Technology Performance Assessment for Offices– A Case Experience from A Knowledge Transfer Partnership Project

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Abstract:

This paper seeks to address the lack of a Technology provision evaluation in buildings. A Technological Performance Assessment framework has been developed that defines the comparative quality and merits of a buildings' technical infrastructure to inform investment and/or occupation.

The framework development stems from a Knowledge Transfer Partnership (KTP) project between KSBC PLC (the industrial sponsor), Innovate UK (the Government sponsor), and UCL (the academic partner). The assessment of technology supply and distribution is carried out by several methods. KSBC's experience in technical site assessment, technical systems costing models, and client requirement for technical support were used to assess eight case study office buildings in London. The assessment framework was validated through focus group method including industry experts and clients.

The results showed that an integrative approach to assess the availability of technologies in buildings, its readiness to support building users, and its capacity to support growth strategies has the potential to mitigate sometimes conflicting needs of building occupiers and building owners.

Keywords: Technology Performance, surveying, Key Performance Indicators (KPIs)

1. Introduction

The rapid growth and increased complexity of information and communication technology (ICT) is changing the organisations that it serves (Clegg, 2000). These organisations are housed in office buildings that need to respond to these ICT developments. The ICT, organisations and buildings are part of a sociotechnical system. The characterisation of the office buildings in this system is less well developed, (Davis et al., 2014). Further, the dynamic nature of ICT driven organisational change is not acknowledge in the facility management literature (Drew, 2006, Mateus et al., 2013, Kim et al., 2015).

The nature and definition of technology is one of the big science questions debate in which building's connected services, utilities, spaces and information systems can respond in an efficient manner to the initial and changing demand of the owner, the occupier and the environment (Clements, 2013). The word technology is usually associated with Information Technology (IT) and related technologies and their infrastructure including computer software, networks and hardware, as well as technology related to wireless, fibre and mobile signals, safety and security, lighting, heating, ventilation, air conditioning, water, vertical transportation systems (Mansfield and Pinder, 2008, Pinder and Price, 2005, Pinder et al., 2003).

When it comes to investment in building technology and its infrastructure systems there often seems to be conflicting perspectives of what constitute a ready-to-use technology provisioning. There are no standard forms of valuing the level of technology provisioning that should be provided into an office space entering the market. From the landlord perspective, technology in ready-to-leas office spaces are seen as a physical recourse that maxims the property's ability to show rental and capital growth in the long term. Existing building assessment tools are either focused on overall environmental and/or sustainability performance of the asset, BREEAM and LEED being the prominent examples, or concentrate on one particular aspect of technology provision such as Wired Score platform, (WiredScore, 2017)

Technology is seen an add-on to increase the building value, and not provided to respond to the needs of the end-user. Although new and refurbished buildings, are always being claimed to be ready for technology facilitation, its level of readiness to accommodate business noticeably varies corresponding to functionality, design and efficiency of the installed technology components (Bluyssen et al., 2015). Some buildings may incorporate full configuration of technology systems where occupants can fit-out their business technology requirements, while

other may consist of no core key provisions components, which increases the fit-out project management risks and occupancy lead time.

From the occupant perspective, recent report by the World Economic Forum (2016) assessing office buildings rental contracts, shows how variable business needs are effected over time by the divergence between the long-term nature of office property leases and the confound short-term technology provisioning planning horizon of the occupier. This is being driven not only by business growth strategy planning and availability of capital, but also by the level of technology provisions that exists in buildings.

Between the building as an investment property (from the owner's perspective) and as an operational resource (from the occupant perspective), the value of building technology will vary in time as it becomes subject to shifting technological conditions. This lead to changing user expectations about the services and amenities an office building should provide prior and during occupancy. Techniques such as Post-Occupancy Evaluation and Building Quality Assessment have been developed to provide consistent, reliable measures of various facets of office building performance (Mansfield and Pinder, 2008). However, none of these techniques appear suitable for assessing building's availability, readiness and capacity of technology provisions. These knowledge gaps have forced project managers and contactors to continuously rely on their experience, 'gutfeeling', rudimentary judgments, or a combination of them, in justifying the investments in the buildings and businesses technology systems.

The main objective of this paper is to identify the Key Technology Performance Indicators (KPIs), and to present a systematic practice-ordinated approach to appraising the connection between technology systems and stakeholders' perspectives and roles. The paper presents the first phase of mainly empirical results and their initial testing, and before concluding, maps out the continuing programme of research.

