

Data-driven design — Using data on human behaviour and spatial configuration to inform better workplace design

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ABSTRACT

Recent studies have shown that the majority of staff are dissatisfied with their workplace environment. At the same time, scientists are beginning to discover clearer and recurring patterns that show how the spatial design of a workplace affects staff satisfaction, wellbeing, exchange of information, communication and movement flows. This paper argues that insights from this body of research could be used to improve workplace design. It gives an overview of evidence-based and data-driven design as new emerging practices, which base design decisions on rigorously collected data. Using various case studies from Spacelab — a London-based practice — as an example, the paper shows how the typical needs of clients can be solved more profoundly by relying on data rather than intuition, opinion or office politics. The main insights include answers to the questions of how to fit more people into a space, whether everyone needs a desk, who should sit where, how to find the perfect property and how to establish the success of a project. In conclusion, the paper identifies key barriers for the further integration of research findings into design practice and suggests how they might be overcome in the future.



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INTRODUCTION: WHY WORKPLACE DESIGN MATTERS

In the perfect office, workers would be provided with everything they need: sufficient quiet spaces in which to concentrate, team areas in which to collaborate and inspiring social spaces for meeting and exchanging ideas — all balanced appropriately to suit the needs of a business and accommodate workflows. But recent studies and reports suggest that the majority of office spaces do not meet these simple criteria all that easily. Gensler reported in its 2008 workplace surveys that only 26 per cent of the workforce in the average UK company is satisfied or highly satisfied with their workplace,¹ while 43 per cent of their counterparts in the USA reported satisfaction.² In its 2013 follow-up survey of US workplaces, Gensler found that workplace performance dropped by 6 per cent from 2008 to 2013 due to an overall decrease in the effectiveness of focused work.³ A similar story of overall dissatisfaction is told by employee engagement statistics collected by the Gallup Institute, which reported that 24 per cent of the workforce across the globe is ‘actively disengaged’, ie unproductive and unhappy.⁴ Distinguishing levels of satisfaction by type of office accommodation has revealed that the highest level of overall workplace satisfaction occurs in enclosed office spaces;⁵ the same goes for performance metrics, which are highest for those in individual offices, as studies of German office workers have found.^{6,7} At the same time, open-plan accommodation is becoming increasingly more prevalent, not least because of increasing pressures on businesses to operate efficiently and save space. This disparity between the perceived ideal (enclosed) and reality (open or shared) has

led to some drastic commentary blaming open-plan offices in general for unsatisfactory working conditions, for instance, in an article in *The Guardian* in 2013.⁸

Business performance and workplace satisfaction are intrinsically linked to the spatial design of offices. Against the background of dissatisfaction with workplace design on the one hand and knowing that workplace design matters on the other, it can be concluded that the spatial design of offices needs to improve. To this end, the authors propose that a new process of designing offices is needed — one that takes into account the increasing levels of knowledge on how exactly workplace design matters and ultimately improves the output product of design: the built office space. Hence, in order to design better office spaces, we need to build on the science behind the workplace, which has begun to receive more attention and reach a critical mass. For decades, researchers have attempted to understand how the design, layout and structures of workspaces affect human behaviour within organisations, such as communication, knowledge exchange, productivity, creativity or innovation; however, for most of this time, insights have been rather ambiguous, if the body of evidence is considered as a whole.⁹ For instance, in the 1960s and 1970s environmental psychologists became interested in the changes in communicative behaviours of employees before and after an office move, and the associated changes from enclosed office layouts to open plan. It was generally hypothesised that communication patterns would improve with a more open layout, yet this could not always be confirmed. A meta-analysis of the literature suggested that, out of 11 studies conducted between 1969 and 1982, four reported an increase in communication with an open-plan layout, one showed ambiguous results, three found a decrease in communication and three did not see significant differences at all compared to the previous situation of

enclosed office space.¹⁰ This has led scholars to conclude that the existing knowledge on the links between social interaction and spatial layout of offices is still ‘scattered empirical evidence’.¹¹ The Commission for Architecture and the Built Environment (CABE) even commented that this amounted to a ‘collective failure’.¹² Only more recently have clearer patterns begun to emerge, possibly due to an increasing number of studies overall. Other contributing factors may include a tendency for more rigorous research designs, for instance, pre and post-comparisons,¹³ larger sample sizes in comparative studies,¹⁴ or the use of randomised controlled trials in the workplace.¹⁵ The ability to collect richer and bigger datasets on organisational behaviours through the help of technology^{16,17} may play a role as well.

