Book Section:
Davis, MC orcid.org/0000-0003-1577-7544 (2019) Socio-technical systems thinking and the design of contemporary workspace. In: Ayoko, OB and Ashkanasy, NM, (eds.) Organizational Behaviour and the Physical Environment. Routledge , Abingdon, Oxon, UK , pp. 128-146. ISBN 978-1-138-05352-6

https://doi.org/10.4324/9781315167237

Please cite as: **Davis, M.C.** (In Press). Socio-technical systems thinking and the physical environment of OB. In, R. Ayoko & N. Ashkanasy (Eds), Organizational Behavior and the Physical Environment. Routledge.*

Chapter 9: Socio-technical systems thinking and the design of contemporary workspace

Abstract:

Physical environments shape, constrain and promote a range of behavioral and organizational outcomes. Top-down or efficiency driven approaches to workspace design often lead to inappropriate design and the promotion of undesirable outcomes for employees. Socio-Technical Systems Thinking is presented as a theoretical framework to guide holistic workspace design. This thinking promotes the joint consideration of workspace alongside other aspects of the organizational system, e.g., processes, culture, organizational structure, and helps account for the broader context. The value of systemic approaches to workspace design and associated organizational change is discussed, using innovations such as open-plan and Activity Based Working as examples.

Introduction

The physical environments in which people work have long been acknowledged as playing a key role in helping to shape, constrain and promote a range of behavioral and organizational outcomes – from creativity to wellbeing, performance to communication, job satisfaction to sick leave (Bodin Danielsson, Chungkham, Wulff, & Westerlund, 2014; Davis, Leach, & Clegg, 2011). Public, corporate, and academic interest in the effects that office environments in particular may have upon their occupants has grown since the widespread emergence of 'open-plan' offices in the 1960s (Brookes & Kaplan, 1972) and the subsequent complaints from workers regarding these environments (e.g., Business Week, 1978). Whilst some firms are still on the transition from traditional enclosed (often individual private offices) to open-plan (offices largely without interior walls or visual obstructions, housing three to many hundreds of workers), many more are embarking on what seems set to become the next big shift in office design. They are adopting Activity Based Working (ABW) or multi-modal offices, embodying a less static view of what employees require from their workspace (Brunia, De Been, & van der Voordt, 2016). With more choice regarding office design it raises the questions as to how organizations decide what is the most effective office configuration for their needs, and how to approach the process of design itself.

In this chapter I consider physical work environments, specifically office space, from a Socio-Technical Systems Thinking (STST) perspective (e.g., Cherns, 1976). I begin by outlining a key problem within office design regarding the prioritization of efficiency over

user needs and narrow thinking regarding successful design. Next, I introduce STST as an approach to place the physical workspace in a broader organizational context. Then, I present the core STST principles most applicable to the challenge of undertaking workspace design and management of the requisite change. Finally, I conclude with a reflection on the challenges posed by applying STST to this domain.

The Problem of Top-Down Design and the Prioritization of Efficiencies

Traditionally many office environments have been designed based upon generic assumptions regarding the needs of workers (Kaarlela-Tuomaala, Helenius, Keskinen, & Hongisto, 2009) or as a result of decision making primarily aimed around "efficient" use of space (Duffy, 2000; Vischer, 2005). This is reflected in the rise and now ubiquitous nature of open-plan office formats – introduced with the aim of reducing barriers to communication and increasing information flows (De Croon, Sluiter, Kuijer, & Frings-Dresen, 2005), popularized through the significant financial savings they delivered (Davis et al., 2011; Laing, 2006). Some potential downsides for open-plan occupants have been recognized, particularly with regards increased density and openness, for example, elevated distraction and interruption, lower satisfaction, organizational commitment and wellbeing (Bodin Danielsson et al., 2014; De Croon et al., 2005; Elsbach & Pratt, 2007; Oldham, Cummings, & Zhou, 1995). Nonetheless, this seems to have little changed the calculus regarding optimal workspace design, with financial and narrow operational concerns prioritized (Davis et al., 2011; Duffy, 2000).

As physical workspace constitutes the second largest financial overhead for most firms, after staff costs (McCoy, 2005), the desire to continue to reduce costs by creating further efficiencies in the design and use of space is unlikely to abate. This trend may be witnessed in the embrace of ABW across an increasing number of organizations (Vos & van der Voordt, 2001; Wohlers & Hertel, 2017) as well as through other innovations such as use of co-working spaces and greater client-side or home working (Cascio, 2000; Göçer, Göçer, Ergöz Karahan, & İlhan Oygür, 2017). ABW typically produces a reduction in requisite office space through a combination of hot-desking (non reservable desks that are available to employees as and when required) and reduced individual workstations, coupled with increased task spaces, e.g., discussion areas, team rooms, quiet spaces. The rationale being that a mix of such spaces reduces the proportion of time that areas of the office are left unoccupied and

increases the efficiency of the office space, e.g., fewer assigned desks are left empty for long periods whilst their occupants attend meetings in traditional conference rooms.

I argue that the desire to reduce overhead and to manage workspace efficiently has driven myopic thinking as to what constitutes successful design and that this is problematic. User and broader organizational implications of differing workspace designs are often reduced to secondary concerns or 'user acceptance' issues, to be managed once occupants arrive in their new offices (Davis et al., 2011; Vischer, 2005). This view runs contrary to calls that have been made across disciplines to view workspace as an integral part of the overall organizational system and to recognize that workspace affects how individuals go about their work, the technologies they need and affect their day-to-day experience (e.g., Allen & Henn, 2007; Becker & Steele, 1995; Blyth & Worthington, 2001; Haynes, 2007; Turner & Myerson, 1998). I present STST as an established framework and set of principles with which to engage in holistic design, countering top-down and efficiency driven prevailing mind-sets. As I will explain through this chapter, STST explicitly promotes the consideration of contingencies and interactions between workspace and other aspects of the organizational system, in addition to balancing competing stakeholder interests (Davis et al., 2011; Ridgway et al., 2008). I will demonstrate the applicability of this approach to workspace design through examples relating to ABW and open-plan offices. We first consider the origins of STST and its core philosophy.

