Industrial IT for performance buildings

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ABB has taken a close look at how buildings are used and has come up with a radical solution for the technical infrastructure that places the end-user's processes at the center and integrates all the building's systems around their needs.

The new solution is based on the realization that tasks like setting up an office meeting, registering a hotel guest or moving a patient in a hospital, can all benefit from the same Industrial IT concepts employed by ABB to optimize manufacturing, for example in the automotive industry.

Ending his phone conference call, John immediately begins organizing an urgent two-day meeting in his office building the next day. Being late evening, there is no-one around to help him with the logistics (meeting room, beamer, hotel reservations, catering, etc) but, undeterred, he pulls up his electronic agenda and presses the 'New Conference' button. The Industrial IT Conferencing wizard helps him set up the date, time, participants' list, room reservation and catering orders. As John saves the details and leaves for home, the participants are automatically registered, as his guests, in the access control system. An order is issued to the catering supplier's ERP system and a software agent is launched to make the travel reservations. An e-mail informs the participants about the meeting agenda, location details, even a 5-digit code they will need to enter the building's public area outside of normal hours.

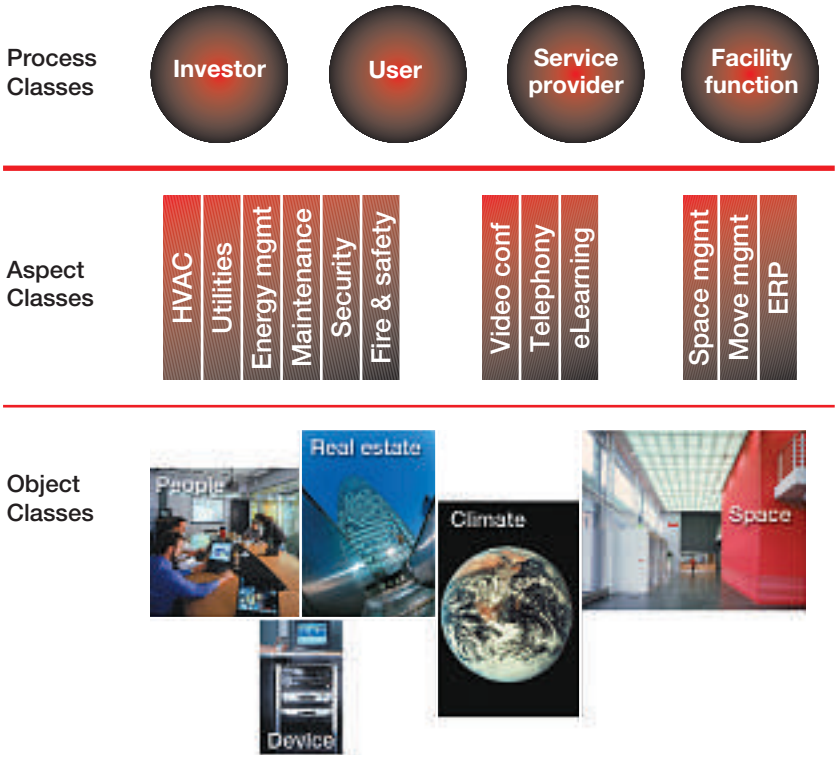
In this example, an organizational task that normally takes hours, if not days, is completed in a matter of minutes. The key to the productivity gain is the end-to-end integration of the various building subsystems. Organizations and companies are spending billions of dollars on the vertical and horizontal integration of their business processes, but there is more they can do and more to be gained. What is needed is for these companies and organizations to apply the same principles and techniques to their oft-ignored office processes.

Automakers are a case in point. At plants all over the world they are busily implementing solutions that allow customers to place and track their own orders or perform other service transactions. Similarly, a modern pulp and paper mill is fully integrated from the sensor to the boardroom, enabling productivity to be continuously optimized in real time. ABB has been successful in supplying solutions to these and other domains by gaining an intimate understanding of the key processes and then applying its unique Industrial IT products to achieve integration.