In summary, various insights into the relationship between human behaviours in the workplace, and spatial structures and design, have now been established, for instance:

- it is clear that the spatial structure of an office combined with the distribution of attractors (such as kitchens, photocopiers and water-coolers) shapes movement patterns;¹⁸
- propinquity and proximity determine who employees meet, bump into and interact with most frequently in their workplaces;¹⁹
- generative offices that allow for the creation of new knowledge have significantly higher levels of internal visibility among teams;²⁰
- spatial cultures, for instance having control over an environment and being able to personalise an office, influence performance, job satisfaction and wellbeing at work.²¹

To conclude, it seems that staff satisfaction and happiness at work, but also communication and knowledge creation, are driven by the way in which workplaces are designed.

So why is workplace design still not delivering satisfaction?

DATA-DRIVEN DESIGN AS A NEW APPROACH

The problem, it seems, lies in bridging research and practice. Research insights rarely find their way into actual workplace design. Architects and interior designers traditionally rely on experiences and intuition to come up with design solutions for the workplace problems of clients. Architectural design as a professional activity has been described as a ‘process of making’,²² ‘experimental trial and error’²³ and a ‘learning by doing’ approach.²⁴ This professional culture does not easily lend itself to the systematic enquiry needed to tackle the problem of limited workplace satisfaction as described above.

In order to address this gap between architectural research and design practice, evidence-based design (or EBD) has been suggested as an approach to integrate research findings into design processes analogous to the practices of evidence-based medicine²⁵ or evidence-based management,²⁶ ie grounding decision making in evidence from systematic research. It has been argued that an evidence-based design practice would have to be built upon, first, a scientific basis in organisational sociology and its relationship to physical design; secondly, an understanding of an ‘aetiology’, ie the mechanism behind a design intervention; and thirdly, the sound measuring and operationalisation of both design and behavioural variables.²⁷ More recently, the notion of data-driven design has emerged, which pays reference to the concepts and mechanisms of analysing so-called ‘big data’²⁸ and has its roots in more technologically derived and computational thinking.²⁹ Nevertheless, both evidence-based design and data-driven design essentially form very similar approaches of systematic enquiry that ground design decisions in insights

generated by rigorous research and evidence/data.

Despite notable exceptions,^{30,31} neither evidence-based design nor data-driven design is practised widely. A recent online survey by the *EBD Journal*, which queried 420 practitioners in architecture, interior design, urban design and landscape architecture, found that, although 80 per cent of participants perceived the need for more evidence, only 5 per cent actively collected some sort of data on occupancy and space usage (with less than 1 per cent of respondents doing this in a rigorous and systematic way) and actually 0 per cent of the sample reported engaging in a second round of analysis upon completion of a project.³² The main reasons for not engaging in evidence-based design were, according to 37 per cent of the practitioners, a lack of interest from clients and the difficulties in getting paid for these services.

UNDERSTANDING BUILDINGS IN USE

The current interest of practitioners to learn more about buildings in use is mirrored by wider policy developments. The UK Government has established the so-called ‘Soft Landings’ policy, which will be mandatory for government buildings from 2016 onwards.³³ It takes a whole procurement process perspective and proposes to extend the duty of care of architects for up to three years post-building completion to review building performance and occupancy aspects. As part of the framework, the policy mandates a systematic post-occupancy evaluation (POE) at several points in time after the completion of a project, in order to understand buildings in use and monitor performance.

