

# Meeting Modern Challenges through Advancing Information Technology

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**Keywords:** Advancing information technology, network infrastructure, competitive advantages, modern world challenges, global business environment.

## SUMMARY

Advancing information technology (IT) will provide stimulating environments for occupants working in commercial buildings to strive in a highly competitive business world. This research is targeted to explore how IT, including telecommunication facilities and network infrastructure can be modernized to cater for such needs, by means of case studies in Hong Kong. After the potential IT facilities are advanced, its long-term investment values and sustainability will be enhanced. Yet, it is expected that commercial buildings will face some obstacles in launching these IT upgrading works. Quantitative approach through a proper designed questionnaire sent to major stakeholders, will be adopted to assess the obstacles and values pursuant to such IT modernizations in commercial buildings to increase its competitive advantages to meet modern world challenges in a global business environment.

## INTRODUCTION

In order to survive in a competitive global business, effective Facility Management (FM) has been adopted to drive all property facilities to fulfill these business demands. FM has not only aided in managing these facilities, but also advocates for better building environmental protection that integrates human and technology. The International Facility Management Association (IFMA, 2014) contends that FM is a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology. In consideration of the technology is changing rapidly in decade, especially on widely expanding the wireless communication network and the network communication protocol. Therefore, the commercial buildings should upgrade itself to carry on the market competition.

It is clear that the technology hardware development and the communication expanding have affected FM significantly. The wired devices and controlling systems represent the improvement of the building facilities operation. Furthermore, the continuous development on the controlling devices is focusing on the wireless remote devices. It becomes most significant facility related hardware improvement areas. Meanwhile the more available devices have been invented that could be used in Facility Information Systems (FIS). Notwithstanding the development of wireless devices, the framework of telecommunication infrastructure is indispensable to accommodate in a commercial building such as using the optic fibre cable as the backbone cabling to transmit data in a stability way.

Young (2005) reckons 10 objectives about the Balanced Scorecard (BSC) concept in Strategic Management Planning Process:

- Provide effective networking opportunities for all FM stakeholders;
- Offer a complete suite of learning programs to advance the career of the FM professional;
- Improve the stature and influence of the FM profession;
- Develop a process to capture and share knowledge on FM globally;
- Forecast trends and influence FM direction;
- Align long-range growth strategy around core target markets;
- Optimize IFMA's role in the global FM community;
- Provide the information technology infrastructure to support the operational excellence perspective fully;
- Foster a supportive environment that embraces staff and volunteer growth and development; and
- Maintain viable fiscal position through good financial management, diversification of revenues, and optimized asset utilization.

Retrospect the leasing market of office building in Hong Kong, most of the Grade 'A' office building has the capability to handle a lot of communication traffics because of the business transactions. Most of the international corporations are requiring a huge capacity of data communication network to accommodate its business transactions. In order to cope with those transactions processing, corporations intend to invest the money on upgrading

the telecommunication facility such as acquire more bandwidth from the telecoms services provider. For example, 56Kbps bandwidth dial-up connection was used to connect the Internet in last decade, however, recently the Internet connection bandwidth has expanded to 1Gbps in order to process a lot of data transactions such as huge e-mails communication, business-to-business (B2B) e-commerce etc.

The adequacy of facility planning is directly related to the availability of good data, such as site master plans, facility audits and service ability evaluations. The FM needs good information for better and faster decision making in both for the long range FM activities like facility planning, maintenance, preservation, and processes with short response times like decision supporting in catastrophic situations.

FM systems can be supported by well equipped information technology infrastructure that can partially or wholly automate facility's operational tasks. Nevertheless, the communication with such devices either wired remote controlling or wireless controlling are needed for an ideal networking infrastructure. The earlier remote control systems have used wired Local Area Network (LAN), notwithstanding mostly of the remote control systems can be converted and working with wireless networks such as Virtual Private Network (VPN).

Davidsson and Boman (2005) apply a multi agent systems approach for the design of control systems for IB. The decentralized system uses PDAs that consist of software agents monitoring office buildings. The study also describes that PDAs have limited computing

capabilities, built-in correction methods for hand writings/drawings, and some storage capacity for a local database with related data files on that small device.

Besides the technology of the Wi-Fi, other cordless developments are evolved e.g. “Infrared” from IrDA (Infrared Data Association) and “Bluetooth”. They are available in both WLAN and Wireless Wide Area Network (WWAN). For the positioning, Feldmann (2003) has proposed to use a Bluetooth based indoor positioning system including Bluetooth equipped PDAs and Bluetooth access points that cannot be used in larger outer areas. Moreover, the Infrared is a direct point-to-point via the light-emitting diode (LED) with short-range communication that could also not be used in larger outer areas.

