The Knowledge Organization : Cultural Priorities and Workspace Design

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The Knowledge Organization

Cultural Priorities and Workspace Design

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General Motors Research and Development (R&D) management is planning to renovate portions of the Warren, Michigan, research facility. The study's goal was to help organizational leaders and planners understand culturally endorsed workspace architecture and design elements. Researchers used a rapid ethnographic assessment research design grounded in cognitive anthropology and methods to capture impressions and cultural requirements for workspace. This study adds to the existing body of knowledge at the intersection of workspace, culture, and user-oriented design by analyzing employee comments and research observations to construct a cultural model of R&D workspace. All model components underscore the cultural values of productivity and pragmatism. The authors examine features associated with the workspace productivity model, behaviors associated with the workspace, and differences in workspace perceptions and behaviors by organizational role. Findings refine the definition of knowledge worker culture and suggest that an orientation to productivity reflects broader American cultural values including pragmatism, individualism, and effectiveness.

Keywords: *knowledge-worker culture; R&D culture; productivity; pragmatism; workspace effectiveness; user-oriented design*

General Motors (GM) is planning to renovate the Warren, Michigan, Research and Development (R&D) facility in anticipation of changing cultural needs for space and overall work environments for a new generation of researchers and other knowledge

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workers. GM R&D management commissioned an architectural firm to construct life-size "mock-up" workspace alternatives in Warren and directed our research team to capture R&D employee perspectives on the mock-up areas, as well as their general ideas for GM's "Lab of the Future." The primary goal of our study was to provide organizational leaders and planners with an understanding of the most widely, culturally endorsed, workspace-design elements from the perspective of the GM research community. We develop a cultural model that illustrates the cultural priorities of researchers—one important type of knowledge worker.[2]

Our theoretical framework incorporates a user-oriented design approach (Drettakis, Roussou, Reche, & Tsingos, 2007; Wolfe, 2007) within a broader organizational-culture theory context to direct attention to the culture and space configurations that will shape GM's Lab of the Future. In the classic work *The Hidden Dimension*, Hall (1966) proposed that both social context and national culture shape the aesthetics and functionality of both "fixed featured" and "semifixed featured" space. More recently, Low and her colleagues have emphasized the historical, social, and symbolic approaches to the physically altered "built environment" (Lawrence & Low, 1990) and urban studies of space (Low, 1988, 2003a, 2003b; Low & Lawrence-Zuniga, 2003). These and other cultural studies (Erickson, 2004; Keohane, 2002; Rapoport, 2005; Yakhlef, 2004) demonstrate the critical effect of space on a group's sense of culture, identity, and belonging, as well as establish the reciprocal condition in which architecture reflects cultural differences in identity and belonging.

We use key insights from these studies to explore the relationship between the structure and dynamics of an organization and its associated workspace, as well as the internal design (e.g., architecture, layout) of that workspace—including all of the moveable, semifixed objects that are likely to be manipulated within that workspace. We also draw on cognitive anthropology (Romney, Weller, & Batchelder, 1986; Weller & Romney, 1988) and American architectural perspectives (Altman, Rapoport, & Wohlwill, 1980; Rapoport, 1976, 1980, 2005) to gain an understanding of workspace preferences and behavior in the work environment. Rapoport (2005), for example, has argued that work environments should be designed to respond to and support the work culture, following a general architectural philosophy that is compatible with American pragmatism (Ramroth, 2006). When the physical environment lacks features considered essential, those affected either adapt to or change their environment to make it more useable or desirable (or less intolerable). Studies have shown that increased productivity results when organizations support workspace accommodation through participatory design (Brill & Weideman, 2001; Vischer, 2005), which includes user perspectives. This approach stands in stark contrast to the common, one-size-fits-all work environments where all workers are grouped together and perceived to have the same workspace and work practice requirements, regardless of culturally significant differences in their work roles, task configurations, or social-interaction requirements.

Our workspace study extends the lines of research on the critical juncture of culture, design, and productivity. Investigating workspace-design preferences enables us to gain a more robust understanding of the cultural values held by the R&D community in their primary work environment. Although we accept the term *knowledge worker* as a starting point for our study participants, we do not assume a priori that all knowledge workers and workspace requirements are similar. In fact, one of the contributions of our cultural model of workspace is that researchers have architectural and special work requirements that distinguish them from other types of knowledge workers yet are necessary for

sustaining, as well as enhancing, their ability to complete their work tasks effectively. We argue that the model not only serves as an advocacy tool for renovation priorities with respect to individual workspace but also reflects the strong current within R&D for maintaining R&D's organizational culture in the face of change. Thus, our study is in line with other research that supports user needs and the optimization of business and research activities by taking employee requirements, role, and work demands into account, rather than proposing a standardized, one-design-fits-all model (Mitchell-Ketzes, 2003; Sundstrom, Town, Brown, Forman, & McGee, 1982; Vischer, 1989, 1996, 1999; Vischer & Fischer, 1998; Vischer, Preiser, & White, 1990). The one-size-fits-all model, although convenient for some managers and planners, runs counter to important elements of systematic variability within cultures and is limited in terms of the cultural features that position knowledge workers to achieve their potential. Our study strongly suggests that workplaces and their workspaces are likely to be most effective when they accommodate the cultural priorities of the users and the way in which those users vary by role and function.