Likewise, the Royal Institute of British Architects (RIBA) has undertaken a redefinition of the stages in architectural projects in its ‘Plan of Work 2013’.³⁴ This plan introduced a stage 0 — ‘Strategic Definition’

of projects — which includes the client’s business case, and a stage 7 — ‘In Use’ — which includes POEs, project performance, research and development aspects. Similar developments can be seen in other countries, for instance, the American Institute of Architects (AIA) included research and evidence-based design in its list of priority strategies for 2010.³⁵

Taking all three strands together — policy developments, the increasing interest of practitioners in an evidence-based design approach and the emerging science behind the workplace — it seems that a real shift in how architectural space is anticipated, planned, produced, valued and monitored is on the horizon. In the following, the data-driven design approach of Spacelab, a practice based in London, will be introduced to exemplify how its process is grounded in research, what benefits it brings and how it differs from a traditional intuition-based architectural approach. After highlighting the method and processes of Spacelab’s data-driven practice in general, extensive case study examples from the practice will be drawn upon to discuss five typical clients’ needs in office design:

- How can we fit more people in?
- Does everyone need a desk?
- Who should sit where?
- How do we find the perfect property?
- How do we know the space is a success?

THE DATA-DRIVEN DESIGN APPROACH OF SPACELAB

Spacelab’s methodology for understanding and designing workplaces is an exemplar of how data-driven design principles can inform better workplace design solutions for clients. This evidence-based approach has been created, and continuously developed, in collaboration with the Bartlett School of Architecture at

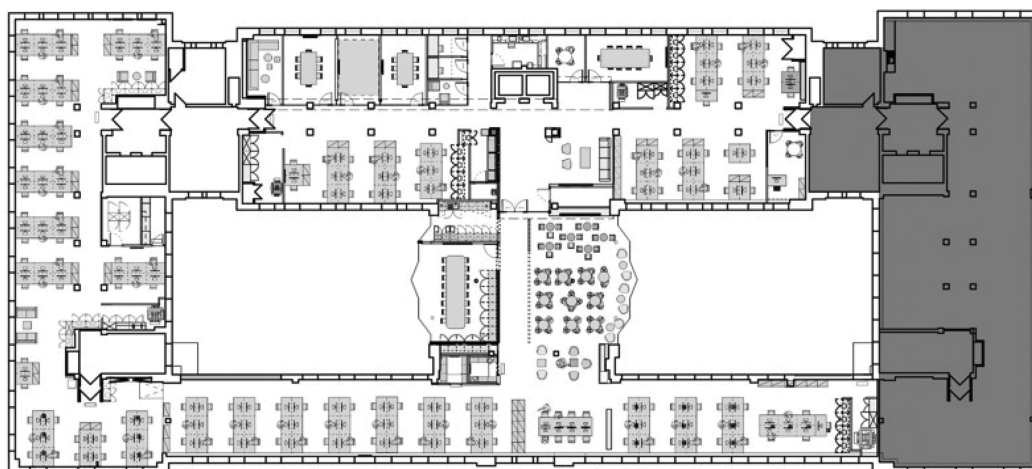
University College London (UCL). Grounded in thorough and rigorous research of both a client's organisation and its space, the process provides new levels of insight into the social and spatial functioning of a business.

The process often starts by working with senior management to establish a clear understanding of the issues and challenges currently faced by the organisation, and to set the overall measurable benefits to be delivered by the project. Often clients do not know exactly what they need from a space; at the same time, not many companies are actively collecting performance metrics themselves. Essentially, the first step of the approach is to create a more informed and systematic brief for the project. A series of structured one-on-one 'stakeholder' or head of department interviews then helps to clarify the current and desired future working practices of different parts of the organisation as well as informing an understanding of the interaction and collaboration networks in the business. An online staff survey is used to explore what individuals need from their workplace, how satisfied they are and how well they perceive it currently matches up to the task. Last but not least, an observation

study of occupancy, movement and interaction brings to light how people actually use the space. These methods are combined with spatial analysis techniques using DepthMap software,³⁶ which assesses the performance of the workplace layout revealing the potential of space to integrate or segregate people, and thus how it facilitates collaboration.

