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How and why to assess workplace design: Facilities management supports human resources

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Contents

Most organizations have a physical footprint, and someone in those organizations makes choices about the physical place with an expectation for the effects it will have. Some high-profile companies commission dramatic buildings from leading architects, such as the new Apple Park in Cupertino, California, designed by Lord Norman Foster, with the goal of creating a "wonderfully open environment for people to create, collaborate and work together". Even high-tech start-up companies with low budgets make considered choices about the work environments they provide, to attract employees, to encourage teamwork, and to send a message to customers and investors about their capacities to innovate. Business and design magazines alike publish glowing descriptions of these design features as the workplace opens, but very rarely do they feature long-term evidence about how well — or poorly — the design succeeded. This creates an information gap in which organizations remain unaware of the full benefits — or the hidden costs — of their capital and operating expenditures for spaces.

One reason for this may be historical. Every undergraduate psychology student has heard about the now ninety-year-old Hawthorne experiments, which famously observed that work output in an electrical manufacturing facility increased in response to increases in light level, decreases in light level, and replacement lamps that left the levels unchanged. Arguably, these findings led to the belief that lighting and other working conditions are irrelevant to job performance, and slowed down research into these effects for decades, whereas research into other aspects of management-employee relations has flourished. Similarly, Frederick Herzberg's Motivation-Hygiene theory (published in the 1950s) suggested that job satisfaction emerges from the work itself and job dissatisfaction develops in response to contextual influences, known as "hygiene factors". Herzberg believed that once the basic hygiene requirements are in place — enough light to see, space for materials, sufficient cleaning to prevent disease — working conditions ought not to matter very much to employee motivation.

One sense in which Herzberg was correct is that employees find fulfilment and pleasure in making progress towards meaningful goals. As psychologist Teresa Amabile has written, managers can help their employees best when they

recognize employees for their progress towards getting things done. The feelings of success with small steps towards meaningful work promote the intrinsic interest in the work. Managers succeed when they can remove barriers that prevent progress, when they can enable employees to achieve what Csikszentmihalyi has called *flow*, a state of effortless attention and focus.

Since the 1980s, environmental psychologists and their colleagues in industrial—organizational psychology and schools of business have built a research foundation that shows how the physical conditions in workplaces can either stand in the way of flow, or can help it along. It builds on existing theories concerning work attitudes, particularly (1) the job demands-resources theory of stress and (2) positive affect theory, currently associated with the positive psychology movement. The physical reality of the workplace and employees' perception of it can either add to the demands of the job, or provide resources that enable great performance. When the demands are high, resources low, or the fit between person, job, and place is poor, stress happens and both individual and organization suffer. Conversely, the right conditions, or the ability to modify conditions so that they are the right conditions for that individual, elicit positive affect, which can lead to favourable outcomes for both individuals and organizations.

This seems logical, and perhaps well-known to some, but experience has shown our research group that institutional barriers can hinder its application. If the incentives for facilities managers focus on the capital and operating costs of physical places, the result is an incomplete analysis. As will be shown here, bringing together facilities management with human resources in a systematic way can help both to work better together to support the organization's goals.

Our starting point is the organizational outcomes that matter. Later sections address the influence of work environments in two well-known theories of workplace behaviours: the job demands-resources model and positive affect theory, followed by a discussion of how building certification schemes for sustainable buildings can also benefit employee well-being and organizational productivity. The closing sections describe a framework that brings all the evidence together.

PRODUCTIVITY DEFINED

According to the Oxford English Dictionary, *productivity* means "The effectiveness of productive effort, especially in industry, as measured in terms of the rate of output per unit of input". Colloquially we tend to think of productivity in straightforward industrial units that could be applied to individuals (e.g., number of garments sewn per shift; number of orders processed per hour). These units do not apply well to many contemporary organizations and occupations, where outputs differ from one to another more widely (e.g., one project report is not like another), and which often rely upon inputs from more than one individual. Both science and organizations have moved beyond seeking to know only which working conditions will lead to faster typing; we want to know whether the resulting document helps the organization to fulfil its mission. We will get farther by thinking about *organizational productivity* when considering how work

environments help or hinder, rather than focusing solely on the individual level. Organizations succeed and fail based on the balance between output value and input costs, and the research shows that work environments influence both sides of the equation. Most of this paper will describe these effects.

