Effective Space Management for Facilities Management using Computer-Aided Solutions

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Abstract

Information Telecommunications Technologies and Automation (ICT&A) are becoming more prevalent within Facilities Management allowing portable access to more detailed information within building systems. Software solutions for space management have also advanced, allowing a greater insight into a building’s core activities and provides useful tools and event tracking at real time. Despite these advances, current methods of data gathering for space optimisation remains as manual observation and recording of space usage by staff; dealing with any potential conflicts or space management issues as it happens via informal decisions by the Facilities Management. It is argued that this epistemic knowledge based approach relies too much on informal evaluations and its subjective outcome is not a true indicator of the potential utilisation of space that may benefit more from an objective decision making process.

Expected performance of spaces by Landlords towards Facilities Management is increasing due to external pressures from rising commodity prices and increasingly demanding sustainability targets. Alongside existing policies, this applies ever more pressure on the Facilities Management to continuously deliver an environment that not only reduces running costs but also manages space resourcefully striving for a productive workplace.

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Introduction

As global markets decline further into crisis and commodity prices become more volatile, signalling uncertain futures for companies across all sectors. Landlords are becoming increasingly more cost orientated and applying relentless pressure on Facilities Management to reduce operational costs whilst maintaining building performance, in an attempt to reduce their exposure whilst subsidising their diminishing business revenue. As a result Facilities Management is often forced to concentrate their attention on short term cost objectives rather than investing time and effort on space management. Significant advancement within Information and Telecommunications Technologies and Automation (ICT&A) has influenced Space management techniques considerably. This has resulted in a change in office culture over the last few decades resulting in an increase in occupant absenteeism due to working away from the office becoming more common practice. This has been made possible by allowing offsite access to network accounts, shared folders and email. Video conferencing has also allowed meetings to take place within a virtual meeting room and encouraged international collaboration across spanning countries. This increase in ‘smart working’ has been greeted by a wide range of organisations, becoming more flexible in working hours and has resulted in more unpredictable space within the office allowing a potentially more sustainable building if managed effectively. Experience in practice demonstrates that significant reductions can be made in the floor space demand of many office-based organisations, but the simulations show that is not feasible to achieve a perfect activity-space "fit" when the pattern of activities is uncertain. [1]

Computer-aided facilities management software solutions (CAFM) introduce solutions to aid Facilities Managers in addressing this shifting issue and have become increasingly sophisticated providing
improved access to operational dynamics of a building such as event tracking in real time. However, these technological advances have not been reflected by recent development in space management methodologies and still involve manual gathering of information by observers recording the current use of space when and if a problem occurs. Current methods of space evaluation can include methods similar to previous time and motion studies derived from Taylor[2] and Gilbreth[3]. These conclusions are based upon an epistemic (theory of knowledge) assessment rather than objective axiological analysis (study of values) of the current variances of the workplace. As a result of this misconception, Facilities Management often focuses efforts on trying to improve building performance by reducing operational costs and increasing occupant density. In this paper we introduce Advanced Space Optimisation Algorithm (ASOA) which allows Facilities managers to effectively optimise space and time management via a standalone web interface and subsequently define the current status of a space’s ‘true value’ which includes elements such as sustainability, productivity and performance. In doing this, the Facilities Manager can not only strive to reduce energy usage and increase investment return but also increase the functional performance of the space whilst decreasing the negative impact on its occupants.[4]

Evaluating Building Performance within a Work Space Strategy

Developing an effective workspace strategy is key for a productive workplace and a building meeting its performance targets. Deciding on the type of workspace strategy can vary considerably depending on the type of building and organisation being assessed; that can include variables such as risks to occupants, need for specialist equipment, rank of stakeholder and strategic business plan. A workplace strategy may also vary where Facilities Management are responsible across departments, such as a reprographic department that requires larger work and circulation space per occupant due to higher risk of injury and therefore costing more per M² area compared with a typical open plan office space that can be classed as low risk.

