

Smart Buildings: Design and Construction Process

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Abstract: This manuscript would try to present an appropriate classification of smart building systems process and link them to present construction market to discover how nowadays construction sector are influenced by smart buildings. Several documents are created during the construction by the engineers, subcontractor, suppliers and manufacturers. These include design, construction and produced data. Mostly, a site is chosen and a preparatory spending plan and schedule are set. Construction for smart building are set up by an engineer or designer and are utilized to facilitate the outline with different experts, utilized by the contractual worker to introduce the frameworks and in the long run utilized or documented by the proprietor or the manager. The smart building systems increases the efficiency of building design and construction and produce more functional building systems that improve the operational performance of the building while lowering costs.

Key words: Smart buildings, systems, process, construction, costs

INTRODUCTION

In the mid-1980s, multiple innovation patterns were under way. One was that the US telecommunications industry was experiencing deregulation and new organizations, items, administrations and advancements entered the telecom commercial center. The second real pattern which at the time appeared to be to some degree separate and inconsequential was the creation and development of the PC business. This time additionally produced the primary genuine association between land engineers and innovation. The recently unregulated information transfers industry displayed an open door for building proprietors to exchange administrations inside their offices and increase the value of their business.

In the following decades, there were some unassuming innovative headways in structures, including organized cabling frameworks, varying media frameworks, building computerization controllers with Direct Digital Control (DDC), adapted space for system, access control frameworks and video reconnaissance, among others. However rules for building development reports discharged in 1994, the Construction Specifications Institute's Master Format had 16 divisions, scarcely saying innovation (Agarwal *et al.*, 2010). Building means a more or less enclosed and permanent structure for housing, commerce, industry, etc., distinguished from mobile structures and those not intended for occupancy (Baghchesaraei and Baghchesaraei, 2014).

Smart buildings are not just about introducing and working innovation or innovation progressions. Innovation and the frameworks in structures are basically empowering agents, a necessary chore. The innovation permits us to work the building all the more proficiently to develop the structures in a more effective manner to give gainful and sound spaces to the tenants and guests to give a sheltered situation to give a vitality productive and supportable environment and to separate and enhance the attractiveness of the building.

A smart building includes the establishment and utilization of cutting edge and incorporated building innovation frameworks. These frameworks incorporate building computerization, life security, telecommunications, client frameworks and facility management systems. Smart buildings perceive and mirror the mechanical progressions and union of building frameworks, the regular components of the frameworks and the extra usefulness that coordinated frameworks give. Smart buildings give significant data around a building or space inside a working to permit the building proprietor or inhabitant to manage the building or space. They are likewise a basic segment in regards to vitality use and sustainability of structures and the smart electrical framework. The building mechanization frameworks, for example, HVAC control, lighting control, power administration and metering assume a noteworthy part in deciding the operational vitality effectiveness of a building (Chen *et al.*, 2009).

MATERIALS AND METHODS

The research with this study was initiated with a general literature study to get an overview of smart buildings. This was done to get a good background knowledge of smart buildings. Then, in the second part several definitions and results are obtained from previous phase, the study explores the advantages and disadvantages of smart buildings. The results from the literature study have served as a basis for the development of a smart buildings methodology and sequencing, since smart buildings provide the most cost effective approach to the design and the deployment of smart building systems. The traditional way to design and construct a building is to design, install and operate each system separately (Fig. 1). This manuscript would try to present an appropriate classification of smart building systems process and link them to present construction market to discover how nowadays construction sector are influenced by smart buildings.

Process: Modern construction methods are a kind of building and infrastructure are its foundation, without an

appropriate foundation the building will collapse. Access to a limited number of systems, local climate and ethnic be selected inside the repetition of numerous systems in order to create more balance in the urban landscape are the other requirements to achieve construction modernity goals (Chen *et al.*, 2009). Several documents are created during the construction by the engineers, subcontractor, suppliers and manufacturers. These include design, construction and produced data. It is important to understand how the building is being “designed” as this will affect the relationship one has to the design team, the owner and the construction company (Fig. 2) (Baghchesaraei and Baghchesaraei, 2015).

The civil engineer is interested in telecommunication service entrances into a building and coordination of those pathways with other utilities. Considerations for these pathways may include multiple telecommunications carriers, multiple entrances, connectivity to other buildings, among others. It may also be necessary to consider items such as pads for satellite dishes or antennas in site planning.

