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"INTELLIGENT BUILDING"

MEMANE AKSHAYA A[1]
SATPUTE TUKARAM [2]
[1,2,]Third Year Civil Engineering,SCSCOE, Dhangawadi, Bhor
Pune ,India

ABSTRACT-

The survey was done right after the first boom of construction of intelligent buildings was over in Finland. There is no universal definition for the intelligent building concept, although a certain consensus about the concept can be found. There is little empirical evidence about the feasibility of or the factors involved in any intelligent building and there is no description of the intelligence of buildings, or if using the concept of intelligence in the context of quality of a building is valid. Consequently, there is no evidence about such an intelligent building, which is defined by the BIF. In fact, at the beginning of the IBs Survey project not only the feasibility, but even the existence, of the intelligent building concept was questioned.. The quality of the intelligent office buildings was compared to that of the other high quality office buildings. The hypothesis of the IBs Survey project was that the existence of the differences between the qualities of the intelligent and the other office buildings will prove the existence of the IB concept. The lack of the differences between the intelligent and the other office buildings will talk for the absence of any effect of the implementation of the IB concept. This difference is witnessed by the quality evaluation of the end product ñ i.e. that of the building itself. This quality evaluation is an end-user evaluation, which evaluates the importance of quality of the office building and that of its components to the working efficiency of the evaluator. This is how the evaluation result turns into the efficacy of the office building system, which is composed of its components, i.e. of its subsystems. The result supports the feasibility of the IB concept in office design. The evaluation results from the post-occupancy study correlate with the job description and gender of the office worker. In general, executives evaluate their working environment better than other occupancy groups.. The existence of the IBs is dependent on the application of the IB concept factors during the building design process. It can be concluded, that the IB concept criteria will be fulfilled best, if the building design is based on more than one of the elements of the IB concept. Furthermore, the quality of the intelligent subsystems must not fail, if the target is a good intelligent working environment. The thesis closes with the synthesis of some of the results of the IBs Survey and the theory of the BIF. Finally, the IB elements should form a functional combination, an integrated solution. Simply adding high technology, is not enough. Embedding the building intelligence by merging it into the building is held up as the intelligent solution to the design of a successful intelligent workplace

KEYWORDS- .Intelligent, sensors

INTRODUCTION

Innovations in technology mostly emerge from the needs of human society. The 21st century is the era of prompt advancement in digital technology. Most of this technology is focused on proficiently monitoring and controlling different activities. Everywhere from mega-structure building automation to small smart homes, big industrial assembly machineries to a kid's toy, a college research laboratory to an international space research center, and even health care service at a desk through wireless sensors and networks, wireless sensor networks (WSN) have become fundamental and crucial devices. The significant improvement offered by introducing wireless technology is that it reduces the complexity to harness wired transmission and facilitates the installation of sensors, controllers, and Actuators. The cost and installation efforts for a large number of sensors in an urban environment are exponentially reduced by wireless technology innovations. There are different wireless communication mediums (technology) in which a wireless sensor network can be constructed according to respective applications and strengths.

Home automation and monitoring are the dominant applications of WSNs, where a number of heterogeneous sensors are deployed, to determine different activities of inhabitants. Wireless sensors can be operated through batteries as well as plugging into the power supply**.** Intelligent Buildings have been researched and developed over the last three decades, but in more recent literature, roadmaps and industrial reports the term smart has started to be quoted more regularly. This seems to be the case in all aspects of the built environment sector; smart sensors, smart

Materials and smart meters within buildings are seen to be the latest, most advanced technologies in our efforts to develop high performing buildings. Smart cities are commonly seen to be the future of the urban built environment, with increasingly populated conurbations, demanding more functionality from more constrainedresources and more stringent buildingregulations. However, when put into the context of buildings themselves, there is a clear confusion as to the differentiation between smart and Intelligent Buildings.There is sparse academic literaturecurrently recognising a distinction between the two – even though buildings are increasingly being referred to as smart. The upper and lower bounds of a Smart Building will be defined, creating a base upon which future research can be established.

