Strategies for smart building realisation

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Abstract:
Smart buildings as a concept is now becoming prominent in the vocabulary of Architects, Engineers, Construction contractors, Technology companies, Property developers and the Estate or facility management function within organisations. Public or private sector, smart building goals are now prevalent in corporate strategies whenever new build or retrofit / refurbishment is planned.

But there seems no common consensus on what this really means. The 1990’s and 2000’s witnessed much hype around intelligent buildings concepts. However in many instances the hype never produced tangible results. Now the scene has changed. Sustainability and carbon management is increasingly on the agenda of boardroom decision making and “smart” in smart buildings seems to have a purpose, almost as a mission statement.

The lack of clear definitions on what encompasses a smart building and what is to be expected when utilising a smart building whether as a solitary or group experience is causing the supply side industry to throttle back the adoption rate. Value structures justifying adoption are not clear in this early adaptor stage. Thus costs associated with the realisation of a smart building are quite hard to justify. This is compounded by the rapid pace of technology advancement and the continual refresh of new products and solutions that purport to provide an improved functionality or better price to performance advantage.

Thus strategies for smart building realisation need to be formalised into industry accepted frameworks which can be applied in many market sectors – or verticals, and which can be applied in the context of small, medium and large buildings or campus premises. This paper presents some thought leadership in this emerging area of expertise and provides concepts that may form the fundamentals for a future framework.

The author provides a perspective as a professional in Consulting for the Engineering and Construction industry with regards to integrating ICT systems into the built environment. ICT infrastructure comprises much of the building blocks for smart building enablement alongside automation and controls, electronic security and facility management applications. Converged IP networks, integrated command and control rooms, utility (smart) metering and integrated BMS (iBMS) enables smart building functionalities to be implemented. This paper presents viewpoints across all of these subject areas in the context of policies, technologies and obstacles.

Keywords:
Smart, buildings, master systems integrator, procurement.
1. Overview

There has been a lot of interest, investment and initiatives in the field of smart building, aka intelligent building, functionalities within the construction and technology sectors in recent times. Property developers, building owners, design and engineering consultants, facilities managers, product or system vendors, and some managed service providers have all invested in this area of work and now this community is effectively a stakeholder offering value added products and services for commercial returns.

The apparent lack in understanding or appreciation of the value structures that frame the concepts for smart buildings has seeded the need for further debate. This paper is intended to promote further debate within the end user and practitioner community with regards to some of the challenges in the whole procurement cycle from early conceptualisation, requirements validation, scoping and subsequent design, construction, commissioning and operational readiness.

Smart buildings realisation ultimately has to exist within the established protocols surrounding design and construction, which on the surface is easily achieved. However the growing dependencies between traditional Mechanical Electrical and Public health systems and business facing ICT together with associated specialist trades such as electronic security, audio visual and multimedia, building automation and control systems provides an additional layer of complexity which if unmanaged introduces new risks to design, assurance, performance and operation.

Ultimately, all the stakeholders involved will aspire to successful outcomes that delivers value add, high availability and reliability (Smith, 2002). This will invariably mean a joined up and co-operative approach across trades – a challenge for the industry which has a bias to conservative methodologies and silo based work practices for specialist trades.

2. What is a smart building?

The very clear and a certain point of principle is that buildings are form and function oriented, meaning that various market sectors will have certain bespoke and generic concepts for a building.

For example in the manufacturing sector, buildings offering office accommodation adjacent to a production facility will have some characteristics suited for the function which would not be found in a city centre professional services office building. This could be as simple as having a low cost approach to the shell or interior of the building, or a design that is demountable or transportable within a manufacturing facility.

In contrast an office building in a city centre intended for multi-tenancy with a target market in the professional services sector may well have attributes of a plush interior and will need to focus on user comfort and convenience.

Achieving a common consensus across all markets for what ‘smart’ means will therefore be difficult unless of course one has a more holistic view and somewhat generic attitude to broaden the definition.

Today such a holistic and generic definition may centre on themes of efficiency, sustainability or rich experience (CABA, 2008). Efficiency may be with building operations...
or business functions, sustainability could associate with energy or materials, and a rich experience could associate with service delivery.