Design: The procedure of planning, developing and dealing with a building is perplexing. Most structures are

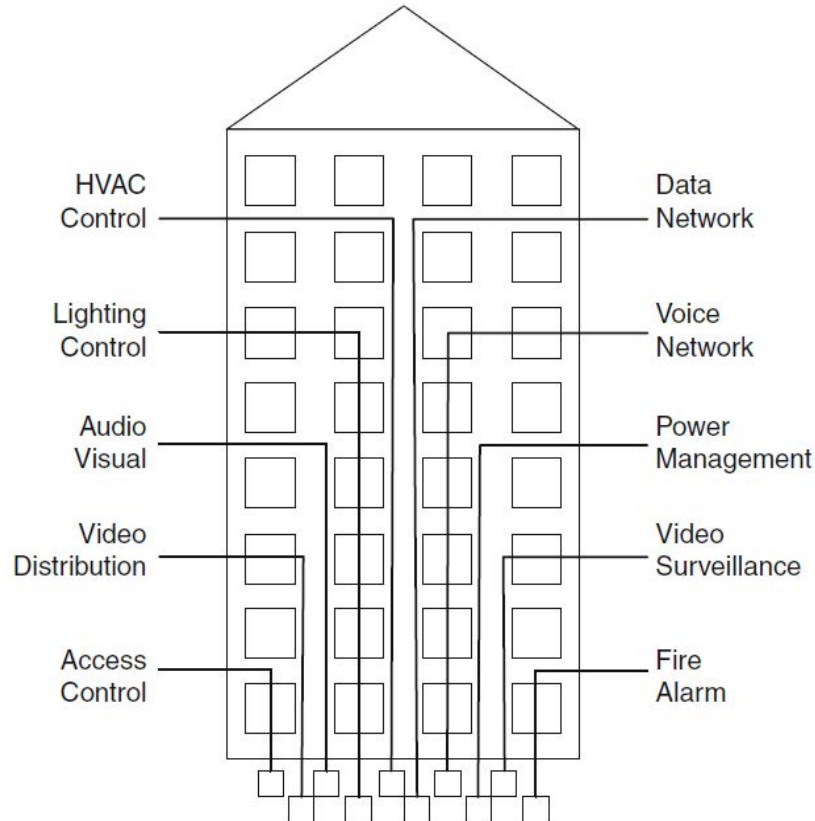


Fig. 1: Multiple proprietary building systems

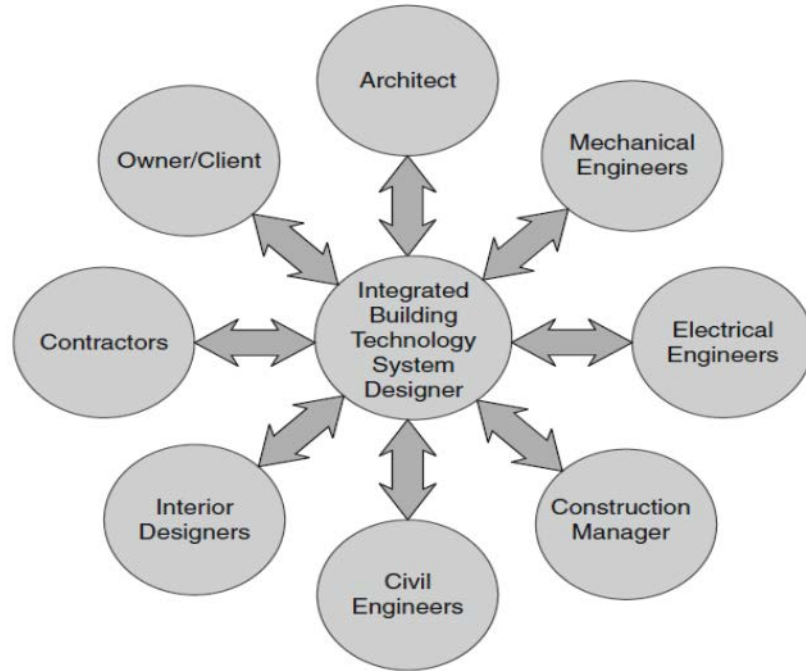


Fig. 2: Project team in a smart building

Table 1: Design process in smart building

Section	Design process
1	Project planning
2	Business solution planning
3	Technical planning
4	Business design
5	Custom design
6	Test design
7	Training design

one of a kind structures intended for certain capacities, spending plans, physical conditions, conveyance techniques, proprietor necessities, regulations, plan imperatives and different impacts. The quantity of individuals or associations taking part in the configuration and development of a building is considerable. Mostly, a site is chosen and a preparatory spending plan and schedule are set. All the more essentially, an office program, in view of the proprietor's qualities or objectives is readied. The facility system is the establishment for a hefty portion of the outline choices. But in instances of strangely shrewd and educated proprietors innovation and coordinated frameworks are once in a while a generous part of the facility program (Table 1).

Construction: It is construction process that will shape the building technology systems and eventually influence how the site will be overseen and how clients will function, live and impart. Understanding the procedure

is critical to engineers and workers of coordinated frameworks if the advantages of the frameworks are to be figured it out. Construction for smart building are set up by an engineer or designer and are utilized to facilitate the outline with different experts, utilized by the contractual worker to introduce the frameworks and in the long run utilized or documented by the proprietor or the manager. The construction process, included arrangements and particulars, depict the configuration point of interest and necessities for the establishment (Sinopoli, 2009).

