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INFORMATICS DESIGN PROCESS FOR INTELLIGENT BUILDINGS

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Abstract: *An intelligent building needs to be designed to meet the needs of initial occupants and be flexible to meet the needs of future occupants. Creating an intelligent building does require an investment in advanced technology, processes, and solutions. An ingenuous investment is required to realize a significant return later on. It is unrealistic to expect to make a project intelligent unless there is early acquisition in on investment. Over, these decisions need to happen prior to the start of design work. One of the challenges is to educate owners on the benefits of an intelligent building design. This makes the education of both owners and architects about the benefits of intelligent solutions significant for success.*

Key words: *innovative design process, future housing, open-building,*

1. Introduction

Over the last 20 years, there has been a lot of discussion and debate about the concept of an "intelligent building." Work has gone on in many forums to define and quantify what the term really means. The end result of all of these efforts is that an intelligent building is realized as follows: "Use of technology and process to create a building that is safer and more productive for its occupants and more operationally efficient for its owners"

Intelligent Buildings drives a proven, co-creative process that will generate long term, sustainable value by increasing quality utilization, aligning stakeholders and permanently changing cost structure.

The results from implementing these technologies and processes are buildings that cost less to operate and are attraction more to their occupants. For projects that are proprietor engaged, the benefits of an intelligent building provide immediate benefits in terms of higher employee productivity.

For commercial developments, these projects are expected to result in above market fees, improved maintenance, higher occupancy rates, and lower operating expenses. All around, this is a win-win situation.

The technologies and processes that are required to create such projects start with design and go through long-term operations, modify the building by adding newly developed parts that were not available when the building was made and eventual decommissioning.

The decision to make a project "intelligent" needs to come early in the design process for intelligent buildings. Making the decision to create a new project or modify an existing one to make it intelligent is similar to invest in a project with superior performance and value. Once

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this occurs, the design process can continue as usual.

Intelligent buildings are designed for long-term sustainability and minimal environmental impact through the selection of recycled and recyclable materials, construction, maintenance and operations procedures.

Providing the ability to integrate building controls, optimize operations, and enterprise level management results in a significant enhancement in energy efficiency, lowering both cost and energy usage compared to non-intelligent projects.

2. Intelligent buildings design

One of the first attributes in an intelligent design is to carefully evaluate the current and future use of the project. This starts by clearly identifying the purpose and needs of the targeted building occupants. This process will vary depending on whether it will be an owner occupied or a commercial development.

For an owner-occupied building, surveys and focus groups can be held with the building occupants, analyzing and prioritizing their needs to select proper project features.

The reality is that most innovations come from a process of rigorous examination through which great ideas are identified and developed before being realized as new offerings and capabilities. It is important to realize, however, that few projects are used as originally envisioned. A good intelligent design should incorporate flexibility to allow for easy change.

Examples of this type of design characteristic include communications, life safety, automation, structured cabling design, and open space with movable or demountable partitions.

An intelligent building needs to be designed to meet the needs of initial occupants and be flexible to meet the needs of future occupants.

An intelligent building design begins by looking at the site as it integrates with existing buildings; space planning as it is a new “green field” location, getting it in the right position for maximum solar efficiency.

Site integration is critical for environmental impact, and strongly affects how the building occupants interact with the building.

At a macro scale, community integration is determined by community space planning and zoning regulations. The attribute intelligent makes the building more marketable with a lower impact on the environment.

An intelligent building starts with an environmentally friendly design. Creating a project that is environmentally friendly and energy efficient connect in closely, with many of the intelligent attributes [1].

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Providing the ability to integrate building controls, optimize operations, and enterprise level management results in a significant enhancement in energy efficiency, lowering both cost and energy usage compared to non-intelligent projects. Intelligent buildings are intended to be the preferred environment for occupants.

This requires focused attention to environmental factors that affect occupants’ perception.

An intelligent design finds the balance, providing a superior indoor environment and minimizing energy usage and operating labor. This is where the technology becomes valuable [2].

The starting point for the development of the building system is based on informatics tools. Thus the quality and efficiency could be enhanced considerably.

3. Building modeling

In architectural design, modeling is a process, either mental or externalized, of translating conceptual ideas into visual forms. Although at its root the idea of modeling has been the same throughout the history, it has taken on many forms of expression. These expressions are mainly the result of technological advances in producing imagery. Design thinking is a collaborative process by which the designer’s sensibilities and methods are employed to counterpart people’s needs, not only with what is technically feasible and a viable business strategy. In short, design thinking converts need into demand. It’s an approach to problem solving, which helps people become more innovative and more creative.