From 'office' to 'performance' buildings

The same approach, and technology, is now being applied by ABB to the office buildings domain. *Performance Buildings is ABB's trademarked name for a building in which subsystems are highly integrated around processes to improve the productivity of the building's occupants and their service providers.*

1 Classes of building infrastructure: The systems in each class are unconnected and provided by different vendors.



Processes like setting up an office meeting, registering a guest in a hotel or moving a patient within a hospital may seem trivial compared with, say, the complex manufacture of a modern automobile. However, the volume of such transactions is an order of magnitude greater, so there is a significant potential for cost-saving and productivity improvements. Like a factory, an office building or hotel can be broken down into several 'objects' that have to be managed from the point of view of the investors, user or service provider, among others 1.

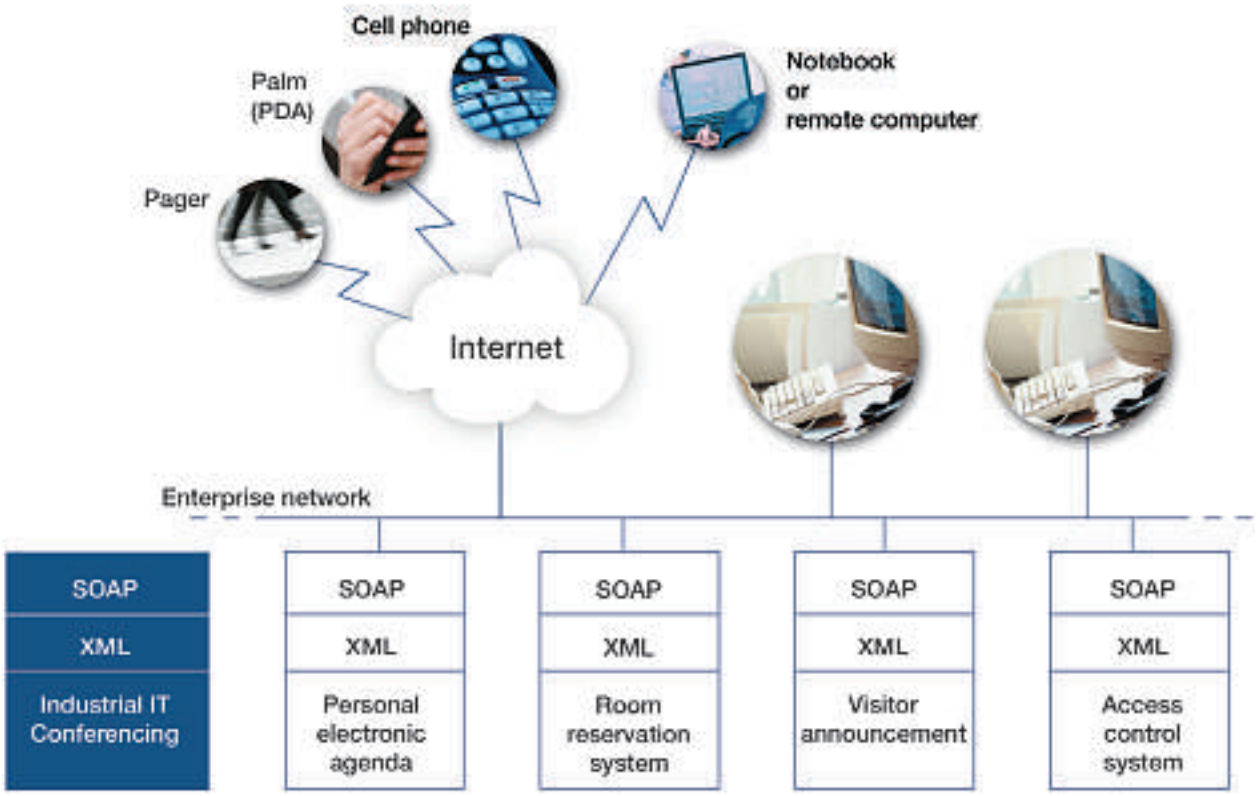
An office building contains a vast array of subsystems – security systems, fire alarms, building automation, data networks, elevators, to name just a few. ABB has extended the traditional definition of building technology to embrace the complete infrastructure. In an office building this can include items such as the desktop computers or functionality like meeting-room reservations, inventory control or human resource (HR) management. It then quickly becomes clear that the resulting technology landscape is a highly heterogeneous set of 'island solutions', each with its own proprietary databases, protocols, controls and operating systems. Some are even physically separated by dedicated cabling.