Through the layering of this evidence, and in conjunction with the client, strategic recommendations are made for an ideal space, and new ways of working within it. A spatial strategy is then developed that includes a schedule of total recommended space requirements, as well as a masterplan (see Figure 1), which maps key spatial relationships between departments. These provide an extensive and detailed brief that:

- defines the fundamental principles of a workplace design that is tailored to the exact needs of an organisation;
- allows an organisation to change (if desired); and
- increases the satisfaction, happiness and wellbeing of employees.



Data-Driven Design - Masterplan

Figure 1 A typical masterplan based on a data-driven design approach highlighting the allocation of space to teams and the ideal location for shared facilities

This strategy and masterplan can be used to either compare options in a property search and inform future design stages within a new property, or reveal how to make an existing space work better for its inhabitants.

Creating a structured brief in this way has two obvious advantages: first, it creates long-term value. The spatial design of a workplace is a big investment and, by following a data-driven approach, the chance of ‘getting it right’ is significantly increased. Thus the short-term upfront investment (in time, money and effort) of data-driven design is justified easily by the long-term gains. Secondly, using evidence and rigorously collected data makes a strong case for a specific strategic design solution. It renders the argument less disputable and helps to communicate the reasons behind the proposed changes throughout the organisation. The chief executive officer (CEO) of Netscape, Jim Barksdale, once famously said: ‘If we have data, let’s look at data. If all we have are opinions, let’s go with mine’.³⁷ Hence a data-driven approach can reduce office politics, allowing the best strategic solution to win.

HOW CAN WE FIT MORE PEOPLE IN?

Cost saving is always on the agenda of any business. Reducing the total area that the business occupies is an easy target for cutting operating costs; however, this is often in the context of the size of the organisation staying the same or even growing. Faced with this challenge, the easy and conventional approach is to add in more desks at the expense of other facilities, such as break-out areas, which are often seen as ‘nice to have’. The data-driven approach, in contrast, is to gather evidence about the way the business actually needs to work and how well the space currently performs against that. This means that a detailed accommodation schedule of requirements can be calculated from the bottom up. In this way it is possible to quantify potential space savings

without the need to compromise the performance of the workspace itself. Often it has been possible to reduce space while in fact, at the same time, enhancing spatial and hence business performance.

In a recent project example, a London law firm was looking for ways of releasing a minimum of 2,800m² of space. Using a range of data gathering and analysis techniques it was possible to demonstrate a potential saving of 7,250m², which represented a 32 per cent space saving on its total London property portfolio, and yet also included some additional facilities that were not currently available to legal and support staff. An accommodation analysis comparing space allocation to benchmarks for equivalent organisations showed savings were possible in storage and primary circulation; there was also the potential that moving from cellular to open-plan workspace would provide. An observation study established that, contrary to perception, actual desk occupancy levels were on average 44 per cent, including in the cellular accommodation, and also showed how little communication was happening on a day-to-day basis between different specialist legal teams. Head of department interviews and an online survey helped to establish the activities that people needed to be engaged in to get their job done, and the bigger strategic issues that the firm was facing. They also highlighted that the current inefficient layout lacked important facilities such as designated multidisciplinary project rooms. The result was the client was able to plan to vacate an entire building that had the additional benefit of bringing the whole firm together in one place, leveraging the possibilities of greater cross-disciplinary working while delivering significant cost benefits over and above the investment.

DOES EVERYONE NEED A DESK?

Advances in technology and the rise of knowledge work have transformed people’s

working patterns. Gone are the days of one-size-fits-all sedentary 9–5 roles, these having been replaced by a more varied and dynamic model in which people increasingly may be away from their desk, and away from the office, for a proportion of the working day or week. Combined with the ever-increasing costs of office space, this trend opens up the potential to achieve spatial efficiencies by providing only enough desks for the number of people working in an office at any one time, and encouraging agile working across them.

