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SMART BUILDING

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ABSTRACT
The Information Communication and Technology industry is made up of enterprises concerned with the design, manufacture, installation, development, support and management of computer-based information systems (both software and hardware).

The rapid expansion of electronic technologies within the global TELECOM industry has been accompanied by an explosion of automation applications that are redefining the way we perceive and experience communication, entertainment and security in our personal and professional environments. Convenience is now a function of the extent to which electronic appliances and gadgets are 'online' and accessible through land and wireless networks. Information flow is expected on demand -constant, reliable, accurate and accessible. Such changes have understandably raised expectations with regards to the how effectively we function, in the places we live and work.

No where have the effects of this new technology been felt as powerfully as in the global real estate industry.

I. INTRODUCTION

As the Telecommunications Exchange examines the issue of "infrastructure" and "access" to advanced telecommunications technologies, consider incorporating into the definition of "infrastructure" the basic facilities in which we live and work. Those basic facilities are the structures; i.e., the physical buildings, in which we live and work. In that context, the issue of "access" should also be examined with recognition of buildings as part of the infrastructure needed for the expansion, growth and diffusion of advanced telecommunications technologies.

What we see, feel and touch in our home and work environments will inextricably impact on our sensitivity to and receptiveness of advanced telecommunications technologies. By promoting the renovation and construction of those environments into "Smart Buildings", we may well be one of the most omnipotent and omnificent vehicles to advance diffusion and drive the demand side of the market.

The purpose of this paper two fold. First and foremost it presents a background narrative on the origins, innovations and applications of novel structural automation technologies and the rarity of experts involved in research, development and practice of this field. The second part of this paper presents a rudimentary framework for a solution addressing this paucity – the creation of an interdisciplinary academic programme at Kuwait University that will be the first ever in the region to address applied information communication technologies (ICT) in the design, planning, engineering and management of structural automation projects.

1.1 Current Applications of ICT in Real Estate: What is a Smart Building?

A "Smart Building" is a building, which is both technologically advanced and sustainable, creating efficient and harmonious relationships between natural, built and social environments. As such, it is designed, equipped and constructed or renovated:

- Incorporating innovative and technologically advanced components and systems to facilitate communications, system management, user control and adaptability to changing needs;
- To be energy-efficient and water-efficient for year-round low operating costs, occupant comfort and environmental preservation;
- To create a barrier-free, non-toxic, healthful, functional and aesthetically pleasing facility to promote occupant and visitor health, satisfaction and productivity;
- Utilizing resource-efficient materials and methods in a low-impact manner to minimize waste in its entire telecommunication infrastructure. and ecological degradation;
- To be affordable, cost-effective and marketable.

The term "Smart Building" refers to technologically advanced structures that are equipped with structured cabling in order to allow it's occupants to remotely control a wide range of electronic features and devices encompassed by its network (Clements-Croome, 2003). Effectively, buildings are designed with an IT infrastructure that resembles the human body's central nervous system - whereby sensory receptors collect input from the surrounding environment, relay the data as electronic signals conducted by the wire infrastructure to a processing centre *usually referred to as the building management system (BMS). The BMS is automation software that allows for (1) the translation of the input signals into meaningful descriptions of the environmental conditions; (2) The comparison of the synthesized data with pre-set conditions; (3) the manipulation of the raw data into effector signals which activate electronic or 'smart' devices, commonly appliances. In this way, environment conditions can be controlled and regulated through an infrastructural IT facilitated feedback mechanism. The origin of the input signal can be self generated through detectors geared towards the collection of specific types of environmental information. or user generated. The process by which these cables are installed and utilised in a structure is referred to as building automation.

The technologies that comprise this sector are:

- *Building Management Systems*
- *Metering technology*
- *Environmental sensors*
- *Lighting control systems*
- *Energy auditing/optimisation software and services*
- *Broadband / mobile network hardware, software and service providers*
- *Environmental sensor technologies*
- *Data loggers*
- Building Optimisation software

The definition offered for "Smart Buildings" may be surprising because it is more expansive than the more common definition that looks only to technological sophistication. The reasoning for the expanded definition is to acknowledge coordinate issues of cost, energy and accessibility.