![Figure 1: The decision pyramid in a maintenance organisation][5]

Space management has become an increasingly important issue for many organisations and is affected by other operational elements such as sustainability, operability, productivity, satisfaction and overall performance. However, it is unlikely that an organisation has fully implemented an effective space management solution that inaugurates a comprehensive set of these key performance indicators (KPIs). Research carried out by IPD (Investment Property Databank) for the OGC provides a performance framework of a building encompassing productivity, sustainability and operability as ‘Building Effectiveness’ compared against ‘Building Efficiency’ which included cost per full time employee (FTE) per M². These elements are weighted with a score (such as 104,103 etc shown below) which can be benchmarked across other buildings. This is an effective method of benchmarking however it still relies on Facilities management correctly interpreting data from a building and also doesn’t include other key elements such as occupant satisfaction, detailed environmental elements and adaptability. Additionally it does not provide any corrective action to the Facilities Manager and is limited as a comparative tool to other buildings that may vary considerably and may require divergent attention.
In order to be able to have a comprehensive workspace strategy there needs to be adequate allocation of resources to enable a regular revaluation of space and other KPIs in order to meet the demand of a continuously changing building environment. For this to be made possible Facilities Management are in the principle position for influencing upper management that an extensive workplace plan has a positive affect on spatial performance and overall value of space. A research report carried by the University of Reading and BIFM [7] shows that 73% of organisations have a single sustainability policy in place with legislation as the main driver for aspects and reporting under a Policy. Waste Management and Recycling, Energy Management and, Health and Safety issues all remain top priority in most respondent organisations. This has resulted in an increase of a sustainable policy since the introduction of government legalisation in September 2008 in the form of Energy Performance Certificates. [6]. Despite this, organisations still do not see the benefits of active Carbon Management with 49% of respondents not managing their Indirect Footprint. [7] Unfortunately this way of thinking from upper management/landlords is a popular frame of mind with response to legislation being a driving catalyst for spatial value investment and lack of a short term return the main factor which dissuades investment especially which has become more prevalent in the current market conditions.

This popular mindset is counter productive to building performance, with increased value of space having significantly positive effect on productivity, satisfaction and sustainability and thus improving building performance over the short term and potentially reducing building expenditure over the mid term. Cases studies have shown that increased workplace performance can add in benefits to building owners, employers and employees. The return of the investment on improvement on workplace performance could be up to 10% for building owners and employees’ productivity could be improved by 8%. [8].

Calculating the True Value of Space

There is considerable research and commercial incentive in optimising office space, resulting in a noticeable financial & performance return to stakeholders. However, many do not successfully offer a complete solution that is able to consistently adapt to activities within a busy building which can only be achieved by continuously assessing the management of space through analysis of the current state of sustainability, building performance (services status), operability, adaptability and occupant satisfaction using benchmarking. Compared against the current cost of per type of space and the environmental factors (temperature, noise, light level, air flow rating). The Advanced Space Optimisation Algorithm (ASOA), described in the next section evaluates these elements and outputs it into a recommendation rating for each key performance indicator. By allowing the Facilities Management to dynamically tailor the varying types of space to different specifications. Different zones of space within an office floor can reflect a sustainability focus when others such as a workspace of an important department can be tailored.
towards productivity. This process is not only dependant on Facilities Management (FM) but also the occupants themselves. By Facilities Management also being aware of the current environmental elements such as Temperature and CO² levels; corrective action can be applied to an area in order to maintain productivity through HVAC actuation. This can be enhanced further by allowing occupants themselves to be able to negotiate their own environment. Research from the University of Reading developed a Collaborative Design Environment (CDE)[9, 10] that allows occupants to negotiate environmental settings to their own personal specification within their allocated workspace zone. The CDE is described in more detail later in this paper.

The Advanced Space Optimisation Algorithm (ASOA)

There is a high demand in development of an analytical diagnostic tool in order to assess the performance of a workplace. The development of such a tool is significant as it can be used at both building strategic design stage and post occupant stage. It will supply the guidance and improvement measures for office design and planning in order to improve end users’ productivity. The Advanced Space Optimisation Algorithm (ASOA) is a standalone software tool that allows Facilities managers to effectively tailor space to selected key performance indicators within an associated workspace.

![Screenshot of ASOA Interface displaying Building Services Status to the Occupant & the ASOA functional architecture](image)

Figure 3: Screenshot of ASOA Interface displaying Building Services Status to the Occupant & the ASOA functional architecture

An important element of the ASOA software tool is a feature that allows occupants to be able to communicate their own evaluation similar to Post Occupancy Evaluation (POE) tests back to Facilities Management. POEs can provide key indicators in a quality improvement process involving customers in defining their priorities and judging their satisfaction with the outcome. [11]. Occupants are able to comment on a number of factors within the building with the most detailed being related to their environment and their planned movements throughout the day via a daily log book interface that allows occupants to successfully plan their daily work package and movements throughout the building such as meeting room bookings, asset usage and entering/leaving times.

