CHAPTER 1.

THE DEFINITION OF INTELLIGENT BUILDING

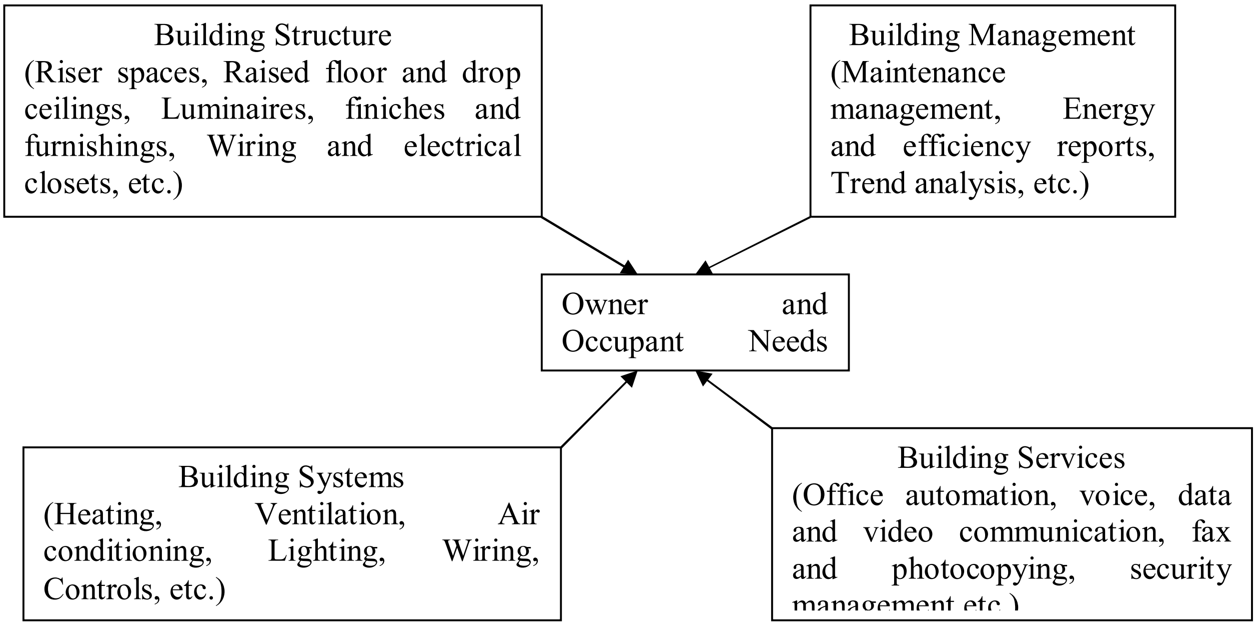
1.1. INTRODUCTION

Intelligent Buildings (IBs) were advocated by UTBS Corporation (United Technology Building Systems Corporation) in the USA in 1981, and became a reality in July, 1983 with the inauguration of the City Place Building in Hartford, Connecticut, USA. The UTBS Corporation was responsible for controlling and operating such shared equipment as air-conditioning equipment, elevators and disaster prevention devices. The company further provided each tenant with communication and shared tenant services, such as office automation services, using local area networks (LANs), digital private automatic branch exchanges (PABXs) and computers. The Hartford Building was advertised as the world's first intelligent building. What do we mean by intelligence? One view is that intelligence is considered to be an innate, general cognitive ability underlying all processes of conventional reasoning.

Up to now, there has not been a universally accepted definition for IBs. However, it appears that most designers agree with the statement that "IBs are not intelligent but they can make the occupants more intelligent". Actually, most existing definitions of IBs around the world are trying to ensure a building is suitable for the occupants to work and live in safely, comfortably, effectively and efficiently. It is time Asia, in particular China with a population of over 1,2 billion, adopted her own definition of IBs. Without a correct definition, new building will not be optimally designed to meet the next century.

