Mayor of London: Supply-Chain Engagement for a Smart City - Teaching Note

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Learning Objectives

- A basic conceptual understanding of the technically complex domain of delivering smart buildings.
- To identify opportunities in standardisation of business eco-systems to support digital innovation.
- Develop an awareness of commercial risks in exposing building systems to public networks and the challenges involved in assurance.
- Understand the importance to end-users of considering local perspectives to the digital transformation of business eco-systems when engaging with cities.

Substantive Analysis

Opening Question = Who is the end-user in this situation? (5 MINS)

Like most businesses, one might think of two end-users that constitute the investors and consumers in this situation. One of these users might be considered the owners of land, who are developing amenities to enhance the value of their holdings as investments. More directly, building occupiers would be considered consumers within this business eco-system. It is the occupier's activities that create value through using the amenities offered, typically paying for these services through entering contractual arrangements.

Through this broad conception of the underlying dynamic, it is often safe to assume that the business eco-system typically caters towards the preferences of the occupiers of land.

Board A: Stakeholders

Are there any other stakeholders who have interests in the outcomes of this standardisation initiative? (10 MINS)

Technology companies have interests in the potential of smart cities to generate substantial data flows for which they can offer services for storage and control that may offer new revenue streams. Smart cities is also an exciting domain for software developers to utilise some of the more advanced innovations offered by technology firms, such as augmented reality.

Device manufacturers might be at the mercy of this initiative. It is the acceptability of their products that are under scrutiny. Some of the solutions that device manufacturers offer today may ultimately be rejected by the industry. In the past, some of the larger device manufacturers have sold products up-front at a loss to recover profit by maintaining the service through an asset's lifecycle. This initiative may undermine this business model.

This initiative would help assure the work of Master Systems Integrators, reducing the costs of contractors work and mitigating commercial risk. This could lead to these activities being viewed as to be more beneficial to overall project outcomes.

This activity might yield a clearer, broader and more reliable ecosystem of options for asset managers when considering how to optimise investments in smart buildings over the longer-term.

Who may have control of smart buildings projects through the various stages of its lifecycle? (10 MINS)

Referring to Exhibit 3, there are a wide range of variations and project ownership may follow a complex chain of contractual arrangements. However, a gross generalisation of project control may be:

The landowner often has control of a smart buildings project in RIBA Stage 0: Strategic Definition, working within the requirements of the planning authority and regulators to identify a scheme.

In RIBA Stage 1: Preparation and Brief, control of the project is often handed to a professional developer and experienced client-side architect.

During RIBA Stage 2 and 3, a professional design team may typically be appointed to develop a design to the satisfaction of the professional developer, client-side architect and planning authorities.

At RIBA Stages 4 and 5, control of the project may be handed over to a main contractor with their own team of designers and contractors. The clients professional design team may check and provide assurance through these stages.

At RIBA Stage 6, professionals will be appointed to assure that the work completed matches the design intent.

Projects are often re-financed before RIBA Stage 7 and the project often changes ownership entirely. The owner may then lease the building out to one or more occupiers to create value by using the amenities offered. During this time the owner will seek to minimise operational costs and ensure a well-maintained standard of service through employment of asset and facilities management teams.

Do the smart building owners need to own and manage the building data themselves? (10 MINS)

Through the buildings design, construction and commissioning Building Information Models are relied heavily upon by design teams, contractors and the trades. These Building Information Models provide a central 3D representation of the building that includes the properties of its assets. They act a single source of truth for the entire project and support detailed coordination between disciplines. It is good practice for these Building Information Models to be handed over to the operators of buildings on project completion, along with other operations and maintenance reference documentation. This provides instruction to the operators of how the building was intended to be used.

It is very possible that the building systems may collect personal data. This is particularly the case for access and control systems, but also in the case of more personal control of the indoor environment. Therefore, treating the data collected as property associated with the building itself when in-use may pose problems in any contracting activities associated with the building. It is more sensible for the building operators to own the data as part of their business to support the provision of the amenities offered on-site. These operators may be a landlord's or occupier's facilities management team.