FM in cultural organizations with artificial objects is affected by improving wireless devices and the fast growth of internet communications. In order to increase the value of building for the owner and have an effective and efficient building management and operation, Facility Managers have to pursue advance technology for implementing the wireless network and accommodate the data-communication network infrastructure in modernizing commercial buildings.

## **INTELLIGENT BUILDING**

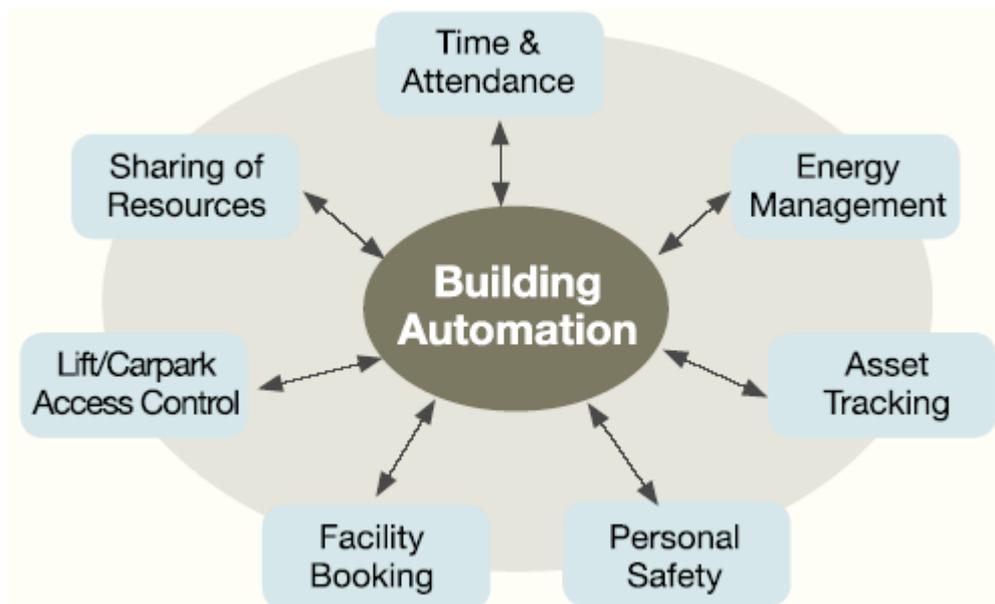
Becker (1990) contends that IT as one of the driving forces for the growth of FM. He sees the evolution of facilities organization moving along a 'trajectory of change' within a dynamic business environment. In responding to the demands for organizational change, facilities organizations must strive to be an 'elastic' facility organization.

The origins of IB and BMS have roots in the industrial sector in the 1970's, from the systems and controls used to automate production processes and to optimize plant performances. The concepts and applications were then adapted, developed and modularized during the 1980's, enabling transferability of the technology and systems to the commercial sectors. The IB encompasses an enormous variety of technologies, including energy management systems, communication network and building controls. However, the centralized controlling system is the BMS, its purpose is to control, monitor and optimize building services such as lighting, heating, security, CCTV and alarm systems; access control, audio-visual and entertainment systems, ventilation, filtration and climate control, etc. Indeed, those systems are among the technology is vast, and our lives are changing from the effects of IB developments on our working environments.

### **Building Intelligence**

With the evolution of the mobile technology over the communication business and the communication requirements from the business continuously increasing, the building becomes intelligence to cater such necessity changes. The importance of communication to

the success of a business cannot be understated. It is the foundation on which all corporate activities are built. Businesses are not made up of individuals working in isolation. Work is organized into departments, sub-units, committees, task forces, etc., all of which depend on the sharing of information and coordination of activities. Whereas businesses in the old days conducted most of the communication face-to-face or over the telephone, supplemented by written reports, letters, and memos, businesses today are adopting a variety of telecommunication service, such as facsimile, electronic mail, short message service via mobile phone etc., in order to meet these same needs. It is the communication context that has driven the increasing reliance on electronic forms of communication. Therefore, the systems, which are used in FM, should be automated by BAS. As shown in Figure 1, all the facility systems are totally integrated into the BAS.