1.2. THE DEFINITION OF IB IN USA

In accordance with the Intelligent Building Institute (IBI) of USA, an IB is one which provides a provides a productive and cost-effective environment through optimization of its four basic elements, i.e. structure, systems, services and management and the interrelationships between them.



FIGURE

IBs help building owners, property managers, and occupants realize their goals in the areas of cost, comfort, convenience, safety, long-term flexibility and marketability. There is no intelligence threshold past which a building "passes" or "fails". Optimal building intelligence is the matching of solutions to occupant needs. Furthermore, the IBI stated that "there is no fixed set of characteristics that defines an IB". In fact, the only characteristic which all IBs have in common is a structure designed to accommodate changes in a convenient, cost-effective manner. IBI tried to put the emphasis on the availability of technologies.

1.3. THE DEFINITION OF IB IN EUROPE

The UK based European Intelligent Building Group defined an IB as one that "creates an environment which maximizes the effectiveness of the building occupants while at the same time enabling efficient management of resources with minimum life-time costs of hardware and facilities". Based on this definition, building providers and developers need to understand precisely what sort of buildings they should develop that will be both profitable and able to meet the users' increasingly complex requirements. Information technology (IT) suppliers need to understand the relationship between the building, its occupiers and the computer systems they install. Building owners and occupiers need to understand what it means to occupy an IB. What economic gains can they expect and how will it change the way their business operates? The relationship between the three groups of people, i.e. building providers and developers, IT building providers do not provide the right sort of building, it will be extremely difficult to install sophisticated computer systems. If users and owners do not understand the benefits of occupying an IB, they will be unwilling to pay the developer a premium for "intelligent space". In 1991/92, DEGW International Ltd., in partnership with Teknibank, carried out a large multi-client research project on IBs in Europe with an aim to closely examine current practice and develop an alternative European model of IB, based more closely on user requirements and changing work patterns. Hence, it can be seen that the definition of IBs in Europe is more on the users' requirements than the technologies.

1.4. THE DEFINITION OF IB IN ASIA

1.4.1. The definition in Singapore

The Public Works Department of Singapore government stated that an IB must fulfil 3 conditions:

i) the building should have advanced automatic control systems to monitor various facilities, including air-conditioning, temperature, lighting, security, fire etc. to provide a comfortable working environment for the tenants

ii) the building should have good networking infrastructure to enable data flow between floors

iii) the building should provide adequate telecommunication facilities

1.4.2. The definition in China

In Shanghai, the developers will label an IB as “3A” or “5A”. “3A” means the building contains three automatic functions: communication automation (CA), office automation (OA) building management automation (BA). Some IBs will divide the fire alarm function from BA, such that it becomes an independent fire automation system (FA) while some IB will have comprehensive maintenance automation systems (MA) to integrate the various automation systems within the building. These 2As, adding on to the previous 3As, become “5A”. It can be revealed that the emphasis of both Singapore’s and China’s definitions have been placed on control and communications using advanced technologies.

1.4.3. The definition in Japan

According to Fujie, IBs in Japan have been developed in a different social and office environment from those in the USA. Privatization of Nippon Telegraph and Telephone (NTT) has not led to the complexity of AT&T in the USA. Large differences are also found in the development of OA and land prices in Japan. Japanese IBs must be designed to suit Japan’s cultural climate. The Japanese of IBs have been on four aspects:

i) serving as a locus for receiving and transmitting information and supporting management efficiency

ii) ensuring satisfaction and convenience for the people working in them

iii) the rationalization of building administration to provide more attentive administrative services with lower cost

iv) fast, flexible and economical responses to changing sociological environments, diverse and complicated office work and active business strategies