In 2012 a business-to-business (B2B) information and events business was looking to reduce its net internal area (NIA) by 35 per cent to 4,000m², and was already thinking that a flexible working approach would be part of the answer. With no data to support a move like this, it would be risky to assume that all parts of a business could work flexibly. It also would be easy to simply apply an arbitrary 10: 8 head: desk ratio, which might either be difficult to achieve or indeed not push the possibilities far enough. In this

case, a week-long observation study of the company's workspace showed an average desk occupancy of just 43 per cent, with an overall maximum of just 55 per cent; no individual team exceeded a maximum of 71 per cent at any point in time (see Figure 2). In addition, it was found that there was an excess of more than 100 desks compared with the current headcount. Layered with other findings from the extensive research methodology, such as the desire of staff for home working and a preference for working together more flexibly across a variety of spaces, this evidence was used to demonstrate how the new space could be designed to support a flexible, non-allocated, desk strategy, with all teams working at a 10: 7 head: desk ratio. While this would enable the client to reach its goal to reduce its NIA, and was consistent with the desire to break down barriers and facilitate greater collaboration, it represented a major cultural shift for the business. The rigour of the data-driven process was therefore pivotal in convincing the client, and its employees, that the strategy

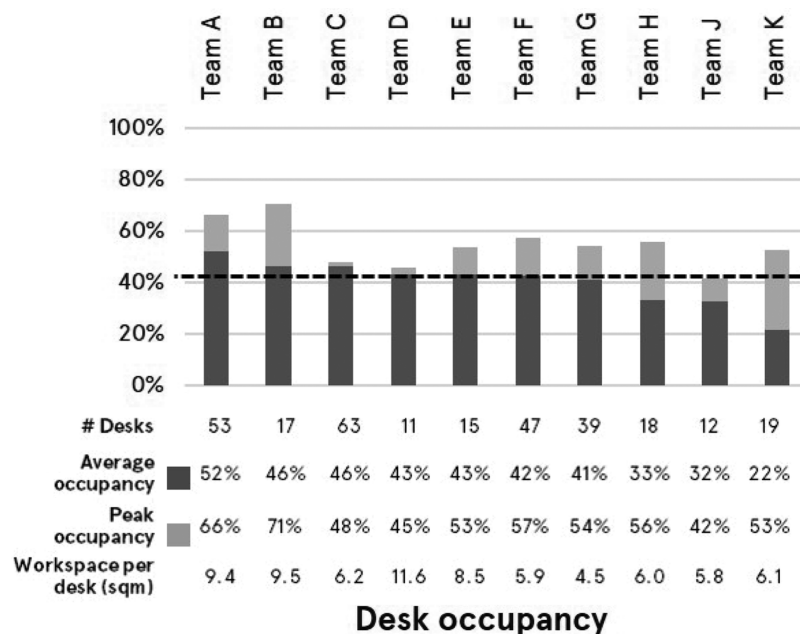


Figure 2 Average and peak desk occupancy figures team by team for B2B information and events business

was achievable. The successful implementation of flexible working has also reduced churn costs for the client and created an attractive work environment for staff, which is crucial in recruiting and keeping talent.

WHO SHOULD SIT WHERE?

For advertising agencies, increasingly complex projects demand increasingly interdisciplinary teams of people with different skills and specialisms; however, the senior management of a major multi-media agency, situated outside Manchester, suspected that spatial siloes were actively reinforcing organisational siloes. With different departments spread across four different buildings on a campus in the middle of the countryside, cross-department interaction was restricted, posing a huge challenge to the organisation's vision for greater interdisciplinary collaboration. An extensive workplace study was undertaken that confirmed that the majority of interaction between staff — particularly frequent interaction — was 'local' (both spatially, and within teams) and staff did indeed feel they had limited visibility of what was going on across the organisation. The recommended revised spatial strategy was therefore the creation of a more integrated, connected space. The final design solution amalgamated the four buildings by covering the courtyard between them, to create one building. The resulting increase in spatial integration of the new scheme could be demonstrated and quantified with analysis using DepthMap software³⁸ rather than just intuitively assuming that this would be the result. Moreover, rather than simply putting everyone back into the same position in the newly connected building, the data gathered from in-depth interviews with department heads and from a survey of all staff informed the planning of team locations, adjacencies and proximities. Social network analysis of desired future collaboration networks across the organisation (see Figure 3) revealed a

desire for the creative team to be at the core of the organisation (Team E), thus indicating that Team E should be located at the spatial heart of the campus. Other teams, such as IT (Team M), which had less need for cross-department interaction and so was positioned towards the periphery of the organisational network, could be located in less spatially integrated areas. This meant the data-driven approach not only made the case for the spatial reorganisation of the overall office layout, but also provided concrete guidance on the placement of teams, which otherwise with no data available might have been determined by office politics.

