Impacts of the IT hardware development on the Facility Management processes

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Abstract

The IT hardware development has a great influence on Facility Information Management systems including those that also use Building Automation systems. The impacts of the IT hardware development on the Facility Management (FM) processes are collected and qualified in this paper. A range of frequently used FM-related hardware devices and networks are also gathered. The advantages and disadvantages of the wireless FM information systems are observed as well.

Key words: Facility Management, hardware, hardware development, impacts

1 Introduction

Technology for office automation and the arrival of the Internet has fundamentally altered the facility planning process [1]. Nowadays the development of wireless devices is among the most dynamically improving areas of the Information Technology. With the new wireless IT solutions remote communication can be supported more efficiently and flexibly than earlier with only wired networks.

It is clear that the IT hardware development has affected the Facility Management significantly from the first analog devices that were used for simple FM purposes. Digital wired devices and systems represent the next two milestones of the improvement.

Later the wired remote sensing/controlling devices and their systems have become the most significant facility-related hardware improvement areas, but in the previous two decades the wireless system improvement has been in the middle of focus. Meanwhile the more available devices have been invented that could be used in Facility Information Systems.

Facility Management is a special application area for these equipments where the demand for remote communication devices is extremely high because there might be long distances among together working people and devices.

Facility Management and Automation Systems are mainly used to manage only buildings but in some cases the supported FM activity has been extended even for the not built, outer areas of the property. The application of wireless elements could be much more comfortable and cost-efficient than any wired solution for managing large facilities, but the FM service quality also can be increased extremely.

The IT hardware development has affected the processes remarkably that belong either to the Facility or Building Automation Systems.

Some specialists think that Facility- or Building Automation Systems (FAS, BAS) are parts of the Computer-Integrated Facility Management System (CIFM), while others are talking about two individual, independent systems, but in those networks these parts are usually integrated in the same information system, mostly via a shared database.

2 Approach, study methods

The main purpose of this study was to observe the impacts of the IT hardware development on the Facility Management information systems. The focus is also on the modification of the collected information in Facility Information Management Systems that can be used to support decision making processes. Several

types of hardware are used in facility-related information systems like e.g. in Building Automation Systems. Now, with the continuous development of these devices and networks, new generations of sensors and control units could be used in Facility Automation Systems. The collected data can be used also for decision supporting purposes. The latest significant step of this development was the application of wireless devices in FM systems.

The newly invented devices help people in several ways since they can provide support in those cases as well, when manual data collection methods could not be automated. The focus was mainly on the analysis of wireless and remote control solutions in FM systems.

The major steps in the history of the FM system-related IT hardware development are presented in the introduction.

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 determine the architectural structure of the information system.

However 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.

Currently 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 were investigated for each Facility Management processes to determine which Facility Management areas were influenced more remarkably and which ones were affected less.

3   Background

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 [2]. The Facility Management 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.

The effect of the WWW revolution on the building simulation is explained in [3]. It is stated that a broad range of simulation software applications has become available for a variety of building performance assessments over the last three decades. The two key aspects dominate this evolution process: (1) attaining an increased level of quality assurance and (2) offering efficient integration of simulation expertise and tools in the overall building process.

Facility Management systems can be supported by well-equipped information systems that can partly or totally automate several facility-related tasks. These information systems with wireless and/or wired remote control devices need a network for the communication. Remote control systems earlier have used mostly wired Local Area Networks, but now there are working wireless networks as well, like in Virtual Private Networks (VPN).

The extra risks of wireless Local Area Networks (LANs) are discussed in [4]. The possibilities of the integration of Building Automation Systems (BAS) and Facility Management (FM) systems are analyzed in the paper [5]. A facility maintenance supporting system is introduced in [6], where PDAs were used to store and correct the collected information on the field.

Paul Davidsson and Magnus Boman [7] apply a multi-agent systems approach for the design of control systems for intelligent buildings. The decentralized system uses PDAs and consists of a collection of software agents that monitor and control an office building. The study also describes that PDAs have limited

computing capabilities, but also have built-in correction methods for hand-writings and/or drawing, and some storage capacity that can be used to have a local database with related data files on the small device.