Origins of Socio-Technical Systems Thinking and its Core Philosophy

STST developed from seminal work conducted at the Tavistock Institute in the 1940s and 1950s, initially examining the impact of introducing advanced machinery within the coal mining industry (e.g., Emery, 1959; Trist & Bamforth, 1951). These and other studies, in the beginning focusing on heavy industries (e.g., Emery, 1959), then later on the introduction of advanced manufacturing technologies, information systems and information technologies (e.g., Mumford, 1983), demonstrated the inter-related nature of human and technical aspects of work systems and contributed to the development of STST theory and principles (Davis, Challenger, Jayewardene, & Clegg, 2014; Eason, 2014).

The consistent underlying STST philosophy that has emerged argues that any organization can be considered a complex system consisting of many interdependent components, both social and technical, e.g., people, culture, goals, processes, technology and infrastructure, with a change in any one aspect of the system causing change or adaptation

elsewhere (Clegg et al., 2017). The interrelated nature of organizational systems is illustrated in *Figure 1*, with the lines between the nodes in the hexagon demonstrating the relationships and contingencies present in any system (see, Davis et al, 2014, for further discussion of these inter-relationships). Furthermore, STST suggests that systems will work at their best when both the social and technical aspects are 'jointly optimized' (Cherns, 1976), i.e., designed or redesigned with consideration as to the inter-relationships and contingencies between different parts of the system. This way of thinking highlights the need to avoid considering any one part of a system in isolation and to recognize that other parts of the system are connected and may support, inhibit or constrain desired outcomes. For example, the effective utilization of machinery was contingent on the prevailing culture and organization of work processes in Trist & Bamforth's original coal mining studies.

FIGURE 1 ABOUT HERE

As discussed previously, financial and other technical factors have been prioritized in organizations' approach to workspace design. Francis Duffy, a prominent architect, captures this prevailing mindset, reflecting that "the design of the working environment has been considered by the vast majority of clients as a marginal and technical matter, best left to experts to sort out." (Duffy, 2000, p. 371). The design of workspace in relative isolation mirrors that which has been observed by STST researchers over many years in the design and introduction of new technologies and information systems (Eason, 2008). This siloed thinking reflects an expert led 'techno-centric' mindset and the primacy of technology, or in this case the physical infrastructure, over the other aspects of the system within which it resides and interacts. This is a particular problem when one considers that the success of increasingly popular concepts such as ABW are reliant upon wider system factors, requiring for example: that individuals work in roles that encompass varied tasks requiring different types of space; individuals have the autonomy to decide where and when to work; individuals are willing to embrace change; technologies that enable workers to get up and take their work with them are available; a culture of trust exists to allow individuals to work out-of-sight or from home (Brunia et al., 2016; Laing, 2006).

Thanks to the long pedigree of STST, there already exists a large body of knowledge, developed across various problem domains, regarding effective socio-technical design (see, Hughes, Clegg, Bolton, & Machon, 2017; Mumford, 2006) which could be used to approach the problem of workspace design. In the next section, key principles to approach such design are discussed in detail.

Please cite as: **Davis, M.C.** (In Press). Socio-technical systems thinking and the physical environment of OB. In, R. Ayoko & N. Ashkanasy (Eds), Organizational Behavior and the Physical Environment. Routledge.*

Key Socio-Technical Systems Principles Applied to Workspace Design

Various sets of 'principles' to guide the design of socio-technical systems or to evaluate and explain their performance (success, maladaptation or failure), have been proposed, based upon observation and analysis of system design and redesign in various contexts (e.g., Cherns, 1976, 1987; Clegg, 2000; Mumford, 1983). These principles provide a well-established framework to approach the process of workspace design, promoting holistic design and stakeholder engagement. They also provide insights regarding the form of the design itself and how to manage the attendant change. The eight principles that are particularly pertinent to the design of workspace are discussed in turn below using Cherns (1987) and Clegg (2000) as organizing lexicons. These principles are summarized in *Table 1*.

TABLE 1 ABOUT HERE

1. *Open Systems Perspective*

STST suggests that system components should be designed in relation to one another and with reference to current and future environmental demands (Cherns, 1976). This principle also encapsulates the overarching idea that a change to one part of the system may have implications elsewhere (Davis et al., 2014), e.g., that a change to the physical layout of an office may result in changes to the organization of teams and processes. This implies that physical workspace should be designed in a way that is both adaptable and responsive (links to principles three and seven below), to enable the organizational system to respond to changes in the external environment (c.f., Mumford, 2006). If client needs or internal functions change, the workspace should be easily adaptable and reconfigurable. Similar flexibility is required with regards to IT and technical infrastructure, acknowledging that technologies and software as yet unknown may be deployed at scale within organizations, or ones that are currently ubiquitous may disappear. For example, as witnessed with the loss of typing pools, large server rooms and, increasingly, the demise of static PC workstations (Laing, 2006). Indeed, the recognition that work organization may change rapidly was one of the drivers of the adoption of open-plan layouts (Davis et al., 2011; De Croon et al., 2005), with the rise in popularity of ABW reflecting in part that technologies are now highly mobile (Gillen, 2006; Wohlers & Hertel, 2017).

2. *Organizational Choice*

This principle relates to the ideas of 'minimal critical specificity' (Cherns, 1976, 1987), that designers should limit formal specification of form, function or process to only that which needs to be decreed, e.g., expected outcomes or safety processes, with the detail of how to accomplish tasks or to organize work left to individuals and groups as far as possible. In other words, "workers should be told what to do but not how to do it" (Mumford, 2006, p. 322). The rationale being that designers can never foresee all eventualities or contingencies that may arise in the real world. Clegg (2000) extends this reasoning to conclude that there are always multiple design solutions to any given problem and that design should reflect the needs of the business, employees and users rather than designers' preferences or convenience.