Are there any competition concerns about ownership? (10 MINS)

The built environment is an inherently uncompetitive business eco-system with large monopolistic players. Land ownership in Central London is dominated by the great estates and City of London Corporation. This land is typically offered to developers and property owners through long leasehold agreements that require approval for any significant changes. There is very little incentive for developers to take on technical project risk as pioneering projects would not only be to the benefit to themselves, but also "free-riding" neighbours who have interests in the local business eco-system. The long lifespans of building assets and duration of lease agreements result in a sector that is particularly slow to adopt new innovations. The market for building system devices is dominated by large manufacturers, such as Siemens, Honeywell and Schneider Electric. These manufacturers often sell initial device installation to contractors very cheaply, so that they can continue to provide equipment upgrades and maintenance services throughout facilities' operational life.

The market for cloud services is even more constrained. Google Cloud Platform, Amazon Web Services and Microsoft Azure dominate the market. However, as these

services are inherently highly standardised, there are very few barriers to change and high levels of customer agility unless a developer finds themselves locked-in to a particular proprietary product.

Board B: Technology

How sensitive might building systems be to network vulnerabilities? (5 MINS)

Exhibit 2 shows some building system island networks that may be found in many buildings.

This diagram shows that some of these island networks operate critical life-safety and security requirements. At a minimum, fire and smoke, access control, vertical transport and the power management systems are extremely sensitive networks to expose to the public. It would be negligent to compromise the functionality of these systems. There may be sensitive functions in many of the other systems too.

How secure are typical UDP networks? (5 MINS)

Exhibit 1 shows a typical UDP Network Stack for building systems.

The UDP protocols typically employed in building systems rely on broadcast, unencrypted traffic over IPv4. The data exchanged can be picked up and responded to by any device within the network without requiring authentication.

BACnet is a typical UDP protocol in use within building systems. When a BACnet device needs addressing from other network segments, a BACnet Broadcast Media Device is used with a similar IP address to the network switch to provide a register of public IP addressable devices to incoming traffic.

Might we have any concerns about some of the new products emerging on the market in this domain? (10 MINS)

Automated Meter Reading at St James's Market may theoretically have exposed the Modbus protocol pulse counters to devices listening on the public network. However, it is impossible to tell whether this is actually the case in the event.

Demand Logic's Data Acquisition Device does appear to be a significant security risk. Even if the Demand Logic service connection itself is secure. It appears unsecure, broadcast UDP protocol Heating, Ventilation and Air-Conditioning Systems may be being exposed to public networks through adoption of this service.

The Building Information Model visualisation could be achieved in a secure and safe fashion. However, overlaying the dynamic properties of systems on these 3D models would require exposing them to the internet and a very rigorous approach to network architecture and device qualification.

Does the Faucet/DAQ software offer an inclusive option in supply-chain standardisation for London? (10 MINS)

All of the dependent intellectual property associated with Faucet/DAQ has been released on Apache License 2.0. This means the software can be adopted without cost by the entire community. However, the software is not a trivial tool to learn and use. There is only a small number of individuals who are competent to operate it.

The tool also has a premium dependency on Software Defined Network compatible switches. This product may not by desirable for a small scale, speculative internet-of-things deployment. Faucet/DAQ is clearly only intended for a full enterprise internet-of-things environment.

Board C: Policy

Has London any existing policies to regulate risks to the business eco-system? (5 MINS)

Exhibits 4 and 5 demonstrate how the planning and regulatory framework for smart buildings covers many aspects and that there are vast number of policies to consider when delivering projects. However, building system network architecture is not one of these. The domain is entirely missing any political oversight.

Why is London attracting this interest in particular? (10 MINS)

London attracts diverse skilled labour from all over the world, drawing upon wide-ranging knowledge and deep business networks. The state of land-ownership in Central London may offer a compelling incentive for district level intervention within prestige property markets for anyone lucky enough to have the opportunity, possibly acting as desirable showcases for international markets to follow. For these reasons, London may be seen as a worthwhile place to exhibit best practices for those with the ambition.

What might this mean for scaling internet-of-things products in the smart cities' domain more generally? (5 MINS)

In stark contrast to web services and interactions with mobile-phones and PC's, it appears significant demands from occupiers needs to be put on landowners within a clear regulatory framework before we are likely to see significant transformation towards internet-of-things services in cities. Property operators would need to replace operational assets early and be confident that options they take are robust looking ahead to support this transformation. Further, it seems there is no "one size fits all" approach to smart cities, as local government has a significant role in influencing supply-chains.

Closing Reflection = How excited are you about the prospects of innovation in this circumstances?

Suggested Reading

This is a complex technical area that is highly political and arguably under-regulated.