In the past, building modeling has been widely used as a design tool and often for construction as well. In an intelligent building we would expect that this model will be used by new sophisticated tools that will actually be able to use the original modeling information to make decisions about optimization and continuous re-commissioning of critical building systems. Ideally, the model will follow through the lifetime of the building, be updated as necessary and serve as a digital document of the building [3].

An intelligent design needs to start with a complete model. This modeling begins early on with CAD designs that evolve into project renderings. Using new standards such as AEC-XML and GB-XML, this information can readily be shared with HVAC and other system models. Three-dimensional modeling and visualization in motion introduce a new dimension to architectural representation.

Building information modelling tools (such as Autodesk Revit®, VectorWorks Architect®) were developed to integrate design information with the geometry, however, studies indicated that such tools were primarily used by architects as visualization tools ignoring their other functionalities.

In architectural design, modeling is a process, either mental or externalized, of translating conceptual ideas into visual forms. Modeling of an intelligent building will be used not just in design, but will continue into construction and operation.

4. Virtual prototyping

A compact definition of the virtual prototype is the following: A virtual prototype is a computer simulation of a physical product that can be presented, analyzed, and tested from concerned product life-cycle aspects such as design/engineering, manufacturing, service, and recycling as if on a real physical model.

On the bases of the virtual prototype the designers manage to lower costs, reduce risks and enhance experience. The actors - the designers and the clients - cooperate in three key areas of interest: strategy development, solution architecture and program management. Once built, a virtual prototype can be used in the whole product life cycle from preliminary design to cost estimation, manufacturing, and marketing.

The construction and testing of a virtual prototype is called virtual prototyping. Virtual prototyping software not only simulates the way things appear but also the way things work. They enable designers to check for potential design problems, such as difficulty in accessing components and completing assembly sequences. Designers can perform several “what-if” tests prior to the development of the first real prototype.

The use of virtual prototyping optimizes the design performance, increases collaboration, reduces costs and shortens time to production.

Even if buildings have static structures, everything else related to architecture is dynamic. Functions and environmental conditions of buildings dynamically change during building life cycles. The types of such changes as recognized by open building literature include spatial changes, increasing or decreasing floor areas, changing functions and changing needs of different groups of inhabitants.

5. Open building design process

The Open Building concept aims to address changeability with individualized characteristics. Open Building aims to involve users in the building process and to create buildings that have increased flexibility. Flexibility of the building is designed with the facility to make changes at the various levels of technical composition of a building. For an open building design process an essential phase is the simulation as a means of imitating a real system and predicting its behavior [4].

Computers have had the ability of simulating most of the aspects of design for a long time, but such applications are not widely used in practice. This is mostly due to the lack of integration between analysis and design tools.

Conventional simulation tools encompass building designers with a large amount of data, often in a format difficult to understand, so the practitioners are not very willing to use conventional simulation tools because of the non-graphical output and uncomfortable interface of such tools.

In conventional building design practices, form generation is followed by performance evaluation. In this “generate and test” model, form generation takes priority over performance evaluation.

The current international effort in building and engineering design is attempting to achieve a higher level of integration between form generation and performance evaluation [5].

Despite the gradual transformation of design techniques, experiencing design in an integrated way is yet only possible with the virtual prototyping approach.

In this paper we propose an non-conventional building design technique using Delphi programming platform. Delphi Object Oriented Programming language allows the programmers to create and manipulate objects.

Delphi, along with C++ and Java, is a fully object oriented language. The principles of object oriented programming are the same in all these languages, though of course the syntax is different.

Once we’ve learned the principles, however, no matter which language we learn them with, we’ll find that knowledge transfers easily to other languages. Basic concepts and data abstraction are the same in C++, Java, and Delphi; it’s just the language syntax that differs.

Virtual prototyping on Delphi platform allows us to look at a system as a whole. A building is a perfect example for such system. Virtual prototypes enable several “what-if” scenarios to analyze the results of change. In our example, a scene shown in Fig. 1, presents a virtual intelligent building.

The virtual building system makes it possible to implement a range of different housing plans and to adapt these plans to correspond at changing housing needs. However, the users (occupants and buyers) did not become involved just after completion; therefore, any design modifications - to meet the needs and demands of future occupants - could not be made in the construction stage.

Inevitably, traditional ways of thinking and working had to make way for more innovative approaches. One innovative approach is the virtual prototyping.