Whilst these ideas may appear obvious, the overwhelming prevalence of open-plan offices (Bodin Danielsson et al., 2014; Davis et al., 2011) suggests that this design has become the unquestioned norm, rather than a considered choice for many organizations. The specification of open-plan designs a priori, reflects design and operational bias on the part of designers and managers. This constrains the configuration of the space, organization of individuals and ways of working. STST would argue that beyond the unavoidable constraints, occupants should be permitted to decide what space is appropriate for their work requirements and to decide where, when and how they accomplish their work. These sentiments are becoming increasingly popular through ABW and flexible work-home arrangements (Daniels, Lamond, & Standen, 2001; Göçer et al., 2017; Knight & Haslam, 2010). This does not necessarily mean that such arrangements will necessarily be appropriate, rather that they should be on the table as options at the start of the design process.

3. *Controlling Problems at Source*

The idea of controlling problems or "variance" at source (Cherns, 1976, 1987) has become one of the most well-known of the socio-technical principles (e.g., Waterson, 2005) and refers to systems operating most effectively where they are designed to make problems visible and to enable them to be resolved where and when they occur. This idea has been applied extensively in manufacturing and technology implementations (Clegg & Davis, 2016; Eason, 2008). The idea extends to broader notions of building opportunities for control and empowerment within systems to improve performance outcomes (enabling systems to

respond to unexpected events, uncertainty and complex problems with variable solutions) and provide psychological benefit to workers (Clegg, 2000; Mumford, 1995).

The workspace literature has identified that the configuration of workspace holds the potential to both enable and constrain individual choice, control and the opportunity to take action to manage problems quickly and directly (Elsbach & Pratt, 2007). Physical design can therefore be used to actively help promote the broader aim of control of variance of source and by extension system resilience and innovation. For example, open-plan offices have been lauded for enabling fast decision making and discussion of problems (e.g., Brennan, Chugh, & Kline, 2002; Brookes & Kaplan, 1972), with break-out and informal discussion spaces increasingly being incorporated into a range of office types to aid this objective (Bodin Danielsson et al., 2014; Morrow, McElroy, & Scheibe, 2012), enabling problems to be resolved as and when they arise. Provision of task or activity spaces provide examples as to design options that enable workers to be reactive, able to respond to changes in task requirements, work demands or to resolve unexpected problems without, for example, having to book meeting rooms or project space in advance (c.f., Allen, Bell, Graham, Hardy, & Swaffer, 2004; Duffy, 1997; Göçer et al., 2017; Laing, 2006).

4. *Boundary Location and Information Flows*

The design of physical, social and technological boundaries, structures and processes can act as barriers to communication and inhibit information flowing to those who require it and effective knowledge exchange (Cherns, 1976, 1987). These concerns are readily observable with regards the design of workspace, with for example, walls and barriers, as well as sheer physical distance, able to impede access and interaction with colleagues (Allen & Henn, 2007). STST suggests that the design of workspace should aim to make physical and organizational barriers as indistinguishable as possible. Where boundaries exist within the work process, e.g., tasks passing between different groups, then this presents an opportunity for learning and knowledge sharing (Mumford, 2006) and may be aided by co-location, whereby colleagues can observe other aspects of the work process (Oldham & Brass, 1979). Exemplifying this principle, Hall and Ford (1998) report the redesign of a manufacturing space that resulted in the removal of physical barriers separating white and blue collar teams. Following the change, empathy, cross-team understanding, communication and problem resolution increased.

Whilst open-plan designs very visibly seek to remove physical barriers to communication they also present a trade-off with individual needs of workers for privacy and control (Davis et al., 2011). Office configurations such as ABW or open-plan designs that provide areas to retreat to for quiet working, may present an opportunity for workers to better manage this tension between the need for privacy and the benefits of interaction (Laing, 2006; Wohlers & Hertel, 2017). Nonetheless, boundary reduction needs to be more nuanced than simply considering physical walls or furniture and be applied to the related aspects of the work organization (see related principles one and five). In essence, holistic design is required. Consideration should be given as to the placement of teams, the organizational structure, working practices and information systems or technologies needed to support easy free flow of information and ideas within these spaces.

5. *Congruence and Support*

This principle refers to the need for any design and the implicated change to working arrangements to be congruent with and supported by related system components and practices, e.g., culture, goals and technologies (Clegg, 2000). This idea is fundamental in anticipating how and why similar office designs may perform differently in varying contexts (e.g., the inconsistencies and paradoxes that are observed in the outcomes for white collar workers in open-plan offices, e.g., Davis et al., 2011; De Croon et al., 2005; Elsbach & Pratt, 2007; Wohlers & Hertel, 2017). This poses the question, is the workspace congruent with what workers are being asked to do, how work processes are structured, current organizational hierarchies, required information flows, reward systems and goals? The assertion being that system performance and outcomes will be enhanced where the different aspects of the system are aligned, as opposed to where they undermine or oppose one another (Clegg & Walsh, 2004; Mumford, 2006). Successful design will flow from recognition of the relationship between the workspace and related aspects of the organizational system.

The necessity of congruence between workspace design and broader organization factors is illustrated by observations from the workspace literature. Previous evaluations of occupant reactions to open-plan offices have highlighted differential effects across workers dependent upon job role or seniority (Charles & Veitch, 2002), with negative outcomes when the spaces fail to provide adequate provision for the range of tasks and interactions that are performed, e.g., Kaarlela-Tuomaala et al., (2009). This suggests that workspaces may need

to be multi-modal to reflect user needs, in other words incorporate a variety of office concepts within a single building. For example, a department may require different sets of spaces (e.g., individual offices, ABW, traditional open-plan) to accommodate the type of workers and individual preferences within their teams. This way of thinking underscores the importance of considering relevant aspects of job design and considering techniques such as job analysis and process mapping to develop an understanding of the existing structures and ways of working with which the physical workspace may support, impede or interact (see, Ridgway et al., 2008). The nature of the work will also influence the use and success of space, e.g., work involving confidential projects or client centered interactions requiring different types of spaces to those where individuals work with non-sensitive material (c.f., Davis et al., 2011; Sundstrom, Town, Rice, & Osborn, 1994). Workspace design should not occur without reference to these factors.