**Figure 1 System in Building Automation**

## **Systems Integration**

The facility systems mainly controlled by certain devices to provide the information to an integrated facility monitoring system. The devices transmit signals to the controller interactively. Gouin (1986) explains that there are two types of integration in between the systems, they are (1) physical integration and (2) functional integration. The physical integration is to merge separate systems together, such as the IP telephony which is the finding of the survey thereafter. The IP telephony integrates the data and voice together, it can go through the Internet or PSTN to contact people. Moreover, the infrastructure of IP telephony is not the traditional telecoms cabling. It may acquire the optic fibre as the communication media to transmit data. It is the second integration method, function integration, such as the office automation (OA). The cables installed among the office and most of devices are using this cable to transmit the voice and data simultaneously.

Furthermore, there are many types of mobile devices and networks can be used in the FM to facilitate the overall facility monitoring and operation. The following list presents the frequently used facility-related periphery types.

### 1. Frequently used to input devices:

- CCTV camera
- Microphone
- Thermometer
- Clock
- Smoke trigger
- Motion sensor

- Door state sensor
- Moisture and air-pressure monitor
- Radar devices for space monitoring
- Glassbreak detector
- Door/Window magnetic contact
- Power failures monitor

## 2. Frequently used output device

- Switches e.g. lighting control
- HVAC
- Audio output
- Video output
- Computer output

## **RESEARCH METHODOLOGY**

### **Methodology**

This study is aimed to observe the impacts of fast growth telecommunication market and the IT hardware development in FM; with focus on modifying the collected information in FIMS for supporting decision making processes. Several types of hardware are used in facility related information systems such as BAS. With the continuous development of these devices and networks, new generations of sensors and control units could be used in FAS. Firstly the types of FM wired and wireless hardware devices and networks are classified. Thereafter the advantages and disadvantages of the new FM related wireless

solutions are observed including those complex systems that can either support the tasks of monitoring, controlling or data collection. The planned communication method, the division of data processing, storing and presentation among the devices in the network helps in determining the architectural structure of the information system.

The centralized system architecture still has several benefits, this is not the only available alternative anymore, since the more distributed networks are built if the more intelligent peripheries and computers (PCs, laptops, PDAs, mobile devices, etc.) will be connected together on the network. These hardware devices can be used for data processing, presentation or information storing purposes. In wireless systems the installation and operation costs could be highly reduced and these solutions support connection among physically moving/movable network points, even in cases of long distances. Networked database software solutions with the possibility of offline working can be used also in those systems and situations where the network is not permanently available. In offline mode local databases will work and support the locally running application. After the network connection has been restored, the information system should synchronize the local and central (or other local) databases.

The individual data processing and presentation devices are not so expensive than two decades ago when usually only one central database and mostly only one central processing have been used and the whole system could work only in online mode. The impacts of the hardware development will be investigated for each FM processes to determine which FM areas were influenced more remarkably and which ones were affected less.

## **Design of Survey**

In order to forecast the trends in the telecommunication and network services, and imply the information technology infrastructure facilitating the facility manager in operational and management in the premises. The survey is designed to identify the market trend of IT networking services. The technology is fast growing up over the past decade. Most of the communication methods are changed such as Internet widely applied on the business, e-mail becomes an essential tool to communicate among the business processing, evolution on overwhelmingly IP telephony which is from traditional PABX to IP network including image transmission during making a call etc. To backup these kinds of innovative evolution is the technology.

## **Case Study - Brief Information of Selected Building**

The selected building is a commercial building built in the 1980', located in Hong Kong Island. It has 32-storey including 4 storey providing 111 parking spaces.

## **Building Performance Analysis**

### ***Electricity***

The electricity supplied by the utility company is 380/220 volts, 3 phase, 4 wire (including 3 phase & neutral), and alternating current system at a frequency of 50Hz. The electricity supply will be backed up by one 400kVA emergency generator.

The busbars for tenant power supply will be running along the meter room and switch room vertically. A plug-in unit with fuse will be installed at meter room to tee-off power from busbar. The distribution board (MCCB board) and all HEC's meter tenants will be positioned inside the meter room. It is allowed for authorized person to monitor and count the power consumption of each tenants.