OBJECTIVES

Although relevant advances have been made in the domestic sector, this paper focuses only on non-domestic buildings, as used in UK building regulations. Anonymous, these are buildings which have no residential purpose. This is in contrast to the ASHRAE definition of commercial buildings, which may include multi-family residential dwelling. The benefits of an intelligent building potentially include energy savings, reducing the cost of changing occupancy and configuration (churn), maintaining a comfortable, safe and secure environment, and improving user productivity. This, in a world where our technology is under threat from a variety of sources and any IT system is potentially at risk, regardless of whether it is stand-alone or part of an integrated system, means the deployment of these innovative solutions is not without risk. We need to recognize that intelligent buildings are complex systems and put in place appropriate practices to ensure the safety and security of the buildings' users. This document forms the basis of a program initiated by the Institution of Engineering and Technology (IET). It examines the issues related to the increasing automation and integration of building systems, identifying a number of steps that may be taken to ensure that benefits offered by intelligent buildings are not offset by the risks potentially inherent in their design and operation.

SCOPE OF THE STUDY

The drivers behind building performance

It is evident that the design and expected performance of non-domestic buildings has changed throughout history. A century ago, hospitals, offices, schools, venues and universities were robust stone and brick buildings with basic gas, water and electrical systems. Modern equivalents are being conceived, designed and built as dynamic and technically complex buildings. In order for any change to be described as progress, it is required that the drivers for the resultant evolution have been met to a higher degree than previously. The drivers for the development of buildings can be said to revolve around adding value to a building (Smith, 2002). This value will, to an extent, depend upon the context and building category, but traditionally have formed from themes relating to the cost of the building over its lifetime, and the performance, comfort and satisfaction of those within the building (Shabha , 2006; CABA, 2008). Reducing energy consumption has now become a driver in its own right, due to increasingly stringent regulations and awareness of climate change. This is recognized in modern buildings as a significant design criterion (Sinopoli, 2010; GhaffarianHoseinietal 2013).

With the operating costs of a non-domestic building being significant when compared to the capital cost and a "shifting culture towards value rather than initial cost" (Clements-Croome, 2011) it is suggested that a more suitable representation of this driver would be its ability to maintain value over a long period of time under changing use and external conditions; its longevity. Therefore the three distinct drivers for building progression are:

- longevity.
- energy and efficiency and
- Comfort and satisfaction.

Whilst the latter two drivers are very traditional terms, they are reflections upon their broadest sense and encompass more contemporary terms such as energy effectiveness and well-being. Therefore, an advanced functioning building will have its energy consumption minimized whilst consistently allowing the maximization of the performance, comfort.

What is the meaning of intelligence?

"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.

Whilst the precise definitions vary around the world, acommon theme is the integration of technologies. For the purpose of this document we define an intelligent building as one where the combination of technologies and interconnected systems supports the use of the accommodation by the building's users, enables the efficient operation of the building and enables reconfiguration of the space in response to changing use. Intelligent buildings may also be referred to as smart buildings

LITERATURE REVIEW

.Building Automation

Building automation describes the functionality provided by the control system of a building. A building automation system (BAS) is an example of a distributed control system. The control system is a computerized, intelligent network of electronic devices, designed to monitor and control the mechanical and lighting systems in a buildings.

BAS core functionality keeps the building climate within a specified range, provides lighting based on an occupancy schedule, and monitors system performance and device failures and provides email and/or text notifications to building engineering staff. The BAS functionality reduces building energy and maintenance costs when compared to a non-controlled building. A building controlled by a BAS is often referred to as ansystem. Most building automation networks consist of a primary and secondary bus which connect high-level controllers (generally specialized for building automation, but may be generic programmable logic controllers) with lower-level controllers, input/output devices and a user interface (also known as a human interface device). Most controllers are proprietary. Each company has its own controllers for specific applications. Some are designed with limited controls: for example, a simple Packaged Roof Top Unit. Others are designed to be flexible. Inputs and outputs are either analog or digital. A digital input indicates if a device is turned on or not. Some examples of a digital input would be a 24VDC/AC signal, an air flow switch, or a volt-free relay contact.