The cost attributable to incorporating advanced telecommunications technologies into building structures can, in part, be offset by the cost-savings gained by utilizing resource-efficient materials during construction and by making those buildings energy-efficient and water-efficient through design methodologies (Karmi, 2005). In order to avoid the segregation of physically-challenged individuals, technologically sophisticated places of work and of cultural/social exchange should not only be "barrier-free" but also integrated seamlessly, through universal design techniques, so that they are psychologically as well as physically accessible (Karmi, 2005).

We are "cave-dwellers" and the more we see, feel and touch advanced telecommunications technologies in the comfort of our work and home "caves", the greater our receptivity. This logic supports greater ubiquity rather than less and suggests that the role of government in fostering infrastructure and access should, in part, be to facilitate and promote the construction of "Smart Buildings" as a diffusion tool.

It is inevitable that future-building standards will adopt high-tech methodologies for construction utilizing recycled materials and integrated wiring. As real estate companies examine their role in the promotion of advanced telecommunications technologies, it may well be appropriate to direct state agencies and sub-recipients to construct and renovate its buildings utilizing Smart Building standards (Younge, 2005). It may also be appropriate to update building codes to promote the stepped-up infusion of Smart Building construction and wiring standards as part of its regulatory policy (*ibid.)*.

1.2 Rationale behind the development of an academic capacity building initiative for Applied ICT Studies in Real Estate

The design, construction and operation processes of smart buildings are undergoing a rapid evolution as a result of major financial, technical and environmental factors operating both regionally and globally. The most characteristic changes revolve around the inclusion of IP-type networks in building management systems resulting in the development of the much talked about 'integrated solutions' approach to building automation. The recent flourish in the demand for such technologies is best explained in light of the financial advantages integrated systems yield when it comes to reducing total capital and operating costs of a building as well as providing efficient control of expensive resources.

Landlords, developers and contractors in general are taking notice of the business case behind building automation and its potential to optimize structure management. Many view integrated building systems as means for producing high performance, cost-efficient 'smart' structures that are capable of creating and maintaining customized internal environments within the buildings themselves. From a tenant perspective, the incorporation of these technologies are seen as value-added services that allow them to control aspects of their surroundings to meet their unique requirements. However, the road to the successful realization of the perfect living or work space is littered with obstacles that can quickly prove disastrous to the uninformed developer.

How do you select the best suited technology amenities that will address tenant needs? Do the building designers and managers have the resources to understand, implement and manage system integration processes and technologies? How do you

manage energy usage and costs or the coordination of multiple designers and contractors? How do you procure the right facility management tools in order to obtain accurate and up-to-date information on the building's performance? These are some of the most common questions developers struggle with when looking to build smart.
The experts capable of providing professional consulting and engineering services related to integrated building technology systems are extremely rare in the Gulf regions as this field is still in the embryonic phases of both academic and practical development. This is the rationale behind the development of the regional capacity building initiative that is described in part II of this document.

II. LITERATURE REVIEW

2.1 Origins and Development of Building Automation Technologies

In 1984, the National Association of Home Builders' Research Centre assembled a unique alliance of leaders from the building, manufacturing and utility industries (Albertos, 1982). The goal of this alliance was to create a Standardized Automated Home Management System of interconnected, compatible electrical and electronic components and equipment (*ibid.*). The result was the development of a commercially feasible, cost-effective energy and communications distribution system that enables integrated building automation (*ibid.*).

At about the same time, the Canadian Home Builders in collaboration with the Canadian Department of Energy, Mines and Resources promoted the development of the Manitoba Advanced House Project to explore energy-efficient, environmentally sensitive construction practices (Mitchel, 2005). In 2005, The European Construction and Autoworkers Union met to discuss contemporary best practice standards in structural automation. During their discussion, they were able to identify key global drivers for the development and expanision of smart building technologies and expertise (Jendi, 2007). These included:

POLITICAL

- Political stability of countries supplying energy
- Will of international governments to reach new international agreement on climate change (e.g. Kyoto 2)
- Governments mandating the use of environmentally smart technologies in public buildings
- Government introduced league tables for 'greenness of buildings'
- Security concerns at use of building monitoring (terrorism and criminal)
- Consistency of views on environmental improvement by political parties
- Eradication of fuel poverty

ECONOMIC

- Investment in energy supply infrastructure
- Liberalisation of energy market across the EU
- Increasing energy consumption due to economic growth in EU, Asia, North America and the Middle East
- Prices of commercial and residential property
- Continual growth of China, India and other emerging economies drive up resource prices of technologies
- Price rises on electronics materials and components
- Growth of renewables as a share of total energy supply