An emergency generator set is provided to support as standby electricity power for the building. The emergency generator is put into operation in case of power supply failure from HEC. The generator set is capable of sharing and starting simultaneously the following life safety and essential systems:

- Sump pump system
- Fire services system & control panel
- Sprinkler system
- Security system
- Firemen's lift
- Essential lighting for entire building

### ***Telecommunications***

For this building, three telecommunication companies had developed their services. It can provide choice for occupants to take their advantages. Therefore, a vertical trucking has fully be installed inside data cable duct for data cable and direct line. Besides, optical fibre will become the main transmission cable in the not-too-long future. Optic fibre system has

high reliability with high quality in data transmission rate, huge data transmission capacity.

There is a provision for these equipments and cabling.

### ***Closed Circuit Television System***

CCTV system is providing to monitor the whole building and provide a secure condition for occupants. Cameras are in placed inside lifts, main entrance, all exits, car park lot and critical areas. All cameras have been wired to the CCTV console inside control room of the building management office.

### ***Fire Services System***

The fire services system is designed to meet the Hong Kong Regulation. The following systems and installations will be provided according to the Code of Practice for Minimum Fire Services Installation and Equipment,

- Emergency generator
- Emergency lighting & exit signs
- Fire alarm system
- Fire hydrant/hose reel system
- Fireman's lift
- Audio/visual advisory systems
- Automatic actuating devices
- Fire detection system
- sprinkler system
- ventilation/air conditioning control system

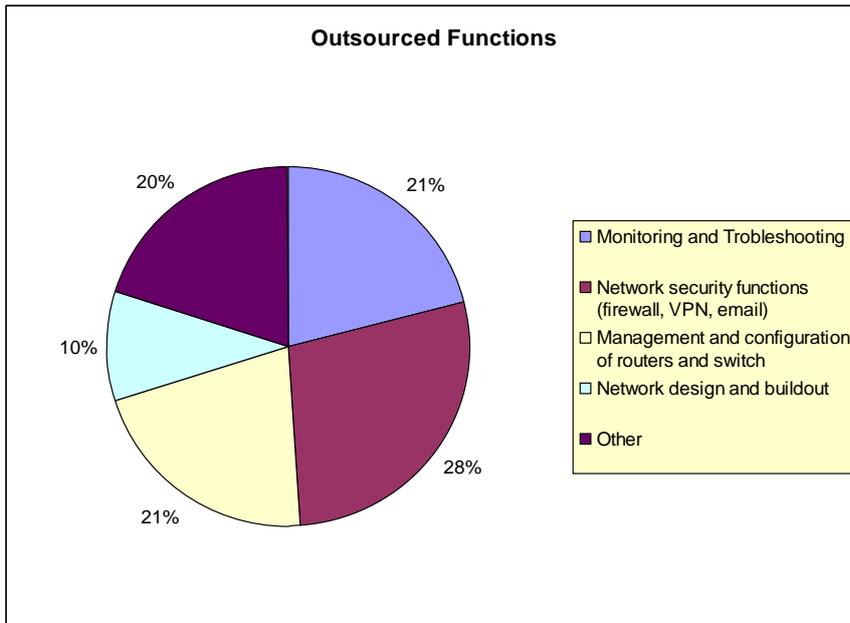
- Portable hand-operating appliances

For all plant and mechanical rooms, the smoke detection and portable hand-operated fire extinguisher has been provided.

## **FINDINGS AND DATA ANALYSIS**

The analyzed data is shown in Figure 2. The organization who have implemented outsourcing are choosing to do so for security functions has 28% of received survey, monitoring and troubleshooting has 21%, and management of network equipments also has 21%. In the IT market, the latest security system is being offered to the enterprises by eager vendors, it is called Network Access Control (NAC). This solution is intended to give the IT department much tighter control over the end-users access and the growing diversity of end-point devices. Hence, the threat from dangerous and vulnerable end-points has made network access control a critical security process for an organization.

The NAC solution works in Layers 2 and 3, and features support for 802.1x as well as the Trusted Network Connect (TNC) open specifications have been developed via TCG (2005, 2007). The organizations should find a solution that to enable them to leverage existing investments in network and security infrastructure, and are capable of interoperating seamlessly within heterogeneous IT environments.