2. Methodology

To understand how to maximize the benefit for both occupants and landlords and all stakeholders involved in building technology provisioning, practice oriented research is needed that accommodates different perspectives. General focus is therefore given to addressing these challenges appraising the connection between technology systems and stakeholders'

perspectives and roles. This project has been undertaken under a Knowledge Transfer Partnership (KTP) between KSBC PLC (the industrial sponsor), Innovate UK (the Government sponsor), and UCL (the academic partner). Although the Technological Performance Assessment (TPA) was developed and used by KSBC before the beginning of the project, the methodology was limited to attaining competitive advantages and providing advice and full project management for clients during relocations. Further TPA development needed to be underpinned by incorporating appropriate theoretical constructs, relevant statutory requirements, and guidance from relevant professional organisation such as Charter Institute of Building Service Engineers (CIBSE) and Royal Institute of Charter Surveyors (RICS) and established building assessment approaches (sustainable buildings assessment methodologies, ICT adaptation strategies, building quality assessments. Etc). As a business-driven performance framework the KTP project will have to combine different research approaches: market research techniques (Mager, 2008, Nunan and Di Domenico, 2013, Sarstedt and Mooi, 2014); building assessment tools methodologies (Fraunhofer, 2012, Gann et al., 2003, Ness et al., 2007); and stakeholder analysis techniques (Verbeke and Tung, 2013, Lorne and Dilling, 2012, Lützkendorf et al., 2011, Jensen, 2010, Friedman and Miles, 2006). To achieve this, overall methodology was broken into 3 stages as presented in Figure (1):

