EXPERTS IN SUSTAINABLE BUILDINGS

WHITE PAPER

HOW TO CREATE A SMART BUILDING FOR INVESTORS AND CLIENTS?

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MANAGEMENT SUMMARY

A smart building creates comfort by interacting with its users whilst minimizing its impact on the environment.

There may be many definitions of a smart building. First Q Network, a European network of leading M&E engineers, defines it as a building that creates a comfortable living and working environment which interacts with its users and its neighborhood while minimising its impact on the environment.
A SMART building should be:

- **S**ustainable
- **M**easurable
- **A**nticipating
- **R**eliable
- **T**ransformable

A building does not become smart by itself. Creating a smart building involves many stakeholders and consists of a whole lot more than putting the right building technologies together. It has to be created as a self-learning building, making itself smarter and smarter during its lifecycle.

Right from the beginning of the building process, investors and their clients should involve smart building designers and engineers in their team, who develop a vision on the future from ecological, economic and technological perspectives.

Smart building designers and engineers extend the lifecycle and value of a building.

The advantages of a smart building are numerous both for the investor as well as for the owner: corporate image enhancement on sustainability, higher employee attractiveness and productivity, user satisfaction, operational efficiencies, … which are often supported by tax and utility incentives.

These advantages do not come by themselves but are part of the application of a process with smart as a philosophy. It involves people with vision to define, create and deliver a smart building. But it does not stop there. The building has to become smarter and smarter during its entire lifecycle through interaction with its users, creating comfort with as low an impact as possible on the environment. The challenge is not only to create a smart building but to make it smarter during its lifecycle.

As a team of smart building experts First Q Network can help you throughout the process of defining and creating smart buildings by consultancy, engineering and follow-up, during the lifecycle of the building and its users.

By involving a smart building expert, your next building extends its lifecycle and investment value much further than any traditional building.

This paper presents a framework for defining and creating a smart building for investors and owners.

NEEDS AND DRIVERS FOR SMART

In the nineties, buildings were called intelligent buildings because they were technology driven with the rise of structured cabling systems, building management systems and computer networks.
Systems were talking to each other in order to create the intelligent building. User interaction was low and came merely from sensors and detectors.

Smart buildings enforce corporate image and user experience resulting in higher productivity.

Technology

Nowadays, technology allows us as an individual user to communicate and interact with the building. Buildings now are user driven. We like to have impact in creating our own comfort. But we are also more conscious of our impact on the environment. Creating our own individual comfort on the one hand, and having a low impact on our environment, can be managed together if we do it the smart way.

From an HR marketing point of view, millennials are our new work force and are much more attracted by a company with a smart profile which creates a healthy, secure and flexible working environment with which they can interact. The corporate image of a company which states to have a smart office environment to work in with low environmental impact, cannot be underestimated.

For the organization, making use of a smart building with a comfortable working environment for all people, including the millennials, will give rise to a lower employee absence and higher productivity. We are all human and we like to have an impact on creating our own comfort zone.

Smart buildings have a lower lifecycle cost by design.

Economy

From an economic point of view, we currently look further than the cost of making and delivering a building. The cost of energy consumption and maintenance of the building exceeds by many times its initial investment cost. Smart buildings have a much lower Life Cycle Cost (LCC) because they react to the environment and its users in a proactive way. The building is far more proactive looking at climate data for days ahead instead of reacting instantaneously. It is also proactive on the user because it knows the user behavior and can anticipate preferences and occupancy patterns, rather than reacting on user presence at a certain moment.

For investors, a smart building does not only have the attractive corporate image for the people to work in terms of flexible, comfortable, sustainable, but even on the economic side it will be cheaper considering its total lifecycle.

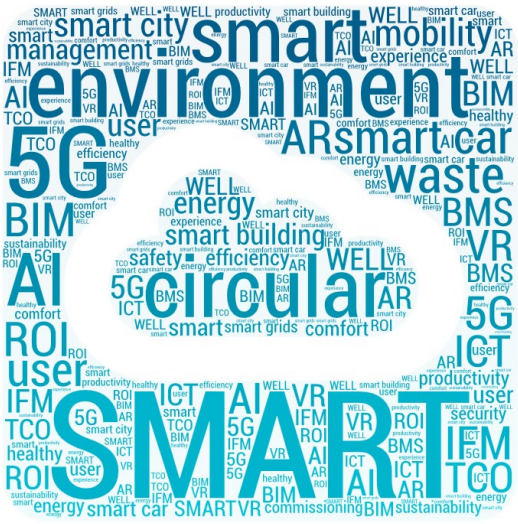


Figure 1 Domains and technologies to be handled in smart buildings.