This paper proposes that such thematic thinking needs to be embraced within the vocabulary of design professionals, clients and supply side contractors. Without such a guiding framework, the plethora of use-cases that could fall under the ‘smart’ definition could be so wide as to cause a high degree of fuzziness in the value propositions being put forward within a business case to justify investment in the realisation of ‘smart’.

In simple terms then a “smart building” could be described as one which is responsive to the functional needs of its occupants, and is efficient and effective from a total cost of ownership view. In this regard cost of ownership could be owner/occupier facing direct costs or a tenancy leasehold with associated service and utility charges. A smart building may also be characterised as having relatively lower depreciation or comparatively higher appreciation in asset values over time in relation to other adjacent or similar structures with comparable uses. Thus a smart building will exhibit traits of higher market and/or balance sheet attractiveness.

3. Why need a smart building?

This is quite a philosophical question to ask. However it is a highly relevant question in the modern context. Many businesses looking to invest in owner/occupier building(s) and those in property development and real estate who are looking to profit from construction of speculative structures will at some stage contemplate such a question.

In the past the smart / intelligent building ‘label’ had origins in marketing attractiveness or corporate ‘branding’ needs as a way to demonstrate a unique differentiator. Sometimes this led to gimmicks of technology ‘bling’ or ‘technology for technology sake’ investments without any tangible business workflow drivers. In other instances investments in ‘iconic’ form and geometry was also associated with ‘smart’ realisation, and led to creative structures either loved or hated depending on the viewpoint of the observer. For example fanciful facade structures offering a utility value were the result of such intervention.

In other instances, simple integration, or common use systems – such as a shared cable system or shared data network (aka converged IP network) were touted as signs of smartness and even intelligence. The 1990s for example had many examples of such embryonic thinking and realisation. In recent times there has also been a simplistic interpretation that a unified building management system computing front end is the manifestation of a smart building. We do need to ask ourselves “Is that the be-all and end-all of smart building realisation?”

Today the need for a smart building is characterised by the following drivers:

- Ability to demonstrate sustainability interventions – for example to be energy efficient in operations and/or in design and construction, and to have a means of measuring and monitoring in real time the utility consumption data to make continual improvements to carbon footprint (Sinopoli, 2012)
- Business responsiveness to modern work ethics – for example to allow formal and informal meetings in the right ambiance, improved user comfort and conveniences, flexitime working and hot-desk working, and a work anytime, anywhere concept
where a unified computing workplace, i.e. the computing desk-top is THE workstation, where the physical surface is just an ancillary necessity

- Outsourcing of non-core support functions – for example a smart building could encourage outsourcing the building maintenance, facility management, catering, IT support and security functions, which in some instances may necessitate a partial devolution of responsibility with regards to building management decisions to a 3rd party
- Agility for change in business operations – for example to respond rapidly to an expansion or downsizing plan – such as how quickly can a floor or part building be sub-let or how quickly can the business relocate with minimal property related costs?

Thus the degree of smartness and corresponding scale of investment (and thus smart interventions at the design stages) has a wide catchment definition for acceptable realisation depending on end user focus on any one or more of the above drivers.

Thus one of the early actions – whenever formulating a building brief – is to strategise focus areas in relation to the above drivers. The building brief to an architect-engineer design team should then be clear in terms of ‘smart’ expectation or requirements. Where necessary such activity may be supported by professional advice from technology consultants and building performance engineers.

4. Smart building design brief

The absence of a formative template for structuring a brief which could provide the subliminal comfort of industry acceptance and recognition, and the absence of generic standards is a real hindrance to the process of smart building realisation. Whereas in traditional engineering such templates exist for Mechanical, Electrical and Public health requirements, there are no real equivalents for ICT and other specialist trades such as Audio Visual, Multimedia, Electronic Security and Building automation, controls and management that are cornerstone to smart buildings realisation. Often this seems to arise from the construction industry as a whole, deferring decisions for such systems to the ‘very last responsible moment’ in their design and procurement process, so as to focus on form, function and structure early in the design stage. This can be quite detrimental to smart building realisation since it means that any consideration of ‘design for operations’ is absent in a building brief.