SOCIOLOGICAL

- Perception of safety of in-building wireless metering/monitoring networks
- Perception of privacy and civil liberty issues from building monitoring
- Growth of an IT/internet literate population comfortable with using new technologies in the home/office

TECHNOLOGICAL

- Supply limitations on materials such as steel for micro-generation technologies
- Degree of investment in enabling networks (i.e. mobile 3G, internet) across Europe
- Availability of integrated 'sense and respond' technologies enabling building management systems to identify external and internal environmental conditions based on sensor and forecast data and optimize the environment accordingly x
- Existence of technology standards for interoperability of key environment technologies
- Availability of skills for the development and support of building environment monitoring and optimization technologies
- Pace of development for low power environment monitoring and optimization technologies
- Growth in micro power generation
- Pace of development for environment monitoring and optimization technologies that are easy to install and support (e.g. based on digital TV, broadband, mobile and other technology platforms)

- Impact of analogue TV ‘switch off’ in any countries around the world in providing an enabling infrastructure in homes and apartments

ENVIRONMENTAL

- Increased demand for cooling technologies and related support requirements
- Climate change
- Catastrophic weather conditions
- The impact of Voluntary codes of practice (e.g. BREEAM)

LEGISLATIVE

- Harmonisation and simplification of several national planning regulations for the use of microgeneration technologies in buildings
- Updates following the EU EPBD directives
- Usage of 2011 census for environmental data gathering
- Changes in the Emissions Trading Scheme
- Impact of WEEE/ROHS regulations
- New Health & Safety regulations
- EU directive for the opening up the energy services market
- Government mandates on energy regulators and the importance in the mandates of environmental issues

2.2 The Business Case for Building Automation: Statistics and Market Review

Fundamental definitions of smart building technologies, standards of practice and achievement in architecture, design and real estate are changing along with the public’s expectation of living and working in a smart space. With innovations in professional practice and related businesses being offered up in the architecture, engineering and construction (AEC) industry, the advent of smart technology is moving forward as an independent driver that operates change and business strategy in real estate.

. This revolution on the horizon has motivated vendors, technology providers and service managers to widen their horizons and ever changing context that smart technology is bringing to the landscape. We feel that such a change is driven by:

- Process innovation, driven by advances in technology and better management - a new, significant distinguishing characteristic of leading architecture and engineering organizations and their clients in Kuwait and across the GCC countries.
- Increasingly competitive architecture, engineering, and construction markets which are changing the fundamental tenets of the design and construction economy.
- Competitive pressures are increasing productivity and changing financial benchmarks of firms in this field.
- Intelligent and integrated buildings are becoming the norm; they require increasingly sophisticated professional service delivery.
- Globalization is forcing increased efficiency in the construction industry and has been credited with lowering professional service fees.
- Speed-to-market is forcing new fields of collaboration, including advanced design-build models, and more sophisticated forms of service-content project management and teaming models.
- Building information modelling (BIM) is perceived as an important tool of change and competitive advantage for organizations transforming the A/E/C industry.
- Building lifecycle management solutions will improve process and open new service expansion doors for entrepreneurial firms and could further disperse and diversify their current offerings.

III. Technology Summary: Current Best Practice in Building Automation

Electrical wiring and gas piping of the building infrastructure to accommodate the future networking of all appliances, communications (telephone, teleconferencing, satellite and video), lighting, personal computers, plumbing, security and ventilation systems with a central building computer programd to operate, maintain, monitor and respond to each element of that infrastructure.

- A technology-based building management system comprised of an integrated building network of energy, communications, audio/visual and telephone services, controlled by a central computer and accessed by a control panel, hand-held remote, touch-tone telephone or local, personal computer. This system allows for the programming of heating/cooling, security, lighting, gas and electric appliances and devices throughout the building.
- Installation of a central control room and central building computer system, programd to operate, maintain and monitor all major systems and to recognize various operational modes, e.g., auto, daytime, night-time, weekend, etc.).
- Every room is equipped with electric outlets that also include small computer chipboards and telephone lines that are integrated into one circuit.
- All equipment is activated by telephone; touch screens or remote control infrared devices.

