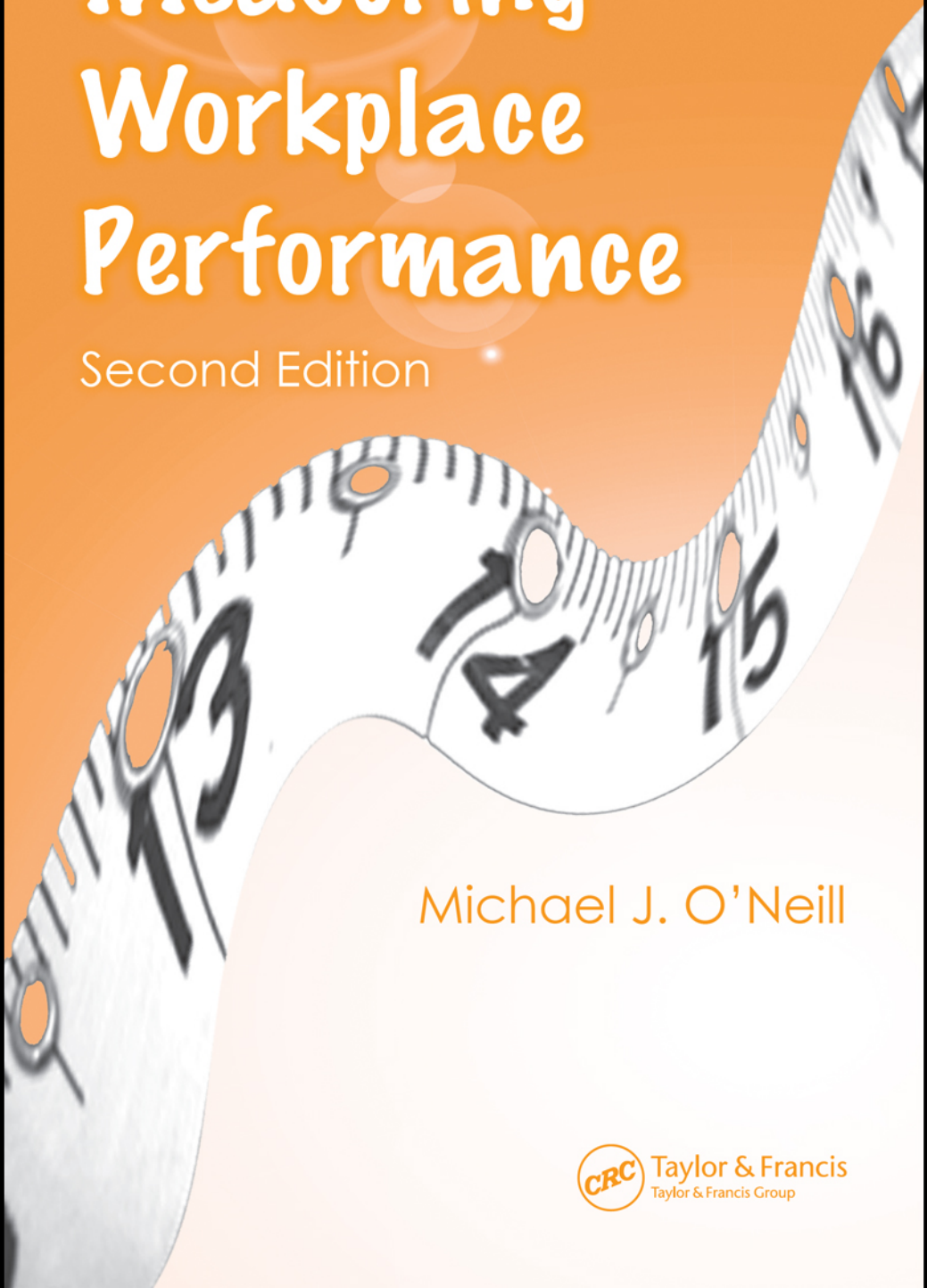
Measuring Workplace Performance

Second Edition



Michael J. O'Neill

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For my wife Danelle O'Neill and son William O'Neill.
Thank you for your love and support.

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To all these people, my sincere thanks and appreciation.

The Author

– Dr. Michael J. O'Neill

Dr. O'Neill leads the Workplace Performance Metrics practice area within the Herman Miller, Inc. Services group. He has 18 years' experience in conducting research projects for Fortune 1000 companies that assess the impact of work environment design on behavioral and business outcomes. A Certified Six Sigma Master Black Belt, he also specializes in implementing quality measures programs related to workplace design and space management. Michael is a Board Certified Professional Ergonomist with a Ph.D. in Architecture, Master of Architecture, and a B.A. in Psychology.

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Michael has conducted workplace research and consulting projects for companies in the Agriculture, Automotive, Consulting, Consumer Products, Energy, Financial Services, and Telecom industries in the US, England, Canada, Europe, and Asia.

INTRODUCTION

In this Second Edition of *Measuring Workplace Performance*, we not only provide the reader with state of the art theory, research and methods, but have made every effort to stress clarity of writing and in expression of ideas. In terms of new content, we have added 10 new Case Studies (for a total of 17 in the book), with 60 new Tables and 60 new Figures. The presentation of concepts and information within the book has been re-ordered and streamlined, to enhance understanding. Every existing Chapter has been extensively rewritten with an emphasis on eliminating technical "jargon," so material is accessible to a wide range of readers. We hope that you find this updated edition to be useful and thought provoking.

An organization's workplace design strategy has far-reaching effects (good and bad) on internal culture, retention, attraction, and the health and performance of employees. Some organizations follow a workplace strategy that emphasizes cost reduction, or ease of facility management. These organizations have a point of view that the physical workplace does not influence performance or business effectiveness. Unfortunately, these companies miss the opportunity to use workplace design to address business objectives related to creating effective workplaces, such as: using the workplace to enhance sense of community in employees, to reflect corporate "brand," to increase collaboration, communication, innovation, or to increase the speed and efficiency of business processes. Some might argue that we can't "prove" that the physical workplace affects performance, so why invest? This book illustrates that we can measure and show credible links between workplace design features, and human performance and business outcomes.

Companies regularly invest in technology and employee development programs in the implicit belief that some of this investment will translate into competitive advantage. Similarly, the facility and workplace is an additional "lever" that management can pull to enhance performance. The challenge to organizations is to design and manage facilities against the dynamic, moving target of business strategy and tactical requirements. A further challenge is to somehow measure the performance of facilities in terms of their impact on work performance of employees.

To address this challenge, we offer a dynamic framework for understanding organizations and their physical workplaces, and an ongoing measurement methodology to analyze workplace performance. Thus, the focus of this book is on measuring the alignment between the physical office work environment, and human performance and business objectives.

As part of the dynamic framework, we employ a "biological metaphor" to understand the function of work organizations and in particular, physical workplaces. The idea of a biological model for understanding phenomena has been applied over the years to areas such as human cognition (Kaplan and Kaplan, 1989; O'Neill, 1991) economics (see Rothschild's 1990 "Bionomics" book), technology and business (Frenay, 2006). The biological model has recently been applied to understanding the transactions between the organization and its physical workspace (O'Neill, 1998). We extend this framework in the current volume.

A key premise of our biological metaphor is that *environmental control* is the dynamic mechanism by which the physical workspace can be adapted and aligned to meet the purpose of the organization. Further, environmental control can be implemented at different levels of the physical and social organization -- at the level of the organization/business unit, the group, and the individual.

Throughout the book we show that measuring the impact of workspace design on specific business outcomes (both human performance and financial) is critical to the successful implementation, ongoing management and improvement of office work environments. To this end, we present a measurement model and methods based on six-sigma approaches and tools.

I. POINT OF VIEW

This volume presents a conceptual model for thinking about the physical, technical and social components of organizations, and the internal processes and external forces that drive change in them. A central theme: workplace design that enhances *control over the physical environment* is a critical mechanism for supporting ever-changing shifts in organizational goals and structure. Environmental control is the means by which the system optimizes the form of the environment in support of the behaviors needed to meet business goals. Increased control over the work process and work environment has consistently been shown to enhance the health and effectiveness of workers and the organization (Karasek and Theorell, 1990).

In this book, we examine organizations and work spaces using the metaphor of a biological system. The system consists of social (people, organizational structure), technical (machines, information technology, rules of business), and environmental (physical work place) processes or components. These components interact (more or less effectively) in the pursuit of attaining business goals. Control over the physical environment is a key mechanism that can be "designed in" to optimize the form of the work environment and ultimately support organizational effectiveness. Workplace

design should explicitly support the *purpose* of the organization (as opposed to design for design's sake).

In this book, we focus on "white collar" or "professional" work that takes place in office settings. We discuss the tools and methods that we have applied to understand and predict ever-changing workplace design requirements for organizations. Central to this book is the application of effective measurement methods that can link human performance and business outcomes with physical workplace design features.

II. ORGANIZATION OF THE BOOK

Measuring Workplace Performance is divided into three parts. Part I, "The Organization and Workplace as a Biological System" describes key components of the biological system as a metaphor for understanding the function of organizations and the physical workplace. Chapter 1 discusses competing office workplace metaphors. Chapter 2 describes the Biological Systems model. Chapter 3 discusses how Environmental Control, which is a key mechanism for dynamics and change within the Biological Model, can be applied through workplace design to improve health, performance, and effective work.

Part II, "The Workplace Performance Measurement Model," focuses on methods to create, manage and measure the performance of work environments. In Chapter 4, we discuss the process of workplace measurement within a Quality framework.

Part III, "Case Studies: Facility/Building, Group, and Individual Spaces" contains the Case Studies in which workplace performance is measured at the organization, group/team, and individual levels. Chapter 5 discusses five Case Studies at the facility/organization level. Chapter 6 describes five Case Studies at the group/departmental level of analysis. Chapter 7 discusses five Case Studies at the individual workspace level. These Case Studies explore the relationship between work environment design (including environmental control) and various behavioral and financial outcome measures, along with observations about the results.

III. CONCLUSION

My goal is not to advocate for a particular office workplace design solution, but to illustrate the application of the biological model for organizations and workspaces, and the use of our workplace measurement model. We use the Case Studies to show how environmental control has been employed at different scales of the organization and workspace to enhance performance.

Individuals at all levels of the organization, from finance and human resources to real estate and facilities management, have a say in shaping our work environments. My hope is that by providing an inclusive framework to define and measure the impact of workplace design, it will help to forge a new mind-set about the role the workplace can play in improving organizational performance.

Contents

PART I: THE ORGANIZATION AND WORKPLACE AS A BIOLOGICAL SYSTEM

CHAPTER 1

Workplace: Machine or Living Entity?

Most people, including business leaders and professionals engaged in the design or management of office work environments, assume certain "givens" about the way the world operates and then act in accordance with that belief system. This belief system can significantly affect the way office work environments are designed and implemented. The work environment, in turn, affects the behavior and performance of employees who use those spaces and, to some degree, the success of organizations. In this chapter we contrast "machine" and "biological" metaphors for the way people understand the world. We then explore how these metaphors have been (and could be) applied to the design of organizations and office workspaces.

I. MACHINE VERSUS BIOLOGICAL METAPHORS

While a number of belief systems filter the way we interpret or predict events in the world, the machine metaphor has been responsible for driving enormous change in technology, culture, and human relations in the past century. The biological metaphor is currently emerging as a much better way of understanding phenomena in various fields, like cognitive science and organizational behavior (Kaplan and Kaplan, 1989; Land and Jarman, 1993; O'Neill, 1991b, 2005).

These metaphors are most visible in the physical form taken by buildings and office workplaces -- which are reflections of the metaphors (whether recognized or not) that influenced the business organizations that built them. In this chapter, we describe and contrast "machine" and the "biological" metaphors for understanding the world, and their impact on organizations and the design of office workspaces.

Table 1.1 provides descriptors to illustrate the contrast between the belief systems, and to provide a basis later in this discussion for thinking about how each of them might influence the design and development of office workplaces.

A. The Machine Metaphor

The metaphor of the machine -- gears, levers, springs, circuits, control mechanisms, and related assumptions about the way a machine functions has had a powerful influence on how people interpret events that occur in the world around them.

1. Reductionism

A central characteristic of the machine metaphor is that components of any problem, event or phenomenon, like those of a machine, can be broken into discrete parts, analyzed, designed, and its activities examined.

Table 1.1 Contrasts Between Belief Systems About the World

Machine Metaphor	**Biological Metaphor**
Reductionism: Phenomenon can be broken into discrete separate entities, events, and examined	System-level analysis -- system cannot be reduced to individual components and studied
Individual as unit of analysis	Group, units of organizations, systems, as units of analysis
Cause and effect relationships between events	No direct "cause and effect" -- Transactions between subsystems can change form and behaviors of organization and workplace
Control mechanism required to manage operation of system components	Self-managing behavior
Independent observer	Observer is part of phenomena

2. Individual as Unit of Analysis

When studying human or organizational behavior (or designing organizations and workplaces), the unit of analysis is the individual (or a discrete piece of an event).

3. Cause and Effect

This analogy uses a "cause and effect" model of relationships that is often applied to predicting, understanding, or rationalizing events in the world. Sequences of events are often seen as being orderly and moving in a specific direction or flow, without considering other factors that may be influencing outcomes.

4. Control Mechanism

Within this metaphor, a control function of some sort is required to organize, coordinate, and manage the activities of the components of the system.

The machine metaphor requires a "homunculus" of some sort to guide the operation of its components (Kaplan and Kaplan, 1989).

5. Independent Observer

The notion of the independent observer states that the observer is separate from, independent of, and does not influence the phenomena being examined. In the machine metaphor, the observer can stand apart from the phenomena being studied and objectively observe and measure events without affecting the results.

B. The Biological Metaphor

In the biological (sometimes also referred to as a "natural system") metaphor, the organization is a dynamic *system* within which people, technology, process, and the environment form *subsystems*, each actively influencing the other (Altman and Rogoff, 1987).

1. System Level Analysis

Unlike the reductionism of the machine metaphor, entire (sub) systems are the unit of understanding - and of design. Some examples of subsystems within organizations include technical subsystems (tools and processes), social subsystems (social networks), and workspace subsystems (offices, meeting spaces, buildings). In this view it is meaningless to analyze specific "pieces" of a phenomenon taken out of the larger context of the system in which it exists. Typically group work, or processes that cut across departments or business units, is the unit of analysis, and it is not possible, nor desirable, to analyze individual work activities or outcomes piecemeal. The individual parts of an organization cannot be studied, or designed, in isolation from each other.

In this metaphor, the subsystems (technology, process, environment) making up the larger whole are *subordinate to the larger purpose of the system* (Kitchener, 1982). This also suggests the potential for purposeful design of an organization (and the office environment) with the goals of the business in mind. In this metaphor, the workplace is designed to meet a specific purpose or objective (see Table 1.1).

2. Transactions between Subsystems

In the natural system, one subsystem may affect another subsystem, a principle known as "efficient causation" (Altman and Rogoff, 1987). This

is not the same as the deterministic "cause and effect" characteristic of the machine metaphor, in which one event triggers the next - like billiard balls on a pool table (see Table 1.1). Rather, "efficient causation" is related to learning and adaptive behavior. Subsystems (such as the office workspace, or technology) can be designed to take in information from other subsystems, easily adapting new forms, or behaviors, or capabilities in reaction to learning or feedback from the other parts, and thus enhance the flexibility of the overall organization.

3. Self-Managing Behavior

The form or configuration of these subsystems is self-managed by the subsystems themselves; they can easily change over time in response to internal and external forces. The ability to learn, change, and grow is built into the structure of the sub-systems themselves. A separate controlling function (homunculus) as found in the machine analogy is not required for the system to work.

4. Observer is Part of the System

In the biological framework, the observer (for instance, the designer of the system or researcher making observations) is by definition a participant in the system itself. The observer cannot stand separate from the system; the act of observation itself influences the behavior of the system.

II. APPLICATION OF THE MACHINE AND BIOLOGICAL METAPHORS TO THE WORKPLACE

The machine metaphor has been widely explored in architecture, most notably through the work of architects such as Le Corbusier and Gropius. An examination of many existing office spaces suggests that the machine analogy continues to dominate the world of interior office design.

Aspects of the biological metaphor have been embraced in several areas of science and business, most notably in psychology, organization development, and knowledge management. In the area of office workplace design and management, the idea of applying biological metaphor concepts is being explored by leading organizations.

Table 1.2 provides a summary of descriptors that contrast characteristics of workplaces using the machine and biological metaphors.

Table 1.2 Comparison of Machine and Biological Metaphors for Workspaces	
Machine Metaphor	**Biological Metaphor**
Workplace is an unavoidable overhead cost	Workplace as asset: A tool for effective work
Environment not linked to business strategy, may reflect hierarchy or other issues	Workplace designed to support business objectives, mission
Individuals have limited control over workspace	Individuals, groups and departments have control over workspaces
Control: Static, not flexible. Design reinforces order, reacts to current problems	Control: Accommodates change. Dynamic, flexible. Design anticipates future needs
Viewpoint: Individual. Emphasize individual workspace, individual activities	Viewpoint: Enterprise. Space supports collaboration between people and groups, flow of business processes

A. The Machine Metaphor and the Workplace

This section discusses general characteristics of organizations and work environments designed from the perspectives of the machine metaphor.

1. Unavoidable Overhead Cost

The environment as machine is viewed purely as an overhead cost to the organization, not as a potential tool for strategic advantage. Under this model, Real Estate and Facility Managers are under constant pressure to reduce these overhead costs through space efficiency and space reduction programs.

2. Workplace not Linked to Business Strategy

Applied to the development of organizational design and workplace strategy, the assumption is that work processes are entirely predictable and are biased towards individual work. Thus workspaces are designed to support

individual activities. Support for group work, business processes or organizational objectives are not addressed by workplace design.

Workspaces are often designed to indicate the individual's status level within the organization. Reflection of hierarchy is important to the machine metaphor because attached to status are specific, static, roles and norms. The predictability of roles, norms, and responsibilities is important to the smooth functioning of the parts within the machine. Of course this approach to design has little relationship to supporting specific goals of the mission of the organization. Rather, the machine approach is directed internally, to the smooth function of the machine. When an organization is designed (intentionally or otherwise) according to the machine metaphor, the approach works well as long as the overall organization remains aligned properly with its external environment. When the external (business) environment changes, organizations using this model grasp ever more rigidly to the rules and roles of its internal functions, including the design of the organization and the physical environment. Thus the parts of the organization, including the office workplace, get out of alignment with the business mission when change occurs, because ability to accommodate change and align with business objectives is not inherently built into the system.

3. Limited Control over Workspace

The machine analogy, as applied to the work environment, results in an emphasis on individual workspaces with limited adjustability. It is not required to give individuals control over their workspace (through adjustability of components) because the design has already been closely optimized to support a specific set of highly defined work processes. The design strategy is not intended to support unanticipated changes in work activities, workflow, or changes in business requirements. Only the designers of the "machine" have enough knowledge to make a change to its design.

4. Control: Static, not Flexible, Design Reinforces Order

The workspace is not designed with the intention of supporting change. When organizational change does occur, however, it is very disruptive because the physical workspace lags behind in terms of its ability to support new ways of working. The workplace in this metaphor is a static mechanism, supporting order within the system, maintaining the system as it was originally designed. It is difficult to modify or change the design of the mechanism (the office environment and supporting technology) to address new needs. The design of the mechanism reacts at best to current needs, most often to past ones, and never accounts for the future.

In this machine analogy, time, context (location or space), and change are not directly considered. Time and location are not considered as part of the functioning of the machine.

Within this analogy *behavior is under the control of the environment*. The implication of this view is that it is possible to design the environment to cause people to behave in specific, predictable ways -- and thus support specific work processes. This viewpoint is useful for designing and managing organized manual work, such as work on assembly lines, in which the work process is often linear, the emphasis is on the individual, and productivity is assessed in terms of quantifiable output, such as number of objects created per unit of time, or number of operations performed on objects in a production setting.

5. Viewpoint: Individual

The machine analogy focuses on individual work activities, processes and places for work to occur. Work processes are highly defined, isolated, and proscribed. Work processes are replicable so that any worker with reasonable training can perform them. Within an organization, all business processes and functions are also highly defined so that overall, work activities are predictable. Thus in such a design it is possible to have all individual work activities interact in a predictable manner, like gears meshing within a complex machine (see Figure 1.1). An overall control mechanism (the Management function) monitors the individual activities and keeps them in sync. The design of the system is fixed, and there is limited capability to adapt to new situations and change from external forces (Pepper, 1942).

When applied to office design, a mechanistic orientation toward the work environment suggests that the individual parts of the workstation, such as the computer, desk, and seating, can be independently considered, and that there will be interplay between these individual elements.

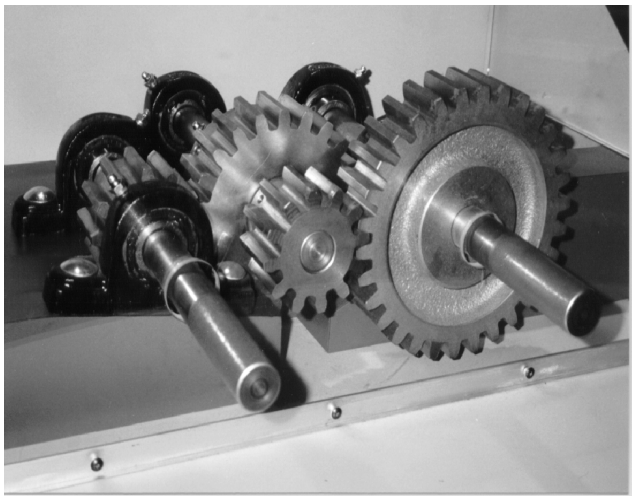

Figure 1.1 Illustration of the machine metaphor (Author)

The machine analogy has also been applied to the traditional way in which Call Center work and other "back room" business operations, including the workplaces to support them, have been designed (see Figure 1.2). Figure 1.2 shows a typical Call Center workstation designed using the Machine Metaphor. In this analogy, individual workspaces might be centralized within a single, large contiguous building space. The layout of workstations could be designed using a large grid of low height cubicle walls for ease of visual monitoring and tracking of location of employees.

The technical system might be designed to include electronic performance monitoring programs in which customer phone calls are randomly monitored and employee performance evaluated. Processes for interacting with customers could be highly specified, including scripts that operators read for different situations. The role of management in such a system is to ensure the processes are followed, thus the analogy of gears within a machine being kept "in sync" by management (Figure 1.1).

6. Observations about the Machine Metaphor

In terms of supporting business needs, the companies employing this metaphor view the workplace as an unavoidable cost of doing business, rather than a strategic investment that can create competitive advantage. The shortcomings of this approach abound, including its static design, focus on the individual as the unit of analysis, failure to consider group or team work,

lack of control over the workspace, and the failure to accommodate organizational change.

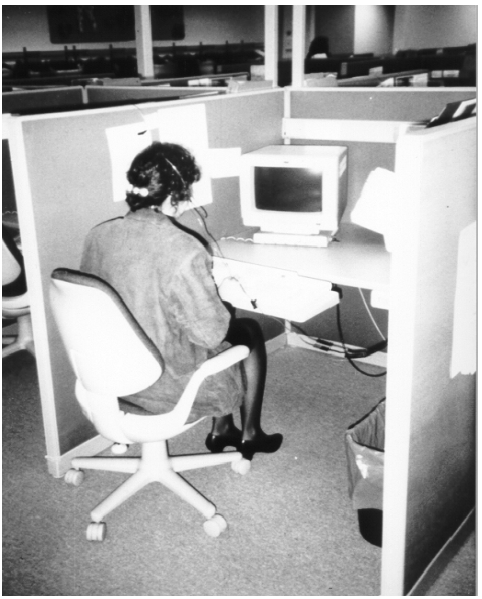

Figure 1.2 Call Center agent's workstation -- Machine Metaphor (Author)

A common problem in designing with the machine metaphor is that individual aspects of the system (such as workstation standards) are addressed independently of each other. The designers fail to consider the larger system, such as relationships between business units, informal social networks, and other aspects that should also be incorporated into a successful design solution.

The machine metaphor is most appropriate when applied to situations in which work processes are well defined and repeatable (such as certain types of data processing or assembly work), and outcomes are clearly quantifiable (such as piece count per unit of time). When this worldview is allowed to influence the design of environments for most other types of workers, particularly knowledge workers, the results are predictable. Frequent complaints about and frustrations with this viewpoint include: lack of support for group or team activities; poor response to technology drivers; design lacks a true business context; the design has no apparent link to broader issues of organizational effectiveness; and general lack of flexibility in the work environment to accommodate change due to internal restructuring or new business opportunities.

B. The Biological Metaphor and the Workspace

The biological metaphor is one of living things, natural systems, and the living organism (see Figure 1.3).

Figure 1.3 Nature -- the Biological Metaphor (Author)

1. Workplace as an Asset

The previous discussion about the machine metaphor illustrates an important contrast between that and the biological metaphor - facility as liability versus asset (Vischer, 1996). Cost considerations exert considerable pressure on planning for the accommodation of workers. As companies reorganize, whether enlarging or reducing their work forces, the costs associated with housing employees and providing their work tools continues to increase. The metaphor chosen for the workspace influences the economic perspective that an organization has on the role of the workspace in business (see Table 1.2). Managers using the machine metaphor typically view the facility as purely a cost center. The facility strategy with this metaphor will be marked by reductions in owned and leased space, reduced service amenities, deferred building maintenance programs, and other results associated with reduced budgets.

This cost perspective can ultimately lead to a reduction in the quality of the work environment and, we believe, in the potential contribution that the environment can make to organizational effectiveness. Because real estate and facilities costs are such an obvious target, programs around reducing these obvious costs are often implemented first, before more difficult business decisions have to be made.

Alternatively, the biological metaphor suggests that the workplace is an investment made by the organization to enhance performance and to fully integrate the facility with the business mission. Thus the workplace may not be designed primarily to reduce space or cost of space, but to support the

work style, business objectives, and to convey the culture and values of the organization. In this perspective, the workspace is designed as part of a strategy that carries the expectation that the work environment will support the work process and, in turn, the creation of value to the organization.

2. Accommodates Change

An important aspect of the biological metaphor is that time and change are "built in" to the system. Thus, the system is inherently capable of changing over time to adapt to changing environmental conditions or demands (see Table 1.2).

3. Workplace is Designed to Support Business Objectives

In the biological metaphor, the whole of the system (organization, technology, physical workplace) is given meaning *by its defined purpose* (Reese and Overton, 1970). In such a perspective, the emphasis shifts from attempting to describe how to do things (work activities and processes) to a focus on the product that results from these actions or other higher-level objectives. This "purpose" focus is common among startup companies and other smaller entrepreneurial efforts, in which roles and specific activities are de-emphasized in favor of reaching business goals. In this metaphor, the workspace is designed for a specific purpose - to attain specific organizational goals, such as behavioral change (enhanced collaboration, etc.), business process improvements, or other defined goals. Figure 1.4 shows a concept for highly adjustable workspace that can be reconfigured to support changes in work behaviors required by business objectives.

4. Control. Individuals and Groups Have Control over Workspaces

Within the biological metaphor, the emphasis shifts from a strategy of control over people to a strategy of providing employees with optimal control over their jobs, and the work environment. Recent research shows a growing link between enhanced control over the workspace and increased job control (see later Case Studies within this volume). A large and established body of research shows a link between increased job control and reduced risk of stress and coronary heart disease (CHD) (Karasek and Theorell, 1990).

Thus the physical work environment might be designed to support high levels of individual adjustability and work team support at the expense of visual monitoring by supervisors. A call center could become a learning environment in which teams support each other, and manage their workflow, and in which individuals learn from each other. Instead of using only indi-

vidual workstations, such an environment could also include varying types of meeting spaces for different size groups in order to facilitate communication and learning. Other forms of performance measurement, such as team or business unit goals, might be implemented in place of electronic performance monitoring. Under such a model, the role of management becomes one of selecting the right skill sets, leadership development, and coaching of employees.