HOW DO WE FIND THE PERFECT PROPERTY?

Sometimes businesses find themselves needing to relocate for a variety of reasons: they may have outgrown their existing space, the lease may be coming to an end or indeed they realise that configurationally the structure of their existing space is itself getting in the way of the business operating effectively. Such was the case for one specialist business information company, occupying 2,700m², which was seeking to change its fragmented culture to a 'one company' culture, where people from across the business would be able to draw on the expertise of their colleagues more easily, in order to be more innovative in the products and services they were providing for their customers. The company already recognised that its existing building and interior design was reinforcing the organisational barriers that existed and was also probably over-sized. The conventional approach would be for a property search agent to get straight on to the case of looking for new commercial space, probably using a rule of thumb square metre per person to work out how much space is required. Decisions about which space to take would then be mainly driven by location, cost, availability and possibly the personal preference of

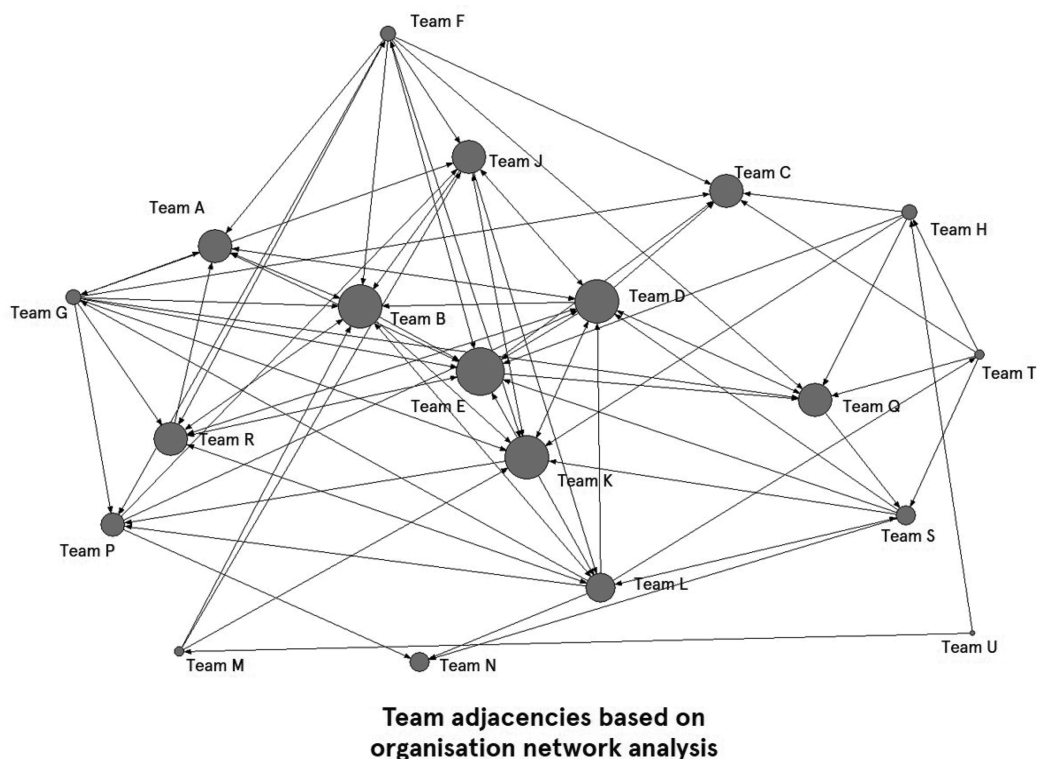


Figure 3 The organisational network of desired future collaboration patterns (based on interviews with heads of department) at a Manchester-based advertising agency