Reflect on what concepts in the following strategy book about the business of platforms might be transferrable to the domain of internet-of-things for smart cities business eco-systems.

Is an entirely different mindset needed?

Cusumano M.A, Gawer A., Yoffie D.B. (2019) *The Business of Platforms: Strategy in the Age of Digital Competition, Innovation, and Power.* HarperCollins Publishers: New York, NY.

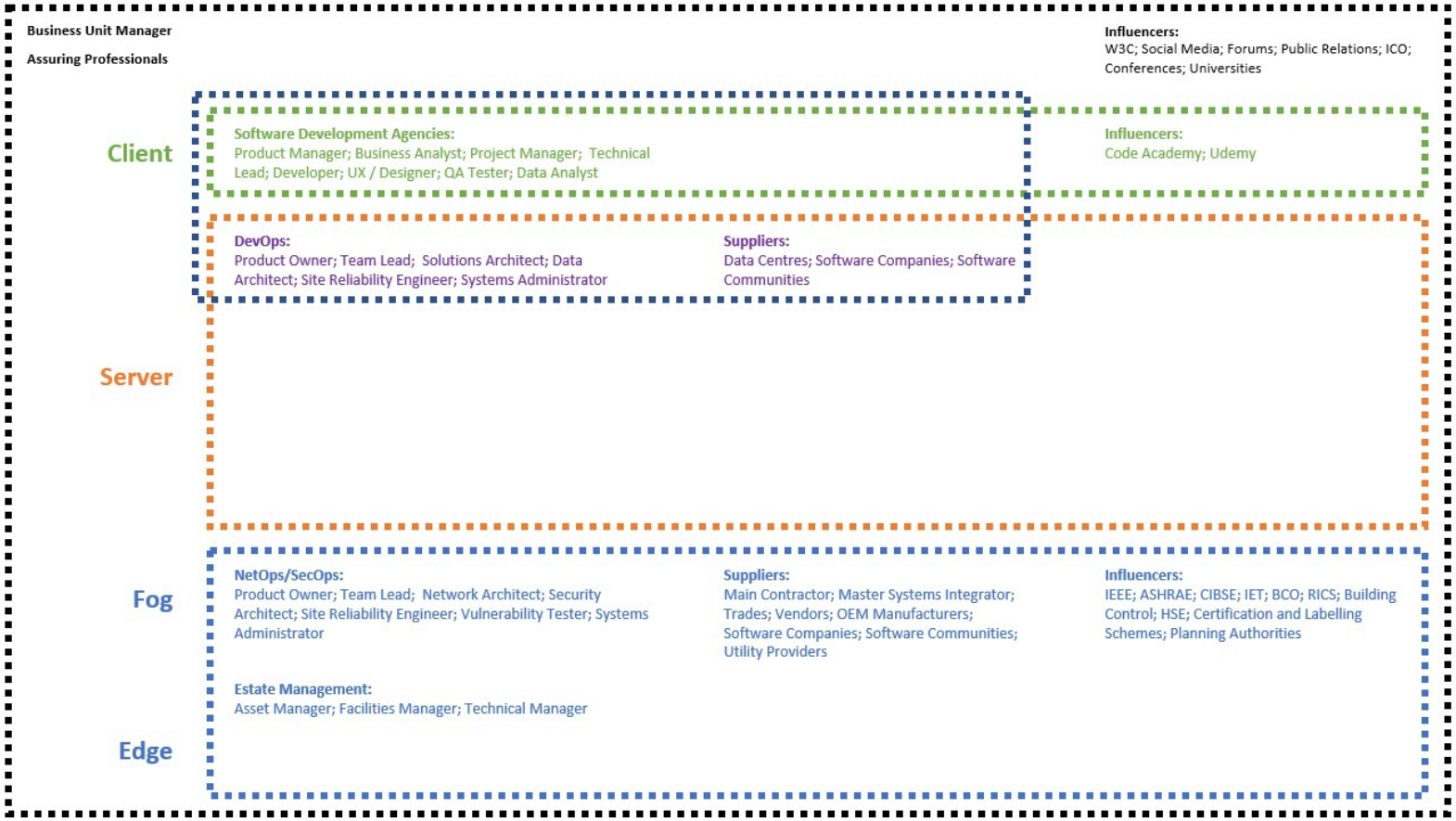

Exhibit TN: Smart Cities Business Eco-System Sketch