The ASOA interface also allows occupants to be able to view the current status of building services specified by FM. There is a distinct unawareness from building occupants towards Facilities Management operations. It is a common notion that Facilities Management are often only recognised in an event of a building services failure, when operational expenditure exceeds its target and when building performance fails to meet expectations. By providing detailed information of building services, stakeholders are always aware of any faults etc. that may have occurred and the estimated time it would take to be rectified and be assured that when a building is consistently being maintained successfully.
The screen shot shown in Figure 3, shows the proposed interface design for the buildings services status section and the functional architecture of the ASOA software. The list on the left (grey) displays the type of building service the Facilities management wishes to communicate with the occupants, new items can be added or removed where necessary. The adjacent coloured box displays the current rating using a traffic light spectrum to reflect the current score of the service. Each service can be selected in which a more detailed appraisal is shown, along with any current faults and fault update. In the journal of the British Council for Offices it was argued that advanced building intelligence can increase the productivity of occupants by 10% annually and improve efficiency to satisfy owner and occupiers needs. In contrast, standard building intelligence can improve efficiency by 8% annually and result in a payback within two to four years.[12]

Within the list the services list, Building Freshness, Sustainability Rating and Overall performance is also listed. This is an approach for allowing occupants to be more self aware of the sustainability performance of their own office in order to share accountability of the carbon output of their building. The sustainability rating is calculated from the current energy output of the building. Additionally the overall performance of the building is also recommended to display to stakeholders. This is a combination of productivity, satisfaction, sustainability, usage of space and air quality. This is calculated from the scores achieved from the ASOA calculation combined with the results from the POE within the personalisation process.

The quality of workplace can significantly affect the health, comfort and productivity.[12] An extensive UK survey conducted by Leaman & Bordass [13] showed that comfort and perceived productivity was greater in occupant where occupants had more control over their environment. Additional research from Preller [14] also found that from an extensive survey of 1100 office workers within 107 office buildings within in Europe, by providing works with more control of HVAC services this resulted in greater perceived productivity, less absenteeism and fewer reported illnesses. The diagram below displays results gathered from a survey of 390 questionnaires by the University of Reading [15] displaying the correlation between predicted productivity value with environment and job factors index. It clearly signifies that self assessed productivity would be decreased with a highly unsatisfactory environment and job symptoms.

![Figure 3: The Relationship between self-assessed productivity and Environmental issues](image)

Previous Research carried out by University of Reading developed The Collaborative Design Environment (CDE). [9, 10]. This prototype was developed to allow occupants to be able to personalise their micro-environment allocated by the Facilities Manager within an infrastructure of wireless sensors depicting environmental settings such as temperature, noise, CO² and light). This system allowed occupants to submit their personal preference of the above settings within their current zone. These settings were then negotiated with other occupants and the CDE algorithm calculated the average mean as shown in the formula below:

\[
N = \left( \frac{1}{X} \sum_{i=1}^{X} O_{T_i}, \frac{1}{X} \sum_{i=1}^{X} O_{L_i}, \frac{1}{X} \sum_{i=1}^{X} O_{A_i}, \frac{1}{X} \sum_{i=1}^{X} O_{N_i} \right)
\]

![Figure 4: The Negotiation Algorithm for the CDE](image)

If there are \(X\) active occupants then calculate the average of their HVAC settings. Suppose each of HVAC settings (Temp, Light, Airflow, Noise) are represented by (OTi, OLi, OAi and ONi), then the result of negotiation algorithm.
Future amalgamation between the ASOA software and the CDE software would complement each other significantly with complex calculation from the ASOA in calculating space tailored by a combination of key performance indicators along with the occupant personalisation of their workspace within an ambient wireless network providing detailed information back to stakeholders.

CONCLUSION

As the performance of spaces within commercial office buildings becomes increasingly more demanding for Facilities Managers key performance indicators such as sustainability, productivity and building performance requires continual assessment to ensure true value of space. Current methods of assessment involve space management analysis that relies upon informal evaluations based on previous experience rather than objective reasoning. This paper introduces an analytic software tool (The ASOA) that incorporates a comprehensive set of key performance indicators against building expenditure that allows a Facilities Manager to tailor space according to its own targets. It is apparent, that innovative computer aided solutions can significantly improve building performance and productivity. However, the main obstacle remains convincing Facilities Management/Landlords/Upper Management of the huge benefits of such software for future investment in a time when financial cut backs are becoming the norm.

FUTURE WORK

The ASOA is still currently under development and is set for completion February 2009 for Alpha testing. After testing is complete, a plan to test within an industrial setting is set to take place in April 2009 in which Facilities Management will be able to apply their current contracted building to the software.

There is currently also an ongoing survey in attaining industry perspective regarding effective space management from Facilities Management and can accessed at http://www.rdg.ac.uk/spearheadproject. Detailed analysis of the outcome of this survey will be presented within the paper presentation.

REFERENCES