The importance of this principle can be further emphasized when one considers the interaction that may occur between the physical environment with organizational goals and culture. Encouraging collaborative work practices where individuals are measured and rewarded on the basis of individual performance is difficult (Clegg, 2000). Similarly, environments designed to encourage team work and cross-team information sharing are unlikely to fulfil their objectives when individuals are incentivized to focus on their own work tasks or individual performance outcomes. Other system components, such as processes and technologies may also be considered as contingencies here. The provision of mobile devices (e.g., laptops and mobile telephony) and software (e.g., video conferencing, instant or professional messaging services), together with supporting technical infrastructure (e.g., high quality wifi, mobile network access, cloud hosting) and requisite training or information, may be crucial to determining whether workers are able to utilize different task spaces to their full, to easily hot-desk or to work from home or client or remote locations (Allen et al., 2004; Brunia et al., 2016; Laing, 2006). Furthermore, the role of management expectations or culture has been highlighted as a success factor within post-occupancy studies (e.g., Hongisto, Haapakangas, Varjo, Helenius, & Koskela, 2016; Laing, Duffy, Jaunzens, & Willis, 1998; Ridgway et al., 2008; Vischer, 2005). For example, presenteeism or close supervision and allocation of work, may place constraints on individuals' opportunities to decide where and when to work (e.g., in the case of more flexible office designs) or to use break-out or coffee spaces within more traditional open-plan offices. These observations

support the argument that design is holistic and congruence between workspace design and the wider organization cannot be ignored.

6. *Quality of Life and Experience at Work*

Mumford (Mumford, 1983; 1995) demonstrated how the design of technologies, information systems, work processes and environments, can tangibly alter the nature of the work that individuals engage in, for example, by increasing levels of surveillance, reducing individual autonomy, de-skilling or fragmenting tasks. These observations are recognizable too in research specifically examining the relationship between the design of workspace and occupant responses and behaviors. For example, the configuration and design of workspace has been related to behavioral outcomes such as the levels of feedback individuals receive (Oldham & Brass, 1979), opportunities for friendships or the quality of co-worker relations (Brookes & Kaplan, 1972; Zalesny & Farace, 1987), job satisfaction (Sundstrom, Burt, & Kamp, 1980; Veitch, Charles, Farley, & Newsham, 2007; Zalesny & Farace, 1987) and work motivation (Oldham & Brass, 1979).

Mumford (e.g., 1983) emphasizes the consideration of values within socio-technical systems design and the responsibility that designers and managers have to design work and organizational systems that enhance employees' quality of life. This aim has often been criticized as being idealistic or too humanistic (Pasmore, 1994). However, when it comes to the design of workspace I would argue that there are good reasons to question whether the most technically efficient design (e.g., in terms of the highest occupancy rate or density of workers within the floor space) is necessarily the optimal overall system state. The technical, procedural or financial gains from differing designs need to be balanced against the impact on occupants and their resultant behavior or organizational outcomes. For example, design decisions that optimize occupancy, e.g., implementing hot-desking, reducing the distance between desks or increasing the openness, may produce negative short-term psychological changes. These impacts may include reducing psychological privacy (e.g., Sundstrom, Herbert, & Brown, 1982), perceived control (e.g., Lee & Brand, 2010) or increasing cognitive load (e.g., Kaarlela-Tuomaala et al., 2009), with implications then for task performance and other organizational outcomes (Block & Stokes, 1989; Brennan et al., 2002; Kim & de Dear, 2013). Furthermore, it is clear from research in this domain that the influence of workspace design on occupants may include long-lasting and potentially lagging effects (Bodin

Danielsson et al., 2014; De Croon et al., 2005; Oldham et al., 1995), e.g., general wellbeing or physical health (Danielsson & Bodin, 2008), withdrawal from the office itself (Oldham & Fried, 1987) and ultimately the desire to seek a new job (Carlopio, 1996). Consequently, short-term gains in terms of reduced build or lease costs may be off-set by longer-term costs relating to reduced resilience, performance or skills retention, e.g., stemming from increased staff turnover, absence or fatigue. Actively seeking to enhance employees' quality of life may be perceived as idealistic. However, it seems entirely rational to try to evaluate the likely employee impact of different workspace options as an explicit design stage (c.f., Clegg et al., 2017; Davis et al., 2011) if we wish to avoid or mitigate undesirable organizational outcomes. This view balances the efficiency mind-set and recognizes that design that reduce financial costs in one part of the system may result in financial or non-financial costs elsewhere.

7. *User Participation and Ownership*

This principle draws across the ideas of both user participation in (Cherns, 1976, 1987), and more active 'ownership' during, design and implementation of the resulting change (Clegg, 2000; Mumford, 1983). STST case studies and evaluations have consistently demonstrated that successful design requires users to be both involved in the process of design, e.g., inputting to requirements and decisions, but also to feel that they own the design and take responsibility for how it will work in practice (Clegg & Walsh, 2004; Mumford, 2006; Nadin, Waterson, & Parker, 2001). STST scenario planning techniques (e.g., Clegg et al., 1996; Hughes et al., 2017) have been used to develop the initial design brief for architects and designers, engaging users in the process of actively considering their various needs, associated system contingencies and to take the lead in evaluating the impact of different design scenarios (e.g., Ridgway et al., 2008).

The emphasis within STST on broad stakeholder engagement and multi-disciplinary design teams is a major contribution towards avoiding top down or techno-centric design. The value and applicability of user participation and ownership to workspace design are evident in the wider literature relating to workspace design, e.g., in terms of identifying users' functional needs or technology requirements, re-evaluating working practices, building acceptance of concomitant change, improving understanding regarding timings and the process of the design itself (Allen et al., 2004; Foland, Rowlen, & Watson, 1995; Vischer, 2005). This participation is a key step in design and acts as an important counterbalance to

the experts or other members of the design team and can serve to challenge their pre-conceptions (see principle two). Participation also provides valuable on-the-ground information from front-line workers with intimate knowledge of the reality of carrying out work tasks and how a change in physical layout or associated ways of working may impact themselves or their teams (Clegg & Walsh, 2004; Davis et al., 2011). The active involvement of workers within the design process can itself provide an opportunity for autonomy and empowerment (see principle three) and provide beneficial satisfaction and interpersonal outcomes (e.g., Foland et al., 1995).