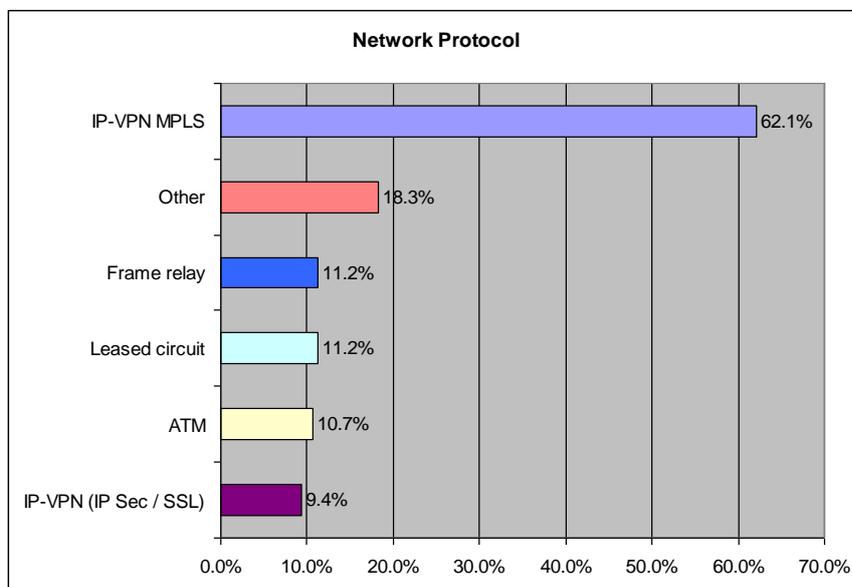
**Figure 2 Data analysis of the outsourced functions**

An organization adopts outsourcing because of cost pressures and the demands of running a business across multiple countries grows. The cost is never too far from the surface in making outsourcing decisions, but it was also about access to new technologies and skill sets and being able to manage complexity. Therefore, the type of services to outsource should be decided selectively to maximize benefit to the organization that through out the service level agreement condition such as products and the ownership of equipments, availability of system and network and the disaster recovery, and the compensation of the service level should be considered carefully during the network outsourced for an organization. In consideration of the marketing trend of the network outsourcing,

Behind the big four is customer relationship management (CRM) system, claiming 18.3% of all networks. It is due to most organization are focusing on the customer relationship

portfolio. It means that the service oriented for an organization is emerging gradually. Hence the telecommunication facility shall be increased to accommodate the business accordingly.

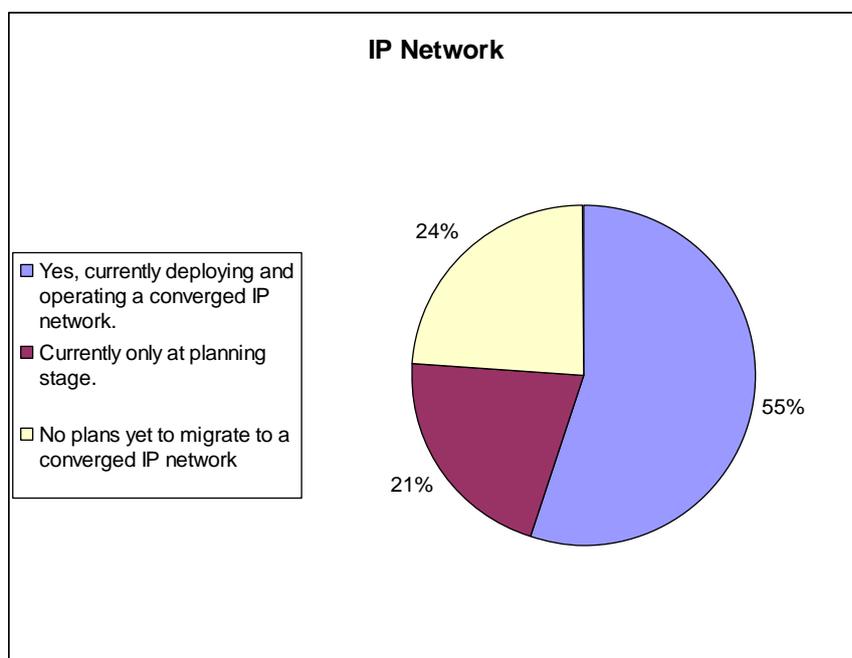
The survey also reveals that the multi-protocol label switching IP virtual private network (IP-VPN MPLS) is the favorable network protocol that is deploying in the most of organizations. Figure 3 shows that it is around two-thirds using same flavor of IP-VPN. As a result of the protocol has the capability to cater both the Internet Protocol (IP) version 4, which known as IPv4, and IP version 6, which known as IPv6, it has 62.1% of surveyed organization used protocol in the telecommunication network (Figure 3).



**Figure 3 Data analysis of Network Protocol deployed in organizations**

Nearly half of all surveyed organizations are working with three service providers or more at local and/or abroad. When they come to service providers, organizations have a good deal of complexity to manage.