Study Overview

ETHNOGRAPHIC APPROACH

Our team adopted a "rapid assessment" research design (Trotter, Needle, Goosby, Bates, & Singer, 2001) to investigate GM R&D researcher preferences for workspace to accommodate the fast turnaround of insights requested by R&D management. This design included freelisting exercises (Weller & Romney, 1988) and standard ethnographic methods (e.g., semistructured questions, interviews, observations, and photography). Freelisting is a cognitive anthropology technique (Weller & Romney, 1988) designed to elicit all of the cultural characteristics or elements of a particular cultural domain—in this case, knowledge-worker views on workspace. It allows us to represent a cognitive approach to understanding the spatial aspects of culture (D'Andrade, 1995; Romney, 1999) from a "cultural consensus" perspective of the R&D knowledge workers (Romney et al., 1986). The ultimate aim is the discovery and representation of mental processes—specifically, how cultural group (e.g., researcher) perceptions, views, and beliefs serve to help organize their behavior, social processes, and utilization of material culture. Toward this effort, open houses to view the mock-up areas were organized by our research team. More than 207 participants, including researchers, lab group managers (LGMs), and executives, voluntarily engaged in the freelisting exercises at the open houses, identifying the positive and negative features of the mock-up workspaces.[3] We used this analytical and interpretive information, along with the observational data and photographs, to construct our cultural model of R&D workspace.

BACKGROUND AND CURRENT CONFIGURATIONS

The GM Technical Center, built from 1949 to 1955 by renowned architect Eero Saarinen, is located in the suburb of Warren, Michigan, north of Detroit. The R&D site has subsequently been designated a National Historic District[4] to emphasize the cultural importance of the original architectural philosophy and design and to protect it from subsequent destruction as a culturally important space. As a consequence, the renovation is limited by the constraints placed on it by the rules and regulations of the National Register of Historic Places. Similarly, the renovations will have to manage

the potential cultural changes in workspace and lab processes as well as worker behavior that have occurred since Saarinen implemented his original architectural philosophy. His description of the GM Technical Center clearly echoes a modernist philosophy (e.g., growth and progress) and especially the Midwestern U.S. version of pragmatism (Dewey, 1929) of industrial America (Saarinen, 1962):

> General Motors is a metal-working industry; it is a precision industry; it is a mass-production industry. All these things should, in a sense, be expressed in the architecture of its Technical Center. Thus the design is based on steel—the metal of the automobile. Like the automobile itself, the buildings are essentially put together, as on an assembly line, out of mass-produced units. And, down to the smallest detail, we tried to give the architecture the precise, well-made look which is a proud characteristic of industrial America. (p. 30)

The same technical and philosophical elements of the space are also clearly emphasized by Hitchcock and Drexler (1968) in their description of several buildings at the Technical Center:

> Constructed of steel frames filled with brick or glass, these three buildings are the first to be completed for General Motors Technical Center. The glazed ceramic sand-molded brick is used in varying tones of burnt orange and bright blue. The office building, adjoining a rectangular pool, has no movable windows: the heat absorbing green-tinted glass, set in matte-gray enamel frames, is permanently fixed. Air conditioning and lighting fixtures are incorporated in the grid pattern of the ceilings. The dramatic rows of blue-black stacks on either side of the dynamometer building are used to exhaust engine gases. (p. 95)

The R&D complex was originally designed to house the office workspaces for researchers and support staff. Currently, researchers, research managers, and support staff work at the Warren R&D facility in such areas as engineering, manufacturing science, electronic controls integration, chemical analysis, material science, and vehicle development research.

The existing architecture is required to accommodate office and laboratory space, library facilities, as well as space for modern computers, communication facilities, and administrative space. Many of the basic "in house" research processes have changed drastically over the years, and as a consequence, the space has had to be modified to incorporate whole new areas of bench science, whereas other spaces have become obsolete for GM's research purposes and are being modified for other corporate functions. The availability of computers for modeling research, and changes in work flow, and technology transfer are also putting pressure on managers to reconfigure the space to accommodate a new generation of researchers, while still providing appropriate space for senior researchers. Time has also had an effect in terms of deterioration of some of the structural elements of the space, as well as the effect of wear and tear on walls, floors, doors, and tiles. The current vision of the GM R&D leaders is to plan and carry out the necessary structural and design changes to create a "world-class research facility" aligning with its world-class researcher talent.