- Interactive multi-media teleconferencing is available in central conference rooms, selective suites and on networked PC-computers within the building and with the outside world.
- Security monitoring is accomplished on a room-by-room basis through the central computer, with fire, burglaries and other emergencies responded to by activating alarms, turning on lights and direct calling of fire and police departments. In certain emergencies, the computer will identify safe exit routes and create a lighted path for occupants to follow.
- Control of safety and security features including video monitoring of individual rooms and exterior spaces, automatic dial-out to police, fire and monitoring stations, TV and computer monitor display of security and safety messages, lighted exit paths, zoned security and electronic door locks.
- Control of air comfort features including zoned temperature and ventilation control, with pre-programd setbacks and outdoor monitoring, motorized draperies and skylights.
- Control of energy management features including remote, direct and programd on/off controls, load management, surge suppression, ground fault protection, remote meter reading, multi-way dimming and switching, pre-set lighting levels, light groupings, and programmable lighting by time of day, "mode" or action-response.
- Affordable, cost-effective and Marketable services, such Features are prioritized according to a cost-benefit analysis and feasibility study.

3.1 Components of a SmartBuilding

Smart Buildings include the following rudimentary components:

<u>Passive Elements</u>
The cabling infrastructure that facilitates land or wireless relay of raw data to and from input and output components. These include network infrastructure, wiring (structured wiring, CAT5, COAX, etc.)

<u>Active Elements</u>
Electronic components that control regulate and manage data flow on the network between different components by modifying the basic characteristics of an applied electrical signal (e.g. rectification, switching, amplification, etc.). E.g. Switches, VoIP.
<u>Access Control & Security Elements</u>

Access control refers to the ability of a controller to allow or deny individuals physical or digital access to predetermined resources and can therefore secure or help to manage them – although the principle application of such technology to this day remains security. Access control is implemented using two types of technology. These are:

- <u>Control Points:</u> Physical or digital barriers that block or allow access to resources (places, files, people) through electronic signaling. These are also referred to as authentification terminals since users are required to produce documentation authentificate their identity and clearance levels to access the resources in question. Examples of a physical access control point is door that is locked and unlocked using electronic switches which may be initiated manually by a security guard in charge of checking the ID of those trying to enter or by asking them to enter a code on a keypad. Alternatively, this process may be automated through the use of radio frequency identification (RFID) technology or biometric measures such as retina and finger print mapping, which are far more reliable.
- <u>Control Databases</u>: When access control points are automated through biometric, PIN, RFID, etc., the identification data input by the user into the access control system at the control point of authentification terminals is recorded and cross referenced by the system in an internal database on which individual ID's and their corresponding resource access is mapped.

<u>Audio-Visual Components</u>
These are components that emit information through visual and/or auditory mediums. The most common examples include televisions and radios.

<u>Building Management Systems</u>
These are large, hierarchical software and hardware components that are installed to monitor, control and modify the performance of the entirety of passive, active, AV, Access and other electro-mechanical components (light. HVAC, power, cooling, security, etc.) Present within a building. Building management systems are used to automate or streamline manual management of the entire facility. Optimization of BMS performance is currently achievable through integration of traditional BMS components and IP based technologies.

The extensive incorporation of IT components into building designs has resulted in changes to the way construction industries select their building materials to accommodate for automation. These changes affect engineered, manufactured building components or modular construction and have created a need for the industry to become more familiar with high-tech cabling system and equipment requiring a specialized approach to design and project management such as:

1. High-tech cabling system with the capacity to provide triple play services (Video, voice and Data).
2. A backbone Fiber Optic foundation to the Building site.
3. Harmonized service structure platforms that provide the billing services.
4. Hierarchical network designs as stipulated by passive and active structure requirements.
5. Hair-thin fiber optic strands that lace the building walls, with light piped through the strands, which upon even modest damage bleed the laser light profusely to reveal cracks in the building structure.
6. Fiber strands that are filled with liquid calcium nitrite, an orange anti-corrosive chemical, are laced through concrete covering metal reinforcing beams (i.e., rebars) and sealed with polyol, a waxy coating that dissolves in water, are used to protect the rebars when moisture seeps through the concrete. The fiber melts when contacted by the moisture and release the anti-corrosive chemical. Likewise, fibers containing sealant glue fracture when concrete cracks and release the sealant to automatically repair the crack.