the CEO. But an alternative approach was taken in this case: investing time up-front to carry out a detailed requirements-gathering study. This included collecting evidence about the way in which staff were occupying their existing space and surveying them about their future business requirements, including modelling current and desired collaboration patterns between departments. Using the data to establish a set of strategic design guidelines, such as adopting consistent workspace densities and moving from departmental meeting rooms to a centralised shared facility strategy, the company was able to draw up a list of measurable spatial criteria that formed part of the property search brief. Each shortlisted property not only could be assessed against these criteria, but also could be analysed in terms of its spatial configuration and potential to integrate or segregate people. Figure 4 illustrates an example of comparing

the spatial potential of two different properties. Both options showed similar overall levels of integration, yet Option 1 provided higher levels of rather integrated space, whereas Option 2 showed a higher range of variation of spaces from integrated (suitable for collaboration) to segregated (suitable for concentration). The link between the two wings of Option 2, however, is rather narrow, which means a natural tendency of the floor plan to split an organisation into two parts. This information allowed the client to make an informed decision (which in this particular case was to reject both properties and look for another, more suitable, one). Therefore, the spatial layout of a potentially interesting property became another layer of information to guide the final selection process. The company has since successfully relocated. The new interior design — based on the strategic guidelines that were

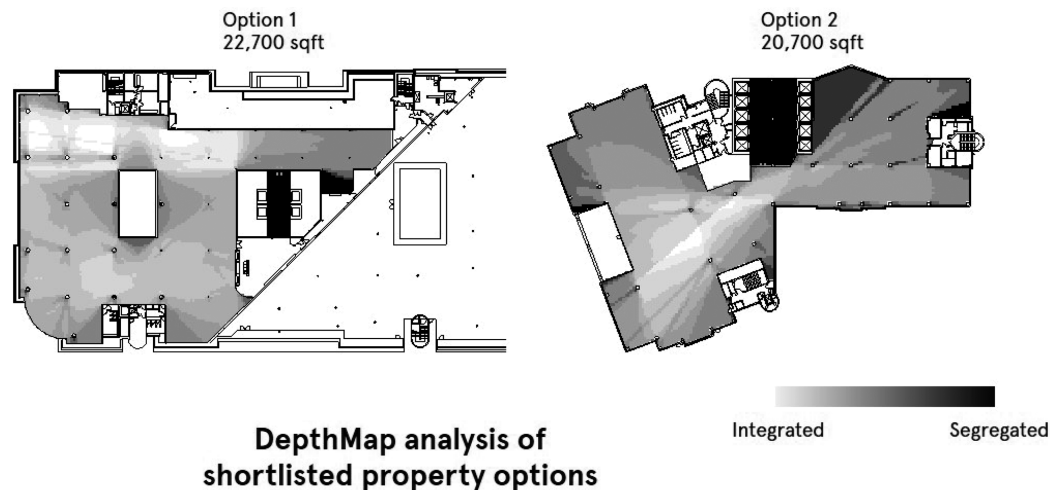


Figure 4 Analysis of the spatial configuration of two properties using DepthMap in order to determine levels of integration or segregation of a floor plan

developed, involving a central knowledge hub to bring people and information together in one place — has transformed the working experience of the staff and the business in terms of its ability to innovate.

HOW DO WE KNOW THE NEW SPACE IS A SUCCESS?