It is important to note that construction details are not the same as a producer's item determinations. As an illustration, a maker's particular for a video reconnaissance camera varies from the development determination for a video observation framework. The construction determinations will depict the work and the required results, quality, establishment rehearses, materials, coordination and documentation of the work.

Standardization: Construction process have been standardized for convenience to diminish blunders and to encourage coordination between parties. The composed particulars contain divisions for each building discipline (common, mechanical, electrical and so on). They utilize something much the same as a "Dewey decimal system" that is utilized as a part of libraries with the determinations having standard titles, an expert rundown of numbers and

an institutionalized page position. Significant divisions of the particulars are further separated into segments. One of the most popular formats for construction specifications is the Master- Format, produced and trademarked by the CSI and primarily used in North America. European and Asian entities have very similar standardized formats.

The Master Format contains a “procurement and contracting requirements” and a “specifications” group. The specification group has the following subgroups (Adeli and Kim, 2009):

- General requirements
- Facility construction
- Facility services
- Site and infrastructure
- Process equipment

Drawing: The other part of the process in a smart building is the plans or drawings, a necessary segment to pass on the outline purpose of the frameworks. The drawings show areas, connections, measurements and subtle element. The outline drawings are likewise sorted out and institutionalized. Drawings or a drawing set are commonly sorted out by control (e.g., common, basic, electrical, information transfers) and afterward facilitate by kind of drawings. Engineers of smart building systems need to see how their items can be indicated on a vocation. What’s more, they should give data with respect to their items in a Master Format arrange instead of the customary item information sheet. This

demonstrates the producer comprehends the procedure and may make it less demanding for the engineers to determine the item.

RESULTS AND DISCUSSION

Construction costs for any building include the building technology systems that are at the heart of a smart building, namely telecommunications, building automation and life safety systems. There are construction costs for these systems whether the systems are installed separately or as integrated systems. The construction cost savings for integrated systems are primarily attributable to the efficiencies in cabling, cable pathways, labor, project management and system management hardware and software. Construction process for smart buildings incorporate the building innovation frameworks that are at the heart of a shrewd building in particular telecommunications, building robotization and life security frameworks. There are development costs for these frameworks whether the frameworks are introduced independently or as incorporated frameworks. The construction cost investment funds for incorporated frameworks are fundamentally owing to the efficiencies in cabling, link pathways, research, venture administration and framework administration equipment and programming (Fig. 3). According to the design and construction process using smart buildings reduce the costs of building in comparison with traditional buildings (Table 2) (McCurdy *et al.*, 2004).

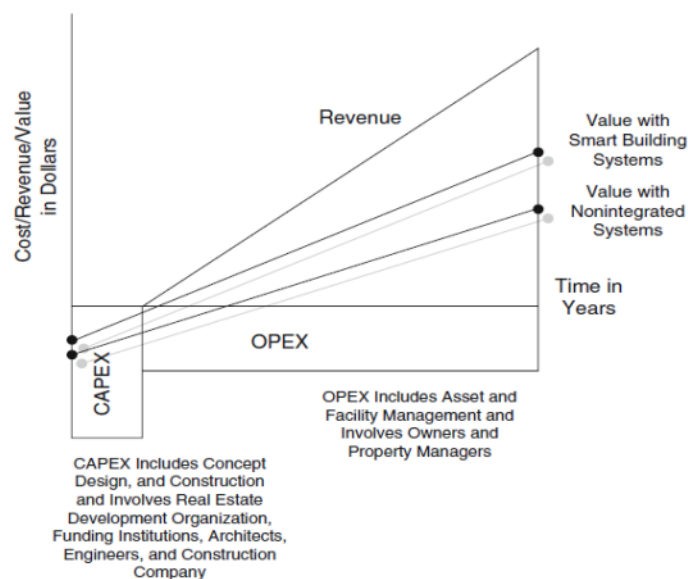


Fig. 3: Distribution of building cost in smart building systems

Table 2: Smart buildings vs. traditional buildings

Amount (%)	Costs
56	Less in first cost
32	Less in annual costs
82	Less in annual maintenance
10	Less in utility costs
16	Less in cabling costs
44	Less in labor hours

CONCLUSION

In smart building systems the project has many more contractors or subcontractors involved. Each contractor mobilizes a workforce and has to be managed, monitored and coordinated by the general contractor. Approximately, 30% of the project management is eliminated by consolidating the systems and cable installation. Smart building systems also involves consolidation of system servers. This consolidation results in less hardware, less space and reductions in ongoing software licenses. This may result in relatively small cost savings but it is still streamlining as a result of squeezing the redundancies and inefficiencies out of the legacy approach to system deployment. Smart building systems also affects the number and functionality of the system administration workstations.

Eventually, the smart building systems increases the efficiency of building design and construction and produce more functional building systems that improve the operational performance of the building while lowering costs.

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