Kaplan and Norton introduced the balanced scorecard as a way to assess managerial or organizational performance using multiple metrics. Among these are traditional financial indicators, to which operational measures add depth. One strength of this approach is the ability for organizations to tailor the specific metrics to a set reflective of their mission and goals. This same approach can be adapted to monitor the effects of buildings by including ongoing monitoring of building conditions and sustainability metrics (e.g., energy use or greenhouse gas emissions) together with employee-based metrics such as absenteeism, retention, job satisfaction, thermal comfort, self- or manager-assessed performance, and so on. My colleagues Alexandra Thompson, Guy Newsham, and I proposed this approach as a way to value the energy, environmental, individual and organizational benefits of building automation systems, which offer the promise of improved efficiencies (reduced energy use, simplified system maintenance), but which can be costly to install and complex to operate. Monitoring the scorecard metrics on a regular basis provides a way to identify weaknesses that should be remedied and the information needed to demonstrate the value of the system in a monetary sense.

Fig. 1 shows an example of what such a scorecard might look like in relation to work environments, although organizations can set their own list of metrics to include and target values for each. Note that it combines values for the building itself and those related to the experience of the people in the building. Extensive guidance exists (e.g., in building regulations, codes, and standards and in voluntary certification schemes) to assist organizations to understand the relevant industry norms and to set their own target values for the building characteristics. The frequency of reporting is customizable, as is the unit base for reporting. For example, an organization with many buildings might report each building; alternatively, one might subdivide by floor, according to the specific design features, by organizational unit, or by job characteristics. Reporting following major environmental change is an obvious application allowing the organization to track the effects of the change. Although we are not the first group to propose this approach to incorporating the built environment into organizational reporting (the first example we have seen was in 2003), there seems as yet to be few adherents to it. (An exception to this is the WELL Building Standard, discussed below.)

Organizations see both capital and operating costs in their budgets related to providing a place to work. These can add to substantial amounts, making them a target for cost savings. It is important to keep in mind that for most organizations, especially those in the knowledge and service sectors, labour costs are far greater than facilities. A commonly cited ratio is \$300/ft^2 for payroll, \$30/ft^2 for space (building and furnishings), and \$3/ft^2 for utilities. The wrong choice of space or equipment to save on the cost side of the organizational productivity ratio, if it adversely affects employees, can quickly cost more than it saved. Conversely, by making choices that support employees, it is possible to improve

Building Organizational Productivity Label Per Building			
Monthly Score	This Month	% of Our Target Value	Industry Norm
Environmental Satisfaction (1-7)	**6**	**70%**	
Satisfaction with Lighting	5		
Satisfaction with Ventilation & IAQ	7		
Job Satisfaction (1-5)	**3.5**	**50%**	
Linked to Organizational Issues	3		
Linked to Environmental Satisfaction	4		
Health Ratings (1-10)	**7**	**55%**	
Health symptoms	6		
Well-being	7.5		
Mood	6.5		
Staff Commitment	**4**	**50%**	
Organizational Commitment	7		
Intent to Turnover	1		
Absenteeism (absence days per employee)	**2**	**10%**	
Business Unit Performance	**5**	**55%**	
Customer Satisfaction	5		
Financial Outcomes	5		
Environmental Conditions	**8**	**70%**	
Average particulate count ($\mu g\ m^{-3}$)	6		
Average ventilation rate (air changes per hour)	6		
Light level range (lux)	200-400		
Average articulation index	.5		
Energy Use (kWhr/m^2)	**258**	**30%**	
Lighting	65		
Heating, Cooling and Ventilation	105		
Water	15		
IT	13		
Plug loads	50		
Others	10		
Responsiveness	**2.5**	**35%**	
Number of complaints (monthly)	3		
Average response time (days)	2		

Figure 1   An organizational productivity scorecard that brings together the human resources outcomes and the facilities might have this list of metrics

both sides of the output value/input costs equation. Just what are those good and bad choices? The sections that follow provide an overview of some of the important issues, but for greater detail, see section 'Selected bibliography'.