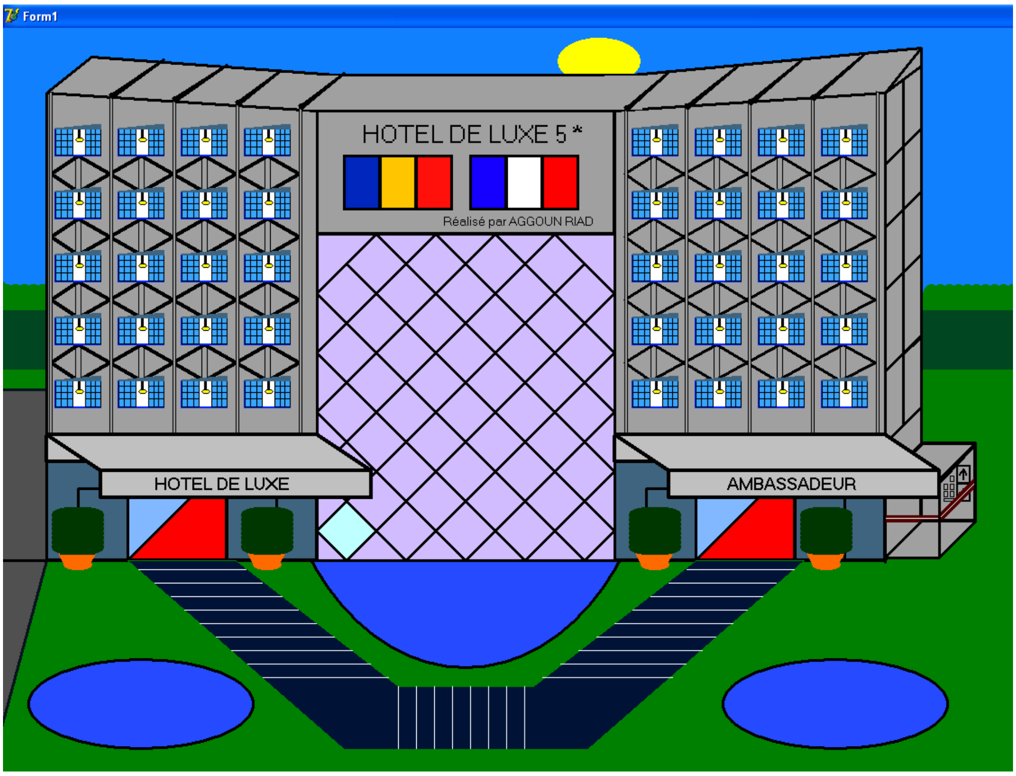

Fig.1. *The use of virtual prototyping for design evaluation in a new building: virtual model with controls to investigate the effects of change in design parameters*

6. Validation of the models

Validation of simulation models and representations for visualization is an important stage of the design process.

Validation of the model is required for any type of simulation to ensure that the virtual model effectively represents the reality. Visualization techniques and virtual representations should well respond to the needs of the building design process.

Virtual prototyping offers new characteristics that make it a distinctive and unique world-class experimental R&D infrastructure designed for the evaluation and optimization of new construction components and solutions, systems and services. The main distinctive feature of the Virtual prototyping is its capacity to create realistic scenarios, its "*openness*", to perform experimental research regarding the intelligent buildings.

It is important to note the contribution of Virtual prototyping for the activities related to the new product development for buildings.

Currently, the technical development of a product begins with the numerical analysis and simulation of the product, carried out in a virtual scenario. The prototype building structures - starting from the most basic problems and leading up to more complicated cases - includes numerous scenario of building frames.

The product is then tested in a laboratory in accordance with standardized procedures, and is finally launched on the market.

7. Conclusion

In this paper, a structure intelligent building prototype with innovative technologies is analyzed. The construction of an intelligent building starts with early planning in the design stage.

The paper contains a virtual intelligent building and design example drawn for a future construction and is joined by a large library which covers background analyses and computer subroutines.

The author considers this analysis a planning technique necessary to ensure the edification of the future buildings. He provides a large range of computer subroutines with reference to the scenario of prototype structures and their components.

The in-depth consideration given to the major design problems associated with virtual prototype structures will reduce the effort and expense involved in future construction.

Prototype building structures will provide very useful guidance for practicing engineers, researchers, designers, technologists, mathematicians, and specialists in computer aided techniques of construction.

Long before construction begins, architects sketch their visions. From casual sketches to intricate architectural drawings, a concept emerges. Next come elevation drawings, section drawings, and detailed plans. Eventually the architectural firm will use CAD software to create complex renderings and 3D views. Each stage of the creative process gives insight into the architect's imagination. Here's a sampling of architectural drawings for a variety of projects, from famous structures to visionary structures that were never built.

The informatics design process serves to planning, designing, and constructing buildings in their totality, taking into account their environment in accordance with the principle of utility and beauty.

This paper purposes and suggests the innovative tools for design the intelligent buildings for avoid the limitations of conventional design methods. The scope of the paper is to facilitate the further studies in the virtual building prototypes. The author hopes that this paper would be useful and attempts to discuss many aspects of the subject with her students.

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