Adopting user participation is likely to be more labor and time intensive than more 'top-down' approaches, however, studies have demonstrated that outcomes are better where employees have been involved in the design of their office, rather than having a design imposed upon them (Foland et al., 1995).The infamous case of Chiat/Day, where employees rebelled against a radical office redesign (akin to ABW) and forced changes to its design and use (Vischer, 2005), reinforces the value of both user engagement and subsequent evaluation (see principle eight). This supports the argument that whether employees are formally provided with the opportunity to design or redesign their space, if it fails to meet their needs, they will attempt to change it (or undermine it) through other means (Chapman, Sheehy, Heywood, Dooley, & Collins, 1995; Davis et al., 2011).

8. *Design is Open-Ended*

Finally, STST incorporates the idea that design is never finished and that it is an open-ended iterative process (e.g., Cherns, 1987). This reflects the need for systems to continually adapt, to the changing nature of the external environment and the demands that they encounter – to meet this challenge it is necessary that "design never stops" (Mumford, 2006, p. 323). Clegg (2000) stresses the need for evaluation to be inherent in the design process itself and for this to be embraced as an opportunity to learn (and by extension) to improve. Cherns (1987) views such evaluation as a core task for those individuals within the system itself, an opportunity for them to apply their skills and knowledge (see also principles three and seven) and not a task to be left to external experts (e.g., architectural consultants).

These ideas run contrary to standard practice and suggest that workspace design should not be viewed as a discrete activity that is complete once a space has been designed, refurbished or reconfigured. Rather workspace design should be considered as an activity to

be repeated and decisions reviewed regularly. The further implication (tied to principles three and seven) is that this is a process that has to be connected to the occupants' own experiences and structures set in place to enable them to surface complaints and ideas for improvements. For example, Davis and Offut (2015) report an employee involvement process and staggered launch of a new ABW office, to enable employees to shape the initial design and for early movers to 'live' in the part completed office, feedback on the reality of the space and help iterate the design prior to final completion.

The evaluation of current and prospective workspace by employees can be supported by the use of existing socio-technical tools and the results used to refine and iterate designs. Many of these tools have been applied extensively in human factors and macro ergonomics to analyze existing systems and identify relevant inter-relationships and dependencies, e.g., HFACS, Accimap, STAMP, STS Hexagon (see, Davis et al., 2014)

Open-ended design and the notion of open systems reflect the awareness that an organization's and individual's relationship with space will change and evolve over time. The need to be responsive and adaptable can be seen in the trend towards ABW in modern organizations, with the spaces enabling individual employees to evaluate and essentially craft their own workspace day-by-day (shifting between task spaces as appropriate). However, at a more macro level, the extent to which most workers are able to influence the design of their office remains limited, with the industry still predominantly organized around design-build or similar processes that see architectural, engineering or furniture companies contracted to deliver a design concept, but rarely contracted to support iteration over time.

Limitations and Challenges in Applying STST

The discussion thus far has focused on making the case for workspace to be considered from a STST perspective and the potential for these ideas to be applied to help manage the design and implementation of office environments. It is important to acknowledge both limitations of STST in general and the challenges that relate to the application of STST to workspace design.

A great strength of STST is its long history and depth of supporting case studies. However, the application and development of STST has predominantly concerned the design and implementation of IT systems or industrial machinery (Davis et al, 2014; Mumford, 2006). This relative narrowness of application is a limitation and means that some of the claims regarding application of principles to physical workspace and buildings design have

received only limited direct exploration (Ridgway et al, 2008). Additional research and validation of the principles in this context is required. The technology change literature has also illustrated that where STST has been applied, the tendency is often still for the technology to take precedence, with the social and work structures designed around this (Clegg, 2000; Eason, 2008). There is a danger that the same may occur within workspace design, whereby engineering, architectural and cost constraints may be imposed early in the design process, resulting in STST being used to fit the organization around the already planned space.

The STST approach raises two key sets of challenges in terms of application specifically to the design of workspace:

First, the highly multi-disciplinary nature of the literature relating to office evaluation and office (re)design (Davis et al., 2011) reflects the complexity of the problem domain, the range of influences on success (both technical, psychological and organizational) as well as the skill-set required to approach this problem. STST argues that any design is systemic and that no one discipline has all of the answers (Clegg, 2000), this rings particularly true when considering the design of office environments. As I have discussed in this chapter, it is difficult to disentangle the influence of component parts of this puzzle and there can be unintended consequences from failing to take account of the relationship that workspace has with other parts of the system. This challenges organizational behavior scholars and practitioners to work closely with colleagues from architectural, engineering, information systems, management and other relevant disciplines, to recognize the value in alternative approaches and to overcome barriers of terminology or methodology. I suggest that to understand differences in outcomes and to theorize appropriately, we need to think of extra-person system factors not simply as noise or potential confounding variance to be controlled and ignored, but as part of what we are seeking to explain and offering explanatory value in understanding the organizational behavior that is observed. Wohlers & Hertel (2017) offers a good example of a theoretical framework incorporating workspace, psychological, organizational and technological factors that may inform such work. A collaborative approach seems imperative both for the development of a more complete understanding regarding the interaction between individuals or groups and their physical surroundings, but also to the active application of our knowledge regarding human behavior and perceptions – an endeavor that is likely to contribute to better design (for both employees and organizations) in practice.

Second, applying a socio-technical approach either to workspace design or its evaluation requires both time and commitment (Davis et al., 2014). In practical terms, the ongoing data collection required to enable STST principles to be tested, or for iterative design and redesigns to be evaluated, is time intensive. It requires us to develop deep and trusting relationships with organizations to enable data to be gathered on multiple occasions, to reassure them that access will be honored and that results will be of practical value. This style of partnership is also important if we as researchers want to influence the design of new workspaces, to develop and refine tools or techniques to improve the design process itself, or simply to be present at the opportune time to collect data from participants prior to an office change. It is my own frequent frustration that even where one has good relationships with managers and executives within a firm, events can sometimes move faster than one expects and the window for data collection can rapidly disappear. The need for speedy data collection suggests that we need to invest in the development of more innovative, less obtrusive and quicker to deploy research methods. For example, making use of performance data already held by an organization, using movement data collected through blue-tooth or Wi-Fi, or the establishment of well-verified short psychometric measures. Furthermore, the research concerning the physical workspace has often resulted in contradictory findings (e.g., relating to levels of communication within apparently similar office types). As indicated previously, there are many contextual and broader systems related factors that might lie behind this, superficial knowledge of the organization is unlikely to aid the identification of these.