PERSON—ENVIRONMENT FIT

In industrial—organizational psychology, person—environment fit refers to the congruence between individual characteristics and the organizational context. For example, an individual who dislikes ambiguous situations and who prefers stability would be a poor fit for an organization in which there is frequent turnover in project teams. When the fit is poor, stress results, and the employee may develop signs of strain. We can extend this theory beyond the psychosocial and job design aspects of job demands to include the physical work environment. Not only will different jobs require

different physical conditions, but individuals also have differing needs and preferences for physical conditions, from lighting, temperature, and air movement, through access to other people. When the fit is poor, the results for individuals can result in increased costs and decreased output values. In the sections that follow, I outline a few of these relationships, and the selected bibliography provides other resources for the interested reader.

Environments and Job Demands

Our research group at the National Research Council of Canada recently reviewed the literature on a variety of corporate strategies to influence organizational productivity, including office layouts. There is a large literature concerning the change from private offices to open-plan spaces, dating from the 1970s when open-plan offices became the

norm. Interestingly, there was clear evidence that private offices provide better support for knowledge-based organizations than do open-plan spaces. The effect sizes were larger than for most other interventions studied, with employees in private offices reporting lower absenteeism, higher self-reported job performance, higher job satisfaction, lower intent to turnover, and better overall health. Organizations may make this change in part to reduce real-estate costs, but without the awareness of the hidden costs to the bottom line.

Another common means to reduce real estate costs is to reduce the space allocated to individual employees, either by changing from enclosed offices to an open-plan environment, or by reducing workstation size in the open plan. The arguments for these changes often include a desire to remove status barriers, to increase communication, or to facilitate collaborative work, about which more below. Regardless of the reasoning, reducing space per employee affects the density of people in the space. Researchers distinguish between *spatial density*, which is the area available to each occupant (e.g., m^2 per person) and *social density*, which is the number of occupants per office. As spatial density drops, social density will increase. Extremes of both are undesirable.

As the amount of space provided to individual workstations or offices drops, people are necessarily closer together. Sound travels more readily from one to another, increasing the potential for distraction and reduced concentration. Even in today's team-based, collaborative organizations, most people spend most of their time in individual, heads-down work. Employees may need less space to store materials in the age of electronic document-sharing and archiving, but the need for a quiet place to think is less different than many assume. Individual differences in environmental sensitivity and stimulus screening ability affect this relationship; those who can disregard unrelated sounds will be less affected by the distractions. The nature of the work also matters: if the pace of work is fast, or job autonomy is low, the additional demands created by the distractors will magnify the resulting stress.

Environmental psychologists have long examined the regulation of social interactions through control of personal space. Increasing social density — for example, by adopting a very large open-plan area design — increases the number of social interactions, regardless of how much space is provided to each individual. Instead of relating to two or three people in and around your workspace, it may be necessary to relate to thirty. This may be magnified by the removal or lowering of barriers between workstations, so that one can see more of one's coworkers. For some individuals, this number of relationships to manage can be exhausting, whereas others with more extroverted personalities may thrive.

The design intent may be to increase both formal and informal interactions, but the evidence shows that this is successful only to the extent that it suits the work unit and its activities. If the tasks are time-sensitive and require coordination between individuals, then it can be effective to bring together the team members and to construct conditions that make it possible for each individual to be aware of the others. In such a case, the open design may reduce job demands and remove the stressor of not being able to coordinate the work. Conversely, work that requires a high degree of confidentiality and privacy would not benefit from high social density or the removal of physical barriers. In this case, poor design would add demands to the work as individuals strive to maintain the necessary confidentiality.

A related design choice for open-plan offices concerns the height of panels between workstations, or whether to have any physical barrier at all between desks. The arguments for low- or no-panel designs generally focus on claims about benefits for communication and collaboration. Some jobs might demand this degree of accessibility, such as service providers or receptionists, but it does come at a cost. Visual privacy — the ability not to be observed, and not to observe others — requires panels at least 65 in. in height. Lower panels also reduce auditory privacy and increase distraction. For jobs requiring concentration and attention to detail, the removal of the physical barrier between employees can impose metaphorical barriers to effective work, disrupting the effortless attention and focus that work progress requires. Our research group has found that satisfaction with privacy suffers when panel heights are lower than 54 in., but satisfaction with lighting is best when panels are lower than 65 in., allowing daylight to penetrate and reducing shadows from ambient lighting.

