EXECUTIVE FORUM: HOW DESIGN AFFECTS PRODUCTIVITY IN SETTINGS WHERE OFFICE-LIKE WORK IS DONE

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Although our research work comes from a different "world," it is definitely parallel to the healthcare world. Ours is that of systematic research about how the design of the office work environment affects productivity and quality of worklife of individuals and groups. Since there turns out to be a large, but relatively unexamined, office work component in healthcare settings, let us explore what happens "when worlds collide."

"Office-type" work in every industry is similar, consisting of information gathering, storage, retrieval, manipulation, and communication. It is often done in places easily identified as offices, but also in other settings such as the factory floor, trading rooms, process control areas, submarines, stores, and farms. To do office-type work well, the same types of support should be designed into the physical environment of all these areas.

Office-type work is almost everywhere in the modern healthcare environment. Office-type work is done in settings for patient interactions and care; preparation and handling of things and stuff; analysis, learning, and diagnostics; and administration, finance and control. It happens in places other than those instantly recognized as office settings, such as nurse stations, doctors' offices, consultation rooms, social work/psychology/psychiatry settings, faculty offices in teaching hospitals, central supply and stores, pharmacies, laboratories, and clinics.

Transferable knowledge about how design affects office work productivity is timely, relevant, and probably replicable and useful in all healthcare activities where information is an important medium. Office-type work — paper handling, electronic communication, and face-to-face interaction — is an increasingly important component of the healthcare system. In hospitals, office-type work accounts for about 10 percent of the total costs and about 25 percent of the total person-hours. Each hospital bed requires the support of more than 2,000 hours of office-type work each year (a one person-year) and about three person-years of other forms of work and care.

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This information-based work is increasing in its amount and importance. Our ability to interact with it and manipulate it, and the number of different types of folks who need to access it is also changing. And, since healthcare philosophy continues to change, the nature of information the healthcare system needs and uses continues to develop. While these changes are not happening everywhere, nor at the same pace in all places, some of the changes that affect what information is needed and how it is used are:

1. A more holistic view of patients requires more information about them (patients are now more than "the gall-bladder in 12-D").

2. Care itself is more integrated, requiring the melding of information from various sources.

3. There are fewer functional divisions between services and departments, so more information flows across divisions, with multiple sources and paths of information.

4. Mobile healthcare technology is used so the patient is not moved around so much. Because

this technology is more decentralized and sophisticated, it is more information dependent.

5. Staff are more flexible, less specialized, and both need and receive more cross-training. Thus, they are better at seeing relationships, but less good at particulars, which now need to reside in the information system and be easily accessible.

Even with the sticker-shock prices of healthcare hardware, the vast bulk of costs in healthcare are employee salaries. The productivity of staff is key to both quality of care and cost-containment. Information handling, what we call office-type work, accounts for a large portion of employees' work. Research shows that the design of office work environments affects productivity. Many settings for office-type work in healthcare are poorly designed and are a major target of opportunity for design professionals.

Office Design Research

The rest of this paper summarizes highlights of research by others, and focuses on the Buffalo Organization for Social and Technical Innovation's (BOSTI) 15-year nationwide research program that explored the ways in which office design affects productivity and quality of worklife. This material is excerpted from the two-volume work, *Using Office Design to Increase Productivity*, published by Workplace Design & Productivity of Buffalo, N.Y.

While we have not had the chance to do this research in healthcare settings directly, there is good reason to believe we would get much the same results. To present this work so it is more useful, let me share the history of the questions our research has posed, which begins with an economic framework.

We had long suspected that too much attention was being paid to the costs of the environments for office work and not enough to the value of the benefits of their use to organizations. So, more than 20 years ago, at the National Bureau of Standards, I and a team of researchers posed an important economic question: "Of all the costs of accomplishing an organization's office-based mission, what portion of the costs goes to support the physical environment for office work and what portion supports the people who do that work?"

In answering this, the following calculations assume that the total cost of the office work environment in operation includes building and buying its furniture; supplying all electronic business and communications equipment; and running it — that is, providing energy and maintenance for day-to-day operations.

Comparing the cost of employee salaries to the costs of this operating office environment, we found that people costs are far greater than office costs, in a ratio of 13 to one for offices newly built, and five to one for offices leased. Put another way, over a 10-year period, 92 percent of all money spent to achieve the organization's office-based mission goes for people's salaries; six percent goes to maintain and operate the building; and only two percent is spent on construction, furnishings, and equipment.

After discovering how little the workspace costs, compared to the costs of the people who work in it, the next important research question was to find out whether the planning and design of the workspace (the two percent part of mission accomplishment) affected how well people perform in it (the 92 percent). Given that large ratio, the effects of design on performance could have great leverage.

Up until recently, this second question has not been satisfactorily answered. Thus, office facilities have long been seen largely as a cost center, as a place that houses workers and their tools; but not as a tool itself, one that can be used to enhance organizational effectiveness. Research done by BOSTI and others in the past decade demonstrates that the office facility really can "facilitate" — it can measurably affect job performance, job satisfaction, and ease and quality of interaction, which are important "bottom-line measures" for all organizations.

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The research suggests that the dollar value of the benefits of appropriately designed spaces for office-type work are substantial, as are the costs of poorly designed ones. And the effects are symmetrical. Nonsupportive design has negative effects on work and workers, and design appropriate to the work has positive ones.

Some aspects of the workplace have stronger effects on "bottom-line measures" than others, so we can be intelligently selective in the use of this research information. By employing it in a planning and design process that carefully examines what individuals and workgroups really do, we can develop a high-performance work environment tai-

lored to the organization's work needs. Designing from the "inside-out," — starting with the work, worker, and workgroup — is the best way to capture the benefits produced by appropriate design of settings for office-type work. Research-supported design guidelines and policy can also be used in the management of these settings so they will be responsive to continued organizational change and yield long-term high performance.

Design & Productivity

We present here the general findings from more than a decade of research examining the effects of work environments on workers and the performance of work. Most results point in the same direction — that the physical environment for office work affects individual and group performance, job satisfaction, and ease and quality of communication. There is now a body of knowledge that is maturing and available, and there is far more information than is summarized here. Some important studies are:

1. Springer's *Improving Productivity in the Workplace: Reports from the Field* describes 48 studies and their results, examining how the physical environment — its furniture, equipment, and facility management, and changes in work procedures — affects individual or workgroup performance. Each of these studies shows positive effects, often on performance.

2. A study in government offices by the Construction Engineering Research Laboratory (CERL) of the U.S. Army Corps of Engineers examined the effect of ergonomically-suited, task-oriented workstations on productivity and satisfaction, and analyzed the costs and benefits of providing new state-of-the-art office furniture. Three situations were tested: two no-change control groups; a somewhat augmented furniture group; and one with systems furniture. Results showed that only the group receiving systems furniture had increased productivity, and that the benefits from enhanced productivity far outweighed systems furniture's space-saving benefits. Payback period of the cost of providing a systems furniture workstation from productivity alone is 11.5 months, and when space savings are considered, drops only to 10.8 months.

3. Springer's own study of a major insurance company examined the impact of ergonomically designed furniture on the performance and productivity of VDT operators. Done in a simulation laboratory that painstakingly recreated all work conditions, it found that the best ergonomic furniture had a 10 to 15 percent performance improvement over normal conditions, with one-third of this attributable to improved seating.

4. DeMarco and Lister's study of software programmers was not intended as research about the environment. They conducted an elegant experiment in which almost 200 programmers competed against each other to develop a software program from common specifications in a race for time and quality. The researchers wanted to find out what were the most potent influences on the quality of programming. They found, surprisingly, that the factor that most powerfully discriminated among the best and worst performances by programmers was the appropriateness of their physical environment for the tasks, and not such things as age, salary, experience, programming language, or methods. They have since published a book called *Peopleware* (Dorset House, New York), using the results of this experience.

5. In a before-and-after study of major upgrades in furniture and renovations to space at Aetna Insurance, productivity increased by 53 percent, absenteeism dropped 14 percent, and job satisfaction increased substantially — all related to both physical and organizational changes. These same results did not occur in a no-change comparison group. In the first of three phases, form-processing employees in a crowded bullpen had measures taken before any change. They were then provided with systems furniture with some enclosure for each individual, and a new floor layout, but in unrenovated space. With measurements taken again, the space was then substantially renovated, and measurements again taken afterwards and results analyzed. Forms-processing performance increased dramatically over the phases, as did satisfaction, and absenteeism dropped. While intervening divisional reorganizations make it difficult to isolate the true impact of environment, most employees felt that the effects of the environmental changes equalled those from organizational changes (each accounting for, say, a 26 percent increase in productivity). Managers, however, felt that environmental changes accounted for less, about 10 to 15 percent of the 53 percent increase — still a substantial five to eight percent increase in productivity due to environmental interventions.

6. BOSTI's research looked at the workspace as a collection of 18 "facets" — things like physical enclosure, esthetics, privacy, furniture, status communication, temperature control, lighting — 18 in all. The research was a set of large-scale

studies, involving thousands of workers in more than 100 organizations, and included a major before-and-after study. It explored how changes in these "facets" related to changes in four "bottom-line measures" of job performance — job satisfaction, ease and quality of communication, and satisfaction with the environment. Job satisfaction and job performance both have measurable economic consequences to organizations. Economic analyses demonstrate that the dollar value of the benefits of appropriately designed offices can be substantial, as can the costs of poorly designed ones. The data suggest that the upper limit of benefits from "perfect" workspace could have an annual benefit equal to 15 percent of salary. (Our own experience suggests that two to five percent is reasonably attainable.)

BOSTI's Research

We should further examine BOSTI's findings to use them to best advantage since it is the largest and most comprehensive study. More than half the facets examined in the BOSTI study affect either job performance or job satisfaction, and many affect ease and quality of communication. The facets that have major effects on *job performance* are listed below. For each, we also show a research-supported theoretically possible annual benefit if each of these facets were optimally supportive of work. Benefits are expressed as a percent of a worker's annual salary. The numbers listed are an upper limit, possible but not probable. We suggest using one third of each value.

1. The amount of *enclosure* individuals have. (More almost always seems to be better, although fully enclosed offices are not the only good solution.) (eight percent)
2. Whether the internal *layout* of a person's workspace is a good fit for the tasks he or she performs. (six percent)

The facets that have a major effect on *job satisfaction* are:

1. Whether the type of *furniture* is suitable for the job being done.
2. How well unwanted *noise* is suppressed. (one percent)
3. How *flexible* the physical environment is in responding to organizational change, and how easy change is to accomplish. (one percent)
4. Whether individuals have the proper amount of *floor area* for their furniture, work postures, and moving about.
5. Whether or not people *participated* as much as they wanted to in decisions about their environment.
6. Physical *comfort* (for everybody, not just video-display terminal users). (one percent)
7. Whether *lighting* is appropriate for the task mix. (one half percent)
8. Whether people can control *temperature* fluctuations. (one half percent)

Economic analysis of the results of BOSTI's nationwide research program suggests that the economic benefit of planning and designing office space based on this research can easily equal two to five percent of each worker's annual salary and could be higher if the office were planned and designed to be a "perfect fit" for the work.

When we examine the kinds of things that offer the greatest economic benefit, it is clear we may not have to spend more on the physical environment, but might have to spend more wisely by targeting spending to those facets of the workplace that research shows the most profound effects. Some benefits may be achievable with no additional capital cost. For example, one of the major contributors to job performance is "layout" — how well an individual's workspace is internally designed to support the work he or she does. This may simply suggest a better arrangement of existing furniture, rather than buying new furniture. It seems that using this new knowledge can help optimize office investments, whatever the level of investment.

False Assumptions

When BOSTI examined its findings in more detail, some of them validated the "conventional wisdom" about workspace design, but some of the more cherished ideas about office design and management were turned upside down. Some of these findings include:

1. *Privacy and communication aren't opposites.* Many managers and designers feel that surrounding individuals with panels is a barrier to good communication, and feel that openness promotes good communication. Actually, the reverse seems true, for research shows a high degree of enclosure supports both privacy and communication for all job types, and low enclosure supports neither. This does not necessarily imply private offices for everyone, for a very good level of enclosure for each individual would be panels on all four sides, with a height at about a standing person's eye level, at least 65 in., and preferably, 68 in.

2. *Enclosure is more important than supervision.* Many managers like the idea of offices that

are physically and visually open, ones where they can see their people. They may feel somehow that random, visual supervision enhances productivity, or that openness enhances team spirit. Whatever the reason, where this becomes policy, it means that many workers will have little individual enclosure. At its worst, workers find themselves in a totally open "bullpen."

Three research-supported findings suggest that low enclosure for workers is an error: 1) decreasing the enclosure of individual workers relates to decreases in their job performance; 2) to monitor employees, managers must be "out there" too — and our research shows that putting managers in the open greatly reduces their own ease and quality of communication; and 3) such supervision doesn't work, for our research shows clerical workers who are visually supervised and those who are not have equal levels of job performance.

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3. *Windows are not so important.* While most people would prefer to be near a window, a window's presence or absence has little effect on bottom-line measures. While a window in one's office does "communicate" higher status, it doesn't seem to enhance satisfaction or performance. Interestingly, when the benefits of windows are ranked by workers, the top three are: a feeling of not being closed in; seeing sunlight; and a way to see outside. Way at the bottom is status. To maximize satisfaction with windows, this suggests a planning strategy where windowed walls in offices might be given over to circulation and common use areas and perhaps not to private offices.

4. *It's not just VDT users who have human factors/ergonomic problems.* The current brouhaha about VDT equipment users experiencing discomfort and health problems has masked the fact that large numbers of office workers who don't use such equipment experience pain and discomfort frequently. Several government-supported studies compared pain, irritation, or fatigue of equipment users with that of non-equipment users. While they found that about 75 percent of all equipment users experience these discomforts frequently, they also found it true for more than half of non-users. Since that's mostly everybody, current concerns about human factors must go beyond VDT users and embrace the ergonomic needs of all workers.

5. *Designers' ideas about space differ from workers' ideas.* Designers often argue against a lot of enclosure for each individual, feeling it destroys the sense of architectural space in the office. Often, entire office floors are designed as vistas, ones that can be seen from one end to the other. Office workers, with different needs than designers, evaluate these very open offices as least attractive and ones with more enclosure and less vista as far more attractive. And remember, as people lose enclosure, their job performance declines. So, a really open office is not a good idea in most cases.

6. *Office workers are serious about work.* The questionnaires were demanding, took about an hour to complete, and were both anonymous and confidential. People could have been frivolous or lazy or thrown them away, but they didn't. In analyzing 1,000 of these questionnaires, we were struck by office workers' desire to be articulate about their work and workspace. Further, the results show that those facets of the work environment most directly linked to their performance of work are more potent for them than are, say, status, esthetics, and personalization.

7. *Finding everybody's comfortable temperature is impossible.* A third of all workers find that temperature fluctuates too frequently, both in old and new buildings and in widely dispersed geographic locations. Analysis shows that for many, the room's thermal conditions matter less to thermal comfort than does their body type — their surface-to-volume ratio. Smaller, thinner people experience temperature fluctuations and are too cool far more often than their larger, beefier coworkers. This natural disparity in people's sizes, combined with the broader thermal comfort zones introduced for energy savings, guarantees that many office workers will never have thermal comfort. Thus, there is no magic overall temperature and there will always be complaints.

8. *Reducing floor area is OK, but be careful.* To save money and/or space, many organizations have reduced the floor area of individual workspaces, often over the protests of workers and managers who have argued "we can't do our work in less space." Well, they may be able to do their work, but they're not going to be happy at it. It seems space can be reduced, but not a whole lot. While performance remains steady, job satisfaction drops when floor area is reduced by more than 25 percent. Unfortunately, our study of many newly-designed offices found an overall floor area loss of 19 percent for professional and technical

workers; some 32 percent for clerical workers; and parallel drops in their job satisfaction.

9. *Private offices aren't so private.* Theoretically, the private office can offer perfect levels of all the forms of privacy. In practice, private offices are noisier and more susceptible to visual distractions than they should be. Part of it is because, in many organizations, there is an unwritten rule, a norm of behavior, that suggests that private-office people who keep their doors closed aren't team players and are somehow aloof and inaccessible; thus, there is a forced open-door policy. Our research shows that 50 percent of private office occupants seldom or never close their doors, while only 25 percent close them frequently or always. It may also be that it is simply too much trouble to use the door selectively, or that it provides unwanted cues to others that this conversation is more serious than others. An open door lets in noise, and because of desk location, often creates visual distractions as well. And, even if the door is shut, there are often still noise and speech privacy problems, for we have lost the construction habit of carefully enclosing these offices about their hung ceiling, permitting sound to travel through this plenum.

In BOSTI's research, office workers' high response rate to a series of precise, demanding, and sometimes boring questionnaires shows they are serious about work and thoughtful about their environment. Results suggest that workers are affected by their workspace as a functional arena and, as well, by psycho-social aspects. These results, happily, can be used on a selective basis. Many aspects of the office that affect job performance and satisfaction act fairly independently of each other. Thus, incremental changes can be made without total office redesign and major investments. Knowing which aspects of the office environment affect bottom-line measures and which aspects don't will alter what managers demand in new facilities, what designers emphasize in designs, and how offices get managed.

The office is more than just a cost-center. It can be an investment with a measurable return and is yet another productivity tool to be used intelligently. BOSTI has worked with a few hundred organizations by now, either doing research about them or using research results to help them design their offices as a tool to increase productivity and quality of worklife. From this vantage point, the major breakthrough we see is not any recurrent new technology, design theme, or physical layout, but a "thinking breakthrough" about what design for office-type work is for — the idea that carefully designing settings for office-type work to support what people actually do (wherever it occurs) is an investment that pays off in both business terms and in positive changes in organizational culture.

References

Brill, M. with Margulis, S., Konar, E., and BOSTI. *Using Office Design to Increase Productivity*, Vol. 1, 1984; Vol. 2, 1985. Buffalo, N.Y.: Workplace Design and Productivity.

DeMarco, T. and Lister, T. August 1985. "Programmer Performance and the Effects of the Work Place," from *IEEE Proceedings, 8th International Conference on Software Engineering*. London, UK.

Frances, J. *Office Productivity: Contributions of the Physical Setting*. Champaign, Ill.: CERL. Technical report P86.13, September 1986.

Springer, T. J. *Improving Productivity in the Workplace: Reports from the Field*. St. Charles, Ill.: Springer Associates, Inc. 1986.

Springer, T. J. "VDT Workstations: A Comparative Evaluation of Alternatives." *Applied Ergonomics*, vol. 13, No. 3 (1982): 211–212.

Sullivan, C. 1989 *Employee Satisfaction & Productivity Study*. Report, Aetna Life & Casualty. Hartford, Conn.