Regarding cultural considerations, IBs must maintain an effective working environment, run automatically, and be flexible enough to adapt to future changes in the needs of the working environment. Those needs include:

i) a precise air-conditioning system that adapts to a variety of working environments

ii) an antiglare lighting system

iii) an area for refreshments

iv) an atrium

v) a digital electronic exchange

vi) an optical fibre LAN system

vii) a self-contained intelligent system

viii) a central monitoring system

ix) an entry-exit control system
x) an automatic measuring and billing system
xi) high-volume wiring system using cellular ducts and raised floor
xii) high-load zone from 500 kg/m^2 to 1000 kg/m^2
xiii) adaptability to parabolic antennas

It can be revealed from the above discussions that the Japanese has placed more emphasis on the occupant themselves. In particular, the consideration on entertainment for the occupants has not been included in any definitions in the western countries.

1.5. THE DEFINITION OF IB FOR ASIA

It is believed that the Japanese mode of definition on IBs is more suitable for formalizing a universal definition for IBs, mainly for Asia but extensible to the whole world. We have proposed a two-level strategy to define an IB. There are eight "quality environment modules", including:

i) environmental friendly-health and energy conservation (M1)
ii) space utilization and flexibility (M2)
iii) life cycle costing-operation and maintenance (M3)
iv) human comfort (M4)
v) working efficiency (M5)
vi) safety-fire, earthquake, disaster and structure etc. (M6)
vii) culture (M7)
viii) image of high technology (M8)

The eight modules, totally, form the first level of the definition. In the second level, we have got a number of facilities or key elements, some of them being listed in Figure while more can be added from time to time. Each of the eight key modules will be assigned a number of facilities in appropriate priority order. With the two levels in hand, a new definition of IB can be formulated.

An IB is designed and constructed on an appropriate selection of quality environment modules to meet the user's requirements by mapping to the appropriate building facilities to achieve a long-termed building value.

This new definition will include two dimensions, i.e. the needs of the building developers/owners/occupants (deliverable items) and the enabling technologies (systems and services). The integration of these two dimensions will generate the values of the building, i.e. productivity, market values etc., that can be measurable. In this way, each type of building will have a set of more or less different design criteria in order to become an IB. The different types of buildings, in mind, can be residential, industrial, commercial (office or retail), transportation terminals, educational, public services (libraries or community centers) and that for religious purposes etc. We can then assign different modules in priorities to each type of building. For example, a hospital can have the following modules in order: M1, M6, M4, M5, M3, M7, M2, M8. In this way, different types of building will have different combinations of modules in different priorities. Once a module has been selected, a group of pre-selected facilities will be assigned accordingly. Whether the designer will include all the facilities in his/her design depends on two factors, the first being the priority of the module under that type of building while the second being the availability of funding.

The pre-selected facilities include all possible technologies and features, such as heating, ventilation and air-conditioning (HVAC), PABX, vertical transportation, indoor touring guidance, office automation, in-house LAN, satellite conferencing, entertainment facilities etc. Each module will be assigned a group of these facilities. Whenever the module is called for at the design stage, the corresponding group of facilities will follow naturally. In this way, a systematic approach of designing IBs can be adopted. This definition, although developed in Asia, may be extensible to all cities in the whole world.

1.6. COST ANALYSIS OF IB

After the definition of IB has been made, the next important step is evaluating the financial viability of it. A systematic method of assessment has been laid down. The values of buildings depend on their life cycle costs and benefits. Different designs will, of course, imply different benefits and costs. When we compare a conventional building to an IB, built on the same site, we should expect different income streams, as well as expenditures. Discounting these expected costs and benefits gives two figures of net present values (NPVs). The IB approach is financially viable, if and only if, it gives a higher NPV than the conventional approach. After the definition of IB has been made, we are able to assess the difference in benefits and costs. On the benefits side, we have higher rent receivable by IBs. Initial construction costs may be higher but the recurrent costs may be lowered and IBs possibly last longer. Cost data, capital and recurrent, for both conventional and intelligent buildings, can be retrieved from the data bases of different countries but the method is universal.