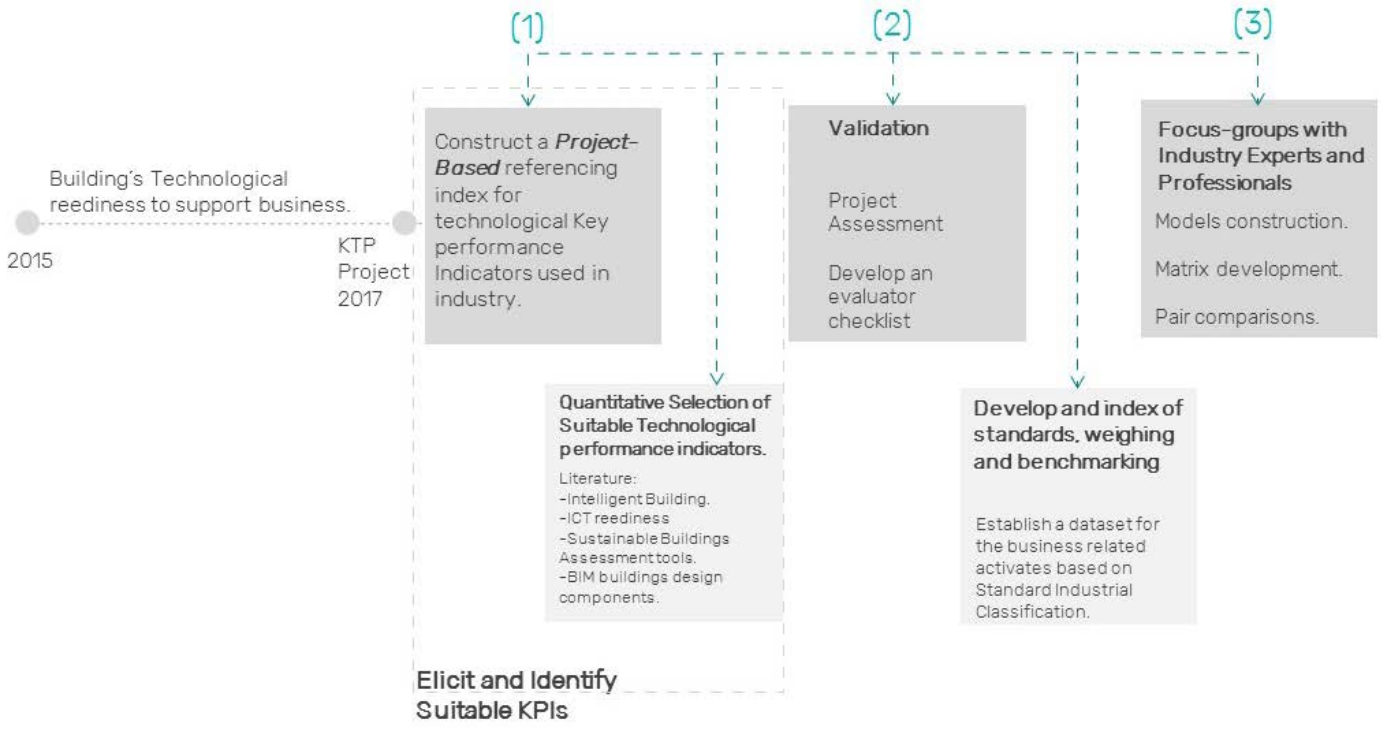

Fig. 1: Research process

The first stage is to construct a referencing index for technology provisions Key Performance Indicators (KPIs) used in industry– selection, indicators and criteria. So far eleven technology provisions are defined and detailed through 6 levels of configurations. Level 1 and 2 are presented in Table (1). The KPI major families (Level 1) were selected to include relevant as many defining systems; from buildings services to information technology as well as planning aspect defining building use categories and information relevant to environmental performance.

Tab 1: levels 1&2 of the building technology key performance indicators

Level 1	**Level 2**
ICT Systems	Fibre optic; Wi-Fi; Mobile; Telephony
Electrical Power	
Lighting systems	Internal Lights; External Lights; Safety Lights
Safety and security	Fire Safety; building Security
Fuel	Gas; District Scheme; Renewables
Heating	Primary System; Distribution system
Ventilation	Natural; Mechanical
Air Conditioning	Individual Units; Central AC systems
Water	Portable; Brown; Grey
Spaces and amenities	Use Class; Staircases; Toilet provision; Floor space; Server Room
Vertical transportation systems	Lifts; Escalators
Future Technology	

The second stage established a validation process using the case study approach that includes site assessments, client communication and an in-house desktop studies. This stage aims to test and refine the general conceptual model to be used on site surveying and assessment. Eight case-studies was used to validate and refine the assessment framework (assessed between March and June 2017). The context of these case studies is illustrated in Table (2). Although TPA is developed under the context of 'non-domestic buildings', all case-studies evaluated represents the use of 'office building'[1].

Tab. 2: Case-studies context

Number	**Number of floors**	**Floor(s) assessed**	**Total floor area (m2)**	**Net lettable Area assessed (m2)**
1	9	Part of the fifth floor	5400	400
2	2	Ground and first floor	230	230
3	2	Ground floor	1000	500
4	3	Ground floor	1245	1166

[1] Details such as location and the visual context about the case-studies are not included for commercial reasons.

5	2	Ground and first floor	100	100
6	2	First Floor	150	75
7	2	Ground and first floor	500	500
8	2	Ground and first floor	600	300

The third stage is based on focus-groups discussions with industry experts and will further refine the TPA process by developing weighing and benchmarking for building technology systems assessment against different client (tenants) needs and costs.

Furhter reserch will aim to develop norms and data-base structre supporting storing and analysis of the technology preforamce of both existing and new builsing stock. This will enable KSBC development beyond the scope of this KTP project. The exitince of such a system will alow for systematically analyse of the spesfice tehcology perormance value to builsings from the perpective of not noly landlords and occupanets but also municipalities (local governments) and property developers.

This paper will report on current outputs from stage 1 and 2 and the outcomes of the first focus group. Further papers will report on the 'system performance score' and 'data-base management protocols and analysis' established in stage 3. Which provide a reference for existing buildings as well as future developments.

3. Technology provision availability, readiness and capacity and stakeholders' control over it

The development of the taxonomy for technology provisions KPIs and their use during the initial case-studies raised several questions in terms of provision boundaries or rather control over them and how to record those. A key insight of the site-survey conducted in this research project was the proposition of introducing three canonical properties that describe technology provision:

1. The availability of the provision.
2. The readiness of available technology provisions to support building users and business.
3. The capacity of the provisions in terms of supporting business and growth strategies of the occupier.

Figure 2 illustrates the concepts of availability, readiness and capacity for some of the KPIs suggested in Table 1.