In conclusion, the ongoing organizational need to reduce costs and manage facilities efficiently suggests that the problem of establishing what constitutes the optimum office design is unlikely to abate. Practice to-date has often prioritized cost and space efficiencies over broader system considerations and led to top-down design. STST offers a well-established and robust set of principles to guide the design of workspace and offers insights into how to balance the competing needs of individuals, organizations and designers. Whilst applying STST poses challenges, it also presents an opportunity to promote holistic design that maintains the interests of workers and supports organizational effectiveness in its broadest sense.

References

Please cite as: **Davis, M.C.** (In Press). Socio-technical systems thinking and the physical environment of OB. In, R. Ayoko & N. Ashkanasy (Eds), Organizational Behavior and the Physical Environment. Routledge.*

Allen, T., Bell, A., Graham, R., Hardy, B., & Swaffer, F. (2004). *Working without walls: An insight into the transforming government workplace*. London: DEGW.

Allen, T. J., & Henn, G. W. (2007). *The organization and architecture of innovation: Managing the flow of technology*. Oxford: Elsevier.

Becker, F. D., & Steele, F. (1995). *Workplace by design: Mapping the high-performance workscape*. San Francisco: Jossey-Bass Inc.

Block, L. K., & Stokes, G. S. (1989). Performance and satisfaction in private versus nonprivate work settings. *Environment And Behavior, 21*, 277 - 292.

Blyth, A., & Worthington, J. (2001). *Managing the brief for better design*. London: Taylor & Francis Group.

Bodin Danielsson, C., Chungkham, H. S., Wulff, C., & Westerlund, H. (2014). Office design's impact on sick leave rates. *Ergonomics, 57*(2), 139-147. doi:10.1080/00140139.2013.871064

Brennan, A., Chugh, J. S., & Kline, T. (2002). Traditional versus open office design: A longitudinal study. *Environment and Behavior Vol 34(3), 279-299.* doi:10.1177/0013916502034003001

Brookes, M. J., & Kaplan, A. (1972). The office environment: Space planning and affective behavior. *Human Factors and Ergonomics in Manufacturing, 14*(5), 373 - 391.

Brunia, S., De Been, I., & van der Voordt, T. J. M. (2016). Accommodating new ways of working: Lessons from best practices and worst cases. *Journal of Corporate Real Estate, 18*(1), 30-47. doi:10.1108/JCRE-10-2015-0028

Business Week (1978) The trouble with open offices. Business Week (7 August 1978), 88, 84–5.

Carlopio, J. R. (1996). Construct validity of a physical work environment satisfaction questionnaire. *Journal of Occupational Health Psychology, 1*(3), 330-344.

Cascio, W. F. (2000). Managing a virtual workplace. *The Academy of Management Executive, 14*(3), 81 - 90. doi:10.5465/AME.2000.4468068

Chapman, A. J., Sheehy, N. P., Heywood, S., Dooley, B., & Collins, S. C. (1995). The organizational implications of teleworking. In C. L. Cooper & I. T. Robertson (Eds.), *International review of industrial and organizational psychology* (Vol. 10, pp. 229 - 248). Chichester, UK: John Wiley & Sons Ltd.

Charles, K.E.,& Veitch, J.(2002). *Environmental Satisfaction in Open-Plan Environments: 2. Effects of Workstation Size, Partition Height and Windows.* Institute for Research in Construction, National Research Council Canada.

Cherns, A. (1976). The principles of sociotechnical design. *Human Relations, 29*(8), 783-792.

Cherns, A. (1987). Principles of sociotechnical design revisited. *Human Relations, 40*(3), 153-161. doi:10.1177/001872678704000303

Clegg, C. W. (2000). Sociotechnical principles for system design. *Applied Ergonomics, 31*(5), 463-477. doi:10.1016/S0003-6870(00)00009-0

Clegg, C. W., Cooch, P., Hornby, P., Maclaren, R., Robson, J. I., Symon, G. J., & Carey, N. (1996). Tools to incorporate some psychological and organisational issues during the development of computer-based systems. *Ergonomics, 39*(3), 482 - 511.

Clegg, C. W., & Davis, M. C. (2016). Automation/advanced manufacturing technology/computer-based integrated technology. In S. G. Rogelberg (Ed.), *The sage encyclopedia of industrial and organizational psychology* (2nd ed.). Thousand Oaks, CA: Sage.

Clegg, C. W., Robinson, M. A., Davis, M. C., Bolton, L., Pieniazek, R., & McKay, A. (2017). Applying organizational psychology as a design science: A method for

predicting malfunctions in socio-technical systems (premists). *Design Science, 3*, 1-31. doi:10.1017/dsj.2017.4

Clegg, C. W., & Walsh, S. (2004). Change management: Time for a change! *European Journal of Work and Organizational Psychology, 13*(2), 217 - 239. doi:10.1080/13594320444000074

Daniels, K., Lamond, D., & Standen, P. (2001). Teleworking: Frameworks for organizational research. *Journal of Management Studies, 38*(8), 1151 - 1185.

Danielsson, C. B., & Bodin, L. (2008). Office type in relation to health, well-being, and job satisfaction among employees. *Environment And Behavior, 40*(5), 636-668. doi:10.1177/0013916507307459

Davis, M. C., Challenger, R., Jayewardene, D. N. W., & Clegg, C. W. (2014). Advancing socio-technical systems thinking: A call for bravery. *Applied Ergonomics, 45*(2, Part A), 171 - 180. doi:http://dx.doi.org/10.1016/j.apergo.2013.02.009

Davis, M. C., Leach, D. J., & Clegg, C. W. (2011). The physical environment of the office: Contemporary and emerging issues. In G. P. Hodgkinson & J. K. Ford (Eds.), *International review of industrial and organizational psychology* (Vol. 26, pp. 193 - 235). Chichester, UK: Wiley.