So what should be or could be in a design brief, and how can we get as close as possible to communicating requirements accurately and timely?

To be effective in practice, a smart building design brief needs to focus on the key areas of:

- **Life expectancy** for the building in terms of a short and long term profile, with a set of recommendations regarding expectations of technology longevity/refresh cycles in all building engineering disciplines – from MEP, facades, fire, acoustics, lighting, vertical transportation, ICT, audio visual, electronic security, automation & controls and FM and logistics. Thus one would expect guidance on major refurbishment cycles and how this would impact on mainstream and specialist disciplines
- **Concept of operations** for the business and the building, in an owner-occupier model, and a concept of operations for just the building in a speculative multi-tenancy type building. Thus one would expect guidance on the workflow dependent
technology aids, decision support systems enablement (such as alarm management, incident management, metering and performance monitoring policies) and KPIs which could also include targets such as carbon emissions

- **User centric experience** for key occupant profiles, from support staff to production workers or visiting guests whether in the knowledge economy or in other mainstream functions such as manufacturing, science or research. Thus one would expect guidance on the level of richness required in the user experience and how the building ambiance and interior, the engineering and technology systems and ergonomics of furniture fittings and equipment will need to be supportive of the set objective(s).

- **Procurement methods and supply chain** management with guidance on how responsibilities are managed during the entire lifecycle of design, construction, commissioning, fit-out and occupation. For example smart building realisation may warrant extended assurances for engineering continuity across a ‘practical completion’ milestone as a ‘hard stop date’ in contract, which if not planned for in advance could become a particular problem later. Early guidance on how fit-out activity aligns with a business facing operational readiness and service activation process in the lead up to occupation will be of value during the planning and construction phases of a building project. Where smart building realisation is enabled using particular software applications which have engineering dependencies across contracting boundaries, early definitions for how this will be managed is highly valuable to mitigate technical and administrative risks and manage/contain costs.

- **Value management** for smart building realisation with guidance on how costs are managed as a whole, where direct costs for engineering assets and systems are compared with opportunistic savings from a smart building realisation; for example reduced man-power in maintenance activities, savings from common/shared assets and integrated spaces and efficiencies in energy consumption should form part of the overall cost model; a smart building realisation should ideally not have a net uplift in construction costs, and a value management statement should outline how this should be achieved, prior to a RIBA stage C or an AIA concept commencing.

Historically investment in a smart building brief is seldom found at a RIBA stage A, B or C or equivalent AIA design stages. This has been a contributory cause towards under delivery on ‘smart’ ambitions set by the client and for being one of the first items to be value engineered out whenever budgets are under pressure – i.e. it is hardly considered to be a must-have non negotiable item.

Thus the availability of a smart building design brief at early feasibility and planning stages which forms part of a design brief to the architect will mitigate some of the risks causing under delivery on many construction projects. In fact at the feasibility stage there needs to be due diligence analysis to align smart objectives with a well rounded technology vision and a technology Masterplan. Why you may ask, the simple answer being that many construction projects tend to have a long incubation period, and timelines of 3 to 7 years are not uncommon. Technology advances in industry are constantly encouraging rapid obsolescence and mature or proven concepts of the day may well be out-of-date by the time a building is ready for fit-out and occupation. This should however not be a barrier towards any form of investment in technology, but it should encourage a means to manage technology deployment, investment budgets and procurement strategies using a custom project governance policy and procedure that is understood by all stakeholders.
5. Prioritisation of objectives

A strategy for smart building realisation needs to consider the issue of prioritisation of requirements associated with ‘smart’ objectives. The ownership of the ‘smart’ objectives customarily is not clear cut – between the estates function, the IT function and the business administration function. Thus it is common for a brief to be a collection of wish-list items with no positive attributable ownership or priority. Moreover business case justifications for wish list objectives are absent or fuzzy in a typical smart building brief which usually causes design team stakeholders, mainly project managers and cost consultants, to begin questioning or challenging the brief.