Many organizations have noted that individual offices or workstations are not occupied all of the time, particularly for staff whose jobs involve meetings or visits to other sites. Technology can support remote work and can make materials available from multiple locations. This makes it possible to adopt flexible approaches to space assignment, known by various names: hot-desking; hotelling; alternative work arrangements; activity-based work. These have the common characteristic of not giving individuals a static work location, instead using a scheduling tool to assign a work location dynamically, the duration varying from part of the day to (in some cases) a few days. Real estate costs may drop because space utilization increases. As yet, there are few investigations in the literature to report on their success or failure. It seems likely, however, that success or failure will depend on the fit to the organization, the work unit, its tasks, and the individuals. Organizations that adopt a complete scorecard and obtain comparison data will be able to determine whether or not it works for them.

Dynamic space assignment inherently reduces the ability for personalization — the display in the workstation of items that are personally meaningful — because individuals do not occupy the same space on a continuing basis. This may have unintended adverse consequences. Personalization improves environmental and job satisfaction and contributes to well-being. Organizations differ in their personalization policies, but in those with permissive policies, women tend to personalize more than men, with different items and for different reasons. Women tend to personalize to express their identity and emotions, using more items related to family and friends, whereas men tend to personalize to show their status in the organization. The effect of personalization on well-being suggests that the presence of personal items might serve a buffering function, reducing the effect of high job demands.

Another consequence of dynamic space assignment is that it may result in difficulty finding colleagues. In organizations in which individuals work alone (e.g., outside sales), this might not reduce effectiveness. In highly interdependent

organizations, the time spent seeking others could be both a labour cost and a disincentive to effective teamwork.

Environments Provide Job Resources

In the preceding section, the focus was on the negative: ways in which work environments can add to the demands on employees. The converse is also true: Some work environments provide the resources that employees need, beyond the minimum requirements of the space and equipment with which to perform the work.

Encouraging or supporting collaboration and communication are often cited as reasons for the adoption of open-plan office designs, lowering the partitions between workstations, and introducing more social gathering places into contemporary workplaces. As seen above, this can have mixed results, but one aspect that does hold true is that people whose offices are located closer together are more likely to collaborate and to do so successfully; one study of academics found that the linear distance between co-authors' offices (even within one building) predicted the citation rate of their shared publications. Carefully planning space assignments to match people who work together, and to co-locate groups close to one another, can therefore contribute to organizational success.

Access to a window for both daylight and a view of outdoors is widely recognized as desirable. For decades it was common for managers to occupy windowed offices and the move to these offices was an important status symbol. Present-day office design tends to place enclosed spaces in the interior, with either circulation or open-plan areas with low partitions nearer the windows so that daylight can penetrate farther into the interior. A growing body of research supports this trend with evidence of several mechanisms at work.

Access to daylight can provide an energy-efficient way to increase daily light exposure, which is associated with improved mental health. Employees can reinforce this benefit by avoiding exposure to bright light at night because having a strong daily rhythm of light and dark exposure improves circadian regulation of physiological processes including sleep, digestion, and immune function. Furthermore, access to a window can provide a view of outdoors and the opportunity to relax the visual system by focusing on a long distance. When the view takes in a nature scene, or if it is judged to be attractive, there are additional benefits in the form of restored attention focus. The benefits of access to nature include immediate improvements to cognitive functioning, and subsequent benefits to sleep quality and reduced cardiovascular strain.

POSITIVE AFFECT: HAPPY WORKPLACES

We have emotional responses to the places we occupy. Conditions may bring comfort, or not; spaces are judged as spacious, or attractive — or not. A growing literature shows that these affective responses also contribute to organizational productivity as well as to the well-being of individuals.

Psychologist Alice Isen showed that positive affect can lead to creative problem-solving, increase the incidence of

prosocial behaviour, and reduce aggression. With Robert Baron, Isen extended this to consider how positive affect could support organizational behaviours. Sources of positive affect at work include organizational culture, social relationships, intrinsic motivation, and experiencing physical conditions that match one's personal preferences. Baron has demonstrated this effect in a laboratory context using introduced fragrances; my colleague Guy Newsham and I have studied the effects of working under preferred lighting conditions in both the laboratory and in field investigations in organizations.