3.2 Smart Homes

Home automation is the use of one or more computers to control basic home functions and features automatically and sometimes remotely. Home automation can include the scheduling and automatic operation of water sprinkling, heating and air conditioning, window coverings, security systems, lighting, and food preparation appliances. Home automation may also allow vital home functions to be controlled remotely from anywhere in the world using a computer connected to the Internet. Besides the functions already mentioned, remote control can be extended to telephones and answering machines, fax machines, amateur radios and other communications equipment, and home robots such as automatic vacuum cleaners.

The fundamental components of a well-designed home automation system include a computer (or computers) with the appropriate programming, the various devices and systems to be controlled, interconnecting cables or wireless links, a high-speed Internet connection, and an emergency backup power source for the computer, its peripherals, and the essential home systems. Ultimately, home automation results in remote or automatic control of things around the home.

Real estate companies realize that home and structure automation in general is cost-effective and affordable while offering many benefits to tenants such as enhanced convenience, personalization and security. The following list outlines how selected building components can be automated to enhance the user experience:

1. Lighting

- Control light fixtures from anywhere in the house, or control them remotely via the internet.
- Connect fixture controls to motion detectors that regulate lighting intensity in response to movement of persons in the home.
- Connect fixture controls to RFID readers that identify a user and activates a personalized lighting profile for that individual whenever they are detected in the proximity.

2. Security Systems & Access Control
- Tenants are automatically alerted remotely in the event of fire, intrusion or any programd alert situation.
- Unlock/lock doors remotely.
- Install biometric or RFID identification protocols to control who is able to access areas within your home.
- Document the number and identity of persons accessing parts of your home along with time and customized alerts.
- Install CCTV and monitor who is at your door by viewing an audiovisual feed on your computer, TV, Landline / intercom or mobile.
3. Home Theatre & Entertainment Systems
- Control all electronic appliances with a single controller.
- Activate customized start up profiles for specific activities.
- Download all channel programming onto digital high definition TV memory at the beginning of the week and select when and which order you want to watch your selected programs.
- Install customized in-built or wireless speakers.
- Archive your movies on your TV memory, browse and access them at the touch of a button.
4. Phone Systems
- Caller ID, Busy number re-dial.
- Receive text. Video and voice messages on your landline

- Reduce cost of your phone bill with Voice over IP (VoIP) applications.
- View your phone messages on your TV / computer.
- Access your phone messages on your computer.

5. Thermostats

- Adjust the temperature of your home on your cell phone or computer.
- Customize temperature settings to match the preference of a user.

6. Irrigation

- Water your plants when you’re away by mobile or via the internet.

Control of smart building components can be accomplished through remote and automatic settings.

Remote Control

Remote control gives you the convenience of controlling lighting, appliances, security systems and consumer electronics from wherever you happen to be at the time, like your couch, car or even in your bed. There are several different "methods" of controlling devices remotely. Below we highlight the pluses and minuses of each.

Remote Technology	Advantages	Disadvantages	Popular Applications
Infrared	Affordable	Line-of-sight	TV / consumer electronics
Power line	Affordable + whole house	May need noise filters & phase couplers	Lighting, appliances and security
Radio-Frequency (RF)	Works through walls	Long distance issues, more expensive than X10	Garage doors, computer networking
Power Line & RF	Affordable, whole house, works through walls, no noise filters required, works with legacy X10 products, maximum speed and reliability, adding products increases reliability	-	Lighting, appliances, computer control
Hardwired	Speed and reliability	Cost & difficult to retrofit	Video, networking & high-end applications

Automatic Control

Automatic control adds even more convenience by making things happen automatically, without any effort being necessary. Examples include having your lights turn on at dusk and off at your desired time, having your whole home theatre turn on and tune to the desired station after one press of a button on your remote.

3.3 Smart Towers: The Commercial Tower Template

The same automation technologies present in home automation are commonly applied in business facilities such as commercial towers – on a larger scale. Technological ‘smart’ components are incorporated into a large, hierarchical network.

Networks are now the centre of the modern, global village’s infrastructure. Increasingly, companies are extending their workforce to far-flung corners of the world, tapping fast-growing emerging markets and new sources of talent. More and more, virtual companies are throwing off the limitations of distance and physical offices. They are exchanging information and linking their systems with those of partners, suppliers, distributors and customers. Their staff operates round the clock and, often, from hotel rooms and conference centres or regional offices.