Prioritisation is a necessary part of the strategy for smart building realisation. To do this effectively one needs to have a CFO / CEO perspective of the business – such as its outlook, core values, near and long term ambitions, and appetite for specific investments in ‘smart’ objectives that support specific causes; for example sustainability initiatives, CSR, regulatory compliance, and monetisation of infrastructure and facilities (such as renting out meeting and conference spaces or subletting excess floor space).

This paper proposes that prioritisation should always be a client function and never delegated to a design team, although a design team or specialist technology consultant may contribute to the prioritisation and decision making processes. Thus at the feasibility stage a design brief should ideally provide guidance on the prioritisation of requirements falling within the ‘smart’ objectives.

One of the safeguards that assures continuity of intent during the project lifecycle from early inception to final occupation is the knowledge of available budget for each of the smart objectives, or at the very least a headline budget for the ‘smart’ brief. Should this budget allocation effectively be a positive sum or zero sum calculation within the whole project is one question which needs to be carefully thought out at the feasibility stage. For example a zero sum calculation is where existing budget allocations across various trades are ‘taxed’ to create a new budget for smart objectives, and a positive sum calculation offers new budget to add to the planned budget. For example a positive sum may be justified on the basis of added property value or kudos associated with a differentiator. There could also be a halfway house where planned budgets are taxed (to a lesser degree) and some new money is allocated for ‘smart’ objectives.

6. Functional use cases

Smart objectives may become fuzzy within a governance structure where requirements are headlines only with little detail. Functional use-cases may be developed for each of the desired smart objectives to illustrate what is actually to be achieved. The importance of elaboration of use cases is the ability for wider communication of business intent and its dependencies with the built environment, interior design, furniture, fittings and equipment and the impact if any to existing workflows in relation to core business activity or support functions. This is often quite important at a planning and concept stage of architectural design since space allocations and related parameters are set during a RIBA stage C.

Typically functional use cases tend to converge around headline themes such as:

- Enhancements to visitor/guest services
Operational enhancements to estate and facility management workflow
Co-ordinated incident management and decision support systems with interfaces to fire systems, security systems, ICT and building controls and automation
Unified service desks across support functions such as ICT, AV, Facility management and Security
Metering and sub-metering
Automation in facility reservation systems
Energy management policies
Building performance dashboards and digital signage systems
Orientation and way finding aids
Unified identity management, one-card access, cashless transactions

Other themes specific to a sector, such as rail or air transportation, are likely to arise and should be included where relevant.

7. Planning for implementation

Smart building objectives invariably cut across a number of building trades. In recent times many ICT contractors, mainly system integration companies, have taken the mantle to deliver smart objectives. In other instances building automation and controls companies have been the prime contractor for this work, and often they are referred to as a ‘master systems integrator’, or MSI.

The procurement of such services is not as straightforward as some might wish. Often issues of timing, contractual interfaces and responsibilities, handover milestones and related critical path dependencies make the process of managing the implementation quite a complex task. Competencies around smart building realisation within general contracting is not yet mature, and finding human resources with the experience and skills to deliver efficiently is still a challenge.

Thus an essential component forming the strategies for smart building realisation is the presence of a joined up procurement strategy that finds the path of least resistance within the supplier/contractor community. The procurement strategy should also consider if responsibility for performance and functionality can be continuous from time of installation through testing and commissioning and early stages of live operations (i.e. the transition to service activation). Often this may need strategic foresight in the decision making process to select a vendor capable of offering services beyond the practical completion of a construction contract, where obligations are clearly bounded but not discontinuous across the hard-stop date of a practical completion and subsequent defects management period. The obvious risk that needs to be managed is that a contractor who is construction facing may have no interest in how the systems perform in real life even though ‘smart’ objectives will be based on the promise of workflow or energy management related benefits which are closely linked to the internal working procedures of a business organisation. Thus a basic reliance on standard warranties and guarantees for materials or workmanship may not be enough.