People differ widely in their preferences for light levels. Our data have shown that for any given static light level, such as the target levels set out in lighting recommendations, at best 50% of the population will have preferences close to that value. Thus, in most workplaces, a large proportion of employees are unlikely to work under their preferred lighting conditions unless they are provided with the ability to control their local light level. When they do work under their preferred light level — not merely to add a local task light to a document, but surrounding them in the workstation — this has several results. Their appraisal of the attractiveness of the space improves, and so does their mood (the positive affect result). The improved mood leads to several good outcomes: reduced discomfort, improved work (i.e., task) engagement, and improved satisfaction with the work environment. Another trigger for this chain of effects is having access to a window.

BUILDING CERTIFICATION FOR SUSTAINABILITY AND WELL-BEING

Corporate social responsibility, sustainability goals, and in some places, building regulations, have led many organizations to seek environmental certifications for their facilities. For example, they may seek to obtain LEED (Leadership in Energy and Environmental Design) or BREEAM (Building Research Establishment Environmental Assessment Method) certification as a goal following a renovation or new construction project, in order to be recognized for reducing energy use or incorporating recycled materials (among other elements for which these schemes award points). There is some evidence that achieving a building label (as a "green building") can increase real estate valuations of the property, and of course reduced energy use can bring its own financial rewards.

Most sustainability programs also seek to ensure that the building conditions will improve the indoor environment for occupants by requiring that the design and operation meet or exceed minimum standards for interior conditions. A few studies have examined whether or not working in a building with a sustainability certification provides this better environment. Taken at the building level, and not differentiating between the specific environmental features in any one building, a growing number of these studies find that green buildings deliver better environments for employees. In most — but not all — green buildings, employees report higher environmental and job satisfaction than in comparable conventional buildings occupied by the same organization. The fact that not all green buildings outperform conventional buildings in this way reminds us that details

matter, and fine-grained analysis is needed in order to identify precisely which features contribute; nonetheless, adopting sustainable design principles provides another route through which organizations can meet their goals. Better longitudinal data combining the energy and environmental features with the human resources outcomes might help to disentangle the successful and the not-so-successful features.

There is at present one system for building certification that focuses solely on the well-being of people in the building, the WELL Building Standard. This system has a set of performance criteria — some required, some optional — that are intended to result in measureable benefits to the health and well-being of the building occupants, both for new construction and renovation. Version 1 is based on six elements, labelled air, water, nourishment, light, fitness, comfort, and mind (Version 2 will be published in 2018). The developers have worked to create criteria that have a basis in evidence while reflecting best practice in construction and design. For instance, continued project certification requires ongoing post-occupancy evaluation using an occupant survey specifically focused on satisfaction with a limited range of features together with a recertification every three years. At time of writing there are said to be over 600 registered projects and 70 certified, but the system is too new for formal evaluations to have been completed or published. Thus, it is not yet clear whether or not the additional attention to the details in the WELL standard result in the intended outcomes.

CONNECTING TO THE LARGER PICTURE

Environments are multimodal: The physical reality is a place, furnished with many elements and providing visual, auditory, and tactile stimuli along with social relationships and perceptions. Individuals perceive all the elements simultaneously, but variably. Individual investigations necessarily focus on subsets of variables on both sides of correlational or causal relationships. Seeing the larger connection to important organizational as well as individual outcomes can be a challenge, particularly as no one investigation can reasonably encompass all of the elements. By linking results from several investigations we can begin to see how the overall result of individual environmental choices, when they are fit well to the nature of the work and the organization, can contribute well both to reducing input costs and to increasing output values.

Fig. 2 shows one set of such connections with good support in the literature (derived from publications in the 'Selected bibliography' list below). The figure is a conceptual blending of several investigations, in which the format of the boxes indicates variables addressed in a single study. At the top are elements that come from facilities choices in equipment selection, design, and operation. We have chosen light distribution, individual control over lighting and temperature/ventilation, carbon dioxide concentration and temperature because of replicated relationships in the literature that have included these, but of course this is not an exhaustive list. These physical conditions influence individuals' appraisals of the lighting, acoustics, and ventilation conditions they are experiencing. There are, as noted, broad individual differences and many other parameters that could be used to describe the environment, but in general people prefer lighter vertical surfaces (>30 cd/m^2) with a combination of direct and indirect light; moderate sound levels (not higher than 45 dB(A)); and, more outdoor air (carbon dioxide concentrations lower than 650 ppm). The literature at present follows two paths, but this is partly a function of where researchers have focused their attention.