Advantages

From an IT perspective it is this integrated use of systems and technologies which delivers the commercial advantage. For example, the convergence of the network infrastructure enables the flexible use of accommodation, and operational efficiencies arise from the integration of systems which support or manage the building environment, space, and operational systems. The infrastructure convergence is typically achieved through the use of a common cabling and/or wireless infrastructure, supporting IP-based networks within the building. Thus the building management systems (BMS) will typically use an open protocol running over an IP-based network for all data acquisition and control functions; and CCTV systems are increasingly IP-based irrespective of the physical and data transport layers. The advantages of employing a converged infrastructure include:

1. A workplace that can be used more efficiently and effectively, by making the use of space more flexible and reducing the cost of churn;
2. The ability to reconfigure access control and security systems to reflect changing use or to enable multiple occupancy;
3. Self-service access to facilities management tools by the building occupants from their office computers.

The integration of systems may occur on two levels: the integration of building systems and ICT systems; or the integration of both building systems and ICTsystems with business systems. The advantages that are realized will depend on the level of integration. An example in an office environment the use of 'smart' building passes to manage access to printer and photocopying services. Similarly, when a user logs on to a desktop computer, it may trigger the automatic association of an adjacent desktop telephone with the user's extension telephone number Thisintegrated approach can lead to a reduction of workspace reconfiguration costs as the users are no longer tied to specific workstations, i.e. any desk becomes a hot desk.

To improve the energy efficiency, systems may be integrated to internal monitoring of the smart building passes to determine when an area is no longer occupied. The BMS may then be configured to allow energy-saving measures to be automatically implemented, e.g. reducing lighting and air conditioning.

- Higher levels of security and safety
- Simplified operation for users and administrators
- Simpler staff tracking
- Reduced administration costs
- Smartcards - single card for security and cash transactions
- Reduced system costs by sharing infrastructure
- Easier integration into university systems
- Information can be delivered to all interested parties in the manner they need.
- Increased mobility - not tied to a specialist workstation
- Training is minimised, use standard operating environments.

What is risk associated in IB

The introduction of a converged infrastructure and integration of building and business systems potentially creates a range of new risks associated with aspects of the personnel, technology and operations. The human elements of the building operations are potentially the greatest risk. Whether deliberately or accidentally, individuals may seek to bypass security controls or incorrectly operate systems. The integration of systems can magnify the impact of errors or omissions. Systems integration will bring together IT and facilities management teams who may have different priorities, cultures and reporting chains. All of these can inhibit an effective response to incidents or faults. From a technology perspective, integration may introduce new failure modes, where building systems For example, it is normal for office computers to run the latest antivirus software and be regularly patched. This may not be true for the BMS or computers used for safety-critical systems, thus leading to potential vulnerabilities from malware introduced over the network or from infected media. The use of IP-based technologies creates opportunities for operational savings through the centralizing and outsourcing of control and monitoring stations. But this can lead to a loss of local knowledge and control. The problem is exacerbated if the support personnel are only deployed in response to incidents as they may not be familiar with the layout and operation of individual buildings.

- Increased complexity of the system.
- Initial cost + the cost of installing a cooling system for the computers.
- Normal buildings last longer than intelligent buildings.

METHODOLOGY

Existing Buildings Can Also Be Smart Buildings

A building doesn’t have to be new to be smart. Facility executives can use a step-by-step process to incorporate smart building capabilities into existing buildings. Providence St. Peter Hospital Providence St. Peter Hospital in Olympia, Wash., was a grand prize winner in the Siemens 2011 Smartest Building in America Challenge. The hospital serves a five-county area and has been in continuous operation since 1887. Its mission is to offer health care to the area’s poor at little or no cost. Providence St. Peter Hospital realized that, to provide a comfortable environment for patients and staff while remaining fiscally responsible, the organization needed a smart building. So, in 2001, Providence began a huge project to upgrade legacy equipment and controls. After that upgrade, facility operations staff began adopting new strategies that the older controls were not capable of performing. For example, because all thermostats served by an air handling unit are now monitored, the supply fan discharge temperatures can be optimized to maintain occupant comfort with the least energy consumption. Occupancy sensors enable the surgical air handling units to be set back when operating rooms are not in use. A sophisticated building automation system program controls a three pass heat recovery system for boilers; boiler feed water, space heating water and domestic hot water are all heated using waste heat from the boilers. Because it uses adaptive control, the building automation system also provides a higher level of control of HVAC system pressures and temperatures than was possible with standard PID loop tuning. Since the upgrade, Providence St. Peter Hospital has seen lower electricity and natural gas bills. Microsoft Jim Sinopoli, managing principal of Smart Buildings, cites Microsoft as another example of an organization that is taking steps to make its existing buildings smarter. Microsoft is rolling out a smart buildings effort that includes, in its initial phase, fault detection and diagnostics, which will identify problems, rank them in order of priority and estimate the cost of wasted energy.

The benefit of fault detection is that it can find hidden problems. For example, it identified a valve that was always 20 percent open, costing the company thousands of dollars in wasted energy. Microsoft’s smart buildings effort also includes tools to help facility staff manage and make sense of the hundreds of alarms they receive every day, as well as an energy management component that will help optimize building base load and power consumption by, among other things, providing analytics to tune set points and schedules. Existing Buildings Can Also Be Smart Buildings as cabling pathways. “With smart building concepts, you can reduce the cable and pathways by coordinating infrastructure,” Sinopoli says. Savings can also come when the fire alarm system is integrated with the building automation system. This results in a design cost savings because the building can use the fire/smoke dampers rather than installing separate automatic louver dampers. That also reduces wiring and points in the building automation system. Integration can also be used to enhance safety and security. “Educational facilities are increasingly integrating their building automation system with their fire and life safety system in an effort to enhance security during an emergency,” says Alejandra Lozano, environmental and building technologies research analyst for Frost & Sullivan. “For example, a building automation system can be used to lock doors to a specific area and can be integrated with the mass notification system to provide critical information to the people located in the affected area.” Building Automation Capabilities Many organizations are closer to having smart buildings than they may realize. That’s

because existing building automation systems may well have capabilities that are the foundation of an integrated smart building. A modern building automation system pulls in data ranging from temperature and humidity readings to motor statuses, says Myers of WSP Flack + Kurtz.
The building automation system often includes energy optimization capabilities. For example, with optimal start/stop, the building automation system learns when it must bring the air conditioning system on line for a particular zone in the building. Another standard feature of the building automation system is electrical load shedding for demand-limiting conditions. In this situation, electrical loads are grouped into categories from critical to high priority to non-essential. "When the building load is rising and approaching the high limit setting, the non-essential loads are turned off in their sub-group order, followed by the high priority loads," says Myers. The smart building approach has the potential to take the building automation system to a whole new level, using open protocols, standardized databases and middleware that can take data points and normalize them to a common database, says Sinopoli. Then dashboards are prepared for different groups. Eventually, the concept stretches from one integrated building to a campus and then to an enterprise.

CONCLUSION

Non-domestic buildings should aim for user comfort and satisfaction, energy reduction, resource efficiency and sustainability into the future. The definition of Smart Buildings given in this paper builds upon the foundations set by previous generations of building design, including Intelligent Buildings. Research into Intelligent Buildings has advanced significantly since the 1980s and Smart Buildings combine some of the more recent research with a more holistic view of buildings. Smart Buildings are buildings which integrate and account for intelligence, enterprise, control, and materials building system, with adaptability, not reactivity, at its core, in order to meet the drivers for building energy and efficiency, longevity, and comfort and satisfaction

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