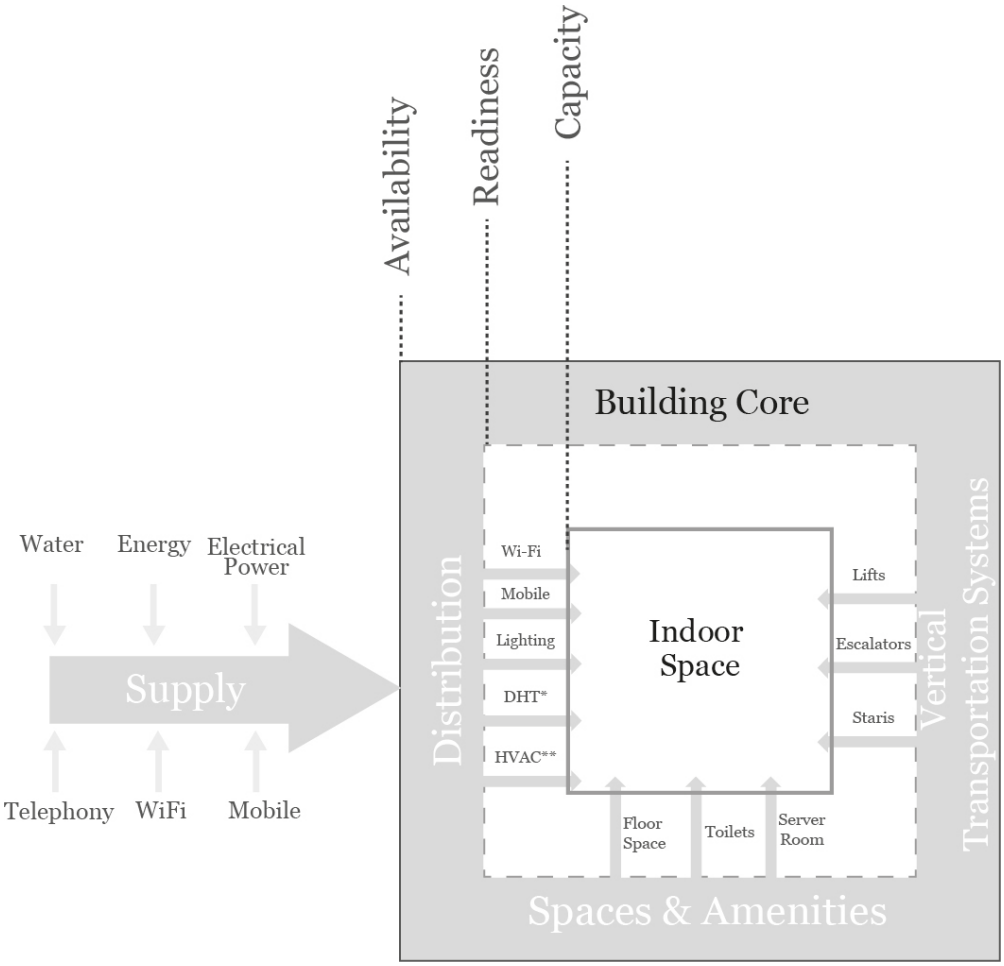

Fig. 2: Simplified diagram of the relationship between the technology supply and distribution and capacity (*DHT indicates domestic hot water, **HVAC includes heating, ventilation and Air conditioning)

Technology Provision Supply is defined as the street level or core building level and it's of a binary nature. For example, the property either has the connection to optical fibre, Wi-Fi; gas, power supply distribution network or has not. At the core building level, the building either has the provision for vertical transportation systems or has not. However, even if technological provisions are available that does not mean that they are ready at the point of use. Depending on the state of the distribution system, different technologies can have different lead times of its full utilisation by the occupier.

As indicated before, the initial surveys raised the issue of technological provision ownership or the level of control different stakeholders have over supply and distribution of different technological provisions. A stakeholder can be defined as '*any groups or individuals who can*

affect, or is affected by the achievement of objectives or purpose' (Diamond and Liddle, 2005, p.79). A stakeholder can be categorised as a *supply and/or demand* actor (Carmona et al., 2002, Brugha and Varvasovszky, 2000), and can take a *primary and/or a secondary* role in any process (Friedman and Miles, 2006, Jones et al., 2002, Garvare and Johansson, 2010). For the purpose of this research, we have defined the main stakeholders influencing technological provision in a building as

- tenants (building users),
- landlords (building owners) and
- external stakeholders which include Local Authorities (LA) or municipalities and utility companies including Wi-Fi, mobile and telephony in addition to energy suppliers and water/sewage companies.