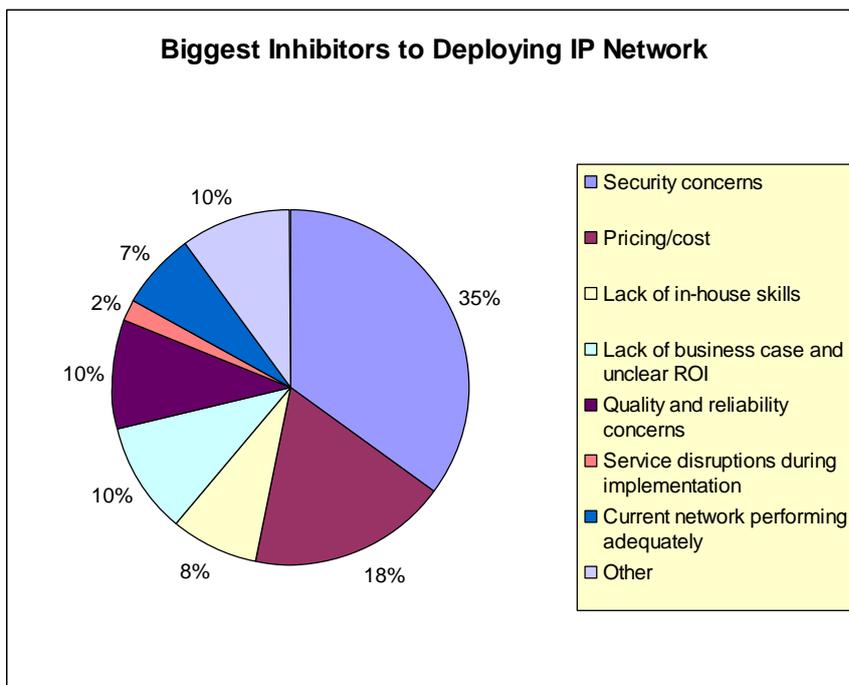
Although the organizations are hesitant about the outsourcing, they have embraced converged networking. The figure 8 shows 55% of organization have already converged voice, data and video, and 21% are planning to do so. Only 24% say it's not on their drawing board (Figure 4).



**Figure 4 Data analysis of IP network critical to business**

The performance is another major factor that shown in Figure 5, 17% are looking for better network performance. However, when it is in a business environment, it will be back to dollars, versus other things like support and quality. Therefore, cost is one of the things that convince organization to change, especially, the cost advantage from voice and video applications.

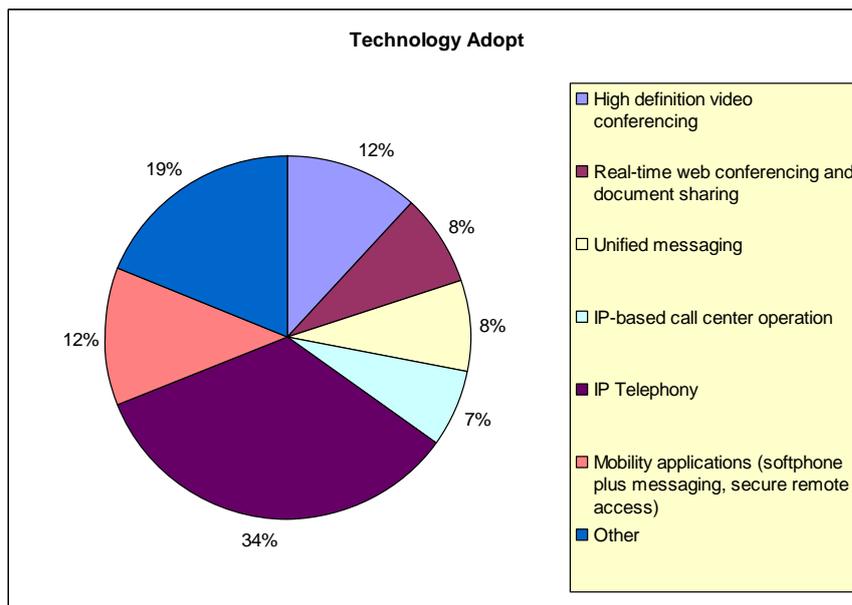
Furthermore, as indicated in Figure 5, 35% are concerning the security issue in current network deployment on a converged IP network, and 18% deem the existing cost still too high that to obstruct the implementation of converged IP network in their organization. There are only 8% thinks that they have not adequate in-house skills to implement. However, some of them 10% are having the impression that concerns the quality and reliability of the warrantable network services.