The consequence, in terms of productivity loss for the office occupants and their service provider (whether insourced or outsourced), are enormous yet accepted without question. The service provider is forced to maintain significant resources to manage and operate all the systems. For the office user, rationalization of even the simplest of processes proves difficult.

In the Performance Building approach, users and their processes are placed at the center 2 and all systems

2 Performance Buildings concept: All systems and applications are integrated to improve the processes of a given user type, such as the service provider, investor or occupant.

3 Web services architecture for all building systems



are integrated around their needs (or 'use-cases' in software parlance). The scenario described at the beginning of the article is a good example of how a meeting might be set up in a performance building. But the process automation need not end there. Consider the possibility that some of the participants arrive late the next morning and find themselves waiting behind a large delegation.

A self-service virtual reception kiosk beckons: after checking in, the participants make their way to the meeting room, guided by the dispensed agenda and map. Even before they reach it, all is ready: the catering staff have delivered coffee and sandwiches and the building management system has flushed the room with fresh air and fired up the audio-visual systems.

There is an almost unlimited set of use-cases which can be rationalized by integrating across systems. As another example, consider the access control and telephony systems. If these systems could be linked it would enable 'presence-based telephone routing'. The access control system tells the telephone exchange router who is in the building and how they are organized. If there is a call for an absentee, the system automatically forwards it to an available colleague. Caller frustration is dramatically reduced without any added expense.

Industrial^{IT}

In spite of their obvious benefits, performance buildings are not common. The main reason is the fragmented way in which buildings are conceived and constructed, but another is the technology fragmentation. Even if the technical systems are supplied by a single contractor, the investor often does not know during the development phase who the final tenant of a building will be. And even if this information were available, it would be dangerous to optimize around a single tenant.

So how can a building be created such that the performance of occupants is optimized irrespective of their process

4 Aspect Objects as the integration framework for building system applications

types and use-cases? ABB has found that this is possible if two criteria are satisfied. First, the IT-based applications in the building must comply with a *web services architecture* as far as possible. And, second, these applications should be *Industrial IT enabled* to facilitate their integration.

Web services architecture

This implies that all IT applications communicate using the Internet Protocol (IP). In other words, systems such as building management, access control and even voice & video run on the corporate data Local Area Networks (LAN) within the building. Of course, some of the real-time communication between field devices and controllers can be run on physically separate networks (LON, EIB or H232) or alternative protocols (BACnet). But, as illustrated in 3, each application should conform to a *web services architecture*.

Web services are applications that can be run over the Internet and can be integrated with other applications with the help of software protocols such as XML/SOAP. Our conferencing example is a result of integrating the following applications, all of which have been created as web services:

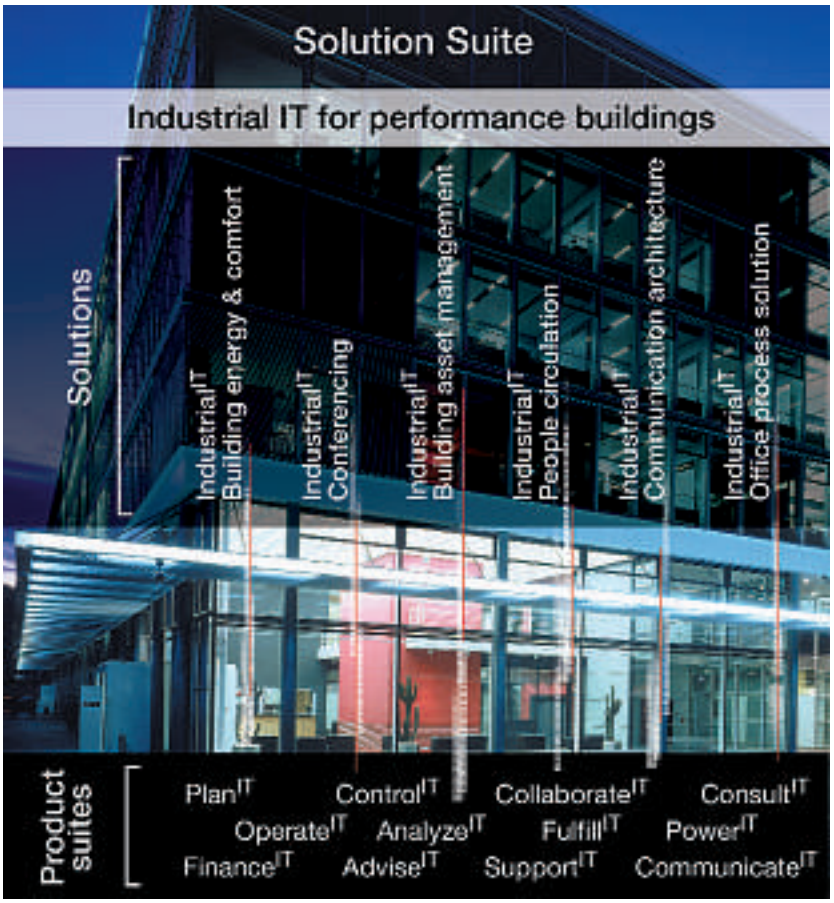
- Personal electronic agenda
- Room reservation system
- Visitor announcement
- Access control system
- Telephony
- Room climate control
- Catering order fulfillment
- ERP (invoicing)

This architecture is what gives the Performance Building concept its tremendous potential. Web services can be anything from simple phone number requests to complicated office supply ordering processes. For example, a weather office could offer a web service that allows a building automation system to retrieve temperature forecasts as input for the heating and cooling controller.

Integration framework based on Aspect Objects

Web services alone cannot provide the integration between applications needed to create performance buildings. They only provide the *means of* communication. For integration, applications must also agree on *what* they will communicate. Consider the case of a new employee's enrollment. The credentials of the new person have to be typically created in various applications, such as the office HR system, access control and the computer network. There clearly needs to be a common definition of *what constitutes a person* so that any change in one of these systems is automatically replicated in the others.

ABB has invented the *Aspect Object* technology to solve this problem [1]. First, an Object data type is defined for the person 4. Each of the applications is then an Aspect system which has to be enabled, by adapting its software, to handle the Object. For instance, if the person is promoted, the HR system is informed and in turn updates the Object data. All other Aspect systems recognize the change in the Object data and react accordingly: The security application assigns the person a wider range of access rights; the travel management system upgrades the car hire car group level; and the computer network management program does nothing.



5 **Architectural view of Industrial IT for Performance Buildings. Aspect Objects™ is the integration and application framework linking Product Suites to create Solutions.**
Product Suites: Open architecture, IP-based, modular and scalable web service applications, also from third parties
Solutions: New end-to-end functionalities for office end-users and their service providers

Such an approach enables completely independent applications to interoperate.

To summarize, a performance building consists of two layers **5**: *Product Suites* with the various building system applications, which are chosen to comply with the web services architecture; and *Solutions*, a new breed of integrated solutions created by combining Product Suite applications with the aid on the Industrial IT integration framework. ABB is going one step further by making all Product Suite applications, including those from third parties, Industrial IT-enabled.

Cityport implementation

Cityport, a newly constructed ABB office building in Zurich, Switzerland, is a pilot of the Performance Building concept. Many of the underlying subsystems from the Product Suites layer have been installed and functions at the Solutions level (eg, People Circulation) have been created.