The areas of control for different stakeholders against different technology provisions, which is not necessarily one-to-one function, is presented in Figure 3. For example, although building users clearly consume electrical energy for lighting and can at least to some extent control lighting levels, the power supply to a building is fully controlled by utility company whilst the positioning and security of power connection is within building's owner control too.

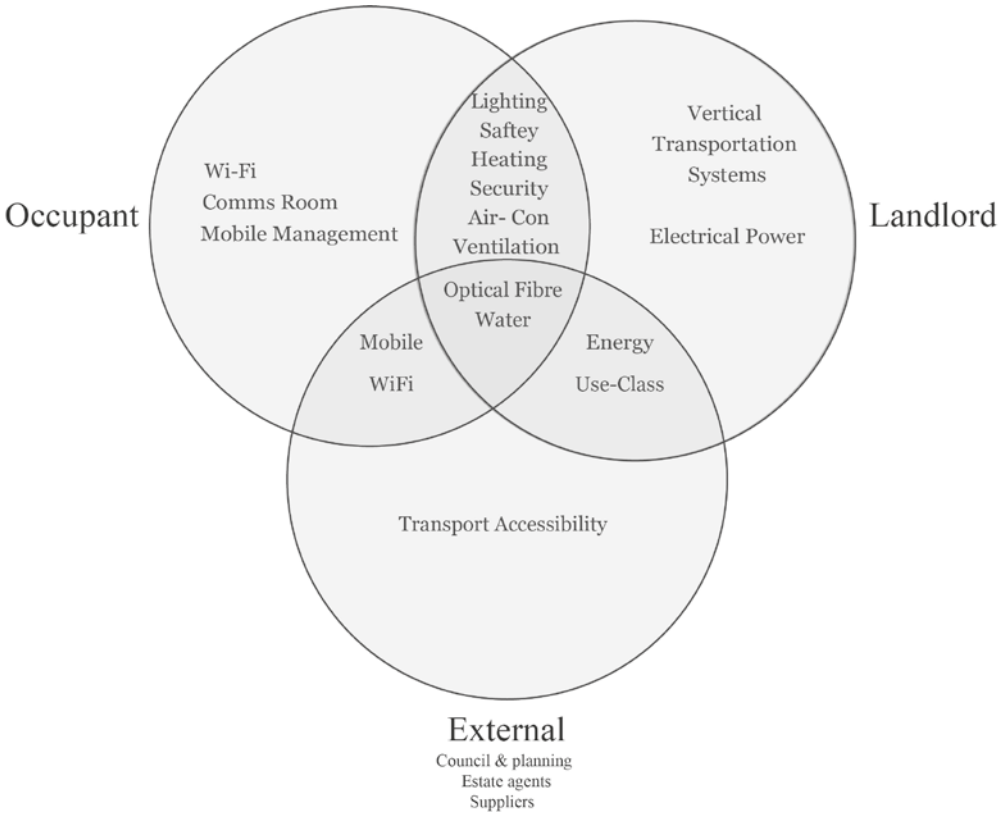

Fig. 3: Stakeholders boundaries over technology KPIs

The provision of vertical transportation system is on the other hand in control of building owner (the building with either be design and built with that provision or not). The use class of the building is in the control of relevant planning authority or local authority/municipality and whilst the owner can apply for the change of use class, the ultimate decision is with the planning department. On a separate spectrum, how will the internal space be used is mainly under the control of tenant(s). For example, based in their business needs, the tenant might decide to set up a server room. The use of telephony, mobile and Wi-Fi provision is also under tenant control as even if these are provided by major providers and exist at the building level, the tenant might decide not to use them for their business purposes.

4. Results

Based on the initial results, the project team has established a two-stage surveying protocol aiming at assessing the technological provision in office buildings. The first stage assesses the availability of the technological provision prior to actual occupancy or before the potential tenant has engaged in leasing contract. The second stage, once the client/tenant is confirmed, assesses the technological provision readiness and capacity. An example of case study No.3 Availability Assessment summary (as detailed in Table 2) is presented in Figure 4. At this stage only certain KPIs at level 1 and 2 were selected to be addressed in this initial assessment and presented to KSBC clients.