One means of mitigating risks associated with the procurement is the availability of competent professional services during the design and tendering stages of a project, which is able to represents the interests of the ‘smart’ objectives in the design team. Creating a specialist package of work that articulates the ‘suite’ of smart requirements using contract
language, technical standards and KPIs which can be verified at set milestones is a specific output that should be delivered by a smart buildings consultant. Industry experience suggests risks may be better managed by way of traditional design team engineers, architects and specialist consultants working for a client/owner directly rather than as part of a design and build contracting team. One reason for such assertion is that the budget holder for smart objectives will be the client at least until a systems design is developed and ratified, whereas in design and build budget control passes to a prime contractor, who may opt to shift budget priorities to manage commercial interests and project outcomes to own agenda. The other reason being that within traditional design teams, a client may have more flexibility to introduce refinement or change to smart building objectives with lower resistance than within a design and build type contract.

8. Wider implications of the proposed strategies

There are many practical and pertinent implications arising from the strategies proposed in this paper. First and foremost, there needs to be acceptance in the construction industry, architectural community and within corporate sponsors of new projects, the growing necessity to include ‘smart’ aspirations in support of sustainability and building performance objectives. This will result in system requirements being mandatory rather than just a “nice to have”. The reason being that, energy and carbon management of the built asset has a growing prominence and is being mandated. Add to this the unspoken or unpublished expectation of business executives for process efficiency aided by a smart building environment.

Secondly there needs to be a greater role for design and consulting engineers in the buildings industry with specialist skills, such as building automation and controls, building operations and logistics and ICT infrastructure, to define performance and functional requirements, well ahead of time. This is alien to the hitherto customary practice of specialist input mid stream in a RIBA or AIA design process. Why, one may ask. The high impact objectives in relation to both the building and the business operational requirements need to influence the design brief for a smart building. Thus, to deliver a smart building with utility value, a considered view of multiples of operational requirements is needed with harmonised inter-relationships. The financial implications (e.g. cap-ex /op-ex) of a smart building need to be assessed at the feasibility stage and a brief generated for an architectural design. For example a wireless and radio friendly building will have requirements in relation to specifications for building materials, facade, interior partitions and an intelligent or active facade solution may have requirements that will not fully align with the former. Equally support contracts for traditional FM functions may not align with a newly acquired smart building. Furthermore, a converged IP network supporting building operations may not align with business requirements for high availability or information security. The outcomes of a requirements analysis and the resulting ‘project plan’ for a smart building/estate will almost certainly influence the form and functional requirements for any building in any sector, small, large or in very large campus construction. The close coupling of building performance aspirations with business work flow efficiency, and the need to collate, process and display various management information KPIs, together with the ubiquity of Ethernet/IP networks in building automation and security systems justifies early input from specialists in ICT infrastructure and information systems.

Thirdly, the construction industry together with the ecosystem of suppliers to the buildings trade need to actively take steps to embrace smart building aspirations even if it means traditional boundaries and responsibility lines need to be reshaped. This may well need new
supportive education oriented information dissemination for continual professional development.

9. Conclusion

Smart buildings realisation is a specialist area of work. There are particular risks to realisation; however the rewards of delivering a true smart building may outweigh potential for disruption from inherent risks. Managing the risks during design and later implementation requires professional expertise, especially if in house technologists and engineers lack experience in this area.

Smart building functionalities are here to stay and will increasingly take on a more prominent role as the ubiquity of anytime-anywhere access to information and knowledge sources becomes more prevalent. ICT tools, mainly end point devices such as the new generation of internet connected tablets and ultra books, and newer generation of AV aids will create opportunities for new applications to emerge offering unified portals to manage the workplace, work area and work station. It is likely that many work places will in the future need to offer a richer experience to its occupants, simplify support procedures to reduce overheads in property and estate, and provide demonstrable sustainability initiatives through smart interventions in design, construction and operations.

Factoring smart building realisation as part of new build or major refurbishment will therefore be top of the list of priorities of many project sponsors.

References:


Sinopoli, J., Smart Building Systems, (2012), Butterworth-Heinemann
Fig. 1. Figure text below the figure (Figure Caption)

References: