A Model of Environmental Control and Effective Work

Dr. Michael O’Neill
Senior Director, Workplace Research
Knoll, Inc.
Environmental control is the capability of individuals, groups or entire organizations to modify features of the physical workplace, and choose location and time of work, to better support their work needs and business goals. The concept of environmental control includes: knowledge of how to act on the environment, policies that support control, and design characteristics of the workspace that permit control (see illustration, Figure 1).

Control can be provided through a wide variety of architectural, interior, and furniture design features (such as flexible meeting spaces, movable partition walls, unassigned workspaces, movable storage units, seating, adjustable shelving, task lighting, etc). Training programs can enhance control by providing knowledge of how to modify workspace features or make choices about which spaces to use. Workplace management policies can provide employee choice over time and location of work, and that give “permission” to employees to make those choices. Organizations can make choices about implementing these aspects of control to provide an overall capability that will vary by organization (see Figure 1).

Environmental control provides a means of self-managed change to work spaces and furnishings that is direct and immediate; people can modify features themselves or take advantage of different locations to work when needed - based on feedback about ongoing business and work process demands (O’Neill, 1998; O’Neill, 2007, Robertson and Huang, 2006). Ideally, workspaces can be modified without costly and time-consuming formal workplace redesign projects or a minimum of facility management intervention (O’Neill, 2007).

Enhanced environmental control improves employee performance and organizational effectiveness. A growing body of research shows strong links between degree of environmental control and outcomes such as stress and group and individual performance and speed and cost of business processes between departments (Carayon and Smith, 2000; Lee and Brand, 2005; O’Neill, 1998; O’Neill and Evans, 2000; O’Neill, 2007; Robertson, Huang, O’Neill, & Schliefer, 2008; Sundstrom, Town, Rice, Osborn, and Brill, 1994). The benefits of environmental control transcend age, generational affiliation, gender, and other demographic characteristics (O’Neill, 1998; 2007).

Organizations that invest in design features and furnishings (as well as policies and training) that provide control can reduce the frequency, costs and disruptions of interior renovation projects by extending the usefulness of the space between those projects (O’Neill, 1998; 2004).

Fundamentally, environmental control is about giving people control over the space, as opposed to being controlled by the space and organizational policies. Thus, we propose environmental control as a key capability that organizations should invest in to enhance their competitive advantage. The planning of policies, training and the physical work environment to enhance control should be a central component of real estate and facility strategy.

In this paper we present a model of environmental control, a review of research that highlights its impacts and benefits, and conclusions about how environmental control might be implemented in the future.

**Model of Environmental Control**

This is a dynamic model, in which external forces such as demands from customers and markets and other demographic, and social and economic factors shape the business objectives of the company.

The business objectives, in turn, drive the underlying programs for products and services and activities in support of those objectives (see top of Figure 2, “External Business Drivers” and “Organizational Objectives” boxes).

Over time the objectives of the organization change in order to maintain alignment with market and customer demands. These changing objectives can also drive changes to organizational structure, business, group, and individual work processes and work styles (see “Business and Work Processes” box, Figure 2).

Environmental control provides the mechanism by which existing spaces can be easily modified to meet business and work process needs and thus keep the business and work processes, and workspace, in alignment with organizational objectives (see “Adaptive Mechanisms” box, Figure 2). These mechanisms (which are discussed in greater detail later in this paper) can include: adjustable furnishings, seating and work tools, flexible meeting spaces, adaptable buildings, and policies that promote control. Environmental control can also be improved through training and organizational policies (see Figure 2).
Literature Review on Environmental Control

Fisher (1990) defined control as “mastery over the environment” but at the time there was little research that operationalized a definition of environmental control or attempted to outline a cohesive model. Becker (1991) emphasized the idea of control as a critical unanswered question related to workplace issues. He pointed out the lack of research on such topics as the types of environmental control employees actually want or need, employee involvement in the process of planning and designing their workplace, and the effects of control—both actual and perceived—on performance. Further, Becker (2002) suggested workplace flexibility can allow firms to change and adapt without being restricted by office space.

In this section, we discuss empirical research that supports the model in terms of behavioral and performance outcomes. Like the model, we organize this review around the scale of workspace and organizational unit.

Policies and Training

Our model of environmental control considers the effects of policies that give employees choice over location and time of work – and training to enhance their ability to exert the control over the workspace. Several studies show that training in the optimal use of the workspace as a tool for safe and effective work (Brisson, Montheil and Punnett, 1999; Bohr, 2000; Kukkonen, Luopajarvi and Riihimaki, 1993; Robertson and O’Neill, 1999) can lead to enhanced control. Enhancing workers’ control over their work environment allows them to influence decisions about where and how they might work (McLaney and Hurrell, 1988; O’Neill, 2007; Robertson and Huang, 2006), leading to improved physical health and performance (Karasek and Theorell, 1990). Several studies show that ergonomics training provides employees with the necessary knowledge on how they should arrange their individual and team workspace, and it promotes healthy computing habits (Amick, Robertson, DeRango, Bazzani, Moore, Rooney and Harrist, 2003; Bohr, 2000; Brisson et al., 1999; Verbeek, 1991). O’Neill (2007) reported that adding a training program to work environments having adjustable features roughly doubled the positive effects of control on business process efficiency. Other research suggests employees who are taught how to adjust or manipulate features of their workspace have improved satisfaction and motivational performance outcomes (Robertson and O’Neill, 1999; O’Neill and Evans, 2000). Policies that increase choice about type or location of workspace to use (within or outside the office building) and timeframes in which employees can work can also enhance control (McLaney and Hurrell, 1988; Oldham, 1988; Olson, 2001; Venezia and Allee, 2007).

Facility/Organizational Level

At the scale of the organization or business unit, the facility can be planned to enhance flexibility of interior building layout (reusability, integration of technology, ability to expand or downsize space through physical reconfiguration). Thus control can be planned into a building by designing a structurally adaptive facility. Furnishings such as storage units can act as dividers of space, creating the boundaries of collaborative zones or marking the areas of large groups such as departments or business units. Storage, while not readily moved by individuals, can easily be relocated to form new areas with minimal facilities’ intervention when compared to the time and expense of drywall or other interior construction approaches. External business drivers may demand that the building be recycled over time to accommodate new uses such as a conversion from office to manufacturing or lab space and back again.

The square footage of the building may need to be expanded or reduced, or could require the internal flexibility to accommodate updated mechanical, computer, telecommunications, and electrical capabilities (Hahn, 1990). Put in financial terms, providing environmental control at the facility level requires that the operation of the building be financially viable for an extended period, as opposed to becoming obsolete and forcing the organization to construct a new facility. This section describes research in which large scale implementations of flexible workspaces were conducted in an attempt to enhance environmental control at the organizational level. The participants include office settings from the consulting, financial services, and manufacturing industries. Two studies examined call centers.
Robertson, Huang, O’Neill and Schleifer (2008) examined the effects of environmental control at the business unit scale of a professional services organization. The company consolidated employees from four buildings into one, using new furniture and interior design concepts intended to optimize the flexibility of the interior space and support collaboration. The experimental workplace had fewer workstations than people and a variety of different types of spaces for collaborative work. This was combined with ergonomic training geared to improve ergonomic awareness and communicate new “rules of behavior” for using this space. It was hypothesized that the flexible design concepts would increase employee and business performance.

The study examined three groups of professional and administrative employees, including a control group, for a total of 1135 participants. Outcome measures were collected 2 months prior to the intervention and 3 and 6 months post-intervention. Overall, the study results indicated positive, significant effects on the outcome variables for the two intervention groups (new workspace and new workspace and training) compared to the control group, including reduced work-related musculoskeletal discomfort, improved job control, satisfaction with workspace, sense of community, communication and collaboration, and business process efficiency (time and costs). The study reported a 5.6% reduction in business process time and cost improvements for employees who moved to the experimental workspace, and a 10.5% reduction in business process time and cost for those who moved to the new workspace and received training. Unfortunately, attrition of workers in the ergonomics training condition precluded an evaluation of the effects of this intervention.