Davis, M. C., & Offutt, R. (2015). *Activity based working: A classic case of change management?* Paper presented at the 2015 Academy of Management Annual Meeting, Vancouver, Canada.

De Croon, E., Sluiter, J., Kuijer, P. P., & Frings-Dresen, M. (2005). The effect of office concepts on worker health and performance: A systematic review of the literature. *Ergonomics, 48*(2), 119 - 134. doi:10.1080/00140130512331319409

Duffy, F. (1997). *The new office*. London: Conran Octopus.

Duffy, F. (2000). Design and facilities management in a time of change. *Facilities, 18*(10/11/12), 371 - 375. doi:10.1108/02632770010349592

Eason, K. (2008). Sociotechnical systems theory in the 21st century: Another half-filled glass? In D. Graves (Ed.), *Sense in social science: A collection of essays in honour of dr. Lisl klein 2008* (pp. 123-134).

Eason, K. (2014). Afterword: The past, present and future of sociotechnical systems theory. *Applied Ergonomics, 45*(2, Part A), 213-220. doi:https://doi.org/10.1016/j.apergo.2013.09.017

Elsbach, K. D., & Pratt, M. G. (2007). Chapter 4: The physical environment in organizations. *The Academy of Management Annals, 1*(1), 181 - 224. doi:10.1080/078559809

Emery, F. E. (1959). *Characteristics of socio-technical systems*. The Tavistock Institute Document Number 527. London: Tavistock Institute.

Foland, S. S., Rowlen, S., & Watson, S. (1995). *Team space & empowerment: A formula for success*. Paper presented at the World Workplace '95, IFMA Annual Conference, Miami.

Gillen, N. M. (2006). The future workplace, opportunities, realities and myths: A practical approach to creating meaningful environments. In J. Worthington (Ed.), *Reinventing the workplace* (2nd ed., pp. 61 - 78). Oxford: Architectural Press.

Göçer, Ö., Göçer, K., Ergöz Karahan, E., & İlhan Oygür, I. (2017). Exploring mobility & workplace choice in a flexible office through post-occupancy evaluation. *Ergonomics*, 1-17. doi:10.1080/00140139.2017.1349937

Hall, D. J., & Ford, T. Q. (1998). A quality approach to factory design. *Industrial Management and Data Systems, 6*, 241 – 245.

Haynes, B. P. (2007). Office productivity: A theoretical framework. *Journal of Corporate Real Estate, 9*(2), 97-110.

Hongisto, V., Haapakangas, A., Varjo, J., Helenius, R., & Koskela, H. (2016). Refurbishment of an open-plan office – environmental and job satisfaction. *Journal of Environmental Psychology, 45*, 176-191. doi:http://dx.doi.org/10.1016/j.jenvp.2015.12.004

Hughes, H. P. N., Clegg, C. W., Bolton, L. E., & Machon, L. C. (2017). Systems scenarios: A tool for facilitating the socio-technical design of work systems. *Ergonomics, 60*(10), 1319-1335. doi:10.1080/00140139.2017.1288272

Kaarlela-Tuomaala, A., Helenius, R., Keskinen, E., & Hongisto, V. (2009). Effects of acoustic environment on work in private office rooms and open-plan offices – longitudinal study during relocation. *Ergonomics, 52*(11), 1423 - 1444.

Kim, J., & de Dear, R. (2013). Workspace satisfaction: The privacy-communication trade-off in open-plan offices. *Journal of Environmental Psychology, 36*, 18-26. doi:http://dx.doi.org/10.1016/j.jenvp.2013.06.007

Knight, C., & Haslam, S. A. (2010). Your place or mine? Organizational identification and comfort as mediators of relationships between the managerial control of workspace and employees' satisfaction and well-being. *British Journal of Management, 21*(3), 717-735. doi:10.1111/j.1467-8551.2009.00683.x

Laing, A. (2006). New patterns of work: The design of the office. In J. Worthington (Ed.), *Reinventing the workplace* (2nd ed., pp. 29 – 49). Oxford: Architectural Press.

Laing, A., Duffy, F., Jaunzens, D., & Willis, S. (1998). *New environments for working: The redesign of offices and environmental systems for new ways of working*. London: Construction Research Communications Ltd.

Lee, S. Y., & Brand, J. L. (2010). Can personal control over the physical environment ease distractions in office workplaces? *Ergonomics, 53*(3), 324 - 335. doi:10.1080/00140130903389019

McCoy, J. M. (2005). Linking the physical work environment to creative context. *The Journal of Creative Behavior, 39*(3), 169-191.

Morrow, P. C., McElroy, J. C., & Scheibe, K. P. (2012). Influencing organizational commitment through office redesign. *Journal of Vocational Behavior, 81*(1), 99-111. doi:http://dx.doi.org/10.1016/j.jvb.2012.05.004

Mumford, E. (1983). *Designing secretaries : The participative design of a word processing system*. Manchester: Manchester Business School.

Mumford, E. (1995). *Effective systems design and requirements analysis : The ethics approach.* Basingstoke: Macmillan.

Mumford, E. (2006). The story of socio-technical design: Reflections on its successes, failures and potential. *Information Systems Journal, 16*(4), 317-342. doi:10.1111/j.1365-2575.2006.00221.x

Nadin, S. J., Waterson, P. E., & Parker, S. K. (2001). Participation in job redesign: An evaluation of the use of a sociotechnical tool and its impact. *Human Factors and Ergonomics in Manufacturing, 11*(1), 53-69.

Oldham, G. R., & Brass, D. J. (1979). Employee reactions to an open-plan office: A naturally occurring quasi-experiment. *Administrative Science Quarterly, 24*(2), 267-284. doi:10.2307/2392497

Oldham, G. R., Cummings, A., & Zhou, J. (1995). The spatial configuration of organizations. In G. Ferris (Ed.), *Research in personnel and human resources management,* (Vol. 13, pp. 1 – 37). Greenwich, USA: JAI Press.