Along one path, shown along the left side of Fig. 2, working under conditions that one judges to be good or satisfactory has been shown in laboratory and field investigations to contribute to improved judgements of the appearance of the room as attractive, and this in turn predicts positive mood. This has some important consequences for organizations. Employees who experience more positive mood report fewer health problems, both in the form of discomfort experienced at work (visual symptoms, musculoskeletal pain, headache) and in sickness absences. Positive mood that derives from the work environment also contributes to stronger engagement in the work, which in turn contributes to more favourable cognitive appraisals and stronger motivation to stick to a difficult task. Thus, what is good for the employee can also make the employee more effective. (At the bottom of the figure we note that other physical conditions are also known to contribute to these outcomes.)

Following the path through the centre of Fig. 2, we see that environmental satisfaction, a composite of the individual environmental satisfaction components, also follows a separate path to outcomes commonly investigated in industrial—organizational psychology and organizational behaviour. Environmental satisfaction is a contributor to greater job satisfaction, and this in turn contributes to increased affective organizational commitment and reduced intent to turnover. The original hypotheses about the job satisfaction links emerged from reading the literature, but our laboratory has observed these relationships in several independent samples where work environmental conditions were in the model.

In blue on the right side of Fig. 2 we have included a set of relationships drawn from the literature to show how the individual effects of job satisfaction work together to affect group or organizational outcomes. Although it can be a challenge to show that a happy individual employee is a productive one (productivity in that case being assessed as individual work output or performance), Harter and his colleagues showed that organizations or work units with higher average job satisfaction among employees have lower turnover, more satisfied customers, and — importantly — better business unit financial performance. Happy organizations are productive organizations.