For the positioning they have proposed to use a Bluetooth-based indoor positioning system [8], [9] including Bluetooth-equipped PDAs and Bluetooth access points that cannot be used in large outer areas. When it is not enough, geo-positioning technologies should be applied.

Wireless and Internet communications technologies for monitoring and control are collected by Haydn A. Thompson [10]. The capabilities of remote sensing and GIS technology are presented by M. Sebastian, V. Jayaraman and M.G. Chandrase in [11]. The usage and the technological possibilities of the Geographical Information Systems (GIS) are discussed in [12]. It also describes the types of mobile devices and the wireless access networks:

3.1   Types of mobile devices

Mobile devices have two main and contrasting characteristics: portability and capacity (memory, processing speed, display size and autonomy). On one hand, users want them smaller and lighter, but on the other hand, graphical applications need wide displays and high processing capacity to process all the information.

Current model types:

- Mobile phone-based smartphone,

- PDA-based smartphone,

- PDA,

- Handheld PC,

- Tablet PC,

- Notebook.

The first three models are rather little, meanwhile the next three models have larger device and screen size.

3.2   Wireless access networks

In order to connect mobile devices to a fixed network in which the server(s) will be set, basically two kinds of wireless networks are available: Wireless Local Area Networks (WLAN) and Wireless Wide Area Networks (WWAN).

WLANs, as the name expresses, have a limited coverage, from few meters to some kilometres. Their main characteristics are that they provide high transmission rates and usually are privately owned.

For the WLAN group, there are three basic possibilities:

- IEEE 802.11

- Bluetooth

- Infrared (IrDA : Infrared Data Association)

WWANS, or commonly named mobile telephone networks, are cellular networks.

These networks have evolved and according to their capabilities are classified in three generations: 1, 2 and 3G [13], [14].

- IS-136 (Interim Standard 136)

- IS-95 (Interim Standard 95):

- PDC (Personal Digital Cellular) : used in Japan

- GSM (Global System for Mobile Communications)

- HSCSD (High Speed Circuit Switched Data)

- GPRS (General Packet Radio Service)

- EDGE (Enhanced Data rates for GSM Evolution)

- IMT-2000 (International Mobile Telecommunications 2000)

Another classification of the wireless systems can be found in paper [15].

The Facility Management in cultural organizations with artificial objects was also affected by the improvement of IT devices. Towards the end of the 1990s new studies of museums and new technology were beginning to make important links to critical approaches. It was The Wired Museum, edited by Jones-Garmil [16] that was the first widely published, edited volume to bring together a series of substantial essays specifically on the subject of museums and new media. Whereas many of its contributions (such as Johnston and Herman) inherited the discourse of Gill, Gordon and Williams [17], [18] and [19], the book is notable in the way some of its authors began to place museum computing into other critical contexts. Most notably, by gravitating towards issues of authority, authenticity and commodification, Besser [20] drew upon Walter Benjamin's seminal essay on the work of art in the age of mechanical reproduction to consider 'the potential effects of widespread photographic digitization on the museum, on scholarly research, and on the general public'. The volume was one of the first attempts to provide, as it says itself, 'ways of thinking about the use of technology in museums' (Anderson) [21]. In a sense, The Wired Museum was the book that helped the profession crystallize many of its thoughts on museums and new media, and identify its needs and its agenda [22].

4 Analysis

4.1 Hardware devices in FM information systems

4.1.1 Roles of system units in FM information systems

The following list shows the most important possible roles of network units in Facility Information Management Systems.

Devices without controlling other devices

- Collect input signals for the system

- Perform output signals e.g. to control the temperature in a heating system or to display the contents on the screen of a mobile device.

Controlling and decision supporting devices

- Perform data processing and evaluation tasks

- Automatic decisions: Create output signals without human influence for the controllable network units.

- Automatic decision supporting. In these cases the system gives suggestions based on the collected inputs. In some controlling units, if the administrators have confirmed the suggested actions, the controlled signals can be generated. Sometimes the actions will be started manually like in such cases when the actions are performed by the employees and not by output peripheries.

Other roles

- Data storing, archiving

- Database synchronization in networks with more databases,

- etc.

Sometimes the same network unit could be used for more purposes on the list above.

4.1.2 FM related device types

More details about the main types of mobile devices and networks are discussed earlier in this paper. The following list presents the most frequently used facility-related periphery types:

Frequently used input peripheries

- CCTV movie-camera [video (and maybe audio) data],

- Microphone [audio],

- Thermometer [temperature],

- Clock [date and time, duration],

- Smoke trigger [smell],

- Motion sensor [motion] (*even laser, infrared sensors),

- Door state sensor [state: opened, closed, key-in, etc.],

- Moisture, Air-Pressure [weather],

- GPS [geo-position],

- Piezometer, inclinometer, etc. [geological] [23],

- pH-level meter, [chemical],

- Radar devices [space monitoring],

- Air photos [air monitoring],

- Glassbreak detector

- Door/Window Magnetic Contact, etc.

- Power failures, Low battery [24]

Frequently used output peripheries

- Switches [e.g. lighting control],

- HVAC [heating, air-conditioning],

- Audio output,

- Video output,

- Computer output [e.g. displaying devices].

There are another types of peripheries for communication (e.g. wired and wireless network adapters), data processing and information storage purposes.

E.g. Honeywell classifies Automation and Control peripheries as follows: [25]

- Environmental and Combustion Control (ECC),

- Fire Solutions Group,

- Industrial Measurement and Control,

- Security,

- Sensing and Control,

- VCSEL (Vertical Cavity Surface Emitting Laser).

4.1.3 Wired vs. wireless networks

Special advantages of the wireless systems used for FM purposes

- Fast

- Flexible

- Exact position measurement with GPS/GIS solutions

- Automated wireless

- Real-time (online) data collection

- No need for paper

- Several data is collected automatically

- Can be integrated with other systems

- No need for wired connection, also usable for extremely large facilities and areas without the need for wired connection

- Intelligent mobile devices could be able to perform data processing, or can be used for querying central database server to present business contents

- Status monitoring reports and queries (working online or offline)

- Real-time queries with immediate response from the database

- Cheaper solutions,

- New standards are forming slowly for both the Building Automation and FM systems on the base of current industrial standards.

- FM, 3D CAD presentations, using GIS information.

Disadvantages of wireless systems used for FM purposes

- Portable devices are currently slower than the PCs usually however it means the less problem since these devices are getting faster. Slower speed means disadvantage mostly when there would be high need for computing capacity like special data evaluation tasks or fast moving and/or complex 3D graphical presentations.

- If there is no connection and for the portable devices only the online usage is allowed, you cannot use your device as a paper. (for these cases can be implemented the offline mode)

- Small machine with poor computing capacity (worse than usual PCs)

- Solution must care about the data communication and transmission from the server to the portable device. Sometimes not all the data can be downloaded (e.g. because of size and network limits) or designed to make presentations on the wireless clients, so there could be some limitations for them.

- Presentation limits: small screen has its own limits.

- Complex synchronization, distributed data processing, offline working mode should be also developed for wireless software, not only online mode. As a result, the prices and the capabilities of these products will be higher. Now in some cases it's also possible to use those codes what have worked on the usual PC screens and resolutions.

- Wireless devices need recharging frequently

- Wireless networks have some service costs as well as using of public networks.

4.2 Facility Management processes

Facility Management can include a plenty of different processes. Leaders and system planners must decide which FM areas will be supported by the applied information system, which ones use paper based solutions or remain under ad-hoc control.

The International Facility Management Association (IFMA), the professional association for facility managers, has grouped the responsibilities into several major functional areas [26]:

- 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.

Unfortunately the classification above is not detailed enough (should be further divided) for the analysis of the IT hardware development on the FM tasks.

For this purpose a better grouping could be found in [27]. Based on it the following FM processes should be distinguished:

- Status documentation

- Area Management

- Facility-related Human Resource Management

- Inventory

- Cleansing

- Key/Access/Security Moving

- Network Management (telecommunication, electric data processing, lighting)

- Fire-protection

- Contract Management/Occupant Management

- Property Management/Property Portfolio Management

- Technical Work Management in Buildings

    - Machines, Equipments
    - Building Lighting
    - Maintenance/Repairs
    - Service-Desk (Helpdesk)/Catastrophe Management

- Place and Building Cost Calculation.

A detailed specification of these FM processes above is discussed in paper [28].

The last two sources can explain exactly the most important major areas of the Facility Management. The impacts of the hardware technology changes will be observed and classified for each processes on the second list:

4.2.1   Determine the impacts for the FM functions

Property status documentation

The status documentation can be supported either by using computer-integrated FM (CIFM) and Building Automation Systems (BAS) or with Document Management solutions.

The information system should store the results of the data/pattern collection for later presentation and/or data processing.

The status monitoring techniques can be separated in the following groups (for each stored input and output signs):

- If the results are collected automatically by the input/measurement units in the system. Using short pattern sampling times, it can result a real-time monitoring solution. The collected information can be used to start human or automatic prevention steps or reactions by controlling the output device(s). Building Automation Systems (BAS) belong to this group.

- If the results are not collected automatically, it usually means human data collection. In these cases several IT techniques can be used to make the data collection easier and to fix the errors of the entered information. The devices or the software are able to add some additional information automatically when the user fills a form and stores its content in the database. In these cases the additional information comes from some input sensor(s) in the system.

E.g. a data collection using a mobile PDA device with a GPS and an internal clock can automatically add a timestamp and the exact GPS coordinates to the contents of a form while storing it in the database, so there is no more need to enter it manually.

The influence and the resulted change of the IT hardware development on this area are rather high.

Area Management

Efficient area allocation should be assured here. The main goal of the Area Management is to 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 Area 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 area requirements are the main inputs of the Area Management, these are usually fed into the PCs by administrators in the office 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 first PCs using FM systems. The development of automatic equipments has caused significant influence on this field until now.

Facility-related Human Resource Management

Generally the more hardware devices are used in the system, the fewer workers the organization needs, but sometimes the maintenance of new monitoring and controller devices require more/better educated system administrators than earlier, or some activities have to be outsourced.

Anyway, the application of remote techniques instead of typing it into a PC would mean no real benefits for the HR-related affairs since they are mostly done in offices where the information system can be accessed using wired local networks however in the latest few years the more new LAN solutions use wireless technology such as WiFi systems.

Until now the changing hardware possibilities have not caused serious impacts for the HR supporting systems, while the required organisation structure has been modified basically.

Inventory

The handled objects according to the financial terms can be distinguished to stocks and assets. Facility Management 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 object status information registration, the status monitoring and its security problems belong to other FM areas.

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 PC any more. Bar code methods for artificial objects like museums are presented by William Albert Manning [29].

This area has been affected remarkably by the arrival of different hardware solutions.

Cleansing

The cleansing tasks are usually mechanized, but these machines are usually manually controlled and these are rarely connected in computer systems.

There are several researches to create intelligent automated robots for cleansing purposes, but they cannot be used to do all the required cleaning, and usually there are remaining cleansing tasks that have to be done manually or with non- intelligent machines, like in cases of staircases, furniture, wall or curtains. The intelligent solutions are rather new, expensive and rarely used, so the impact of the IT hardware development caused only minimal changes in the practice.

Key / Access / Security

It is well known that the security solutions were heavily influenced by IT hardware and software developments. Information Technology has been used widely in security systems for a long time. Additionally this field has achieved most of its results before the age of the wireless devices however the wireless solutions should meet different security criteria than wired systems. Typical wired security systems are

working in the banking sector and others in prisons. The computerized security information system should be distinguished from the protected process. Different persons have the authority to enter in the information system than into a given restricted area of the facility. The wireless technology has resulted new possibilities for the crackers as well. It means some extra risks to those at wired networks. In this case the transmissions can be observed or sent e.g. from mobile terminals, not only from terminals with fix positions. Of course, for mobile devices there are also solutions that can provide appropriate security level for the transmission, but if such a mobile device will be used for bad purposes, the allocation of the current/and maybe also moving accessing position could be much harder than e.g. in wired systems with fix access points. Earlier the Key Management was supported practically only with a simple database where the user key and area authorizations were registered with the issued keys that can be easily supported with simple software while facilities that use electric-card based access systems are equipped with special IT hardware. Fortunately these e-solutions are widely used and several implementations have been finished successfully even in those areas where the security risk is not extremely high, sometimes also in the non-profit sphere. Some of these systems can be used to determine the current positions of the users in the managed area, too. These systems should alert if there had been too many wrong attempts in a short amount of time.

Moving

Facilities and its parts can be classified by the frequency of moving (based on previous research [30]).

Good examples for frequently moving real estates are the hotels where moving is a permanent activity. Moving is also a usual thing in such facilities where different sport and cultural events can be held in the same place. Some of these buildings can either have parquet, grass or ice as a floor. In most of the office buildings or industrial plants moving is not so frequently done, but stock movements in warehouses are common events. There are a plenty of definitions for FM, so in integrated ERP solutions that support Inventory and Facility Management in the same information management system it is an arguable question if the stock management is part of the Facility Management or not.

There are such facilities where the possibility of moving is zero or very low for some reason like those places where the status of the objects in the managed area have to be conserved like e.g. in treasuries, some secret military facilities, nuclear power plants, or even on the territory of some cultural or natural sites. There are some places where moving is only acceptable in or near to catastrophic situations.

Moving is mostly could be supported by software, however e.g. by using bar code readers the speed of administration of moving could be increased remarkably with cheap IT hardware peripheries.

This FM area was rarely influenced by IT hardware technology changes.

Network Management (telecommunication, electric data processing, lighting)

It is hard to find such a result in the improvement of electric and digital networks that was not used during facility network implementations, including wired and wireless, local and public network solutions.

Earlier those problems that require very much and fast counting were usually processed on special hardware devices, but currently most of these problems can be solved remarkably cheaper with fast software on common PCs and multi-purpose micro-controllers. The trend is that with the increasing of the counting speed earlier hardware solutions could be replaced with cheaper software solutions.

Lighting systems usually use high-voltage networks in most of the facilities. There are several examples where lighting is controlled by computers.

Now clear and waste water, gas, oil, heating, waste water, etc. pipelines, computer, electric and other networks worth the more percentage of the properties' value. There are some industrial plants where the pipelines and other networks represent more than 50% of the real-estate's value. These networks can be controlled and monitored in Building Automation Systems (BAS) that can use PCs and PC networks.

Building Automation Systems usually use electric cables to receive signs and control the system. It is usual that in facilities with more individual sanitary systems parallel cables of different systems can be

found. In these cases maybe the whole system could be implemented cheaper using an integrated system with one cable or pipeline in every direction that are currently duplicated.

Fire protection

If it exists in the property, 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.

Contract Management/Occupant Management

Managing contracts and occupants are such processes that can be rarely supported by special hardware. Typically software is used for these purposes.

Software tools can also alert if the deadlines are close. It can send messages even by e-mail or just to show the message on the screen maybe with some alerting sound. The alerting systems could be also used to perform automatic restrictions like e.g. if a renter doesn't pay, his authorities will be restricted with some time.

Property Management/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, so 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.

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 paper.

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. Helpdesk 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.

Place and Building Cost Calculation

The accounting and costing tasks could be supported with software from the IT side. Hardware devices cannot support significantly this area of the FM.

5 Conclusion

In this paper the influence of the IT hardware development on the Facility Management processes are analyzed and qualified.

The roles of the network units in facility information systems were classified firstly, thereafter the most important types of input and output devices are presented. The advantages and disadvantages of the new FM information system-related IT solutions are also observed.

Unfortunately the IFMA's classification of the FM processes [26] is not detailed enough for the analysis of the IT hardware development on the FM tasks. For the purposes of this analysis another grouping was used that can be found in [27]. The impacts are discussed one-by-one for each FM areas.

Property status documentation	Highly affected
Area Management	Low influence
Facility-related Human Resource Management	Average influence
Inventory	Highly influenced
Cleansing	Rarely/not influenced
Key / Access / Security	Highly affected
Moving	Rarely influenced
Network Management (telecommunication, electric data processing, lighting)	Highly affected
Fire protection	Highly affected
Contract Management/ Occupant Management	Rarely/not influenced
Property Management/Property Portfolio Management	Rarely/not influenced. Almost zero affect
Machines, Equipments	Highly affected
Building lighting	Highly affected
Maintenance/Repairs	Low influence
Service-Desk (Helpdesk)/Catastrophe Management	Highly affected
Place and Building Cost Calculation	Rarely/not influenced. Almost zero affect

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