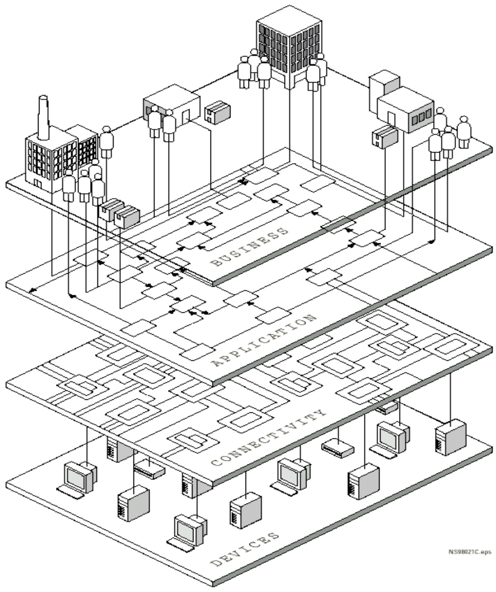
In this emerging twenty-first century model of business and organizations, the network is the glue that holds the organization together. It is a medium of commerce, coordination and collaboration. As the limits of the enterprise are extended, the network must become totally global, 7x24 and dependable. To do so, requires re-engineering of the corporate network and integrating it with public services delivered over the Internet. It also requires that IT managers take a hard look at how they manage this business-critical information infrastructure.

Today, it is no longer enough for IT operators to think of applications and information as just bits on their network pipes. Real Estate Network service managers must now understand the business, its information needs, and its application usage patterns. Network failures and service degradation directly affects customer satisfaction, worker productivity and supply-chain coordination. Network performance and availability must be ensured to keep the business running smoothly.

To address this growing dependency between business operations and real estate service network management, This is a comprehensive methodology for strategically instrumenting, monitoring, and controlling business-critical enterprise networks infrastructure. This methodology provides meaningful information about network availability and performance, voice traffic, workloads, as well as where and why a network failed. A well-planned investment in Network architecture and services Flow Management also improves management efficiency through capacity planning, performance tuning, policy management and accounting since it monitors what application is using a given critical resource and who is running it. In designing the framework, and when viewed from the service structure,

This approach is based on the following milestones.

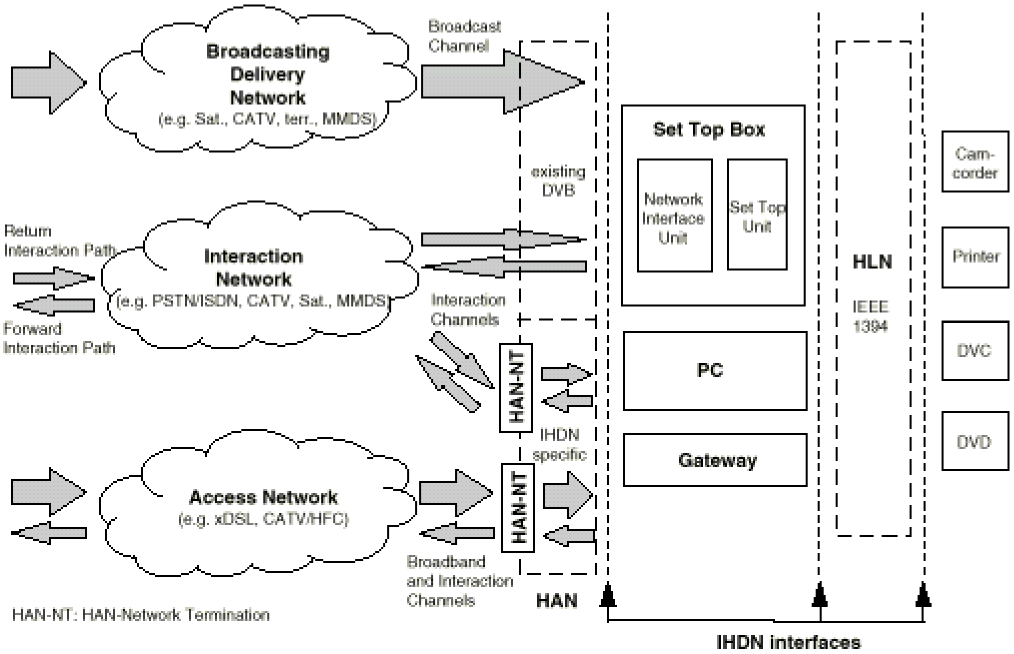
1. How do we start?
2. How do we implement it affordably?
3. How do we structure the offerings?
4. How do we assure the security at every point?
5. What are the building blocks for the new e-Infrastructure?