Can we accept not transforming our working environments into smart ones if we want to have a win-win situation in the near future.

Ecology

Sustainability can be enhanced in an ecological manner by making it part of the circular economy. In this economy, not only renewables but also the use of smart materials is one of the basics. At the end of the lifecycle, the elements of the building can be re-used as raw material for a new building. A smart investor will look for smart re-usable materials during construction while using renewable energy during the exploitation of the building. On a city level, energy can be switched from one building to another by the smart city energy network, making optimal use of renewable energy.

So, why not consider making existing buildings smart or creating new smart buildings? Or, putting it the other way around:

Risks and difficulties

Even when the answer is that we probably have to go for a smart building transition, we should be aware of some of the risks and difficulties we will face in the journey:

- Local legislation not yet prepared. For example, fire regulations ask fire systems to be independent from the rest of the system and therefore make integration difficult.
- Product manufacturers are still supplying equipment with non-compatible interfaces, favouring their own proprietary systems.
- Data privacy and cybersecurity issues need to be addressed properly, as there could a potential risk.
- Rapid technology development, that could make some products obsolete in a few years.
- Initial cost, that would be higher than a conventionally designed building. This extra cost should be recovered during the lifecycle of the building.

SMART BY DESIGN

Smart building experts are multidisciplinary and evaluate the impact of user interaction on smartness, sustainability and lifecycle cost.

To make all these technological, economic and ecological elements work together, one needs smart building designers and engineers which go beyond the traditional way of working. Smart building experts know how to combine:

- user interaction with the smart building
- building interaction with the smart city including smart grids
- sustainability from a circular economy point of view

while keeping the lifecycle cost below the cost of a traditional building.

A smart building is part of a larger world with which it interacts. Already from the design, these interactions should be considered and evaluated because they determine the level of smartness as will be experienced by its future user.
The interactions are found in this model

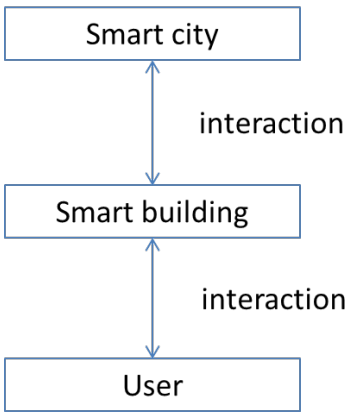


Figure 2 Interactions with smart buildings

Smart by design is a critical success factor to obtain a sustainable building that becomes smarter and smarter.

Smart city interaction

The smart building is at the center and interacts with the smart city regarding mobility, energy and waste management. In order to make these interactions possible, the design of a smart building should provide the infrastructure such as: battery charging stations for electric cars, smart traffic control especially at peak times, connection with smart electric grids and city heat networks, connection to the (city) waste system, etc.

New technologies enhance interaction: wired and wireless public and private networks (5G, IoT, cloud networks), data processing in edge datacenters, distributed software systems (blockchain, cloud computing) but also battery technology. Each technology is powerful by itself but when combined with user interaction they result in smart possibilities beyond imagination.

User interaction

With current technology, users have their own smartphone with apps to interact with their locker, to adjust settings in their workplace, to interact with traffic, etc. So the users can far more interact with the building and personalize their workplace.

Augmented Reality will further enhance interaction between the user and its environment, whether at home, at the office or in between. Artificial Intelligence will detect user patterns from big (user) data and optimize comfort, sustainability and cost making the building smarter and smarter towards its users.

Smart by design

The combination of all these systems and interactions creates a smart building experience extending much further than the functionality of each individual system. Every element and component contributes according to the principles of distributed intelligence. There is no master system, there are no slave systems. All systems are part of the ecosystem of the building interacting with another.

Putting all of these new technologies and interactions in the right perspective, is one of the tasks of the smart building expert. The expert has to evaluate to what extend each interaction contributes to the priorities of the investor, owner or user while keeping the interaction with the user as simple as possible and the environmental impact as low as possible at optimal lifecycle cost.

Smart building design requires designers and engineers to go beyond traditional M&E engineering. Besides knowledge on electromechanical systems, they have to know about IT systems, building automation systems interacting with users and smart grids for heat and electrical supply which interact with the building.

Smart by design requires insight into the overall functionality of a building and its users and is needed so the building becomes smarter in time. From the start of the design of the building, the needs for the life cycle management have to be defined so the right management systems are in place before the construction of the building has finished.

For the manager, the smart building should be easy to interact with despite the underlying complex systems helping them to focus on improving user comfort, reducing operational costs and impact on the environment.

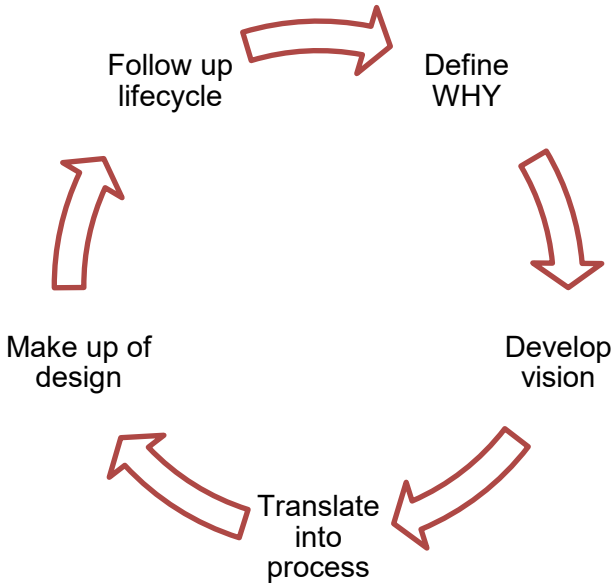
For the user, the smart building should feel like a wellbeing focused place to work.

For putting this all together, the smart building experts must work very close with the investor or owner to have a complete understanding of the building and must have the consulting skills that help them realize these needs, implement them accordingly and follow them up during the lifecycle of the building.

A SMART METHODOLOGY

Right from the moment one considers to create and deliver a smart building, one should involve smart building experts and involve all stakeholders connected with the building project. Defining, creating and sustaining a smart building needs a process driven approach and asks for a multidisciplinary team of experts in several domains beyond the 'classic' design team of architect, M&E engineer and structural engineer.
A smart building methodology - and linked to that the tasks of the smart building team - consists of:

1. Define the WHY of a client aiming to provide a smart building
2. Develop a vision with the client and its stakeholders
3. Translate that vision into a process, systems and technologies
4. Make up of a design and operational model in which user interaction, life cycle cost and management systems are key
5. Follow up during its lifecycle to keep giving the users a comfortable working environment in a sustainable building by continuously monitoring, controlling and , automating; and if necessary, go back to (Re)Define



Define WHY

Defining the WHY of a client investing in a smart building, makes clear to the design team what priorities should be taken into account. Be it the corporate image, the user experience, the ROI or other. With this input, a vision can be developed on the several domains covering the smart building and putting the right accents as briefed by the client. The domains go way further beyond architecture and engineering. Social, economic, ecological and technological trends must also be taken into account.

Develop vision

In developing that vision, one should look further than only current possibilities of current systems and technologies. Hence, during the building lifecycle, as workplaces and needs of users keep evolving, the building will have to undergo changes. This means that the building must already be SMART BY DESIGN.

Translate into process

Developing a vision is one thing, but translating that vision into a process with many stakeholders, is the next challenging step. A smart building process differs from a usual building process by looking far further into the future and challenges all stakeholders to do this also. One example: buildings can be made smart if the city also allows smart interaction on domains like smart mobility, smart energy, smart waste management, etc.

Smart by design, fit to operate.

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Make up of design

Designing a smart building goes way further than a classic 3D BIM design combining architecture, structural engineering and building services engineering. The 'Smart by design' philosophy must be applied from the first day in order to end up with a modular, flexible, sustainable, user interactive smart building.
As technology advances and our jobs change, our workplaces have to evolve as well. Integrating new technology, changing the layout of workplaces to do our job, adapting building techniques to create comfort in this new environment, are all possible if 'Smart by design'.

Digital twin

The outcome of the smart design is not only a static Building Information Model as we know it today, but shall be combined with the dynamics of a Facility Management System. So, the design model is not only 'Smart by design' but also 'Fit to operate'. In fact, a digital twin of the building will be put in place right from the start of the design according to BIM. But this static model will be enriched by a dynamic BMS (Building Management System) resulting in a Facility Management System acting as the virtual twin of the real smart building.

Commissioning

During the commissioning process, the virtual model will be fine-tuned to its real life model. Commissioning experts will then have to master not only the M&E and other building techniques but also the interactions between the virtual model and the user as well as the building interaction with the smart grids. The importance of the commissioning of a building, fine-tuning the operational environment and setting up the management systems, cannot be underestimated.

A smart building made 'Fit to operate' has the operational and management systems in place to monitor and control its internal systems, to monitor the interaction with the smart city and the user and to control the impact on its environment.
The task of the smart buildings team is not only to define the operating dashboards on sustainability and user experience but also to optimize the user experience and minimize environmental impact.

Follow up during lifecycle

The team will continuously look for improvements and fine-tune the smart building accordingly. In the near future, the smart experts will develop a Building Operating System (BOS) based on technology like Artificial Intelligence and IoT using the big data coming from sensors and users to further improve the user experience and the buildings impact on the environment. Maintenance to the building and its systems will be done in a proactive instead of a reactive way. The smart buildings team will assist the BOS to further fine-tune and improve the building and its users during its life time.

(Re)Define

And in the end, beyond the change of technology and systems and after an initial life span of over 25 years, a building which was initially designed as an office building could end up in a residential building or hospital to function for another 25 years.

EXPERTS IN SUSTAINABLE BUILDINGS

CASE "KANTOOR 2023" VLAAMSE OVERHEID

Onder de werknaam 'Kantoor 2023' hergroepeert de Vlaamse overheid de komende jaren een aantal kantoren in de Brusselse Noordwijk. Ingenium begeleidt Het Facilitair Bedrijf van de Vlaamse overheid in het streven naar een project dat maximale duurzaamheid koppelt aan een flexibele, comfortabele en gezonde werkomgeving.

De ambtenaren die Het Facilitair Bedrijf (HFB) in Brussel huisvest, zullen in de toekomst een werkplek vinden in drie grote kantoorgebouwen: het Herman Teirlinckgebouw, het Hendrik Consciencegebouw en de te renoveren WTC torens op wandelafstand van het station Brussel Noord. Dat laatste zal het Arenberg- en het Ellipsgebouw (beide einde huurcontract) en het Ferrarisgebouw (aan renovatie toe) vervangen. De Vlaamse overheid vermindert het aantal gebouwen onder meer om kosten en belastingen te drukken, samenwerking tussen entiteiten te bevorderen, specifieke infrastructuur maar eenmaal te moeten voorzien en efficiënter gebruik te maken van de voorzieningen. Het project omvat 2.600 werkplekken voor 3.900 ambtenaren. Ze moeten allen worden gehuisvest op maximaal 1 kilometer van het kruispunt Koning Albert II-laan – Simon Bolivarlaan.

Er wordt gestreefd naar een gebouw dat energieneutraal of zelfs energiepositief is, smart naar de gebruiker toe en via maximale inzet van hernieuwbare energie een minimale impact op de omgeving heeft. Om de duurzaamheid van het project te meten, wordt gebruik gemaakt van het toegankelijkheidslabel en duurzaamheidsinstrument 'GRO'. Bovendien dient in het ontwerp en de bouw rekening gehouden te worden met circulaire principes om de herbruikbaarheid van producten en grondstoffen te maximaliseren en waarde vernietiging te minimaliseren.

In tegenstelling tot in veel andere projecten, treedt Ingenium in dit project niet op als klassiek ingenieursbureau voor de engineering van het gebouw. Vanuit een raamcontract met HFB begeleidt Ingenium dit project in de verschillende fasen van het veranderingstraject, met specifieke aandacht voor duurzaamheid, energieneutraliteit en onderhoud. Bij de evaluaties en onderhandelingen over de ingediende prijsoffertes adviseren we de bouwheer in het matchen van enerzijds hoge ambities en anderzijds realistische verwachtingen. Tijdens de uitwerking van het project volgen we de vastgelegde principes op. En ook tijdens de exploitatiefase en dit ondersteund door een adequaat BIM model zorgen we door middel van commissioning voor de bewaking van het programma van eisen.

Door deze manier van werken wordt een evenwicht gevonden tussen comfort van en voor de gebruiker, de duurzaamheid waaronder energieneutraliteit van het gebouw en de impact van veranderende wetgeving. Een niet evidente evenwichtsoefening voor smart building experts.

Vlaamse overheid