**Figure 5 Data analysis of biggest inhibitors to deploying IP network**

It is the true, nowadays, technologies influence our lifestyle. Traditionally, the telephone systems, especially private branch exchange (PABX), dominate over the telephony market. An innovated telephony technology is surrounding in recent years, it is IP telephony. In the survey, shows in Figure 6, 34% will consider to implement the new generation of voice over IP (VoIP) in next 12 to 24 months. It is because the cost of the implementation is low

and offer tremendous benefits by consolidating data and telephony capabilities to a single network. Perhaps VoIP can only partially to replace the existing telephony infrastructure of PABX systems. The coexistence of both systems shall be simultaneously available in the telephone system. It is due to the contingency of the availability of telephony, so that the public switched telephone network (PSTN) shall be maintained to serve the traditional telephone system.



**Figure 6 Data analysis of new technology adopt in next 24 months**

In consideration that the IT sector completed study the feasibility of implements the IPv6 to replace existing IPv4, and the implementation of IP telephony, the telecommunication infrastructure should be upgraded simultaneously to accommodate the expansion in the future. Of course, IPv4 is the basis of the TCP/IP communication protocols which are used to transport data, voice and video packets over the Internet. IPv6 is the next generation network protocol which has been standardized to replace the current IPv4. It holds great promise to be the backbone of the next generation Internet and offer a significant

improvement over IPv4 in terms of scalability, security, mobility and convergence. The basic framework of the IPv6 protocol was standardized by IETF (Internet Engineering Task Force) in the 1990s. Yet there is still ongoing development of certain advanced aspects of the protocol.

IPv6 will be the critical backbone of next generation networking technology. The potential business benefits resulting from IPv6 include lower network administration costs, protection of company assets via unified security model, investment protection by phased transition and deployment of new applications.

## RESULTS AND RECOMMENDATIONS

FM can include a plenty of different processes. The IFMA, the professional association for facility managers, has grouped the responsibilities into several major functional areas:

- Long-range and annual facility planning,
- Facility financial forecasting,
- Real estate acquisition and/or disposal,
- Work specifications, installation and space management,
- Architectural and engineering planning and design,
- New construction and/or renovation,
- Maintenance and operations management,
- Telecommunications integration, security and general administrative services.

However, the portfolio management and the technical work management are most important areas of the FM. The impacts of the technologies changes will be observed and classified for each processes on the following.

### *Space Management*

Efficient space allocation should be assured. The main goal is to well organize the operations in the allocated and free areas of the real estate, including scheduling and long-range cost optimizing. From the view of users the main system settings relating Area Management are

- The tuning of the optimized area allocation planning algorithms;
- Appearance/layout of the separated areas on the screen (graphical user interface);
- Reports and other customizations.

This process can be supported dominantly with software, however e.g. using portable devices the Space Management related information can be monitored and controlled remotely, but in most of the cases there is no need to change the area structure of the facility remotely, so it usually would not result better cost efficiency. The space requirements are the main inputs of the Space Management, these are usually fed into the computer automatically however it is also possible to create new requests remotely, e.g. from wireless portable devices or via an internet access. The arrival of remote devices has resulted the first significant impacts from the hardware side since the appearance of the computer using FM systems.

### ***Inventory***

The handled objects according to the financial terms can be distinguished to stocks and assets. FM systems usually focus mainly on the assets that remain in handle in long range. The stocking differs from what we know about the stocking methods, or what we know about stock handling without the FM. The stocks and the assets and their changes have to be maintained and stored, the inventory management is always based on the stock and asset changes, and inventories when the registered stock amounts and the reality are compared one-by-one. These processes usually do not need additional hardware, but using mobile devices workers can easily register their inventory movements and/or check the stored

amount e.g. of a given storage-bin. Mobile devices also could be used to show the daily/weekly/monthly tasks for the employees, it can be used very well in large facilities where it would not be implemented without mobile devices. The inventory methods using bar coding techniques have caused faster inventories. It was the first significant hardware-based efficiency step in this area. Now with mobile computers that are equipped with bar code readers the speed of the inventory can be further increased since there is no need to move the objects from their storage place to the computer.