6. How do we maximize availability and uptime?
7. How do we manage the network?

The concept of Intelligent e-services in a complex is based on the following 4 conceptual layers, The devices layer, The connectivity, the applications layer and finally the Business layer. Such concept have made the following significant contributions to end customers and building management alike:

- The corporate network becomes a competitive differentiator
- The network management becomes business critical
- Building services and networking facilities has evolved to better support the business.
- The Age of device Management is evolving
- Fault isolation, service routing and troubleshooting are a must for businesses today.



For all services, users will interact with a common Integration platform that delivers high-speed connectivity. This backbone framework will allow users to have a common interface point that can deliver all their communication needs. This platform will then interact with the second layer of which all activities are processed and service is modelled. And then finally, the service is provided by the delivery mechanism, being a set-up top box or a computer interface or a universal USB or even Blue tooth connectivity. In a service industry like Hotels, the accessibility is based on three tiers of network architecture, a Broadcasting Delivery Network, Interaction Network and Access network.

Part II: Proposal for Establishment of an Applied ICT Specialist Program in Structural Automation:
A Collaborative Capacity-Building Initiative Between Engineering, Architecture and Information Communication Technology Disciplines

IV. KEY ELEMENTS OF THE PROGRAM FRAMEWORK

Part I of this paper has highlighted the plentiful and economically significant applications of ICT in the global real estate industries, with specific attention on the rise of structural automation technologies incorporated into smart buildings. The purpose of this section is to propose a rudimentary framework for the installation of a capacity-building initiative at Kuwait University that will see the interdisciplinary collaboration between Engineering, Architecture and ICT programs. The purpose of this program is to enhance regional research and development capacities in the field of structural automation while supporting the creation of a suitable, qualified workforce that will meet the industrial demand in ICT practical applications.

4.1 Vision Statement

To create the first ever, regional capacity building initiative in applied ICT studies specialising in structural automation.

4.2 Mission Statement

To provide students with the skills and knowledge to pursue careers in newly emerging applied ICT fields while creating a regional capacity for the creation of a qualified workforce to meet the industrial demand and to spur research, development and innovation.

4.3 Learning Objectives

The learning objectives of the applied ICT program in structural automation will supplement the current learning objectives of electromechanical and communication engineering programs already installed within Kuwait University. The program aims to develop in it’s students technical proficiency in the following:

- Data Networks
- Voice Networks
- Video Distribution
- HVAC Control System
- Lighting Control
- Lifts
- Access Control
- Video Surveillance
- Power Management
- Audio Visual Systems
- Facility Management Systems

In addition to the above, students are expected to develop core competencies in the following areas:

Project Management The ability to:

- Confer with engineering, IT consulting and design staff to discuss ICT components of specifications and procedures.
- Coordinate and direct projects, making detailed plans to accomplish goals and directing the integration of technical activities.
- Analyze ICT resource needs, and market demand, to plan and assess the feasibility of projects.
- Plan and direct the installation, testing, operation, maintenance, and repair of ICT components, systems, facilities and equipment.
- Direct, review, and approve ICT component design and changes.
- Prepare budgets, bids, and contracts, and direct the negotiation of ICT based contract and contract components.
- Develop and implement policies, standards and procedures for the engineering and technical work performed.
- Perform administrative functions such as reviewing and writing reports, approving expenditures, enforcing rules, and making decisions about the purchase of IT related materials or services.
- Review and recommend or approve IT components of contracts and cost estimates.

Analysis The ability to:

- Monitor and identify performance of selected ICT system components
- Assist users to identify ICT related requirements and recommend solutions that incoproprate them.
- Design and implement systems, network configurations, and network architecture, including hardware and software technology, site locations, and integration of technologies.
- Identify areas of operation that need upgraded equipment such as modems, fiber optic cables, and telephone wires.

Design The ability to design passive, active, access control and security components of structures.