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O’Neill (2007, p. 121) assessed the effects of a move to a more open (and collaborative) work environment on the behavior and performance of 1000 call center agents within a financial services company. Job responsibilities for this type of work have dramatically expanded in the last 10 years. What used to be an individual “help desk” job may now include selling, problem solving, and other interactions that can benefit from collaborating with peers. In this 12 month study, data were collected at four points in time from an experimental group (three different groups of employees who moved to the new facility) and control group (employees doing equivalent work, who did not move).

The key measures for this study included: job control, communication, collaboration, sense of community, retention rates (voluntary separations), and three aspects of agent performance, number of calls handled, AHT (average handle time per call), and AGW (time to complete work after call has ended). The study reported significant improvements in job control and collaboration for employees who moved to the new space. The study found that employees who moved to the new space had 2.8 percent lower rate of voluntary separations than did employees in the control group, over the 12 month period of the study.

O’Neill (2007, p. 141) studied the effects of a building consolidation project for the headquarters campus of a global shipping company. The 720 participants in this research worked within 18 departments such as HR, finance, legal, and other groups typically found within a corporate headquarters; they were moved from four widely separated buildings into one existing location. As part of the design process, adjacencies between departments and work groups were carefully optimized and flexibility in use of the space was enhanced by a variety of different sized new meeting rooms scattered throughout the space.

The study measured “business case approval time” by conducting a business process analysis (BPA) of this process, and used it to collect data on the time and cost of conducting this process before and after the move. The study found a 32 percent reduction in time and costs for one process, with an annual cost savings in labor dollars for this one process of $120,000 per year.

The study found that five variables predicted a significant amount of the variance in speed of the approval process, including: adequate spaces for meetings between groups, interior layout of the workstation (work materials close at hand, floor area, arrangement of equipment and furnishings, work surface size, ease of organizing work materials), level of visual and noise distractions, travel time between workstation and all other departments, and workstation has adequate space to support collaboration with another person. Many of these features are related to aspects of environmental control.

O’Neill (2007, p. 170) studied the effects of a move due to a building consolidation, and implementation of a workspace model emphasizing the use of unassigned workspaces, on the behaviors, perceptions, and business process efficiency of individuals and groups for 750 professional employees of a manufacturing company. The new workspace strategy was intended to enhance the flexibility of the interior space and the amount of control that departments and individuals had over the location of their work.

Over 750 employees participated, comprising 22 departments. Data were collected at two points in time from an experimental group (those who relocated to the new facility) and from a control group with an equivalent number of employees who did not move.

Individual measures included an assessment of quality of workspace features (storage, lighting, layout, comfort, privacy,
sense of community, etc.) perceptions of job control, and behaviors such as collaboration and communication. Measures at the departmental level included assessments of quality of departmental output (responsiveness and quality of deliverables) by all other departments. Measures of business process efficiency were made on three routinely occurring business processes within three departments, in which detailed time and cost calculations were made.

Analyses showed that there were either no changes (such as in job satisfaction) or decrements on some individual assessments of workstation features (such as storage, layout) and related behaviors (privacy, communication) at the individual level. At the group and departmental level, the study found significant improvements in the quality of departmental outputs (responsiveness and quality of work) and on assessments of degree to which spaces support collaboration of groups, sense of belonging, departmental identity, potential of space to attract new employees, and communication of corporate identity.

O’Neill found a 7.5 percent decrease in cycle time for one business process that contributed $375 of cost savings to the business each time the process occurs. Based on the number of process occurrences, $4,000 of cost savings were realized annually for just this one process.

Next, a regression model was computed to determine the predictors of cycle time for this process. The model included six workspace predictor variables, including: availability of collaborative space, lighting, quality of group process, design of interior space supports shift from individual to collaborative work, amount of time spent in unassigned workspace, and quality of storage in the workstation. Several of these predictor variables are related to environmental control, including: availability of collaborative space, and support for the shift from individual to collaborative work.