THE CURRENT STATE OF WORKSPACE ACCOMMODATIONS AND ADAPTATIONS

We conducted baseline observations of current architectural and workspace configurations in two of the key R&D buildings scheduled for renovation. The offices ranged in size from 100 to 210 square feet. The majority of offices were occupied by a single researcher, with executives and LGMs always occupying individual offices, and

researchers occupying both one- and two-person offices. The single-person space for managers is congruent with the cultural expectations for those positions. On one hand, it expresses some of the hierarchical nature of the organization, and on the other hand, it expresses some of the pragmatic conditions of those roles, including the need for privacy to deal with some personnel issues.[5] Some workers also had a small office space in a large research laboratory. R&D offices contained an average of three partial-glass walls (with views to the outside, a neighboring office, or hallway) and one solid wall accommodating a heavily used blackboard/whiteboard measuring 20 to 32 square feet. All R&D offices had at least one desk per person, with computer. Most had some additional work surface space that was generally made up of an eclectic combination of desks, credenzas, tables, and tops of filing cabinets that were all actively used as work extensions of the basic desk space. The work surface space averaged between 10 feet and 12 feet per person. All offices had at least one additional chair to accommodate a visitor.

Many researchers acquired furniture over the years—especially additional bookcases and file cabinets—that was highly durable. The offices contained 37.5 to 42.5 lineal feet of bookshelf space, whereas each researcher had seven file cabinet drawers on average for storage. There were numerous cultural manipulations or accommodations of space use in virtually all of the offices. One notable observation was that in more than 90% of the offices in our sample, posters and bookcases were used to cover at least some of the glass portions of the walls. Many had personalized their spaces with photographs, corporate awards, technical papers, and knick-knacks. Individuals, when asked, were generally positive about the space they occupied and indicated it worked well for them.

OPEN AND CLOSED MOCK-UP CONFIGURATIONS

A portion of the second floor of one of the Saarinen-designed buildings was reconfigured to allow R&D researchers to view, try out, and discuss two competing Lab of the Future workspace configurations. One configuration was designated an open-style workspace with some managerial offices and small conference rooms surrounding a large open space populated by low cubical-style individual work areas. The other configuration was predominantly made up of individual researcher offices with varying door options and configurations.

The open space design included eight seating areas, 90 square feet in size. A partition at sitting-eye level divided the eight seating areas into two groups of four. Each seating area had an adjustable desk of a hard, plastic composite and a chair made of a mixture of metal and fabric. In addition, one rollaway one-drawer file cabinet, covered with a colorful, cushiony material, was intended to provide storage and function as a visitor stool in each seating area. Between four of the seating areas was a set of four moveable tables that could be used for collaborative work (see Figure 1). Two private enclave spaces for individual "heads-down" work (i.e., focused work requiring concentration and quiet) were located next to the open area. Each enclave contained a small work surface and one chair.

The closed space design included eight clustered individual offices, 80 square feet in size. The walls were a combination of metal and frosted glass. Four of the offices had traditional hinge doors, whereas the remaining four had sliding doors. Two of the eight offices were semiprivate, separated by a floor-to-ceiling partition and accessible through a joint entrance (see Figure 2). All eight enclosed workspaces had the same furnishings as the open workspace.

Our research team subsequently evaluated employee views of the open and closed mock-up areas, with the following cultural issues becoming increasingly substantiated during the study.

Figure 1. Tables and Seating in the Open Space Mock-Up Area

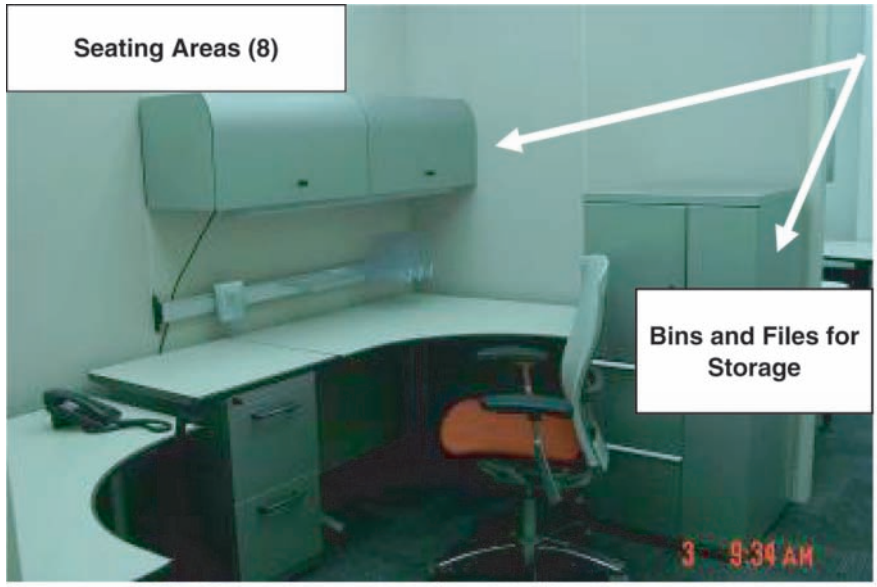

Figure 2. Tables and Seating in the Closed Space Mock-Up Area

Cultural Workspace Model for Getting the Work Done

The cultural meaning of workspace for researchers revolves around both pragmatist philosophy and positivist ideology, with a strong element of the modernist ideal of progress embedded in it as well (Dewey, 1938; Ramroth, 2006; Varenne, 1977). Researchers can both subjectively and objectively articulate the ways in which space plays a powerful role in their work lives: stimulating or inhibiting creativity, fostering or constraining task completion, fashioning a comfortable or uncomfortable work environment, or creating or preventing beautification. Workspace plays a significant role at Warren R&D because of the amount of time spent at work and the kinds of

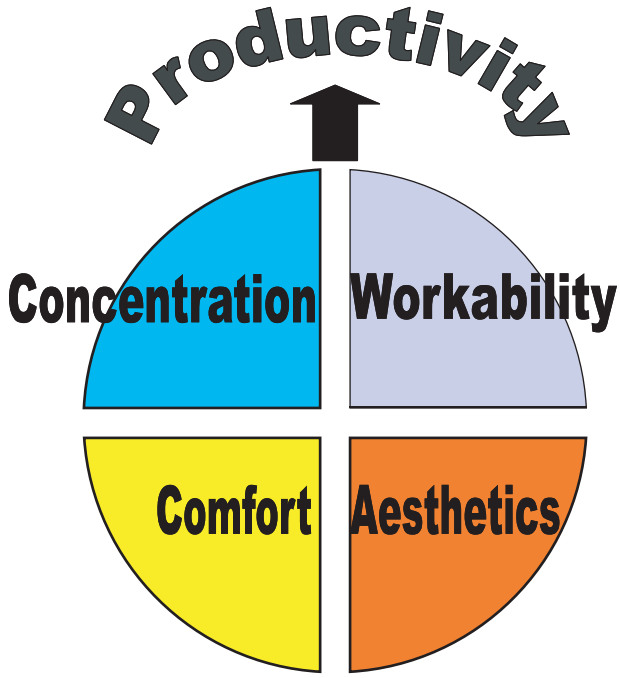

Figure 3. The Warren Research and Development Workspace Model

activities occurring there. Because symbolism, feeling, and identity are attached to the workspace (Vischer, 2005) as well as embedded in it (e.g., through furnishings, employee personal items), it is worthwhile to understand how Warren R&D employees conceptualize their ideal workspace and use and change their existing workspace to accommodate their work requirements and styles.

Our four-quadrant cultural model of workspace (see Figure 3) emerged inductively and without prior assumptions by the research team, through a thematic analysis of the freelist data in conjunction with the interview and observational data. The researcher workspace model emphasizes the researcher priority of "getting the work done" (i.e., the successful accomplishment of work goals and tasks) in numerous ways that are congruent with the Saarinen architectural expression, combined with the individualism and pragmatism embedded in Midwestern American culture (Ormerod, 2006; Varenne, 1977). We argue that the underlying cultural meaning of space for R&D researchers is to be able to conduct work tasks in a workspace that enables productivity. We define productivity as the output or accomplishments of the work process that create value for the individual and for the organization. The model expresses a dynamic balance between four cultural themes that emerged from the researcher view of space: concentration, workability, comfort, and aesthetics. These themes clearly express a number of key cultural values that are explored in the sections below.

CONCENTRATION

Overall, the freelist items and interview responses that were thematically related to concentration suggest that researcher workspace must support a variety of *heads down*–related[6] conditions in the workspace. These conditions include acoustics (e.g., *quiet*), privacy, visual

isolation, and security (from having someone look over your shoulder). When we compare the positive enabling features and processes and the negative inhibiting features and processes related to the theme of concentration, we find that participants list parallel groups of key concentration aids in the positive list of workspace features, and critical distracters in the negative list. Participants use virtually the same words, such as *noisy* from the negative freelist and *less noisy* from the positive freelist, or antonyms (e.g., *noisy* versus *quiet*). In the negative freelist, *noisy* emerged as the most distracting item, followed by *no privacy*. In the positive list, participants strongly endorsed *private* offices where *noise isolation* is possible and where work can take place in a *quiet* environment.

One study participant commented, "It is impossible to concentrate or focus on complex technical material [in this open mock-up setting]." Other statements were similar: "Research requires thought and it is hard to think with a lot of peripheral chatter," and "When I visit colleagues in other parts of GM who work in bullpens, we often cannot talk in front of the computer terminal because we disturb others and are disturbed by conversations."

Participants also recognized the importance of balancing *privacy* and *quiet* against *claustrophobic* feelings or the sense of being *isolated*. These reactions were reinforced by certain design features. The lack of privacy was noted in the open space configuration, along with concerns over the security of one's work and personal effects, whereas certain features in the closed office space (e.g., frosted glass from desk to ceiling and maze-like hall and workspace configurations) were identified as more claustrophobic. Photographs of the current R&D workspace offered insights into how employees reconcile privacy and quiet in their current offices. Posters and maps at and below standing-eye level as well as a partition that can be opened or closed at will illustrate some of the ways researchers achieve privacy and reduce visual distractions while minimizing claustrophobic feelings.

For example, in Figure 4, the two researchers share adjacent office space that is divided by a sliding glass window. The researcher in the foreground, to ensure better privacy and concentration, has mounted posters and calendars on the sliding glass that separates his office from his colleague's. These accommodations can be seen as a cultural response to the competing cultural themes of individualism and the need for construction of community (Beteille et al., 1986; Varenne, 1977), allowing researchers to manipulate the semifixed featured space that surrounds them.

WORKABILITY

Workability pertains to the spatial distribution of workspace tools and semifixed feature attributes that are necessary for balancing two sometimes-competing conditions that face researchers. The first is the need for a workspace configuration that supports individual work, and the second and simultaneous need is for that workspace to support collaboration (i.e., community space) within the same overall fixed-featured space configuration. The space must be workable for both conditions because both occur frequently and sequentially during most work days.

Individual workspace requirements include such features as a *large workspace* (e.g., surface and shelf) with a *good floor plan*. Engaging in research efficiently requires *good storage* and *shelf space* that is close at hand for storing and fast retrieval of project file folders, hard copies of research articles, books, and technical manuals. Figure 5 closely resembles the acceptable architecture requirements for writing and analysis—wide table spaces and easy access to bookshelves and storage. One participant wrote, "I need quiet to write reports, but I also need papers." This comment underscores the difficulty of storing and

Figure 4. Strategies to Improve Privacy and Visual Distractions

Figure 5. Bookcases and File Cabinets Reflecting Workability Attributes

accessing all reference materials electronically; participants indicate that using hard copies helps them to be more efficient in their research. Other participants told us that there was "not enough storage space for books and reference materials" in the mock-up areas.

Figure 6. Sufficient Collaborative Work Tools Supporting Workability

At the same time, both individual workspaces and larger collaborative areas such as conference rooms should be equipped with collaboration tools. For example, researchers desire *whiteboard surfaces*, *blackboards*, or *writing boards* in their individual workspaces as well as conference areas. Figure 6 shows a chalkboard used in a researcher's office. Typically, chalkboards are used for calculations, working through data analyses, recording notes, formulating ideas, and/or planning. Within individual offices, chalkboards or whiteboards are important transition spaces between individual work and collaborative discussions. As depicted in this picture, chalkboards encourage collaboration because they offer a way to display aspects of work tasks and processes to multiple individuals. Having a *guest chair* in an office also reflects the potential for both impromptu and planned collaboration, between an individual researcher and one or two others, whereas conference rooms tend to be used when three or more individuals are working together.[7] Other collaborative tools found in many of these spaces were small tables or surfaces where two or three individuals could discuss issues and write at the same time.

COMFORT

Comfort is the third thematic component that comes through very clearly and consensually in the Warren R&D cultural model of workspace. This component refers primarily to two aspects of the physical comfort of the workspace: adjustability and usability. The conditions associated with adjustability include ergonomic furniture, room temperature, and lighting, whereas those associated with usability

include technology, storage of personal items, door type, and accessible design (i.e., user friendly for those with special needs). One underlying component of this theme is the need for the researcher to have some ability to control the comfort of the workspace environment. Customizing or adjusting the workspace to accommodate research functions—even if those functions change frequently or evolve over time—is desirable.

When the workspace is *adjustable*, employees are able to modify or change something about the furnishings or arrangement, thereby enhancing their comfort. Some specific features associated with adjustability include *flexible furniture* designed with ergonomics in mind and *good chairs* that are *adjustable and comfortable*. Environmental features of great importance to employee comfort levels are *ventilation*, *climate control*, and *good lighting*, including *natural light*. Such features help employees stay focused on their work and not on the environmental conditions around them.

In terms of usability, current work demands require moving from meetings of varying sizes to individual work areas and back again. We infer from these work demands that participants want to be able to move their work and themselves easily from place to place. For example, portable electronic equipment such as laptops, projection capabilities, and communication devices (e.g., wireless Internet, cell phones) allows increased flexibility.

A number of the freelist and interview comments also emphasize appropriate accommodations for personal object storage. Researchers want sufficient space for placing personal belongings (e.g., purse, coat) safely away from work activities. Participants specify that large or long coats will not fit in the slim compartments designated for coat storage in the mock-up areas.

The general findings about usability support the need to accommodate participants with an easy-to-use and a barrier-free workspace. Lighting needs vary depending on office location (i.e., interior vs. perimeter), time of day, and personal preference. Participants generally prefer traditional hinge doors on individual offices. The sliding doors are awkward, reminding them of prison lock-down situations. In addition, these doors are difficult for someone who uses a cane or crutches. Participants suggested that wide doors should be constructed to accommodate wheelchairs as well as scooters. Moreover, carpets should be thin enough to move scooters and wheelchairs easily through the research facility.

AESTHETICS

Aesthetics, the fourth component of the workspace model, refers to both the tangible and intangible aspects of the workplace representing the domain of beauty or art. Both affect participant perceptions of the work environment and the organizational culture. Tangible elements in the data include particular surface types (e.g., *updated furniture*, *modern furniture*), workspace colors (e.g., *blue and green colors are professional*), and *views outside*. Intangible aspects of aesthetics include the quality, feel, and warmth of the furnishings and the space.

The data suggest that these tangible elements are inextricably linked to intangible elements such as quality and feel. For example, participants indicate that particular surface types are either a positive (e.g., *contemporary looking*) or a negative (e.g., *metal*, *plastic*) feature. They prefer *quality* furniture rather than something that is *cheap* or *unattractive*. Generally, participants dislike *too much metal* in their workspace (e.g., industrial-looking furniture, storage areas, work surfaces), linking metallic surfaces to descriptors such as *cheapness*, *lack of durability*, and *stark/cold feelings*.

Workspace colors and access to external views from one's workspace enhance or detract from the work environment. For example, some colors such as blue and green are considered *professional* compared with others such as gray that are considered *ugly* or *dull*. Outside office views are important to participants. Windows enable them to see aspects of nature, afford significant natural light, and provide a view beyond the immediate workspace. Although participants recognize that GM must be mindful of overall renovation costs, they warn that *cheap-looking* and *unattractive* workspace features transmit inappropriate messages to employees and R&D visitors, potential hires, and customers. The aesthetics data map onto behavior we observed at Warren R&D. Photographs indicate that some researchers attempt to minimize the *stark* and *dull* feelings in their existing offices and labs by adding artwork, plants, photos of family members, and other personal effects. The result, they believe, is a professional, personalized, and warm workspace.

MODEL COMPONENTS AND ROLE

The model provides an interesting and potentially provocative tool for comparing cultural issues across subcultural groups. For example, our analysis indicates that three groups of knowledge workers—executives, LGMs, and researchers—recommend a balance among the four key components of the model. However, although each group indicates that all components of the model are important, the three groups prioritize the components of the workspace somewhat differently and, consequently, have differing views of how the workspace should be configured for the highest productivity. The closest agreement in ranking the components occurs between the LGMs and researchers. Our validation surveys and interviews confirm that the LGMs and researchers display a high level of consensus in their preference for workspaces that are closed rather than open. They indicate that the enclosed offices provide opportunities for *privacy* and *heads-down work*, whereas the open space is *noisy and distracting*. The greatest disparity in ranking the model components appears between the executives and researchers. Executives were the only group to list almost twice as many positive factors about the open space (e.g., *open feel*) compared with open workspace negatives (e.g., *noisy*, *no privacy*).

Workability is the most important component of the workspace model for both researchers and LGMs. Their comments stress how much they value sufficient work surfaces, bookshelves, whiteboards, enough room to accommodate a visitor or two, and ample collaborative workspaces when several people are involved in a discussion. By contrast, workability ranks third for executives. With respect to one aspect of workability—storage capacity—we have heard executives speculate that researchers of the future will be working almost exclusively electronically and will not need the storage capacity that researchers and LGMs currently advocate. This perspective runs counter to that of LGMs and researchers, who hold surface area and storage in very high regard.[8]

For researchers and executives, concentration ranks as the second most important model component. Both of these groups prioritize productivity; however, they have different conceptualizations of how productivity is best achieved in the workspace. We suggest that executives are responsible for the synthesis of research findings and of that knowledge transfer into products. Consequently, executives conceptualize productivity as more of a community effort. This process is best achieved across more open workspaces where there is an exchange of information and cross-pollination of ideas. In contrast, the researchers focus on individual actions as they pertain to productivity and only seek collaboration when community knowledge can move individual productivity forward. Researchers like to control diads and triads of collaboration and

indicate that productivity is best achieved through an individual, private, enclosed office design that offers the virtue of reducing both visual and auditory distracters.[9]

The aesthetics component of the model is highly ranked by executives and LGMs and less highly ranked by researchers. Executives rank aesthetics first, whereas LGMs rank it second. Based on comments we heard, we suspect that this pattern is tied to the roles that executives and LGMs play in some of the key "symbolic" actions that are necessary for connecting the workspace to the internal GM community and those external to it. Executives and LGMs see aesthetics as an important element in getting the best possible "face" of the company exposed to the public when they are conducting new-hire recruiting and representing the company to the outside world. LGMs and executives also spend a significant amount of time in meetings, entertaining visitors, and acting as spokespersons for R&D. We suspect that the image these groups would like to present is reflected, at least partially, in attributes of the physical setting. If the aesthetics were considered pleasing, they would enhance R&D's image.

All three groups rank comfort as the least important component of the model. This consensus across roles has an unintended effect of redirecting the focus to the other three salient components of the model. Comfort is not a priority for R&D; what matters instead is the ability to "get the work done." However, this finding should be interpreted within the overall baseline observation that the existing space appears to meet the basic comfort standards for the group. If it did not, we speculate that the comfort component of the model could easily be one of the more dominant components.

Discussion and Implications

A key contribution of our work is in disentangling the relationship between space (i.e., workspace) and culture (i.e., researcher culture) and in making that connection explicit. Whereas the organizational and architectural literature emphasizes workspace requirements, there is very little focus on aligning workspace design with cultural variation in job function and work practices among knowledge workers.

In this discussion, we deconstruct a number of the assumptions made in the literature about workspace design. We argue, based on our research results, for an alignment between space considerations, on one hand, and cultural considerations, on the other. If workspace design decisions are made without sufficient knowledge of the cultural group, without sufficient understanding of the intracultural variability expressed by the group, or without taking that group's consensus about work function, goals, practices, and cultural interactions into account, knowledge-worker effectiveness is likely to be seriously compromised. We propose new ways of minimizing the gap between cognition, form, and function by appropriately aligning workspace and culture so that the organization maximizes the cultural value of its particular knowledge workers.

Our user-centered cultural model of workspace reflects both the overall philosophy of science (positivism) that is expressed by the GM researcher knowledge workers as well as the modernism and pragmatism prominent in Midwestern American culture and the architecture that stems from that cultural milieu (Dewey, 1929; Ramroth, 2006; Varenne, 1977). Other types of knowledge workers may (and probably do) work out of other cultural paradigms and consequently will want to construct their space and culture needs out of other cultural frameworks. In this case, researchers are expressing the meaning of their space in terms of use, couched within the cultural themes of individualism (Beteille et al., 1986) and effectiveness. These themes hold

high value (saliency) for researchers, and architecture that reflects those cultural frameworks becomes a culturally congruent tool for recruitment and retention of both new and existing researchers. A visible cultural expression of these themes sends very positive cultural messages to visitors, new hires, and current employees. The expression is also consistent with the overall philosophy and purpose of the proposed renovation of R&D facilities.

When the elements from our cultural model are put together into an architectural footprint, they create a workspace that accommodates individualism (one-person office protecting concentration when needed) but also accommodates dyadic and triadic collaboration (the most common forms for these researchers) when there is embedded collaborative space (the whiteboard space and small table or surface space that can be used with one or two others) in those individually oriented spaces. The need for larger group collaborative space and the construction of a research "community" (Varenne, 1977) can be accommodated by incorporating attractive and useful laboratories, transitional spaces, conference rooms, social gathering spaces (coffee areas, etc.), and larger community spaces (such as lecture halls) into the larger workspace footprint surrounding the individual office space. This footprint accommodates the changes in knowledge work that have occurred over the years, while also remaining relatively true to Saarinen's original design philosophy.

The four-quadrant model also helped us explicate our understanding of researcher knowledge-worker culture through a cognitive and symbolic exploration of workspace. Culture, in the context of our research, is built on a foundation of cognitive processes particular to researchers: the ability to concentrate (evident in visual and acoustical privacy strategies), expectations related to workability (evident in use of chalkboards and desk surfaces), and engagement in collaborative work tasks as the situation merits (evident in the availability of a visitor's chair). Researcher comments, the foundation for the model, set us on a course for understanding an optimal integration of space and culture. It is the deliberate juxtaposition of space and culture that is most valuable in designing an appropriate workspace for knowledge workers. The model subsequently allowed us to both validate[10] and transfer that knowledge to the decision makers who will have the final authority when renovating the facilities. They will need to negotiate the structural constraints imposed by the Register of Historic Places and the opportunities imposed by a better understanding of the critical cultural elements that our study elicited.

Our approach varies from what appears to be the standard presented in the literature on workspace design. Overall, there is limited or virtually no attention to a cultural evaluation or discussion of the type of work that goes on in the workspace. Thus, there is limited opportunity to match the space with the needs of the user community or with the cultural models of space produced by that community. For the most part, when managers and consultants are interviewed for articles pertaining to workspace, the options presented and discussions produced center on open versus closed structures (Semenak, 2001), decisions about commons-style workplace amenities such as gyms and kitchens, and recommendation of features that will elicit a positive feel of the space (Eisinger, 2002). In addition, too much of the dialogue focuses on the increase in costs for retail and office space (Gardner, 2000; Tahmincioglu, 2000), thus justifying more modular, flexible, open workspaces (McGhee, 2002). One of the cultural traps (or excuses) for these discussions is that these flexible spaces, when proposed, are justified in being easily modifiable, changeable, and capable of meeting unforeseen needs, whereas any simple cultural exploration of these types of semifixed featured spaces demonstrates that, once constructed, they are subsequently treated as fixed featured space, are not flexible, and are not often changed on the basis of the cost of changing them. This overall condition

creates a situation in which a cultural solution for one problem (cost of new space) is actually in conflict with the solution for a completely different problem (constructing the best fit of space for a particular cultural enterprise such as knowledge work). At best, these cultural elements are largely ancillary to the problem (best space configuration) that is supposed to be solved (i.e., getting the work done). At worst, these cultural elements represent a misunderstanding of the tensions between concentration and collaboration for these knowledge workers, with a misplaced American culture emphasis on community building to offset the need for individual heads-down time. If organizational success is a function of work effectiveness, changing a longstanding and proven workspace design (i.e., closed to open workspace) carries a high degree of risk, threatening the researcher community's ability to complete work tasks well and in a timely fashion.

In some very interesting ways, a modernist–postmodernist debate is occurring within and around the knowledge-worker workspace, often without the knowledge or full participation of the individuals who are most affected by the results of that debate. For example, Cvornyek (1999) captures both sides of this debate in her article. Her interviewee begins by saying, "The corporate office unites through the imposition of a structure." However, in the next line, the interviewee explicitly recognizes the importance of aligning space and cultural needs:

> The new workplace, on the other hand, unites through deconstructing work processes. It is defined by spaces that respond to tasks and social needs. Places must be created to support varied activities, such as brainstorming, negotiating, analyzing, creating and communicating. (p. 56)

Our research contributes to this discussion by demonstrating that the most salient cultural value that R&D knowledge workers hold is the desire to be productive. Through their comments and recommendations, they indicate a dedication to the discovery of new knowledge and its transformation into automotive applications. They view their workspace as a critical factor in their continuing efforts to be effective researchers. Researchers, LGMs, and executives agree that heads-down work should be the key priority for the renovation. Indeed, the robustness of our cultural model of workspace is demonstrated, in part, by the consensus evident across all R&D members. Moreover, researcher preferences for workspace designs that enhance concentration and workability are also historically consistent with workspace designs within the broader research community in which knowledge workers have been trained, including the philosophy of science, modernism, and individualism. Without recognizing the cultural variability across different kinds of knowledge workers, it is easy for managers and designers to assume that all such workers can be grouped together in common, standardized workspaces. We challenge this notion of commonality of space requirements across knowledge workers and suggest that knowing the users and recognizing the diversity of tasks are critical to workspace design.

Our study has also enabled us to understand some of the diachronic elements of space and culture by assessing the current researcher space use patterns, particularly the modification, adaptation, and customization of original spaces to meet (or express) the critical themes and cultural domain elements in our model. Our observations and photographs illustrate how R&D personnel customize their current workspace, organizing and decorating their work environment in a variety of ways to ensure productivity through the cultural manipulation of concentration, workability, comfort, and aesthetics. Many have added posters to the glass walls of their offices or manually moved bookcases against them to block off portions of their offices to minimize visual and audio distractions (while also staying within the work culture's aesthetic

boundaries or expectations). When engaged in heads-down work, researchers typically work in their offices or labs with the doors closed. Similarly, they may seek an alternate location to ensure concentration, privacy, and quiet. When working with others, long discussions typically occur only in single-person offices or in offices in which the officemate is not present. Furniture has been acquired (e.g., more bookcases, file cabinets) or rearranged to improve the usability of space. Adding photos, trinkets, and carpeting improves the feel by personalizing the workspace in the unique style of the individual. A final example of culturally adaptive behavior for knowledge workers forced to adapt to culturally incongruent space and architecture is the increased prevalence of working at locations other than the primary or official workspace. Going somewhere else allows some workers to counter the conditions that interfere with the four model elements (interruptions in concentration, discomfort, lack of workability, and poor aesthetics) and to accomplish their productivity goals. These types of cultural adaptations were not the primary focus of our research, but it is clear that further explorations of researcher (and other knowledge worker) workspace should include an exploration of alternative workspaces in which work occurs to produce a more holistic view of the overall connections between space and work culture. There are efforts under way to explore the mobile and nomadic worker from a social perspective, which will contribute to the cultural interface between work, space, culture, mobility, and fixed location design for workers (Bean & Eisenberg, 2006; Bean & Hamilton, 2006).

Notes

1. We would like to thank Alan Taub, who sponsored the investigation of this very interesting and timely research topic. We appreciate the willingness of so many R&D employees to respond to our surveys, talk with us, and allow us to observe and photograph their workspaces. We also appreciate the help of Jing Zhang and Steve Swarin for their consultation on project design and coordination. In particular, we thank Dan Reaume, Steve Swarin, Tony Foust, Bill Jordan, and Ralph Mitchell for their helpful and insightful review comments and Delf Dodge and Alan Taub for their ongoing support of this work.

2. *Knowledge worker* is a term first used by Peter Drucker in his 1959 book, *The Landmarks of Tomorrow*. Knowledge workers include those in the information technology fields such as programmers, systems analysts, technical writers, engineering designers, and others using new knowledge to perform creative tasks. It also includes academic professionals and researchers, among others, who are creating that knowledge in the first place.

3. The primary analysis for our free listing data was conducted using ANTHROPAC, an analysis package that generates a list of mutually exclusive elements in a cultural domain and provides several types of saliency measures, in descending order of frequency (Borgatti, 1996).

4. The GM Technical Center was listed in the National Register of Historic Places beginning in March 2000.

5. Although there is no difference in size between the researcher and LGM offices, the executive offices are significantly larger and have higher quality furnishings. Administrative assistants also have large offices, often adjacent to an executive office. These offices are open spaces, allowing employees, visitors, and others to approach the "admins" with questions and information.

6. All terms in italics are actual freelist items listed by participants.

7. Participant comments indicate that long-term visitors (e.g., consultants, collaborators, interns) need their own workspace and computer access points (e.g., Internet and printing capabilities).

8. In this study, data from young researchers strongly challenge this view that researchers will operate largely electronically.

9. We believe that transitional areas such as lounges, informal meeting spaces, break rooms, and cafeterias should be incorporated for the stimulation of ideas and interaction while still achieving the priority of researchers in enclosed offices.

10. Our validation process included presentations and discussions with the R&D community.

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