Engineering The ability to:

- Read and interpret blueprints, technical drawings, schematics, and computer-generated reports.
- Confer with engineers and other personnel to implement operating procedures, resolve system malfunctions, and provide technical information.
- Research and analyze customer design proposals, specifications, manuals, and other data to evaluate the feasibility, cost, and maintenance requirements of designs or applications.
- Specify system components or direct modification of products to ensure conformance with engineering design and performance specifications.
- Research, design, evaluate, install, operate, and maintain mechanical products, equipment, systems and processes to meet requirements, applying knowledge of engineering principles.
- Investigate equipment failures and difficulties to diagnose faulty operation, and to make recommendations to maintenance crew.
- Assist drafters in developing the structural design of products using drafting tools or computer-assisted design (CAD) or drafting equipment and software.
- Provide feedback to design engineers on customer problems and needs.
- Oversee installation, operation, maintenance, and repair to ensure that machines and equipment are installed and functioning according to specifications.
- Conduct research that tests and analyzes the feasibility, design, operation and performance of equipment, components and systems.

Financial Analysis The Ability to:

- Caulcuate cost of projects IT components
- Capital planning of ICT projects

- Ability to forecast on model the financial affect of ICT integration on project and end-result.

Specification Preparation The ability to:

- collect and analyse ICT requirements from a user perspective.
- ability to assess user's pre-existing ICT components.
- The ability to prepare, analyse and cost ICT component specifications.

Operational Support The ability to understand ICT systems and how they operate.

4.4 Assessment & Measurement Index

The program will comprise of two parts: (1) required course study (taught components) and (2) a practical paper written after the student has completed internship participation on a structural automation project.

Quantitative and qualitative criteria for assessing student's development of core competencies will be developed at a later stage.

V. IMPLAMENTATION STRATEGIES

5.1 A multidisciplinary approach to Coordination and Collaboration

The Applied ICT program in Structural Automation draws appropriately from primary disciplines that inform it (such as, ICT, planning, engineering, architecture and design) to define and apply new ways of understanding complex situations. To realize this framework, a new department, institute or academic division should be founded to administrate courses and manage curricular activities.
Applicants are admitted to the specialist program under the general regulations of the School of Applies Sciences. Admittance will be decided by a special admissions committee composed of representatives of all the primary disciplines. Ideal candidates should hold an appropriate four-year Bachelor's degree in electromechanical engineering, communication engineering, structural engineering or ICT-related subjects, with a final year average of at least B+ or its equivalent from a recognized university. Students who have done coursework in related fields which they would like the admissions committee to consider should attach a separate sheet, listing these courses and explaining the relevance to the proposed program of study in applied ICT in structural automation. Explicit and implicit- set forth in the student's "AREA OF CONCENTRATION."

Each student, with the help of a faculty adviser, must select courses and focus his/her major on the basis of a unifying issue, theme or topic called an Area of Concentration. The area of concentration must meet three criteria to be acceptable:

- First, the area of concentration must be interdisciplinary. This means the area of concentration must integrate knowledge from at least three fields and disciplines. The principle of integration can be historical, regional, thematic or problem-focused.
- Second, the area of concentration must not replicate one in an existing major.
- Third, the area of concentration must be feasible. Each student's proposed program must be discussed with a faculty adviser to make sure that the range and number of courses required will be available.

5.2 Monitoring and Evaluation

Processes for reviewing, monitoring and evaluating the program form part of its quality assurance framework. They are to be conducted taking account of the policies and strategic directions of the University, with reference, as appropriate, to relevant comparative or evaluative data. Information derived from evaluation, monitoring and review processes will be used to develop and shape the teaching and learning environment. The policy and procedures outlined below provide the framework within which the university will oversee the review, monitoring and evaluation of the Applied ICT program in structural automation.
Definitions
For the purposes of this proposal: "Review" refers to course reviews, normally undertaken on a five-year cycle, including reviews of significant course components or academic offerings. "Monitoring" refers to annual monitoring of courses including significant course components or academic offerings. "Evaluation" refers to student evaluation of topics, and five yearly evaluations of all topics by the relevant Academic Organisational Unit/s.
Review, monitoring and evaluation of courses, topics and components of courses are intended to enable the University to:

- assess the overall quality of the teaching and learning environment, and judge whether educational aims and learning outcomes have been achieved;
- identify areas where performance needs to be improved, and strategies for improving performance in these areas; and monitor improvements over a given period of time
- Consider the ongoing value, viability and sustainability of the course or topic, and its

relevance and place within the University's academic program.

VI. CONCLUSION

As regional economies become more and more familiar with the benefits of incorporating ICT into their business processes and structures, the demand for experts who can design and implament related solutions is expected to increase. The need for a home grown capacity-building initiative to strengthen applied ICT discplines has never been greater. It is with this manpower forecast in mind that this white paper is submitted for your kind attention.

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