Conceptual models such as the one shown in Fig. 2 are always incomplete. The intent here is not to suggest that the work environment is the only or the principal determinant of absenteeism, work output, job satisfaction, or financial performance. The work environment — and employees' perceptions of that environment, including its of fitness for the work being performed — is a contributor to employees' well-being and to organizations' well-being. Including HR outcomes in the facilities balanced scorecard is justifiable.
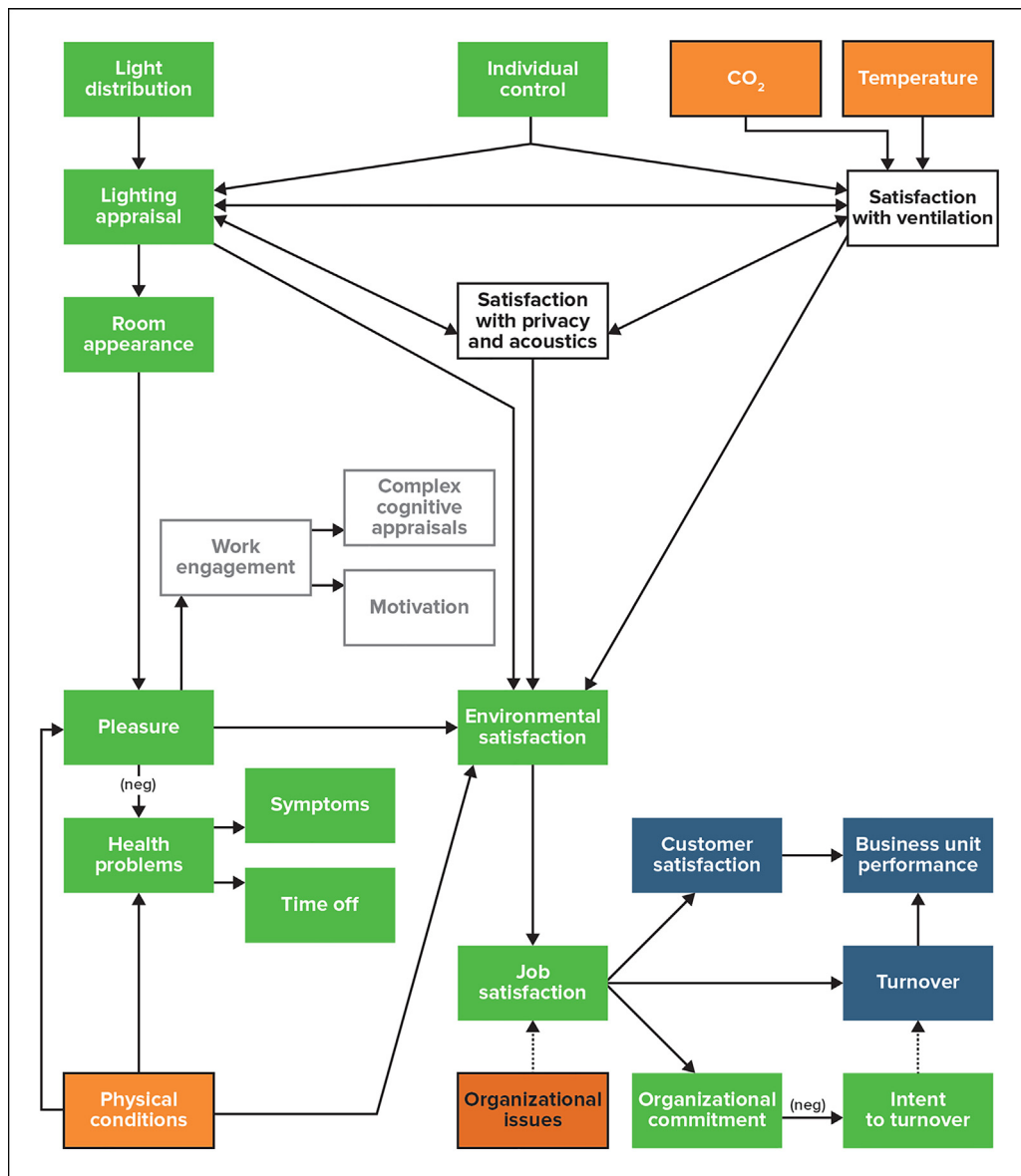
Figure 2   When different investigations use overlapping concepts, we can draw logical connections that show how work environments can support individuals and the organizations that employ them. In this figure, boxes of the same format show variables included in the same investigation. No study has included all of these variables

CONCLUDING REMARKS: GETTING THE MOST FROM YOUR SPACE

Rapid technological change has brought us computers in our pockets that rival the room-sized mainframes that sent astronauts to the moon and data storage in remote locations "in the cloud" that permit access to information — even sensitive commercial data — in places other than the office. The first waves of baby boomers are retiring, or in some cases not retiring, bringing suggestions that workplaces must change to accommodate generational shifts. Some writers propose that the most likely change will be an increase in older workers, whereas others see a future dominated by the hiring of young people more familiar with texting than talking to friends. It would be easy to think that the nature of workplaces must change dramatically too.

Fundamental needs, however, have not changed: Analyze the jobs to be done and the equipment used to perform them, and provide spaces that facilitate those tasks. People require privacy and freedom from distraction in order to concentrate, access to people and resources needed to perform the work, a degree of stability in location and relationships to provide group cohesion, fresh air and an interesting visual environment for restorative purposes. Providing ways for individuals to control these parameters for themselves helps to ensure that individual preferences and needs are met. These requirements are more than the hygiene requirements that Herzberg suggested: The evidence is clear that a suitable job environment — suitable

in the eyes of the individual — contributes to individuals' job satisfaction and motivation in ways that add to the organization's bottom line. The right environment elicits a positive frame of mind, setting up the conditions for employees to experience progress through the draw of their intrinsic interest in their work. The details are complicated, but the right conditions have ripple effects that together have substantial benefits for individuals and the organization.

The route for organizations to fully realize bottom-line benefits through the work environments they provide lies through breaking down barriers within organizations and between research disciplines. Better work environments influence organizational productivity metrics with effects that are as large as the effects of workplace health promotion, performance bonuses, and flexible work practices. By bringing together facilities managers and human resources departments to recognize this interdependence, organizations could fully weigh the costs and benefits of their corporate real estate and facilities choices. They could track the success of design choices and course-correct to fine-tune in areas that underperform, by systematically tracking an organizational productivity scorecard that includes built environment metrics.