If a business wants to boost performance and is using the physical workspace design to do it, it will obviously want to know if the investment is generating the desired result. This is where POEs come in. Without a pre-occupation study of the same organisation, baseline data for comparison are missing. In that case, the only possible quantitative evaluation is against benchmark data gathered from other organisations, for example, as done in the building use studies (BUS) methodology.³⁹ This has some value but says nothing about the idiosyncrasies and needs of a specific organisation. It can become virtually impossible to compare one organisational culture in one spatial setting to another organisational culture in another setting, since the interplay between space and organisation is so intertwined and, without taking culture into account, it is impossible to

control variables. In the case of a market analysis company, it could be shown in a pre and post-occupancy comparison that the reduction in the number of meeting rooms from 16 to seven was a successful move, since occupancy of the meeting rooms rose from 20 to 52 per cent. Space was freed to be invested in a greater proportion of shared facilities and informal break-out areas while still providing enough flexibility for the appropriate number of meetings to take place. In another case, this time for a media company in London, which brought its staff together under one roof in a more compact new workspace layout with additional new communal facilities, a pre and post-occupancy study was undertaken. It proved how crucial staff satisfaction is, since around 70 per cent of staff reported that the new workspaces facilitated collaboration and allowed opportunities for unplanned interaction. The company also introduced a flexible working strategy and, as a result, the percentage of staff working from home up to one day a week rose from 25 to 57 per cent. The majority of staff were happy with this change: 68 per cent of staff reported they enjoyed the newly found freedom of being able to partially work from home and 35 per cent

even said it improved their work-life balance. Without baseline data from a pre-occupancy study, it would have been very difficult to show exactly how the new space worked in a POE.

WHY DATA-DRIVEN DESIGN IS SO HARD ... AND HOW TO CRACK IT

Despite its obvious advantages in allowing architects and consultants to provide better workspaces that allow organisations to thrive and staff to feel valued and happy, data-driven design is not an easy approach. On the contrary, it requires expertise and skills in collecting, analysing and interpreting data — traditionally not skills in which architects are well trained. Outsourcing the data collection and analysis stages to external consultants has the advantage of tapping into the skill sets of consultants and analysts, yet it creates barriers in the later stages. If external consultants have intensively engaged with a client organisation, all the knowledge about that organisation resides with the consultants and the tacit nature of this knowledge makes it tricky to hand over. If interior designers have not been involved throughout the process, they might struggle later to own the solutions and fully grasp their subtleties, which can result in a failure to implement them accordingly. Hence, embedding data-driven design inside a design practice can be fruitful and refreshing for both sides: the consultants/analysts as well as the designers. Additionally, a data-driven design process needs time, which is often difficult to negotiate with clients, for example, when a lease is running out and a design decision has to be made quickly. Data-driven design can add up to 3–4 months to a design schedule (depending on the size and scope of the project), time that many clients are unwilling or unable to provide. Also, of course, it costs money to collect and interpret data, which clients may be unwilling to invest. The above-mentioned

results from the *EBD Journal* survey are testament to this;⁴⁰ however, the investment into data-driven design is an investment worth making, since it maximises the opportunities that come with a new workplace design to ensure increased business performance and staff satisfaction are actually realised.

Change is important here. Humans are habitual creatures and by nature often oppose change. A data-driven design process turns the way in which workplace projects are delivered on its head and clients might not have heard about this approach before. As it means an additional upfront investment, it does not present itself as a natural solution; however, it often is the more long-term and sustainable one. It also should not be underestimated that a change in the spatial design of a workplace needs to be embedded in behavioural and management changes. It is not only the CEO who needs to be convinced that a change to data-driven design is a good move, staff also need to be convinced of the suggested changes in their workplace. If a strategic solution includes for instance flexible working or an increased diversity and choice of places where people can work, a change management strategy is required to establish new ground rules of behaviour and organisational cultures in line with the spatial design.

With policies now in place to support data-driven design, the evident need for better workplace solutions can be addressed. With an increasing number of examples in practice of how this can be done successfully, the time is right for more emphasis and investment in both the upfront and post-occupancy data gathering process as a means to ensure that the significant sums of money spent on property projects is money well spent. This will include developing the skill sets and competencies in architects and designers to engage with research. A new job role may evolve in the future at the

intersection of design practice and consultancy: a consultant, who is confident to handle large-scale and complex multi-modal datasets and who is skilled in delivering an improvement in business performance through spatial design (rather than via organisational restructuring, as traditional management consultants do). It also means that architects, designers and spatial consultants have an active role in educating their clients and convincing them of the long-term benefits of the approach with rigorously presented facts and figures.

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