Developing of intelligent building as an aspect of facility management in the Malaysian context

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ABSTRACT: Technology advancement has had its effect on the construction industry. More and more buildings incorporate automated integrated services systems, which contribute to what is termed "intelligent buildings". There is no formal definition for intelligent buildings but the increasing number of buildings in Malaysia, categorized as 'intelligent' instigated this research, which aims to highlight the problems associated with the management of the intelligent building. This initial research study seeks to: a) Identify 'intelligent features' of a building and how these match the needs of users; b) Identify the basic concept of facility management and how appropriate it is for the management of intelligent buildings. The paper is focused on the role of Facility Management in controlling and monitoring modern buildings provided with automated systems. Two case studies of major new buildings, recognized within the intelligent building category, are examined for analysis of their management and organizational structure. The findings have revealed that the concept of facility management is not generally understood and where the scope of work of facility management is covered the title is not adopted.

Conference theme: Building technology
Keywords: intelligent building, facility management, Malaysia

INTRODUCTION

The Intelligent Building (IB) concept is on the increase and IB undoubtedly is the forward approach to new office buildings. The IB approach consists of automated integrated systems for various facilities and services, which are carefully planned, managed and maintained to ensure cost-efficient and effective operations in support of the organizations core functions. (Albus K., 2000).

According to Yeang K. (1998), the reason for the adoption of the integrated systems is none-other than to ensure that energy can be thoroughly conserved, thus minimizing the cost of the building. In order to achieve the aim of the development and adoption of the systems, appropriate management planning and organization are necessary, specifically to manage all the facilities and services that are classified as 'intelligent systems'.

As the business of space depends on the facilities and services installed to support the building’ function, systematic management is required for the management of facilities. (McGregor W., 1999). Systematic management of facilities is seen as the best approach for administering and managing an intelligent building. The facilities and services provided in an intelligent building are based on the intelligent concept in which integrated and high-tech systems are being used to achieve total control of the facilities.

The facilities provided for an intelligent building may be similar to those in a normal building, but the mechanical and electrical facilities in the former are being integrated and controlled through a computerized technology system. The system may be managed from one station. However, if a breakdown occurs, the building would be completely dysfunctional. Managers should therefore have a thorough understanding of the system and its operation.

The combination of a sound understanding of the concept of facility management and of the complexity of technology systems is likely to produce good systematic management of the building. All criteria need to be clearly identified and defined for the automated integrated system to ensure that efficient and effective management is achieved in an IB.

Most important of all is not to lose sight of the fact that the buildings and facilities are for the use of human beings, owners, occupiers, and operators. Management should be well adapted or designed to cater for the needs of people and be responsible for, and responsive to, their comfort, requests for service and quality of service.

1. DEFINITIONS

1.1. Intelligent building

According to research by Jepson (www.fmlinks.com), intelligent buildings can be defined as:

• A building that has features that enable and enhance the occupant’s business.
• The enhancement may be in the form of financial, operational and strategic functions.
• Providing optimum scale of comfort within the working environment, with the flexibility to cater for changes in technical business operations over the period of occupation.

The intelligent building concept started to occur in the early 1980s. According to Coogan, (2001), issues on ‘Intelligent Buildings’ first appeared in publications concerned with mechanical and automation systems that made buildings more energy-efficient. Journal articles serving the telecommunications industry reported how advanced telecommunications systems increased efficiency in buildings and thus made them more ‘intelligent’ and easily marketed.
| Table 1: The development of intelligent building definitions (Low 1995) |
|-----------------------------|-------------------|
| **Features** | **Basic Concepts** |
| Traditional view 1981–1985 | Building management, office automation, communication | An IB is a collection of innovative technologies |
| Enlightened view 1986–1991 | Building management, office automation, communication, responsive to change | An IB is a collection of technologies able to respond to organisation change over time |
| Advanced view 1992 | Building management, space management, business management | An IB provides a responsive, effective and supportive environment within which the organisation can achieve its business objectives. The IB technologies are the tools that help this happen. An economic benefit is sought. |

1.2. Facility management

The International Facilities Management Association (IFMA) gives the following definition: 
*The practice of coordinating the people and the work of an organization into the physical workplace.*

A more explicit definition, (adapted from Barrett, 1995) is: 
*An integrated approach to operating, maintaining, improving and adapting the buildings and infrastructure of an organization in order to create an environment that supports the primary objectives of the organization.*

The functions of facility management are wide and include the management of real estate, of finance, of change, and of human resources, in addition to services maintenance, domestic services, utilities supplies, security, safety and health and contract management - all of the non-core activities of the organization. Hammer J.M. (1998) has included the following functions: inventory management, programming, master and layout planning, project administration and implementation, purchasing co-ordination, maintenance planning, site management, overall systems coordination. It is a multi-disciplinary function that involves many professionals in the decision-making processes, but as yet in Malaysia few are designated ‘facility managers’.

2. FACILITY MANAGEMENT CONCEPT IN THE MANAGEMENT OF AN INTELLIGENT BUILDING

The management of buildings should change to meet changes in business and technology. The introduction of information technology has changed the way buildings and facilities are designed and controlled and therefore these changes influence the way buildings are managed. Also the occurrence of knowledge workers and professional staff who expect high quality workstations and other facilities to enable efficient tele-working or virtual meetings, do challenge the performance needs of buildings, e.g. multi-cabling, trunking, integrated workstations, obsolescence, relatively dust free environments, etc.

These needs together with the growing emphasis on more effective energy control and more efficient management of facilities are a few of the main reasons for the increase of Intelligent Buildings and for the growing use of the concept of Facility Management Facility Management is concerned with fulfilling the corporate strategies of the organization through the management of the support facilities required in order for the organization to attain its goals in relation to user’s needs.

The facility management team must ensure successful integration of people, buildings and technologies in order to meet the total performance requirements of IB. The facilities provided must be coordinated to fulfil customers’ needs and ideally set up a single source to which those needs can be addressed. Generally the integration would involve both organizational change and physical change.

3. BENEFITS OF FACILITY MANAGEMENT

Implementing a comprehensive facility management program should not only improve equipment and space utilization efficiency, but more important, should minimize the operational costs. Facility costs include initial development cost, operation costs, maintenance costs, moving costs, costs of furnishings and equipment costs. (Hamer, J.M.; 1998) has noted that all building capital costs are trivial in comparison to building operating costs such as wages and maintenance over time. This fact provides even more justification for reducing operating costs via a facilities management program, by so doing the facilities manager should be able to accomplish the following goals:

- Develop more meaningful and accurate forecasts of future space requirements, reducing expenditure of resources.
- The overall work environment improves, and a more functional, flexible, and cost-effective facility is made possible.
- Interior planning, design projects and design components become standardized.
- Space utilization efficiency improves etc.
- Electrical, communication and similar services are distributed more effectively etc.

Also facilities management has major commitment to achieve a balance in facilities strategies with corporate goals in relation to the needs of the user.

4. PROBLEMS IN THE MANAGEMENT OF AN INTELLIGENT BUILDING

Earlier definition showed that the concept of intelligent building is continuously evolving. Therefore, the opportunity to implement new method and the incorporation of intelligent building technique into premises presents facilities managers with a series of performance challenges. Designers of buildings and of working environments must also anticipate the trends that will affect buildings during their expected life.

Many previous researches have claimed that intelligent building based on technical systems could not succeed because of technical deficiencies in the systems. In addition, IBs did not provide in their buildings what the organization and people need.

There was also an in-built assumption about what building users and organizations required from the building environment and other facilities such that these requirements were not provided by the automated systems, for example, organizations were required to change their operation to allow the use of computer systems rather than the computer systems being brought into support the operation. The present intelligent building approach basically represents a technologically centred idea, not a human-centred one. The following problems have been noted repeatedly in IB:

i. Sensors not calibrated
ii. Line connections between sensors and central management not functioning
iii. Central computer systems not installed or not
operated as intended (lack of training).
iv. Local controls not adjusted for the occupancy
v. Local sensors not corresponding with local controls
due to frequent spatial or layout changes
These problems become worse with current centrally
managed environmental control systems that are unable
to cope with the major changes in building functions,
rapid changes in activities or rapid changes in exterior
environmental conditions.
The goals of intelligent buildings must provide comfort to
the occupants and building users in terms of weather,
lighting, noise, safety and flexibility in carrying out tasks.
In order to attain effective building performance for
building intelligence, it is necessary to know the effects of
all these interacting factors. Adequate maintenance and
management practices are therefore critical to ensure
human needs are met and people are protected from all
discomforts.

5. CASE STUDIES

5.1 Case Study 1, Petronas Twin Tower (PTT)

Located at the junction of Jalan Ampang and Jalan
Pinang, the building is the landmark of Kuala Lumpur.
Completed in year 1997, the building was designed by a
foreign architect, Cesar Pelli and features one of the best
intelligent building systems in Kuala Lumpur, although
the systems were designed 10 years ahead.

5.1.1. Facility management concept
The Facility Management of PTT works on the basic
concept on providing quality facilities and services for the
occupants of PTT premises. The quality value that to be
achieved is mainly emphasised by the integrated
intelligent building system. In this case, the management
organization placed concern on satisfying the occupants
through reliable and flexible management on all aspects
under the scope of the Building Control System (BCS).
Thus, enhancement on the relation of occupants and
process, valuation and contract procedures are taken
seriously into consideration. This is achieved throughout
the establishment of the management policies as
guidelines for carrying out the monitoring and control
system of the facilities offered for the tenants. Basically,
the functions of facilities management cover the scope of
building operations and functions and facility planning.
As explained, the planning of the intelligent building system
had been designed some 10 years ago. Given such long-
period, BCS management is now at the stage of
implementing and executing long-term planning and life-
cycle costing to meet the changing trends of the IT, also for
demands and requirements of the occupants and for
developing the scope, functions and structure of the existing
organization that is responsible for the running of the
intelligent system.
Due to security-control needs, the Security System
Control Room cannot be entered by anyone except by
those who are directly employed by the building owner,
which is PETRONAS.

5.1.2. Intelligent system
Intelligent systems for the PTT is defined as the various
types of integrated services that are considered as the
communal services that are provided using modern
computer networking technology. The systems are
planned to be interfaced to attain both the safety and
functional operational requirements of the development.
The four special systems installed as intelligent features of
PTT comprises of the following systems:
• Building Control Systems (BCS)
• Fire Alarm Systems (FAS)
• Building Security Systems (BSS)
• Building Telecommunications Facilities

The Building Control System (BCS) for the PTT building
project is designed as a state-of-the-art system with BCS
Operator Workstations located in Building Operations
Rooms (BOR) throughout the development. The BCS is
a Direct Digital Control (DDC) system having a fully
distributed processing capability such that control
functions are totally independent of the Operator
Workstations. The reason for adapting an independent
system is to ensure that any lack of supervision in the
workstations would not affect the efficiency of the
integrated system’s operations. Figure 1, shows the
types of services monitored from BCS. All 3 types of
building systems are controlled and monitored by KLCC
Urusharta through the use of BCS except for the
Building Security Systems, which are managed by
PETRONAS due to confidentiality and security
measures.

![Building Control System](image)

**Figure 1: Types of services controlled by Building Control System.**

All intelligent systems provided operate during working-
hours only, which is from 9 a.m until 5 p.m. except for the
security system. Demands on service systems after
working-hours can be demanded and requested from the
Tenant Service Department.

5.1.3. Facilities Management Organisation
The integrated system is administered and managed by
2 departments. The head of the property department,
which is known as KLCC Urusharta, is led by a Senior
Manager with help of the Building Managers, employed
separately to manage the 2 towers. Each Building
Manager has his own team that comes with various
scopes of work. Each tower, comprises sub-departments
or sections which are as follows:
• Housekeeping
• Civil and structural
• Mechanical and electrical
• Security
• Maintenance
• Building System

Figure 2, depicts the organization structure of KLCC
Urusharta, showing the sub-departments and scope of
works that are under the responsibility of the department.
Intelligent features of the building are directly monitored from the workstations and this control room is under the management of the Building System Manager. The Building System Department comprises 5 sections and each carries out different tasks and responsibilities, the main role is to monitor, to control and to manage the intelligent systems provided for the building occupants. The scope of work for this department is divided into 5 sections, as follows:

- Tenant services department
- Filing department
- Safety department
- Building control system
- Cabling

The main responsibility of the Building Control System Department is to carry out the management, administration and the operational tasks. Breakdowns that occur on any system will be recorded and the documents will then be sent to the Maintenance Department. The role of the Maintenance Department is to provide services as the means of managing contractual matters in which maintenance works are all outsourced to external contractors. Other responsibilities of this department are to supervise and to record the maintenance works done by the external contractors. Tenant Services Department handles tenants’ requests, billing for services used by the tenants, property and asset management as well as other promotional activities. The Filing Department manages all documents related to the systems used and the billing of the tenants. Safety Department monitors, plans and executes policies, audit and emergency responses. The Building Control System monitors and controls all troubleshooting as well as keeping track record on the maintenance works and the status of the integrated systems while Cabling Department executes analysis and research on the cabling and networking of the integrated system.

5.2. Case Study 2, Central Plaza

Completed in 1996, Central Plaza was one of the first intelligent buildings to be built in Malaysia. Located in Jalan Sultan Ismail, Kuala Lumpur, Central Plaza is owned by Malview Sdn. Bhd. This prestigious office building was designed by one of the renowned architect, Ken Yeang, an intelligent building system was installed to cater to the customers’ needs and demands. The ‘high-technology’ intelligent system adopted meets the ‘hi-tech’ look of the building. Central Plaza is one of the earliest buildings in Kuala Lumpur that features developed intelligent building systems.

5.2.1. Facilities management concept

The main concern of the facility management in the past was to provide a sophisticated Integrated Building Management System, endowed with tenant-friendly features. The management of facilities is directed towards satisfying occupants’ needs while at the same time minimizing the operational costs of the building by adopting an environmental considered design and features. Based on this concept, the management offers reliable and flexible services with the support of a Building Control System as the means of automation for all integrated systems that are equipped to complete the building functions. Basically, the functions of the facility management cover the scope of building operations, functions and facility planning.

5.2.2. Intelligent systems

The buildings are equipped with intelligent features that are dubbed as ‘tenant-friendly features’. The intelligent features comprise of facilities and services purposely installed to accommodate the needs of tenants, which are as follows:

- Air-conditioning system with variable air volume and automatic temperature control
- Fire fighting system with remote linkage to Fire Station
- Latest security system with CCTV, access card, panic buttons and door sensors
- Standard cleaner office environment complete with filter system and carbon dioxide monitoring system
- High speed lifts
- Computer riser ducting

The Integrated Building Management System comprises of Integrated Building Automation System (BAS) and Security System which function as the medium of controlling and monitoring the building services. BAS controls and monitors the air-conditioning, ventilation and public electrical systems while the Security System consists of CCTV, door sensors and duress switches. Dual Tone Multiple Frequency (DTMF) cabling system is installed to provide remote linkage that benefits both the occupants and the management. Figure 3, depicts the types of intelligent systems provided in Central Plaza.

The integrated systems operate during working-hours only which are from 9 a.m. until 5 p.m. except for the security system. Remote telephone dial-up command is
installed at each floor level as an intermediate communication for the occupants and the management.

5.2.3 FACILITIES MANAGEMENT ORGANISATION
The Property Management Department of Central Plaza administers the management of the integrated system. The head of the property department is the Building Manager. The team is comprised of the assistant building managers, building supervisors, technicians and automation system’s operators. An in-house management of the building has been established. Facilities management is a part of the scope of works of the Property Department of Central Plaza. Basically, the scope of work is under the responsibility of the following departments:
• Property Management
• Building Operation and Services Management
• Maintenance
• Security Management.

The intelligent features of the building are directly monitored from BCS. Complete with workstations, this BCS, which is known as IBMS, monitors and controls the following features: Security System and Integrated Building Automation System. The scope of work for this department as explained above is divided into 5 sections, as follows:
• Tenant & Billing Services
• Filing and Documentation
• Security System
• Integrated Building Automation System

The main responsibility of the IBMS is to provide and integrate the facilities management of the services installed in the building. Breakdowns that occur in the integrated system will be recorded and the maintenance works are all outsourced to external contractors.

6. ANALYSES.

The case studies were examined to determine the extent that facility management is established as a concept within the management structure, and how the concept is applied to the management of the operations of intelligent features and associated technologies.

The first step was to identify the intelligent features installed and used in the case studies. The second step involved an analysis of the organization structure for the management of the intelligent features including the control and monitoring methods adopted.

The findings identified were as follows:

a) The management of the facilities in each of the case studies covered two primary functions, namely:

Building operations and maintenance.
Facilities planning.
b) The Control of the services in the Twin Towers is achieved through a separate Building Control System in each tower. The Control of the services in the Central Plaza is handled by an integrated Building Management system from one Building Control Systems Room. The methods of automation of the intelligent system are the same for both buildings and comprises the following:

Systems integration
Centralized monitoring

c) Security: For confidentiality and security reasons the security system for the Twin Towers is separated from the integrated Building Control system, whereas the security system for Central plaza is part of the Integrated Building Management System.
d) Working hours: the integrated systems in each of the case study buildings operate only during working hours from 9 a.m. to 5 p.m., with call-up provision after working hours. It poses the question ‘does the system govern what is offered rather than designed to meet the needs of the users?’
e) Aims: the management at Central Plaza aims to provide tenant-friendly features and satisfies occupants’ needs. At Twin Towers, the management aims to ensure zero breakdown operations that can satisfy the occupants. It would appear from these statements that the aim of management of the Twin Towers is not directed at primary level to what users want but is simply to satisfy them that there will be no breakdowns. On the other hand, the aims of management in Central Plaza are more directed to tenant and occupier needs.
f) Maintenance management strategies: Maintenance work is all outsourced, as is the preparation of the maintenance programs. How well is this managed and controlled and by whom? Maintenance Manuals are prepared and used by the departments as a basic guideline to evaluate the works done by the contractors. But perhaps we need more professional inspection and control in this area.
g) Facility Management: The enlightened term of facility management is not used in either organizational structure at present, although it is noted that the management is in the process of improving the structure. There appears to be little identification of core business from that of non-core support functions to achieve the goals of the organization.
h) IB: The early definitions of IB were more concerned with energy efficiency and economic review but are now moving more towards user comfort needs.

CONCLUSION

• The aims of management of the Twin Towers should reflect more on user needs.
• The concept of Facility Management could enhance the management of IB. Much emphasis is placed on the efficient operation of the various IT systems rather than on how these relate to the needs of the users.
• It is likely that the managers of facilities in IB need to have a higher-tech profile than for normal buildings and this appears to be the current trend in Facility Management. Perhaps we need to review the nature of education and training in facility management.
• The level of IB has not been clearly defined so it is difficult to establish what constitutes an IB. However the rapid uptake of automated integrated systems, more related to user needs is likely to result in a more defined position to identify IB.
• Facility management is proving difficult to establish in Malaysia possibly because it too lacks precise definition. Many companies and firms offer the management of facility in one or two specialist areas like safety and security, or in maintenance, whereas the concept of facility management is holistic, concerned with the strategic management of built facilities associated with all non-core functions which support the organization’s goals.
• The organization should clearly identify its core function, for example, in the case studies examined the letting leasing and marketing of commercial space units, and then identify the primary facilities that support these core functions.
• The needs of the users and of the organization can change rapidly and the management of change
requires careful consideration and planning, particularly within IB where developments in a high-tech competitive world can be far-reaching and costly. The management of buildings under study is facing such a dilemma. To maintain a competitive advantage, the latest technologies and management structures need to be continuously reviewed and adopted to give optimum performance. The strategic role of facility management and its dependence on the human capital of the organization, rather than on cost reduction and operational tactics, is the way forward.

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