A strength of this approach is that, regardless of how workplaces may change in response to future technologies or job design, it provides the information that organizations need for a comprehensive understanding of the consequences of capital and operating decisions. Leveraging existing data from HR functions, matched to facilities, offers an efficient way to determine the value of work environment choices. The development of the WELL Building Standard and the growing collaboration between its developers and various Green Building Councils around the world brings greater attention to the importance of how buildings affect their occupants, but also highlights the necessity for ongoing evaluations of how the facility serves its occupants. Systematic thinking about the needs of individuals — together with the flexibility to provide for those needs, and the ability to evaluate their success — will enable organizations to get the most out of their facility investments, fulfil their goals, and provide great employee experiences.

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Work environments are a focal topic for environmental psychology and human/factors ergonomics as well as some writers from a more architectural or environment-behaviour research perspective. For a theoretical perspective on the topic, see a chapter I wrote for the *Handbook of Environmental and Conservation Psychology* (Veitch, J. A. (2012). Work environments. In S. D. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology* (pp. 248–275). Oxford, UK: Oxford University Press). A more applied perspective — still valid although it was written more than a decade ago — is provided by a practitioner-oriented booklet written by NRC together with designers from Public Works and Government Services Canada (Charles, K. E., Danforth, A., Veitch, J. A., Zwierzchowski, C., Johnson, B., & Pero, K. (2004). *Workstation design for organizational productivity*. (NRCC 47343). Ottawa, ON: NRC Institute for Research in Construction and Public Works & Government Services Canada. http://doi.org/10.4224/20377787). BOSTI Associates wrote an excellent summary of the topic, intended for design and organizational professionals (Brill, M., Weidemann, S., & BOSTI Associates (Eds.). (2001). *Disproving widespread myths about workplace design*. Jasper, IN, USA: Kimball International) A forthcoming book provides a blend of theoretical and practical perspectives on the topic (D. J. Clements-Croome (Ed.), *Creating the productive workplace* (3rd ed.). London, UK: Taylor & Francis).

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Several investigations have reported that better buildings or green buildings support improved outcomes on organizational productivity metrics. Studies that have included large numbers of buildings include Baird et al. (Baird, G., Leaman, A., & Thompson, J. (2012). A comparison of the performance of sustainable buildings with conventional buildings from the point of view of the users. *Architectural Science Review, 55* (2), 135–144) and Newsham et al. (Newsham, G. R., Birt, B. J., Arsenault, C. D., Thompson, A. J. L., Veitch, J. A., Mancini, S., et al. (2013). Do 'green' buildings have better indoor environments? New evidence. *Building Research & Information, 41*(4), 415–434) However, not all investigations find this effect (Altomonte, S., & Schiavon, S. (2013). Occupant satisfaction in LEED and non-LEED certified buildings. Building and Environment, 68, 66–76).

Two recent NRC investigations factored into the conclusions above. One was a comparison of the effects of various corporate strategies, including both better buildings and office type, on organizational productivity outcomes (Newsham, G. R., Veitch, J. A., Zhang, M. Q., Galasiu, A. D., Henderson, I. S., & Thompson, A. J. L. (2017). *Improving organizational productivity with building automation systems: Phase 1*. Ottawa, ON: Continental Automated Buildings Association). The other was an analysis of the effects of green-certified versus conventional buildings on employee satisfaction and manager-assessed job performance in one Canadian financial institution (Newsham, G. R., Veitch, J. A., & Hu, V. (in press). Effect of green building certification on organizational productivity metrics. *Building Research and Information*).

Specific guidance on environmental conditions comes from local and international regulations, codes, and standards from relevant professions and standardization bodies. In Europe, CEN publishes regional standards in this area (www.cen.eu). US standards that apply generally have ANSI (www.ansi.org) or ASTM (www.astm.org) designations. The US Green Building Council (new.usgbc.org) is the originator of the LEED building certification system; BRE (www.bregroup.com) developed the BREEAM certification. Some of the requirements of building certifications rest upon the application of standards written by other bodies, including ASHRAE (www.ashrae.org). The International WELL Buildings Institute (https://www.wellcertified.com) operates the WELL Building Standard, which is based in part on literature such as the sources listed above.

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