O’Neill (2007, p. 205) assessed the differences between two call centers of a telecommunications company. The call centers used two different models of workspace furnishings, layout, and quality of the architectural space itself. One site was a “Class A” building space with high quality finishes and furnishings, with traditional low panel height, 90 degree angle cubicles for agents. The other facility was a converted “big box” retail store and used furnishings that provided comparatively more open workspace, and quality of storage in the workstation. Several of these predictor variables are related to environmental control, including: availability of collaborative space, and support for the shift from individual to collaborative work.

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Collaborative Spaces/Work Group Level

Most knowledge work is now performed by groups of people and teams, as opposed to individual efforts. Research shows that knowledge workers have three distinct work modes, varying from individual to group work, that they operate within throughout their work day (Formway, 2005).

- Focus mode: individual work, concentrated, requires full attention
- Active mode: impromptu discussions, open to new stimuli
- Collaborative mode: working together on a problem

At the work group level, overall layout of the work environment can be designed to support these three modes. The transition of work between individual and group work can be facilitated - or hindered - by the ability to manage or control the size and form of the physical and social boundaries between groups. Boundaries serve to control the flow of information to and from the group. Organizational boundaries can be reinforced or made more permeable through the design and layout of the physical work space. Boundaries can be used either to integrate the team into the larger organization, or differentiate the team from the organization (Sundstrom and Altman, 1989; DeMatteo, Eby, and Sundstrom,
Research indicates that the way teams manage interaction across their organizational boundaries influences satisfaction and group effectiveness (Gladstein, 1984; Cummings and Worley, 2004). When the team mission depends on integration, effectiveness can depend on pace and timing of information exchanges with other units. Team effectiveness can also hinge on the ability to isolate certain activities from outside interference, such as problem solving meetings or sensitive advance R&D areas. Both the integrative and differentiating functions can be supported by team control over boundaries.

The space should support the group’s ability to self-manage the reconfiguration of boundaries between themselves and other parts of the organization, depending on business requirements. Boundaries can be represented through variations in lighting, color, and movable furniture elements such as screens, panels and storage elements. [Storage can substitute as an architectural element that provides more control than drywall world] In addition, having a variety of collaboration spaces of varying sizes that are suited to formal and informal meetings, and policies and technologies to assign these spaces to different groups - can signal to employees the ongoing connections between groups and reinforce collaborative project work and the general flow of ideas through social networks.

Formway (2005) suggest a shift in the role of the physical workspace from supporting basic ergonomic needs and physical interaction between people, to supporting collaborative, social networks in which ideas are shared and developed. Group space features that enhance environmental control can be used to support social networks and the ever-shifting boundaries of these collaborative constructs.

The layout of collaboration spaces between work groups may also influence inter-member communication and cohesion. Face-to-face interaction between team members may be influenced by the proximity of workstations and meeting places to each other (Sundstrom, 1986). Thus, designing these spaces with appropriate proximity and availability can enhance environmental control for workgroups. Control can be a mechanism for mediating and supporting team member interaction, which could also enhance workflow and quality of decision making for team members. Control over the collaborative environment could also serve as a mechanism for enhancing the fit between the work group and other organizational groups.

Davenport (2005) suggests that high-performing knowledge workers have a high level of collaboration as part of their work style, and that they will be most effective when the space is designed to foster collaboration. Davenport describes the importance of providing knowledge workers with choice in terms of the features and capabilities of the group spaces they are given, as well as supporting their mobility. This is congruent with our model; choice about group spaces is a form of control that groups can exercise to optimize their effectiveness. Thus, the flexibility, availability and ease of use of collaborative space is a key component of environmental control.

**Individual Workspace/Individual Level**

There are a number of features that can provide control at the individual level: letter trays, shelving, paper trays, storage bins, storage towers, mobile pedestals, seating, adjustable lighting, personal air control, coat hooks, a place to securely store personal belongings, and areas to display personal items.