Oldham, G. R., & Fried, Y. (1987). Employee reactions to workspace characteristics. *Journal of Applied Psychology, 72*(1), 75-80. doi:10.1037/0021-9010.72.1.75

Pasmore, W. A. (1994). *Creating strategic change: Designing the flexible, high performing organization.* New York: Wiley.

Ridgway, K., Cerulli, C., Davis, M., Challenger, R., Wiseall, S., Hill, P., Clegg, C. (2008). *Designing the factory of the future*. Paper presented at the International Conference on Applied Human Factors and Ergonomics (AHFEI), Las Vegas, USA.

Sundstrom, E., Burt, R. E., & Kamp, D. (1980). Privacy at work: Architectural correlates of job satisfaction and job performance. *Academy of Management Journal, 23*(1), 101 - 117. doi:10.2307/255498

Sundstrom, E., Herbert, R. K., & Brown, D. W. (1982). Privacy and communication in an open-plan office: A case study. *Environment And Behavior, 14*(3), 379-392. doi:10.1177/0013916582143007

Sundstrom, E., Town, J. P., Rice, R. W., & Osborn, D. P. (1994). Office noise, satisfaction, and performance. *Environment And Behavior, 26*(2), 195 - 222.

Trist, E. L., & Bamforth, K. W. (1951). Some social and psychological consequences of the longwall method of coal-getting: An examination of the psychological situation and defences of a work group in relation to the social structure and technological content of the work system. *Human Relations, 4*(1), 3-38. doi:10.1177/001872675100400101

Turner, G., & Myerson, J. (1998). *New workspace new culture: Office design as a catalyst for change*. Aldershot: Gower Publishing Limited.

Veitch, J. A., Charles, K. E., Farley, K. M. J., & Newsham, G. R. (2007). A model of satisfaction with open-plan office conditions: Cope field findings. *Journal of Environmental Psychology, 27*(3), 177-189.

Vischer, J. C. (2005). *Space meets status: Designing workplace performance*. Oxon: Routledge.

Vos, P., & van der Voordt, T. (2001). Tomorrow's offices through today's eyes: Effects of innovation in the working environment. *Journal of Corporate Real Estate, 4*(1), 48 - 65.

Waterson, P. E. (2005). Sociotechnical design of work systems. In J. R. Wilson & N. Corlett (Eds.), *Evaluation of human work* (3rd ed., pp. 769-792). London: Taylor & Francis.

Wohlers, C., & Hertel, G. (2017). Choosing where to work at work – towards a theoretical model of benefits and risks of activity-based flexible offices. *Ergonomics, 60*(4), 467-486. doi:10.1080/00140139.2016.1188220

Zalesny, M. D., & Farace, R. V. (1987). Traditional versus open offices: A comparison of sociotechnical, social relations, and symbolic meaning perspectives. *The Academy of Management Journal, 30*(2), 240-259. doi:10.2307/256272

Please cite as: **Davis, M.C.** (In Press). Socio-technical systems thinking and the physical environment of OB. In, R. Ayoko & N. Ashkanasy (Eds), Organizational Behavior and the Physical Environment. Routledge.*

Figure 1: Hexagonal Socio-Technical Systems framework, illustrating inter-related natured of organizational systems. Reproduced from Clegg, Robinson, Davis, Bolton, Pieniazek and McKay (2017) under a CC-BY 4.0 license (http://creativecommons.org/licenses/by/4.0/).

Please cite as: **Davis, M.C.** (In Press). Socio-technical systems thinking and the physical environment of OB. In, R. Ayoko & N. Ashkanasy (Eds), Organizational Behavior and the Physical Environment. Routledge.*

STST Principle	Description	Applied to Workspace
1. Open Systems Perspective	A change to one part of the system may have implications elsewhere. These changes may be unanticipated.	Workspace cannot be viewed in isolation. Workspace design may influence how employees feel and behave, how tasks and processes are ordered etc. Successful workspace design may require attendant changes to other parts of the system (e.g., technology, culture, processes).
2. Organizational Choice	Designers should specify as little as possible, allowing users to decide how to solve their design problem.	Designers should not impose a design solution or close off potential designs at the outset. Employees should be empowered to decide what space is appropriate for their work and how, when and where they work.
3. Controlling Problems at Source	Systems are most effective when they make problems visible and easy to resolve as they arise.	Workspace may be designed to facilitate fast decision making and knowledge sharing to resolve problems as they are identified. Workspace can be designed to be flexible, enabling employees to respond to change.
4. Boundary Location and Information Flows	Physical, social and technological boundaries can affect information flows.	The interaction between technologies and workspace design may support the easy flow of information. Co-location and reductions in physical barriers may ease communication and understanding between groups.
5. Congruence and Support	Any change to part of the system needs to be congruent with, and supportive of, related components.	Workspace should reflect organizational goals, culture and ways of working. The workspace may support or inhibit individual work practices. Evaluation of individual needs and tasks should be used to tailor workspace to support these. Diverse employee and organizational needs may require multi-modal workspace.
6. Quality of Life and Experience at Work	Design of any system component can change the nature of work and the experience for employees.	Evaluation of the impact of workspace design on employees needs to be built into initial design phases. Technically optimal solutions may produce lagging employee impacts (e.g., stress). Behavioural impacts should be balanced against financial and technical outcomes.
7. User Participation and Ownership	Successful design requires users to actively participate in the design	Occupants should be involved in the design process (contributing functional, social and technical needs) and participate in decision making

	process and to take ownership of the practical implementation.	(e.g., about space, furniture and aesthetics). Occupants should be responsible for how space will be used and the hand-over from designers.
8. Design is Open-Ended	Design is never finished and is an open-ended process that needs to adapt to a changing world.	Organizations' and individuals' needs will change over time. Workspace should be designed to be adaptable, never viewed as 'complete' and occupants equipped to re-evaluate their space requirements over time.