### ***Property Portfolio Management***

The management of the real estate portfolio can be supported by software only, the hardware capacities of this software are also not too high, therefore, the hardware development has zero affect lately on this area from the point of view of the supporting information system. It is clear that property with better equipments worth more. The infrastructural factors can be distinguished to IT and non-IT factors. By a decision if to buy or not buy a given property, the more possible solutions and mix of these solutions should be considered and compared.

### ***Fire protection***

The fire protection network is only one of the network systems in the real estate. There are well equipped BAS solutions where the protected area has been equipped with sensors and/or controlling units. Other facilities have simple systems where the only task is to handle the fire protection tools (axes, dry chemical and other extinguishers, etc.) and their

state. In these cases hardware devices play no role, so their impact can be considered minimal, however the hardware development has been affected intensively the fire protection solutions with automatic systems.

### ***Technical Work Management in Buildings***

The following sub areas can be distinguished in the technical work management: machines, equipments, lighting, maintenance, repairs, and service desk systems. Nowadays the mobile devices have affected significantly the development of these areas.

#### *Machines, Equipments*

Machines and equipments were highly affected by the IT hardware development.

#### *Building lighting*

As the fire protection systems, lighting systems are networks, too. More details about networks in facilities can be found under Network Management in this dissertation.

#### *Maintenance/Repairs*

Life-cycle management should be performed by optimized planned maintenance and improvement system. Maintenance usually covers such kind of tasks that can be rather hardly (or not at all) replaced with automated non-human work. IT hardware devices are in use only for some very simple purposes. The resource planning for maintenance, repairs and improvement can be supported from the ERP software. Planning algorithms can assign

the resources based on either the age or the status of the handled objects. Of course, the latter option also requires a systematically refreshed status monitoring database. It can be done automatically (e.g. in systems using integrated BAS systems) or manually.

Development of those hardware devices that can be used for remote communication also has significant affect for the maintenance related tasks.

### *Service-Desk (Helpdesk)/Catastrophe Management*

Mobile devices have remarkably improved the efficiency of Catastrophe Management and service-desk systems. Help desk systems mostly use phone for communication, however there are a lot of systems that also supports writing Help desk requests using the internet or the intranet. To make good decisions, the need for new, exact information about the objects and its environment is usually extra large in or in the near of catastrophe situations. It requires much better data collection and data processing capacity from the whole catastrophe management team. The capacities and capabilities of the new IT systems are significantly better than a few decades ago. Analysis of databases with well integrated data collector systems could be much easier and faster than in non-integrated independent databases. In catastrophe situations even those results should be taken into account that should not be monitored by the normal working of the facility like e.g. listening to detailed weather reports. The impact of IT hardware development for this FM area is high.

## CONCLUSION

In this study, the influence of the technology development on the FM processes are analyzed and qualified. The roles of the network units in facility information systems have been classified, the important types of input and output devices are presented, and also the new trend of IT technologies development are introduced such as Wi-Fi, wireless device, IP6 etc. According to the findings and results, it should be considered to remove the old cables and accommodate the new optic fibre as the vertical backbone cabling system; and upgrade the facilities for centralization operation in a single location to improve the building monitoring on performance and preventive measures.

## REFERENCE

- Becker, F., (1990). *'The Total Workplace – Facilities Management and the Elastic Organization'*, Van Norstrand Reinhold.
- Davidsson, P. and Boman, M., (2005). *'Distributed monitoring and control of office buildings by embedded agents'*, Information Sciences 171, pp. 293-307.
- Feldmann, S., Kyamakya, K., Zapater, A. and Lue, Z. (2003). *'An indoor Bluetooth-based positioning system: concept, implementation and experimenetal evaluation'*, International Conference on Wireless Networks, 2003.
- Gouin, M.D. and Cross, T.B. (1986). *'Intelligent Buildings: Strategies for Technology and Architecture'*, Illinois: Dow Jones-Irwin.
- The International Facility Management Association web page, <http://www.ifma.org/> (accessed in April, 2014).

- Trusted Computing Group (2007). '*Controlling Network Access and Endpoints*', Trusted Computing Group.
- Trusted Computing Group (2005). '*Open Standards for Integrity-based Network Access Control*', Trusted Computing Group.
- Young, D.A., (2005). '*Articles by Issue - Career Development: IFMA's Strategic Management Planning Process*', Today's Facility Manager web page, [http://www.todaysfacilitymanager.com/tfm\\_05\\_09\\_profdev.php](http://www.todaysfacilitymanager.com/tfm_05_09_profdev.php) (accessed in January, 2014).