O’Neill (1995a) reported that for sales professionals, environmental control was a significant predictor of group effectiveness. For computer technical support workers, environmental control was a significant predictor of individual performance and work group effectiveness. O’Neill and Duvall (2006) found enhanced sense of belonging for employees when they were shifted from a traditional cubicle environment to a more open concept that included the addition of collaborative spaces. The work teams were given support to shift their boundaries and relocate individuals within the overall workspace as the assignments and work processes of the groups shifted over time. Lee and Brand (2005) found that more personal control over the physical workspace (e.g., adjustment) and easy access to meeting places (which is a form of control) led to higher perceived group cohesiveness and job satisfaction.

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There are a number of features that can provide control at the individual level: letter trays, shelving, paper trays, storage bins, storage towers, mobile pedestals, seating, adjustable lighting, personal air control, coat hooks, a place to securely store personal belongings, and areas to display personal items. Adjustable tools to support technology, such as monitor arms, keyboard trays, and laptop supports, can all make comfort and organization better.

Workers benefit from tools to organize their work in sequence, separating active work from less active projects, and by setting aside the least active work but being able to find it easily. They can gain control by having easy access to electrical and computer connections and portable computer and telephone accessories. Many of these features are also related to ergonomic and health considerations (Scalet, 1987).
At the individual level, research suggests that environmental control over workstation components has a direct relationship to performance (O’Neill, 1994; 2007). Measuring the impact of giving individuals control over lighting in their environment, Moore, Carter and Slater (2004) found that the option for control over lighting in individual workspace may account for higher occupant satisfaction than actual differences in luminance. This study also reported that workers may be more likely to forgive unsatisfactory features of an environment if they can control other features related to comfort.

Other research has found that higher levels of perceived control can influence employees’ ability to use their work space and its adjustable features effectively, and can lead to higher environmental satisfaction and communication (Huang, Robertson and Chang, 2004).

In a field experiment examining the reactions of 400 insurance underwriting and accounting employees, Kroner, Stark-Martin and Willemain (1992) found that when workstations were equipped with user-controllable air control units, objective measures of performance increased an average of 2.8 percent.

Paciuk (1990) examined the satisfaction and thermal comfort of workers in 511 workstations within 10 buildings. Control was defined as: availability of control (type and degree of control made available by the environment); perceptions of control (knowledge of available control strategies); and exercised control (frequency of engaging in behaviors aimed at regaining thermal comfort). Paciuk found that perceived control was positively related to worker satisfaction.

O’Neill (1992) examined perceptions of the thermal comfort of 200 office workers within a building that had standard HVAC systems on some floors, and under floor mounted user-adjustable air control units on other floors. The study measured several aspects of control, including: availability of control (access to user-controlled HVAC), exercised control (frequency with which employees manipulated the interface controls of the air system), perceived control, and importance of thermal comfort. He found that perceived control was a significant predictor of thermal satisfaction, and that exercised control was the most important predictor of employee perceptions of air quality.

Zimmer and Cornell (1990) investigated worker reactions to flexible individual and group spaces. Spaces were designed to give users environmental control through flexibility of lounge furniture, tables, tack boards, white boards, and lighting. They found that 89 percent of participants felt that the flexible elements in the spaces made them more effective at their jobs.

O’Neill (1994) investigated the relationship between environmental control, and the self-assessed performance of 541 managerial and non-managerial workers in 14 office buildings. Environmental control was measured as: the degree to which the work space supports organization of work materials, ease of adjustment of storage and display features, and ease of rearranging furnishings. Regression and path analyses revealed that control contributed directly to satisfaction and performance, and indirectly to these outcomes through mediating perceptions such as distractions, privacy, and communication. The findings of this study also suggested that workers use partition enclosure features to control privacy and visual access by others into their spaces.

O’Neill (1995b) examined the relationship between job type, workstation design features, and the self reported psychological stress, musculoskeletal pain, and health of office workers. A total of 62 workers in four job types working in four field sales offices of a U.S. computer manufacturer provided data. Regression analyses tested three indexes of workstation design as independent variables, including: environmental control through adjustability of workstation features, layout of workstation to match job requirements, and appropriateness of storage.