Fig. 4: An example of an availability survey results summary

The main aim of the Availability Assessment is to provide the insight necessary for occupiers to understand what costs and time are needed to equip new work spaces to fit their needs. Three classifications where presented to show the available level of provisioning as an indicator of confidence in the follow up technology readiness and capacity assessments. This was described through three levels of classification as:

- Management
- Install and management
- Design, install and management

This approach was tested during the first KTP project focus group organised at 30/06/2017. In total, 8 representatives from RICS, CIBSE FM, building wayleave lawyer and clients ranging from a global publishing firm to large Higher Education campus estates took part. The participants were asked to compare the KSBC used to issue before the KTP project started with this newly suggested Technology Availability Assessment approach. They were asked to rank the usefulness of the categories, from o to 9 as well as the overall usefulness of the assessment report. The results are presented in Figure 4.

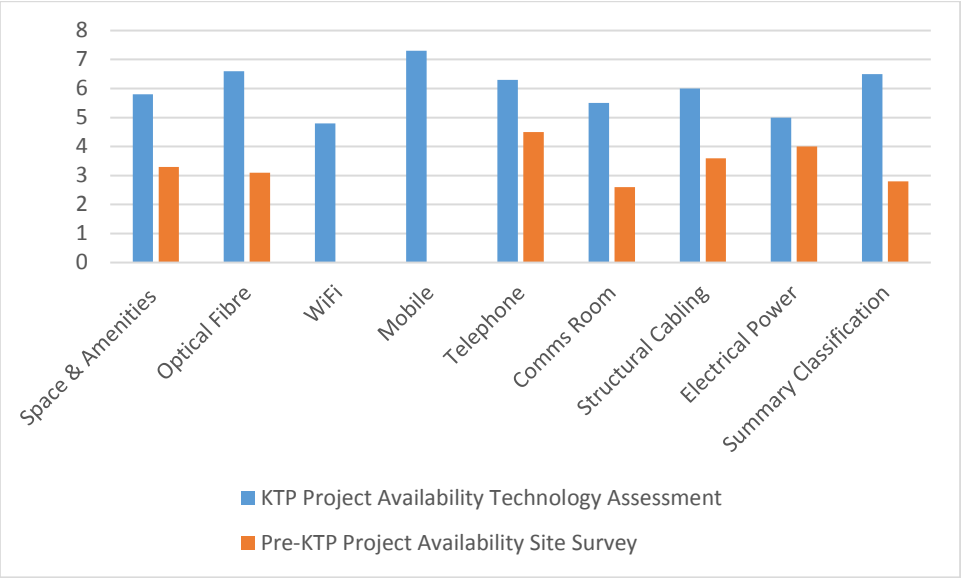

Fig. 5: The focus-group comparative feedback of the usefulness of the KTP project and pre-KTP project Availability Assessment reports

The results clearly indicate that the new Technology Availability Assessment framework was a step forward in providing valuable information for perspective tenants regarding the level of technology provisioning in the buildings.

In addition, the focus group was asked to discuss the requirement of building technology assessment. The outcomes of the discussion indicated the different perspectives of defining building technologies. Ranging from the need to outline the technical needs of system install and design and as a result its performance, to the viewpoint that fits within the occupant/business needs as a benchmark of technology performance imbedded within the provisioning process and project management.

5. Conclusion

This paper presents the development of a performance assessment model of KPIs for building technology, which aims at assisting stakeholders to gain insights of the interrelated components of surveying, design, management, and installation of technology. It addressed the gap in the current understanding of different stakeholders' perspectives, on what constitutes a technology system that supports businesses.

The results of the Availability survey as part of a three-stage performance assessment method opens the prospect of communication between landlords, occupants and the external actors involved. As mentioned, further papers will report on the readiness and capacity assessments as an element to define technology performance.

The approach presented in this paper suggests that office buildings technology provisions can be assessed from the perspective of both the landlord and the occupant and can be integrated with the wider stakeholders' network. Thus, the system can be used for, both, to explore the gap that develops between the expected and perceived utility of available technology provisions and defining its readiness and capacity.

Such an assessment model will be of practical worth in assisting all stakeholders to minimise the risk of investing in technology provisioning and addressing building infrastructure obsolescence. The formwork also creates opportunities for novel representation of information on technology performance that can be integrated in data-base management system designed to develop market norms and buisnsess benchmarks for both occupants and landlords. Further reseruch will present the comparative quality and merits of a buildings' technical infrastructure to inform investment and/or occupation

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