term 'Integrated Building System' (IBS) was entering Indonesia in 1980s, it is only implemented in 2008, still limited, in building management system (BMS) to maximize building cost effectiveness. BMS is controlling the energy usage in electricity, air conditioning, and other utility devices. Some experts stated that using this system is less profitable for building owner because BMS initial cost is overprice and technology is still considered premature in controlling building energy usage.

While the concept of IBS is getting popular in Indonesia, the term 'IBS' is not popular due to confusion with the term 'smart building' – more popular term, even though 'IBS' and 'smart building' are different in meanings. This confusion is credited to marketing and branding issue in construction and building material industry. In general, 'smart building' is an advancement of IBS so its definition is evolving because the definition of IBS is evolving as well.

The complexity of 'smart building' definition is explained by Buckman, et al. (2014) in following passage: 'smart Buildings are buildings which integrate and account for intelligence, enterprise, control, and materials and construction as an entire building system, with adaptability, not reactivity, at the core, in order to meet the drivers for building progression: energy and efficiency, longevity, and comfort and satisfaction. The increased amount of information available from this wider range of sources will allow these systems to become adaptable, and enable a Smart Building to prepare itself for context and change over all timescales. Buckman, et al. (2014) point that there are 4 features of 'smart building': 1) intelligence, 2) enterprise, 3) materials and design, 4) controls. Those aspects are developed through adaptability process.

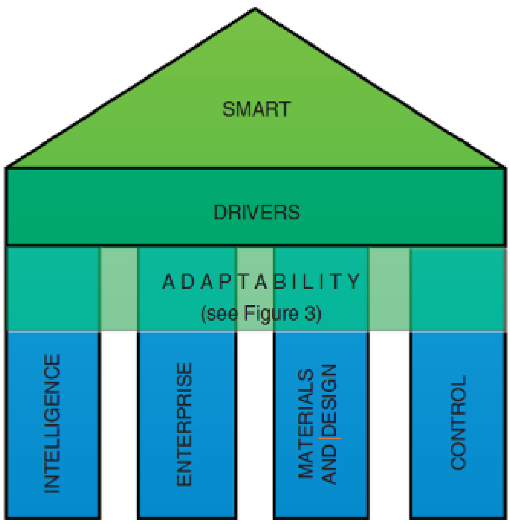

Diagram 2. Features of a Smart Building
Source: Buckman, et al. (2014)

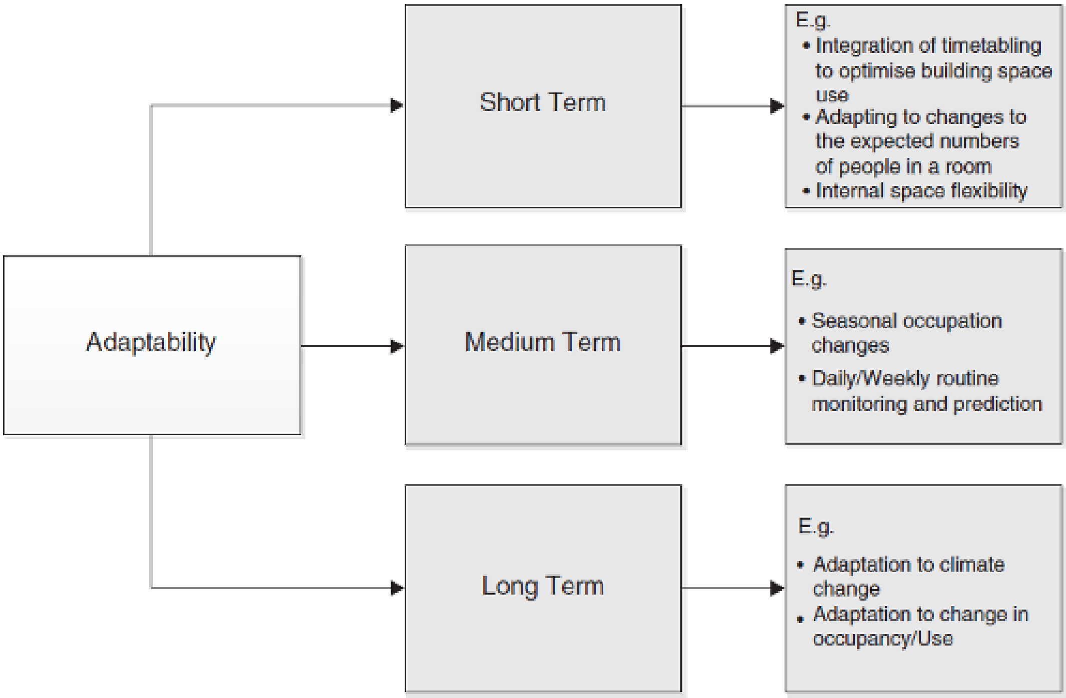

Diagram 3. Adaptability over different timescales in a Smart Building

In fact, 'smart building' that is popular in Indonesia is not the 'smart building' as defined above. What is so called as 'smart building' is building that used 1980's IBS – early definition of IBS, where most of buildings apply this system after the building had constructed and its need an integrated system to control energy usage.

Green Building Council Indonesia (GBCI) which was established in 2009 introduced 'green building' as to implement 'smart building' concept since the design phase to operational phase. The term 'green building' itself is used to meet the trend in construction/building material industry. Wang et al. (2012) argue that this development 'address both intelligence and sustainability issues by utilizing computer and intelligent technologies to achieve the optimal combinations of overall comfort level and energy consumption.

3. Comprehensive Intelligent Building System (IBS) implementation in 'Green Building' Program.

The 'green building' term introduced by GBCI is an attempt to bridge the gap between outdated definition of IBS in Indonesia with current definition of IBS. In 2010, GBCI also introduce the point system of 'green building' that include some aspects of IBS. This integration is not something new as Sinpoli (2010) shows in following diagram.

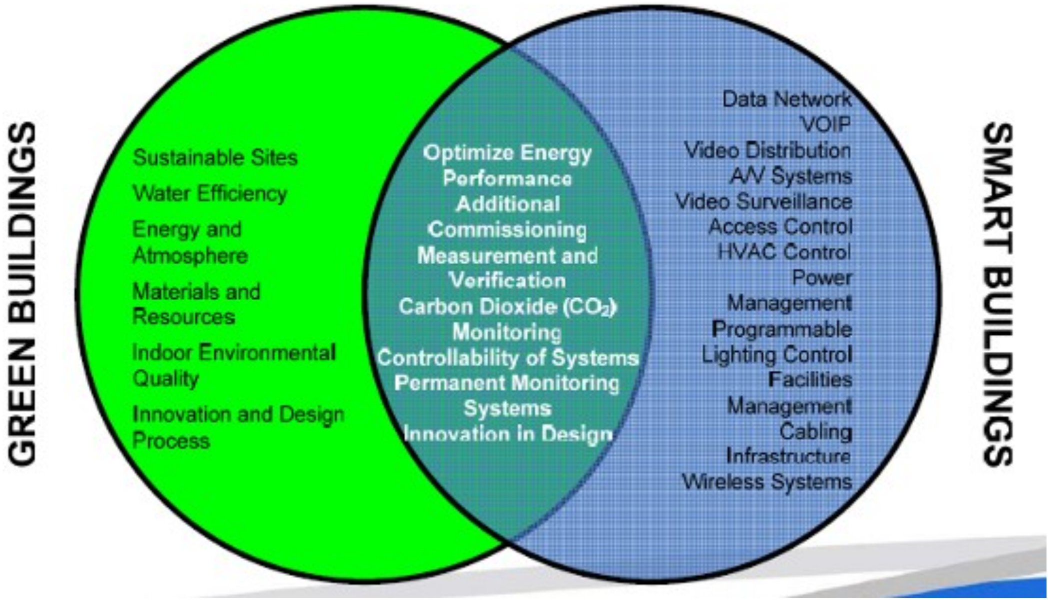

Diagram 4. Communality of Smart and Green Building
Source: Sinpoli (2010)

The 'green building' point system table that developed by GBCI below shows some point that related to Integrated Building System aspects.

SUMMARY OF GREENSHIP CRITERIA Version 1.1			DR	CA
Code	Criteria		Max Points	Max Points
Appropriate Site Development			22%	17%
ASD P	Basic Green Area	A		
ASD 1	Site Selection	A	2	2
ASD 2	Community Accessibility	A	2	2
ASD 3	Public Transportation	A	2	2
ASD 4	Bicycle	A	2	2
ASD 5	Site Landscaping	A	3	3
ASD 6	Micro Climate	A	3	3
ASD 7	Storm Water Management	A	3	3
			17	17
Energy Efficiency and Conservation			34%	26%
EEC P1	Electrical Sub Metering	A		
EEC P2	OTTV Calculation	A		
EEC 1	Energy Efficiency Measure	A	20	20
EEC 2	Natural Lighting	A	4	4
EEC 3	Ventilation	A	1	1
EEC 4	Climate Change Impact	A	1	1
EEC 5	On Site Renewable Energy (Bonus)	A	5B	5B
			26	26

Table 2. *Greenship Criteria of GBCI version 1.1*
Source: GBCI (2012)

Water Conservation			27%	21%
WAC P1	Water Metering	A		
WAC P2	Water Calculation	A		
WAC 1	Water Use Reduction	A	8	8
WAC 2	Water Fixtures	A	3	3
WAC 3	Water Recycling	A	3	3
WAC 4	Alternative Water Resource	A	2	2
WAC 5	Rainwater Harvesting	A	3	3
WAC 6	Water Efficiency Landscaping	A	2	2
			21	**21**
Material Resource and Cycle			3%	14%
MRC P	Fundamental Refrigerant	A		
MRC 1	Building and Material Reuse	NA		2
MRC 2	Environmentally Friendly Material	NA		3
MRC 3	Non ODS Usage	A	2	2
MRC 4	Certified Wood	NA		2
MRC 5	Prefab Material	NA		3
MRC 6	Regional Material	NA		2
			2	**14**
Indoor Health and Comfort			6%	10%
IHC P	Outdoor Air Introduction	A		
IHC 1	CO_2 Monitoring	A	1	1
IHC 2	Environmental Tobacco Smoke Control	A	2	2
IHC 3	Chemical Pollutants	NA		3
IHC 4	Outside View	A	1	1
IHC 5	Visual Comfort	NA		1
IHC 6	Thermal Comfort	A	1	1
IHC 7	Acoustic Level	NA		1
			5	**10**
Building Environmental Management			8%	13%
BEM P	Basic Waste Management	A		
BEM 1	GP as a Member of The Project Team	A	1	1
BEM 2	Pollution of Construction Activity	NA		2
BEM 3	Advanced Waste Management	A	2	2
BEM 4	Proper Commissioning	A	3	3
BEM 5	Submission Green Building Data	NA		2
BEM 6	Fit Out Agreement	NA		1
BEM 7	Occupant Survey	NA		2
			6	**13**
Total Criteria Point			**77**	**101**

IMPLEMENTATION OF INTELLIGENT BUILDING SYSTEM (IBS) IN INDONESIA

1. Grand Indonesia

The original building of this mix-use commercial complex is originally built in 1960s. Later years, it is altered and new parts of building added. IBS is implemented to make energy usage more efficient and to enhance its security.

The operator of the complex PT Grand Indonesia, has provide the total design, supply, delivery and installation of an intelligent management solution, including control systems and IT infrastructure for Grand Indonesia's first phase of re-development and deploy its Unizon IBFMS (Integrated Building Facility Management System) to form the core operating platform for the complex's intelligent management solution. The IBFMS will provide building management staff with the tools necessary for effective monitoring and control of all the facilities within Grand Indonesia. Unizon can communicate with up to 32 network subsystems such as Security Control System, Building Automation System, Lighting Control System, Fire Alarm System, Digital Communication System etc., and at the same time, able to support multitasking real-time performance.

Image 1. *View of Grand Indonesia Complex*

The integration of various environmental, safety and security-related devices from multiple buildings enables the building operator to optimize the use of energy, thus significantly reduces operational costs and improve tenant service.

2. The Plaza BII Building

When this building is designed and constructed in 2000s, some of IBS aspects have been implemented, limited to optimize the building operation cost efficiency. When the construction is finished, IBS is also implemented to enhance the comfort for building user. The energy saving system in electricity and air conditioning is corresponding with building user safety and comfort. This building also upgrading the building automation system by installing outside temperature sensors. The system can adjust the chilled water supply of air handling unit based on the outdoor temperature.

Image 2. *View of BII Plaza Building at Jl. M.H. Thamrin*

3. New Office of Ministry of Public Work

It is built in 2011 with integrative implementation of 'green building' and IBS concept. Since its design phase, 'green building' aspects is considered by the architect. Later, it is awarded the 'platinum' grade of green building by GBCI.

Image 3. *New Office of Ministry of Public Work at PU Complex, Jakarta*

DIFFICULTIES IN IMPLEMENTING INTEGRATED BUILDING SYSTEM (IBS) IN INDONESIA

In Indonesia, IBS is still considered as a tool, not an integrative planning process – since design phase to construction phase. In fact, IBS will be performing optimally if it is considered since design phase. Some differences regarding how IBS implemented is often found in the discussion between stakeholders (building owner, architect, contractor, and regulator) due to 1) Lack of understanding of the importance of IBS system, 2) The high cost of IBS, 3) The system is still limited in big cities, especially Jakarta, 4) The operational method and maintenance which is hard to do, and 5) IBS is viewed by many stakeholders as a tool of commercial use only. This differences lead to some opinions that disregard the concept of IBS. They mainly misinterpret IBS as 'a branding tool' for property developer, building owner, or building material industry. In fact, IBS concept is important in shaping sustainable environment through energy efficiency and occupant's satisfaction.

Himanen (2003) argues that the concept of IBS only can implemented if *human intelligence*, in this case building owner, architect, developer, and regulator, has the same understanding of IBS concept.

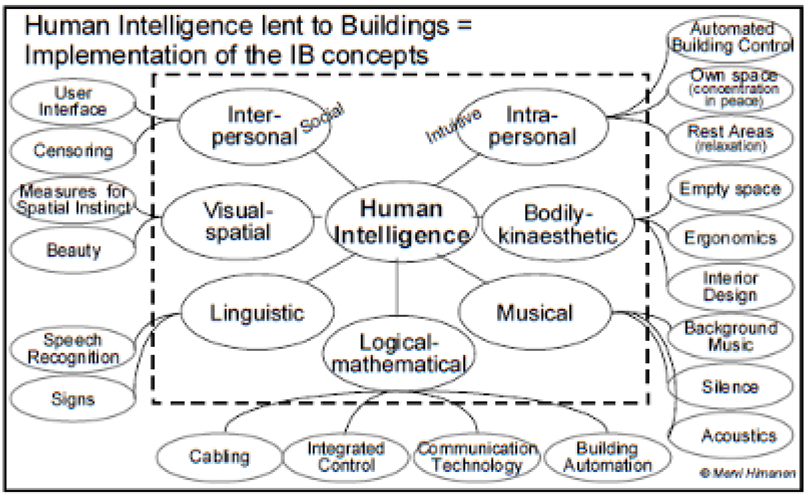

Diagram 5. Implementation of the intelligent building features and their connection to human intelligence
Source: Himanen (2003)

It is vital to have a common ground in defining IBS. Through integrative 'green building' and IBS program, promotion of IBS on various level of stakeholder, and more public discussion on IBS as well as 'green building' can achieve the common understanding of IBS concept. It is worth to note that to promote IBS in Indonesia effectively, the devices of IBS should also adjusted to local costum and average financial capabilities of user.

CHALLENGES IN IMPLEMENTING INTEGRATED BUILDING SYSTEM (IBS) IN INDONESIA

Unlike its neighboring country, Malaysia and Singapore, Indonesia is slow in developing Integrated Building System (IBS). Comprehensive study on suitable smart system that corresponding to social and environmental aspect in Indonesia should be conducted in order to acquire the optimal IBS implementation in Indonesia. This challenge is derived from Clements-Croome (quoted by Ghaffarianhoseini, et al. (2016)) argument about key constituents in making 'smart building' as shown in following diagram.

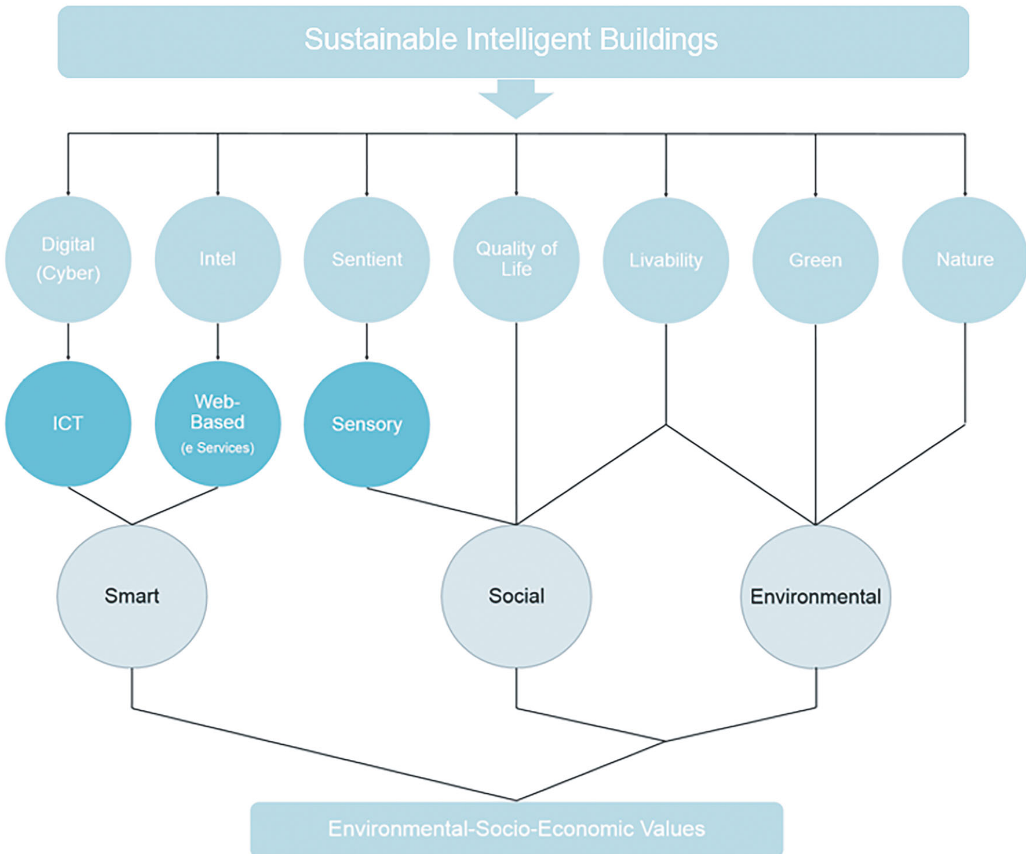

Diagram 5. *Key constituents of IBS*
Source: Clements-Croome 2013, quated by Ghaffarianhoseini, et al. (2016)

This diagram shows that devices of IBS should meet the environmental-socio-economic values in Indonesia. Devices of IBS should be adjusted to Indonesian building user specific needs. For example, Building Information Modelling (BIM) as a tool of IBS design should be more Indonesian user-friendly.

CONCLUSION

Integrated Building System (IBS) is important to be implemented in Indonesia. Mainly because it can increase the energi efficiency and environmental sustainability, increase user comfort (thus its productivity), improve safety and building reliability, improve operational effectiveness, enhance cost effectiveness, etc.

However, this system should meet the environmental-socio-economic values of Indonesia. It cannot just be implemented as an imported product without adjustment to local condition.

In case of Indonesia, common ground in understanding of IBS concept between stakeholder is urgently needed, because IBS and 'smart building' can only be developed by 'human intelligence' who understand it comprehensively.

REFERENCES

Ghaffarianhoseini, Amirhosein; Umberto Berardi, Husam AlWaer, Seongju Chang, Edward Halawa, Ali Ghaffarianhoseini & Derek Clements-Croome (2016), "What is an intelligent building? Analysis of recent interpretations from an international perspective", Architectural Science Review, 59:5, 338-357, DOI: 10.1080/00038628.2015.1079164

Buckman, A.H.; M. Mayfield; Stephen B.M. Beck , (2014),"What is a Smart Building?", Smart and Sustainable Built Environment, Vol. 3 Iss 2 pp. 92 – 109

Wang, Z., Wang, L., Dounis, A.I. and Yang, R. (2012), "Integration of plug-in hybrid electric vehicles into energy and comfort management for smart building", Energy and Buildings, Vol. 47, pp. 260-266.

Leifer, D. (1988), "Intelligent Buildings: A Definition", Architecture Australia 77: 200–202.

Sinopoli, James (2010), Smart Building System, Oxford: Elsevier Inc.

Wong, J.K.W., Li, H. and Wang, S.W. (2005), "Intelligent building research: a review", Automation in Construction, Vol. 14 No. 1, pp. 143-159.

Powell, J.A. (1990), "Intelligent design teams design intelligent buildings", Habitat International, Vol. 14 Nos 2/3, pp. 83 -94.

Everett, R. (2008), "The 'building colleges for the future' program. Delivering a green and intelligent building agenda", New Review of Information Networking, Vol. 14 No. 1, pp. 3-20.