Environmental control was measured through a six-item index including: adjustability and ease of adjustement of seating, ability to rearrange furnishings, adjustability of lighting, ease of organizing work materials, and overall adjustability of workstation. The study reported that for sales professionals, who worked in teams, lack of control over the workstation environment was a significant predictor of psychological stress. For computer technical professionals, lack of environmental control and inappropriate layout were significant predictors of increased stress and health assessments. Environmental control predicted 50 percent of the variance in overall health assessments for general office workers.

O’Neill and Evans (2000) conducted a laboratory experiment to examine the effects of interior workstation adjustability - and the effects of training in how to use that adjustability - on physiological stress and motivational performance levels under high workload. They hypothesized that more control (through adjustability or internal workstation features such as: seating, storage and display tools) and training would have the most desirable impact on these outcomes. Statistically significant findings of the study suggest:
Given the opportunity through workstation adjustability, people will exert control over the work environment.

Physiological signs of stress (as measured by epinephrine and urinary cortisol levels) are reduced when people have workstation adjustability and the training to use it.

Motivational performance is enhanced when people have workstation adjustability and the training to use it.

Taken in concert with prior field work on adjustability in the workplace, the results from this laboratory study lend support to the claim that control in the form of adjustability of workplace features is an important element in stress and performance motivation. The findings of this study and others also underscore the critical role of proper training.

Conclusions

This paper shows that the model of environmental control is supported at the individual, work group and facility levels by the empirical literature. The findings suggest a consistent relationship between opportunities for control provided by design features, policies and training, and positive behavioral and performance outcomes for individuals, teams and business units.

This model provides a framework for a cohesive implementation of control as part of a proactive strategy for reducing stress and enhancing individual and group effectiveness. It provides a wide range of potential tactics for implementing control depending on the scope of the project and the needs of the organization. This model incorporates both physical and behavioral components. Haynes (2007; 2008) points out that any framework for improving the productivity of knowledge workers needs to consider both the physical and behavioral environments.

Looking forward, it may be possible to apply the design and layout of furnishings to provide control in novel ways. A key idea is that the provisioning of control should be transparent to the user (Formway, 2005). The features and functions of the workspace that provide control (through adjustability and movement) should conform to the needs of the user as automatically, or intuitively, as possible. Research shows that training on how to adjust furnishings and work tools can amplify the positive effects of user control. However, products designed from the outset to make adjustability automatic, or at least obvious, could bypass the need for training. Design that embeds knowledge of how to manipulate the space or adjust furnishings and work tools could bring the benefits of environmental control more quickly to a greater number of workers without the cost and delay of training programs.

For instance, from an ergonomic perspective, seating could be designed to provide control over individual task work by supporting unrestrained movement between a reclined, to upright, to forward active posture – without the need for the user to make complex adjustments for every change in posture. To support collaborative work, user control could also be enhanced by seating design that responds to a continuum of postures from individual work, to casual interaction and collaboration, and back to individual work.

Storage furnishings could double as boundaries for collaborative zones and act as sub architectural elements to demarcate “ownership” of space by larger departments or business units. They can easily be relocated or reconfigured with a minimum of intervention by facilities processes, as compared to the time and expense of drywall or other permanent architectural solutions. Likewise, demountable walls can be used in the same manner to identify spaces, and provide enclosure and work zones that can be readily modified.

In addition, personal work tools, furnishings (display shelves, mobile peds, seating, etc) and technology devices used at work (Blackberry, etc) could also be employed to provide symbolic representations of control at work. The symbolic representation of control could become a status marker like the door on a private office or the level of finish on a cubicle once were.

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Knoll researches links between workspace design and human behavior, health and performance, and the quality of the users’ experience. We share and apply what we learn to inform product development and help our customers shape their work environments. To learn more about this topic or other research resources Knoll can provide, visit knoll.com/research.
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