

This presentation was live at:



Smart Buildings

SHOW

18-19 October 2023 • ExCel London



Baking Digital into Smart(er) Building Design

...or, why and how to design digital in sooner rather than later.

Ceri Williams

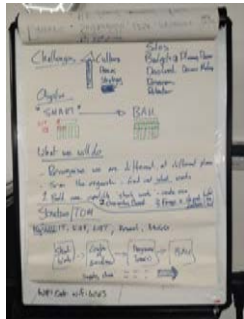
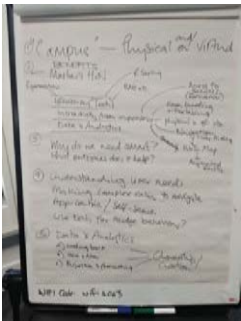
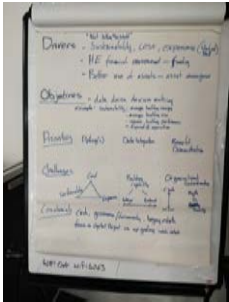
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In a nutshell...

- ❑ Best Available Practice discussed during an intensive set of workshops held in June that brought together senior leadership from Estates and IT functions, Architecture, Construction and Smart Building specialists
- ❑ Consensus was - **typically digital is considered late (e.g. RIBA Stages 4 & 5) in the building design process (new and refit) when it is too late to have much of an effect of the concept and design of space or the business case - especially Opex and User experience. This relegates the role of 'Smart' to building management and operations.**
- ❑ This session covers: Best Available Practice on who should collaborate, when and how to fully exploit the role of digital in smart building design.
- ❑ It considers the transferability of existing practice and inclusion of 'Smart & Digital' as a plug-in, drawing on mature Digital/IT-world methods and frameworks an 'Design-assist' practice.

We brought 40+ folk from Estates, IT, Architects & Constructors together



This is what they said...

- ❑ Digital (especially Smart) significantly affects the business case for the building/refurb project (Stage 0/1 activity)
- ❑ Benefits (e.g. sustainability, user experience, operational cost, utilization) become more constrained, the further through the RIBA PoW you get
- ❑ Digital significantly affects the design of teaching, learning, working and living spaces - future space flexibility has to be designed in early
- ❑ Upfront capital investment reduces operations impact/cost but Smart elements of a building design are usually 'Value Engineered' out to reduce short term Capex and deliver PC asap
- ❑ Smart buildings and campuses are about User experience as much as building & estates management and carbon reduction.
- ❑ While there are technology protocol standards (e.g. for wireless) and BIM standards, there are no viable operational data interoperability standards
- ❑ Convergence of physical and digital components needs representing in development of business cases
- ❑ Existing design guides and policies need modernizing to incorporate Smart Campus capabilities
- ❑ Smart buildings and campuses need a better way of articulating to non-technological senior decision-makers
- ❑ 'Smart' demands an integrated programme of investment into physical and digital
- ❑ Foundation infrastructure and systems (e.g. network, building management systems, middleware, software) to enable visibility and control

...and much more.

So...how to systematize early consideration of 'Digital' and 'Smart'?

We'll need some common points of reference

point of reference

Word forms: plural points of reference
countable noun:

A point of reference is something which you use to help you understand a situation or communicate with someone

point of reference

noun

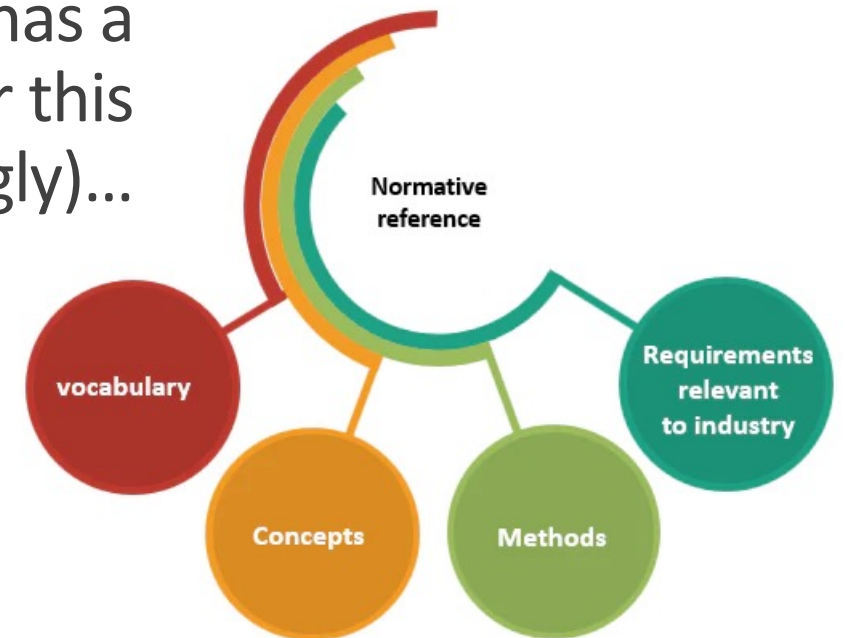
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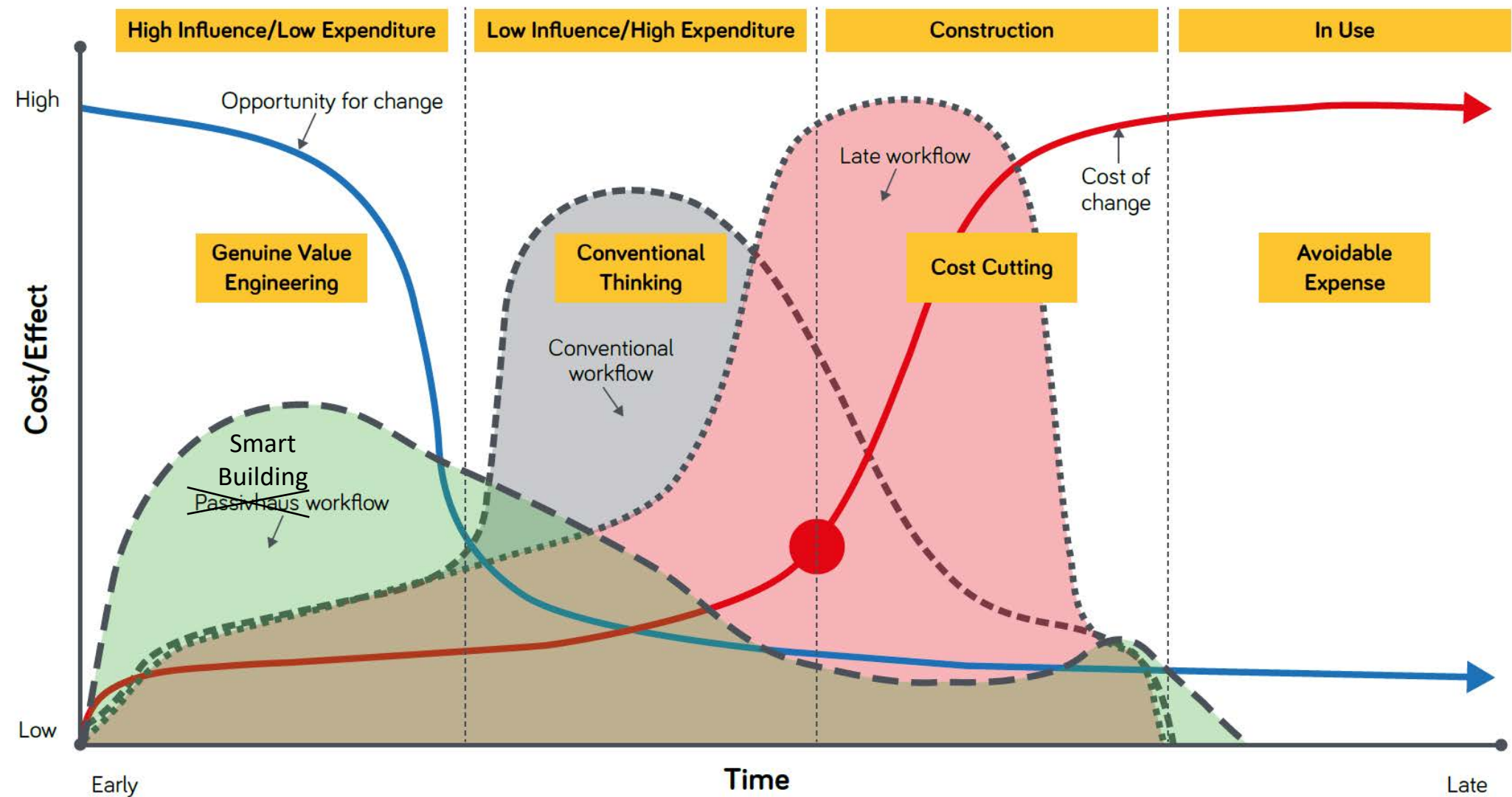
(plural points of reference)

1. something that you already know that helps you understand a situation or explain something to somebody

ISO has a standard for this (unsurprisingly)...

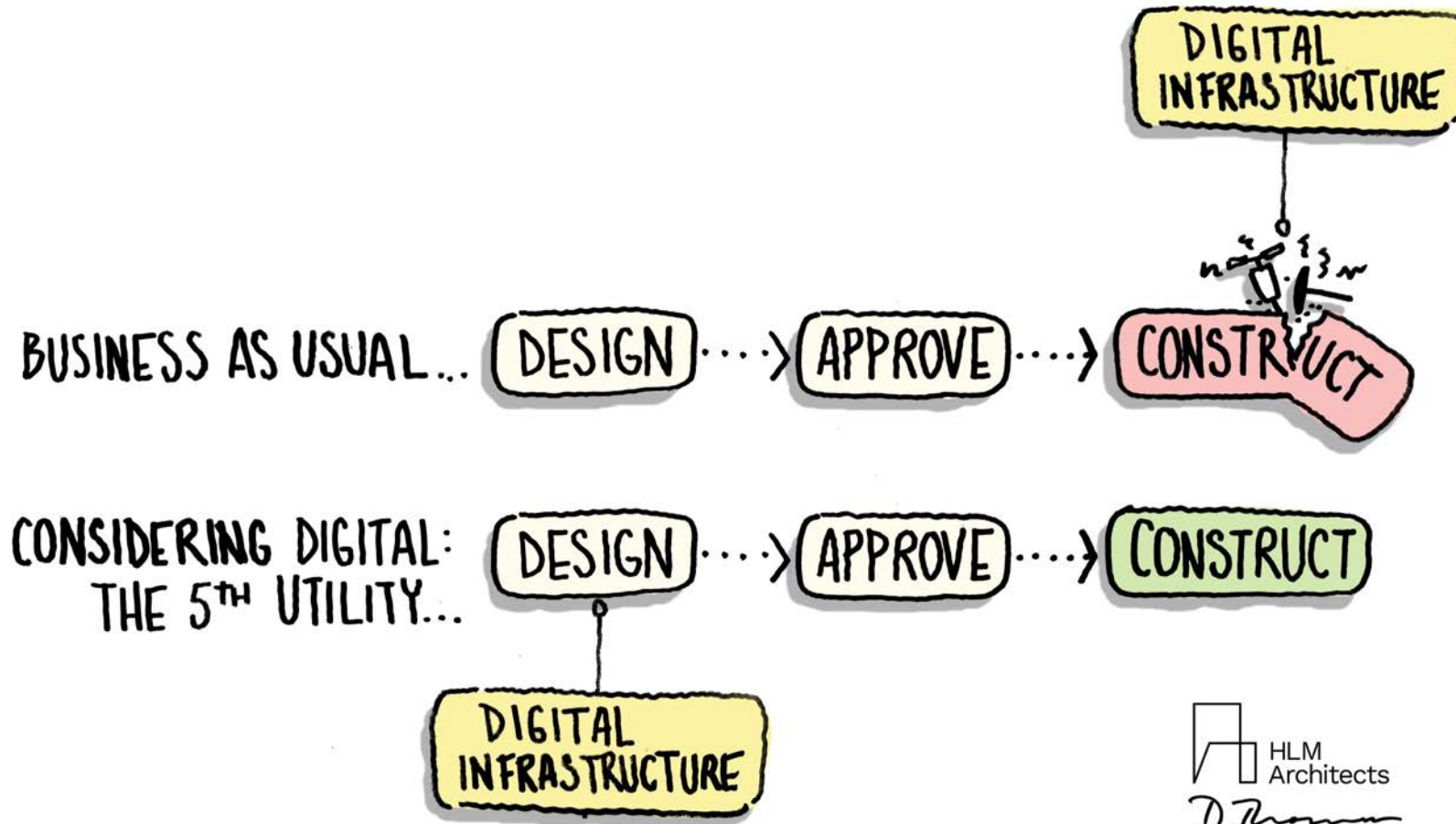


Taking the lead from Passivehaus – RIBA PoW Overlay



Would Smart Digital be much different?

Same message, more playful...



It's about avoiding disruption as a minimum and factoring Smart & Active Building capability into the space design and the business case.

Could we use *Design-assist*?

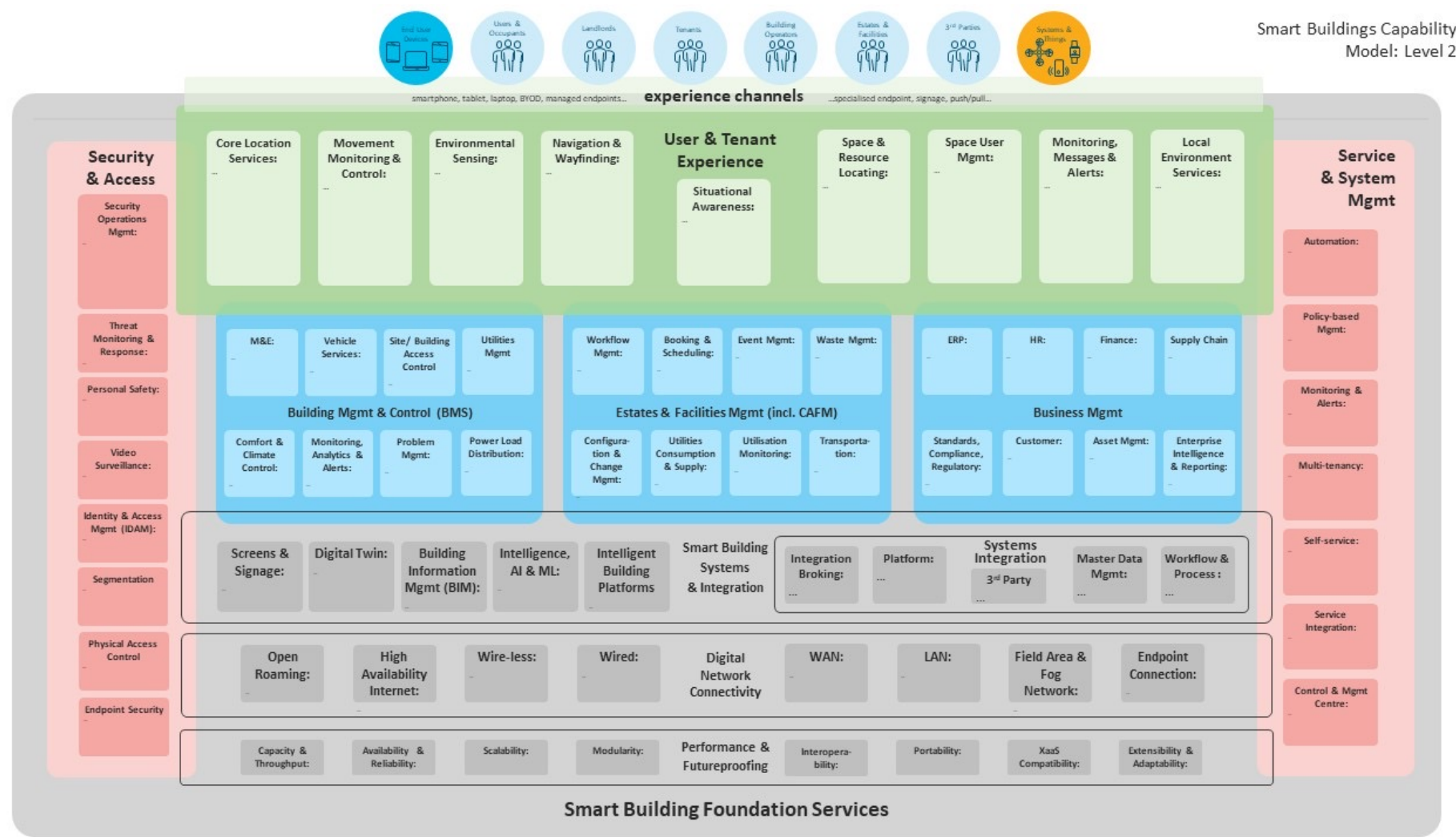
(Formalised practice from ‘over there’)



- ❑ Developed and codified by the AIA with reference to the use of steel
- ❑ Not much of a (formal) presence in the UK, but is occasionally practiced.
- ❑ Emphasises and embodies (contractually) early formal engagement of domain skills, knowledge and capability in the design process.
- ❑ *Design-assist* is a systematic way of mobilising discipline-specific capability early enough in the building project that it maximises:
 - ❑ Recognition of opportunities
 - ❑ Recognition of constraintsi.e. – enabling proper *Value Engineering* not just cost-cutting
- ❑ It systematises good practice that otherwise is highly variable (and therefore not interoperable or delivering ‘standard’ expectations).
- ❑ Details here: www.aia.org/articles/6319252-design-assist-vs-delegated-designindustry
- ❑ All are variants of *Collaborative Design*
- ❑ Worth at least checking out

Design-assist is well established in the US – but has not yet incorporated Digital.
Question: What about a *Design-assist Digital Plug-in* with additional early engagement starting at Stage 0?

To facilitate - we will need a common collaboration language



Something like this

a **Smart Building Digital Capability Reference Model**

to structure the collaborations and decisions at RIBA Stages, plan technologies, suppliers, systems integration and User experience – and not just at Practical Completion.

Common concepts, common language – open and available in the public domain

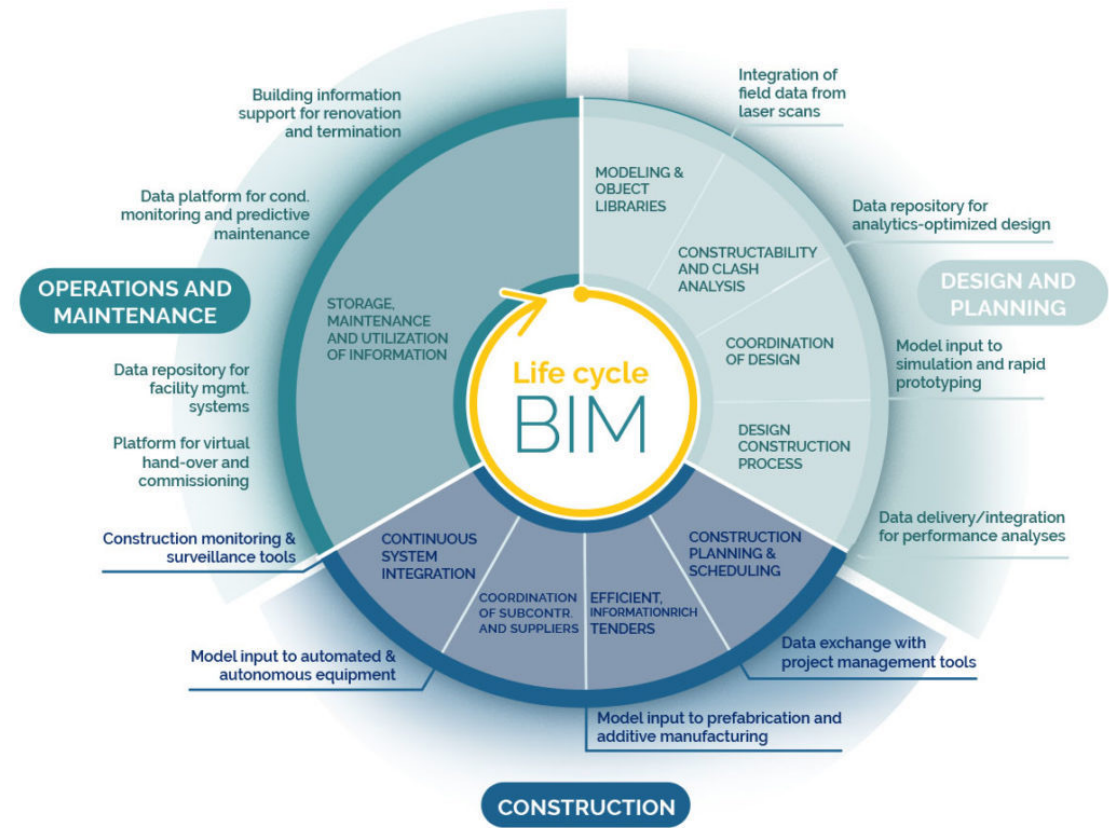


(bread and butter to an Enterprise Architect)

Are we moving beyond BIM 8D and Level 4?

- ❑ COBie (aka BS 1192 & ISO 16739) and BIM (ISO 19650) variants are good (in the right hands) at model interoperability of static building and operational planning & maintenance elements, but...
- ❑ Smart Digital Buildings also need standards for dynamic & behavioural characteristics and the digital technology within the building.
- ❑ This includes registering current state of many environmental, equipment and asset characteristics and actual implementation of real-time control.
- ❑ If Time and Cost are conceived as '4D' and '5D' BIM, Performance 6D, Facilities management 7D, Security 8D then maybe Smart (especially real-time) is '9D' (or BIM Level 5)?

(Or maybe just 'XD' and 'Level X')



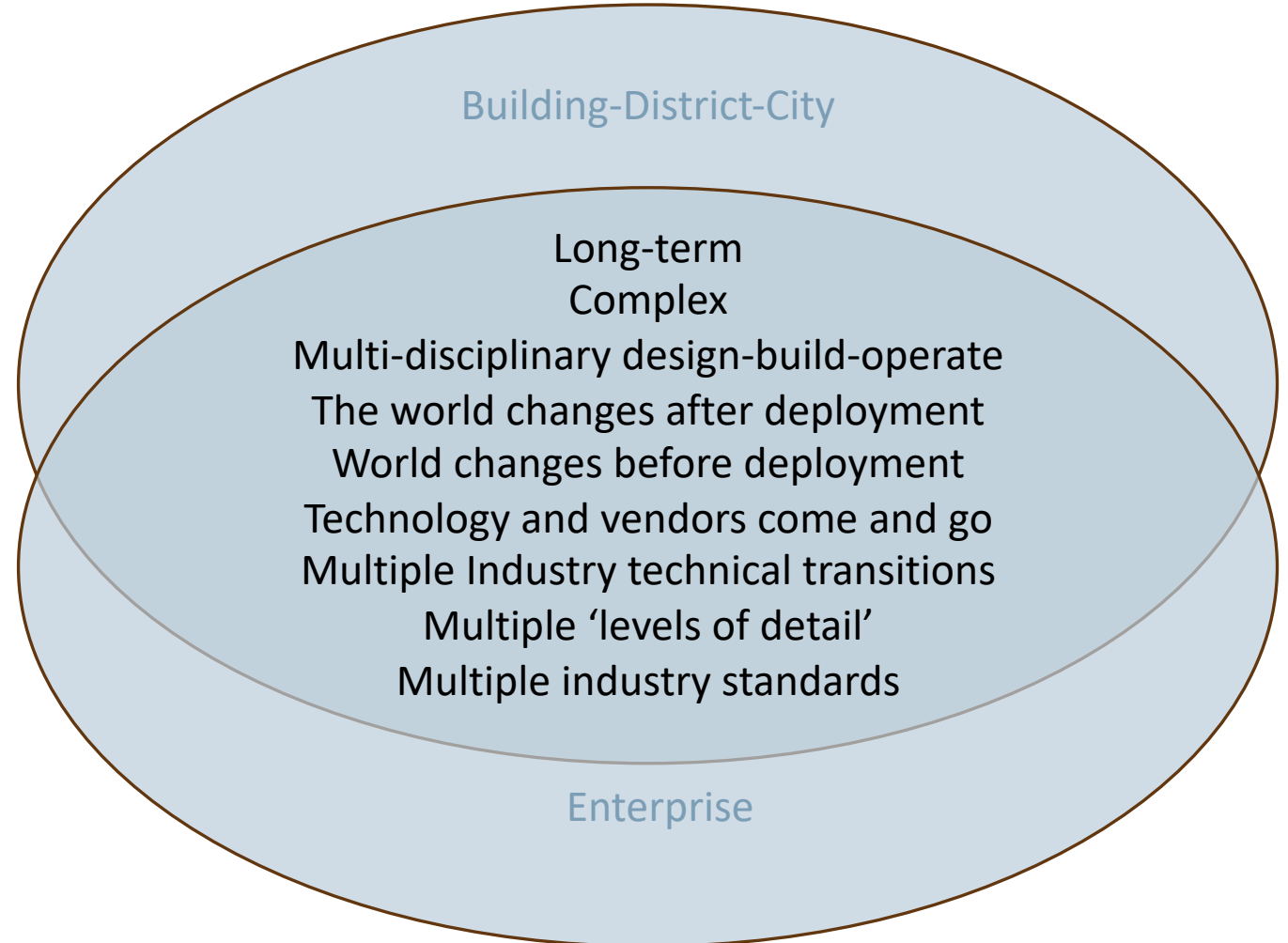
If we are – some sources to consider:

- ❑ Process control – manufacturing, utilities, energy, e.g. PERA (1990s), IEC62443 (Cyber Security)
- ❑ IT, Digital & Service Management – TOGAF (1990s), ITIL (1990s)
- ❑ Enterprise Architecture (2000s), TOGAF, EABOK, ISO 42010
- ❑ Telecoms, Supply Chain & finance industries – SCOR, BIAN, TMF eTom
- ❑ Manufacturing: STEP (ISO 10303) 1988 (echoes in BIM standards)
- ❑ Aerospace: AECMA/ASD-STAN/S1000D (more echoes in BIM standards)
- ❑ Systems Engineering: INCOSE
- ❑ ISO/IEC 30141:2018 Internet of Things (IoT) — Reference Architecture

Learning from Enterprise Architecture

- ❑ In Digital, about 25 years ago, we found that for complex, large scale, enduring estate, a 'Solution Architecture' mindset rarely works
- ❑ It would need an unrealistic fixing of requirements and an unchanging business/market environment
- ❑ Transient technology and vendors mean technology churn and refresh have to be assumed and accommodated
- ❑ Long term evolution facilitated by future-proofing is needed, not point in time 'solutions'
- ❑ 'Open APIs' do not mean 'industry quality' or 'industry standard'. Many are proprietary & at best 'de-facto' standards, not backwards compatible and unstable

Why a building is more like an Enterprise...
than a 'Complex engineering object'





Thank you – let's
talk later

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Smarter Buildings
Overlay to the RIBA Plan
of Work
(Straw Man for feedback)

Smart Building Digital
Capability Categories:

- **Spatial Engagement:** e.g. location, movement, environment sensing, navigation & wayfinding
- **Situational Awareness:** e.g. complex situation detection, AI situation composition, analytics
- **Connectivity:** e.g. Wireless (Wifi, BLE, LoRa), roaming, human end user device, IoT endpoint
- **Access & Security:** e.g. identity, authentication, authorisation, permissions, context-aware authorisation, segmentation
- **Performance:** e.g. capacity, throughput, availability, reliability, accessibility, responsiveness, scalability
- **Architecture Quality:** e.g. modularity, interoperability, extensibility, future-proof, composability, portability
- **Service Management:** e.g. automation, policy-based security & provisioning, monitoring & alerts, configurable, multi-tenancy, self-service
- **Smart Building Platforms:** e.g. integration broking, automation, process mgmt, intelligence
- **Building Management:** e.g. HVAC, entry, monitoring & diagnostics
- **Asset Management:** e.g. fixed and mobile assets, condition based maintenance
- **Estates & Facilities Management** e.g. booking, scheduling, maintenance,
- **Enterprise Management:** e.g. ERP, Finance, Customer, HR, Supply Chain, Business Intelligence

		<div>0</div> <div></div> <div>Strategic Definition</div>	<div>1</div> <div></div> <div>Preparation and Briefing</div>	<div>2</div> <div></div> <div>Concept Design</div>	<div>3</div> <div></div> <div>Spatial Coordination</div>	<div>4</div> <div></div> <div>Technical Design</div>	<div>5</div> <div></div> <div>Manufacturing and Construction</div>	<div>6</div> <div></div> <div>Handover</div>	<div>7</div> <div></div> <div>Use</div>
Stage Outcome		Ensure that Client Requirements are inclusive of the hybrid built/digital experience and active environment control for all space users (e.g. Students, Teachers, Workers) and services.	Capture design parameters in the Project Brief to direct designers to accommodate digital infrastructure in the design and integrate digital and physical experience. Ensure the Project Brief includes the intent to actively manage the environment to deliver a low carbon footprint.	Clearly identify and articulate the role of digital capabilities on User experience, mix of active and passive elements and the relationship between them in terms of the effect on specifics of space design. Identify areas where hybrid experience is significant and capture in the Architectural Concept .	Define the placement, distribution & intensity of Spatial Engagement digital capabilities in relation to all relevant elements of the Outline Specification . Ensure that the relationship between digital and physical elements is coherent. Define interoperability requirements for RF digital components.	Elaborate the Outline Specification to stabilise and detail Smart Digital Building system components and the integration & interoperability between them. Develop detail to a point that facilitates effective procurement of vendor-specific technologies and services.			
Tasks & Information Exchange	Smart Digital Building elements of standard Stage Tasks and Information Exchanges	Prepare the Smart Digital Building elements of the Client Requirements , ensuring coherence and synergy with the built environment, behavioural and environmental elements. Follow all other RIBA Stage 0 Core Tasks guidelines in relation to the Smart Digital Building content (e.g. Business Case, Project Budget).	Prepare the Smart Digital Building elements of the Project Brief , ensuring coherence and synergy with other elements such as Sustainability Outcomes and Spatial Requirements . Follow all other RIBA Stage 1 Core Tasks guidelines in relation to the Smart Digital Building content (e.g. Site Information, Site Surveys, Project Execution plan).	Prepare the Smart Digital Building elements of the Architectural Concept and Outline Specification , ensuring coherence and synergy with other elements such as Strategic Engineering Requirements and Project Strategies . Follow all other RIBA Stage 2 Core Tasks guidelines in relation to the Smart Digital Building content (e.g. Site Information, Site Surveys, Project Execution plan, Plan for Use).	Further develop the Smart Digital Building elements of the Architectural Concept and Outline Specification , ensuring coherence and synergy with other elements such as Cost Plan and Project Strategies . Follow all other RIBA Stage 3 Core Tasks guidelines in relation to the Smart Digital Building content (e.g. Design Studies, Engineering Analysis, Cost Exercises to test the Architectural Concept).	Develop the Smart Digital Building elements of the architectural and engineering technical design, ensuring coherence and synergy with other elements such as Smart Digital Building Systems information. Ensure inclusion of digital capabilities, building operation & coherence of content across all Building Systems information systems, Building Information Management (BIM) systems and Digital Twins .			
	Additional & specialised Tasks and Information Exchanges to address design & use focus items for Smart Digital Buildings	Consider how Smart Digital Building impacts on the Business Case and Client Requirements including how smart technology might influence Smart Digital Building Objectives : <ul style="list-style-type: none">Operational running costs, incl. energy & utilitiesSpace Utilisation, especially multi-purpose/useUser behaviour, incl. footfall, flow & dwellMonetisation and revenue generationPhysical design and user interaction with it The blend of active and passive building elements in achieving project objectives. Consider how Smart Digital Buildings might impact the set up of the project team, Core standard PoW Tasks & Information Exchanges. Consider which Smart Digital Buildings Digital Infrastructure design decisions need to be made at each Stage to accommodate design options at later stages and to ensure minimal disruption in the event of change.	Initiate Smart Digital Building design thinking, including iterative design processes to manage opportunities & tradeoffs between built, digital, social and operational environment objectives. Consider how to incorporate the Smart Digital Building Digital Infrastructure Capability Categories into the Project Brief and Project Programme . Consider Smart Digital Building solutions when undertaking Feasibility Studies considering best practice Smart Digital Building exemplars. Consider how Digital Infrastructure Capability Categories impact the set up of the project team including the Responsibility Matrix, professional services contracts and intellectual property issues. Ensure the Project Brief includes guidance on the key parameters guiding hybrid build design (e.g. User behaviour & experience Strategy, building operations, converged infrastructure).	Embed appropriate Digital Infrastructure Capability Categories into the Architectural Concept , developing relevant detail, prioritizing for investment and defining the extent to which Smart Digital Building Objectives depend on them. Identify and include Smart Digital Building solutions in the Concept Design to deliver Smart Digital Building Objectives in relation to Client Requirements and Business Case . Identify Agent Scenarios, Use-cases and User Journeys (incl. human and technological). Develop guidelines against each to direct elaboration in the Spatial Coordination Stage, the blend of digital/physical capabilities and structures intended. Identify and describe high priority Digital Infrastructure Performance Requirements including capacity, ease of access, availability and responsiveness in relation to human and technological Agents.	Distribute Agent Scenarios, Use-cases and User Journeys over time and space, integrating them into the updated Outline Specification and Architectural Concept . Use this distribution to map Digital Infrastructure Performance Requirements across time and space. Develop clear statements of intent in relation to Common & Shared Digital Infrastructure Capabilities to ensure Technical Design coherence and minimise unnecessary duplication across Information Technology and Operational Technology domains. Define Interoperability Standards for components of the built, technological, digital and human environments to direct the Technical Design stage and ensure decoupling of domains. Further refine Digital Infrastructure Capability Categories and adjust to ensure coherence, including: human-spatial engagement, human-human interaction, access & connectivity, security, service integration & management.	Establish digital technology governance inclusive of the relationships between Smart building technology, the built environment, human user experience, building management & operations technology. Consider & direct how Smart Digital Building capabilities impact on building systems including 'plug and play' connectors and interfaces. Develop the Smart Digital Building Component Architecture considering component granularity, interfaces and specifications. Define the optimum mix of industry standard and de-facto/proprietary standard interfaces. Derive requirements for implied capabilities such as: Local & Wide Area Networks, Security & Systems Management and select key generic technologies, standards and services. Ensure all specifications developed in this phase are agnostic of specific vendors and service-providers.			
Service & Technology Acquisition		Develop the Smart Building Service & Technology Acquisition Strategy and include in Client Requirements to ensure that the built and digital environments are considered as a systemic whole. Define the guiding principles for composite built & digital environment acquisition and operational management. Ensure that acquisition & procurement processes facilitate iterative exploration, options development, value engineering and tradeoff management between built and digital environments.	Define and include in the Project Brief , the key parameters and intentions guiding the Concept Design Stage that constrain the options for consideration in relation to: <ul style="list-style-type: none">Composite/ combined hybrid (i.e. built-digital) building service management & deliveryCapability areas where options for outsourced and managed services should be actively exploredCapability areas where the Client intends to retain hybrid building technology selection decisionsCapability areas where the Client intends to retain or acquire and internal Service Management & Integration capability for the hybrid building.Mapping of key hybrid building service & technology acquisition & management decisions to PoW Stages. Identify and propose the preferred reference standard for service & technology acquisition & management processes (e.g. ITIL-RIBA PoW Hybrid). Develop initial version of the ITIL Service Strategy or equivalent.	Develop the coarse-grained Target Operating Model (TOM) for Hybrid Building Service Integration and Management and include in the Architectural Concept . Use the TOM to demarcate the areas of technology or service management capability to be: <ul style="list-style-type: none">Owned & operated internally by the ClientOwned & operated by third partiesOwned by the client & operated by third partiesOwned & operated by Client or third parties where the decision is dependent on Stages 3, 4 and 5. Explore market for technology vendors, systems integration & service integration 3rd parties and establish feasibility of acquisition. Consider converged approach for all elements (i.e. built and digital) of the hybrid building. Undertake Research and Development with manufacturers to determine supply chain capability prior to design commencing.	Develop second iteration of the ITIL Service Design Model or equivalent based on emerging Architectural Concept, Outline Specification and feedback from the marketplace. Confirm market for technology vendors, systems integration & service integration 3rd parties and shortlist based on capability, track record and ROM cost/ risk/ timescales estimation. Ensure shortlisted organisations are committed to the content of the Smart Digital Building elements of the Outline Specification and Architectural Concept , clearly indicating where they are unable to or have a viable alternative approach. Ensure that the Service Design optimally partitions components of the Target Operating Model and that they are coherent & likely to operate as a unified whole across the hybrid building domains and other organisational capabilities (e.g. IT, Customer Service).	Develop final version of the ITIL Service Design or equivalent based on refined Architectural Concept, Outline Specification and feedback from the marketplace. Develop initial version of the ITIL Service Transition or equivalent. Iteratively develop the Technical Design based on opportunities and constraints discovered with bidding 3 rd parties during the value engineering process. Downselect technology vendors and service providers to be the preferred bidders in each capability domain. Ensure that the party with overall responsibility for coherent design, build, transition and service delivery is clearly identified and capable. Note that this may be a 3 rd party or the Client, depending on the Target Operating Model .			

Stages 5, 6 and 7 are not significantly sensitive to the **Smart Digital Building** domain. Buildings and Campuses are inherently complex capabilities with industry standard frameworks and methods that address the complexity of many diverse interrelated components and parties.

Each organisation and project is likely to already be capable in all aspects of Stages 5, 6 and 7, with preferred frameworks that have already have been subject to significant capability investment, especially by 3rd parties, so the framework will come as part of the commercial package subject to proposal. For this reason, only the Client can own the inter-framework integration model which will be essential for maintaining coherence between the digital and built environments.

The choice of frameworks (there will be several) should be made during Stage 3 to stabilise the concepts, language and re-usable body of knowledge used in subsequent Stages.

The **Smart Digital Building** places particular demands on the frameworks to effectively deal with multiple digital domains (e.g. Applications, Data, Infrastructure) and their relationship with non-Digital domains (e.g. built environment).

Clients, or consultants in their employ, will need to select the relevant Industry Standard frameworks for Digitally-intensive Systems and Complex Multi-domain Systems Development. The frameworks need to cover life-cycle and governance processes. Prime candidates for consideration will be:

- ITIL [www.itil.org.uk] focused on Service design & delivery (not specifically digital)
- INCOSE [www.incose.org] focused on complex multi-domain systems engineering
- TOGAF [www.opengroup.org/togaf] focused on structural aspects of digital capability
- COBIT [www.isaca.org/resources/cobit] objectives-driven governance framework

While these frameworks typically have formal alignment defined with each-other, as yet, no digitally-oriented framework has formal links with the RIBA Plan of Work or other non-Digital frameworks (e.g. built environment, Electrical & Mechanical). Until these emerge, Clients will need to define their own integration approach with the RIBA Plan of Work as their common reference point.

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We look forward to seeing you in 2024