A highly systematic approach has been taken. This consists of breaking down all the processes in an office building in terms of Actors and Use-Cases and then developing an end-to-end integrated function to increase productivity. At the time of writing, two of the Industrial IT solution suites for enhancing performance **5** – People Circulation and Conferencing – have been implemented.

Industrial IT People Circulation

The circulation of people in an office building is a key process since it defines the access control and security infrastructure. Office employees are issued access badges and visitors are carefully managed to avoid unauthorized access. ABB has analyzed visitor and occupant building entry and exit processes, and on the basis of this analysis developed a complete solution **6** for tenants who require a regulated flow of people; especially those who want to know, at any given instant, exactly who is in the building. In such cases, single entry systems have to be installed and only controlled access (ie, via badges) allowed. The penalty is that all building users (including visitors) have to be registered and given access rights (badges). This can be expensive as it raises the required levels of staffing.

6 IT architectural view of the People Circulation function – Industrial^{IT} not only integrates all modules but provides new functionalities for creating an end-to-end process.

The Product Suite applications in this solution comprise:

Control^{IT} Access Control
This application consists of card readers 7, door controllers and an access control rights administration system. The fire and safety systems are configured to directly open the emergency exits as well as those exits controlled by the access control system.

Operate^{IT} Virtual Reception Kiosk
Here, a visitor can identify himself and receive an entry badge without the need for administrative help 8.

Communicate^{IT} Telephony
This is the in-house voice communication medium used to link the reception or the kiosk automatically to a host when the visitor arrives.

Fulfill^{IT} Visitor Announcement
The host in the building uses this application to announce visitors. Announcements may be made via standard desktop applications, such as Microsoft Outlook or Lotus Notes.

The Industrial IT People Circulation solution integrates all of these Product Suite applications to fully automate the flow of occupants and visitors within a building while ensuring high-level security and safety.

The productivity of both the office user and the service provider is impro-

7 Access Control – card reader

8 Virtual Reception – console and card dispenser

9 All technical functions (lighting, blinds, climate, audio and video) in the meeting room are controlled over the web.

ved. When arranging a meeting the office user can organize the reception of visitors exactly as required, and in minutes as opposed to days. The visitor handling capacity can be expanded even as the staffing requirements are reduced; if desired, a manned reception desk can be dispensed with altogether.

In addition, the solution suite opens up new possibilities:

- Greater flexibility in operating the building.
- Reduced running costs outside of normal office hours.
- New operator models with several access points or further buildings, all managed from a single center.
- Added functionality in the reception area (eg, travel advice from a call center), as staff are relieved of menial tasks.

Industrial IT Conferencing

The ABB Conferencing solution encompasses all aspects of conferencing processes, from room reservations right through to ordering a taxi at the close of a meeting. Particular attention has been devoted to integrating the functions within the conference room itself.

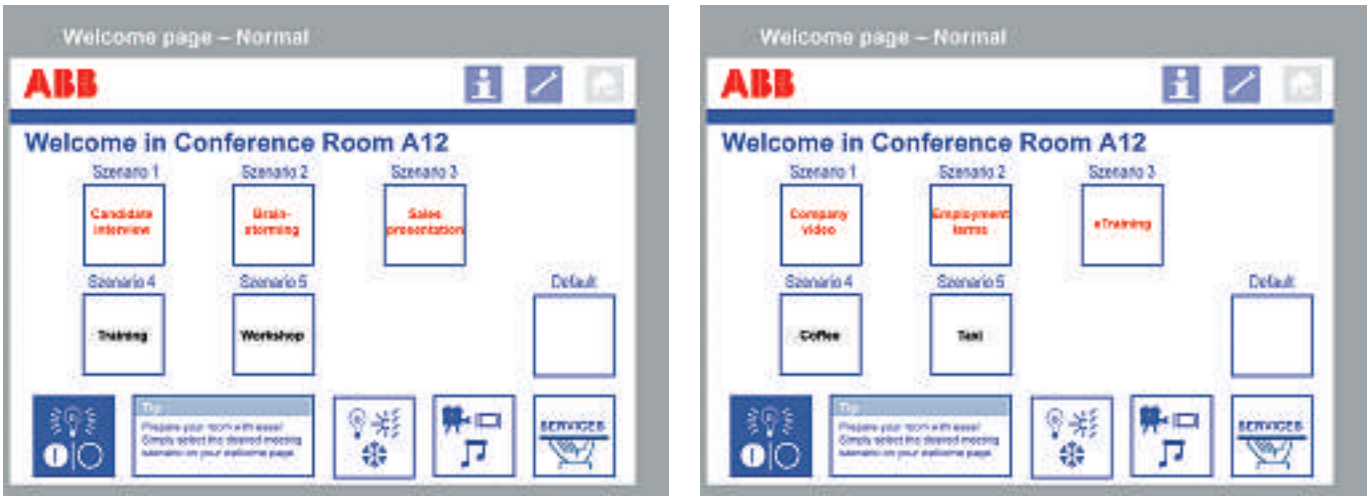
A modern conference room is an assembly of various systems, ranging from lighting and climate control to the audio-visual equipment. ABB has created a web-based human-machine interface (HMI) to ease operation by integrating all the functions on a use-case basis. The Operate^{IT} Conference Room Portal in Cityport 9, for example, offers the meeting chairman scenarios such as 'Computer Presentation' or 'DVD Movie'. Depending on the selection, lighting, blinds, curtains, the audio system and the LCD projector all assume pre-programmed settings.

The application itself is only one part of the equation. The office building service providers, for example, are also required to adopt a new approach in order to support this level of system integration. If the blinds fail to respond to a command there could be a number of causes: lack of user familiarity with the application; a network fault; or a motor failure. Service Level Agreements with the various subsystem suppliers have to be clearly thought through. Fewer support staff are needed, but they will have new roles in a performance building and have to be trained accordingly.

The flexibility of the web-based integration approach has become clear after only three months of operation at Cityport. Based on user feedback, several improvements could be implemented simply by modifying the software. The next goal is to go beyond the state of the art as installed and provide the means to control the environment and the supplied services from inside a running conference.

When entering a meeting room, for example to hold a candidate interview, instead of selecting scenario settings such as 'audio-visual system' and then starting a company video the meeting room control system will offer this option directly. Process choices are shown immediately on the starting screen 10a; selecting 'Candidate Interview' calls up the next screen with further options 10b.

10 The human-machine interface first offers process choices on a starting screen (left). Selecting 'Candidate Interview', for example, calls up the next screen (right) with new options.



All system functions and process control commands are then taken care of automatically, ensuring a more productive meeting.

Benefits across the value chain

ABB has redefined the scope of office building technologies beyond heating, ventilation, air-conditioning, telephones and elevators, to include processes and applications for all support functions from catering to visitor management. This radical approach has benefits across the entire value chain, in fact for everyone involved in the creation and operation of an office building.

The investor has a much more flexible building since it can be tightly adapted to the processes of a wide range of tenants. Occupancy rates are higher and the lifetime of the technical installation is longer. Architects, consultants and contractors are given a new dimension with which to position themselves more clearly in the marketplace. Facility managers and service providers are not only able to save costs but also to offer new kinds of services to the occupants. Last but not least, the building end-user's range of needs, many of which may be afterthoughts, are firmly at the process core.

The way forward....

Although the Industrial IT for Performance Buildings solution suite presented here is focused on office processes, it can be applied to all types of buildings. ABB is already developing solutions for hospitals and hotels. For example, presence sensors in rooms can be integrated with an hotel's ERP to match cleaning staff schedules with the occupancy status of rooms. Enabling hotel guests, in the future, to sleep in after a long tiring flight, and not be disturbed by housekeeping staff eager to clean the rooms. 'Suite dreams', so to speak, courtesy of Industrial IT.

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References

[1] The ABCs of Industrial IT. ABB Review 1/2002, 6–13.