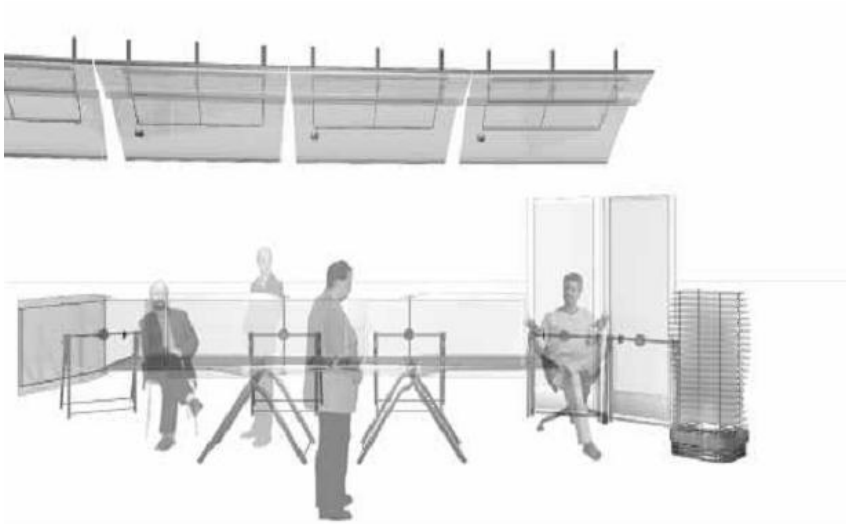

Figure 1.4 Workspace design employing Biological Metaphor Concepts (With permission of Herman Miller, Inc., copyright 2005, All Rights Reserved.)

5. Workplace Accommodates Change

Since the nature of the output required of the business organization (products and services) can change in a relatively short period of time due to the nature of market conditions and customer demands, the overall work environment must be flexible enough to respond to those shifts. Thus, the focus of the office design process within the biological metaphor is to provide workplaces that possess the ability to change rapidly in unpredictable contexts. In the machine metaphor, work and the workplace are designed in stasis - for one point in time in the history of the organization. Neither the "pieces of the machine" nor management processes are designed for change over time or to accommodate new demands in the business environment. The biological metaphor explicitly considers time and changes in the subsystems over time in reaction to the external environment.

In a biological metaphor, the workspace is conceived as a self-regulating, flexible mix of features and capabilities that support a variety of work styles and processes, and gracefully accommodate change. This system provides workers control over their environment to dynamically react to changing needs and work processes rising from the purpose of the organization as it reacts to changing business and market conditions. Design using the biological metaphor anticipates change by incorporating flexible design concepts. It supports no single "order" of things, but can support the types of organized chaos that groups and individuals oriented toward a common purpose will create en route to that goal. This metaphor also reflects the inherently non-mechanistic nature of human beings.

Thus, the biological metaphor supports a different perspective on the provisioning of office work environments, especially in support of knowledge work, in which the work process is inherently unpredictable. In this approach, the environment must support the lack of predictability in work process, due to the shift in focus from job design and monitoring of tasks, to working towards organizational goals.

6. Viewpoint: Enterprise

The viewpoint of the biological metaphor is at the enterprise/organization level, which includes explicit consideration of facility design and layout issues related to business units, departments, and group spaces. The design of spaces reflects the organizational purpose and mission, as opposed to, for instance, reflecting individual status or position within an organizational hierarchy.

7. Observations about the Biological Metaphor

Companies employing this metaphor view the workplace as a strategic asset, an investment that can be leveraged to gain competitive advantage in the marketplace. Thus the design of office space is oriented toward achieving (and success measured on) business objectives, as opposed to compartmentalized design requirements.

The objective of this approach is to support group and team knowledge work, and business processes that flow across groups and departments. A key aspect of this metaphor is the concept of designing environmental control (through adjustability and flexibility of space) into the system at all levels, including individual workspace, group spaces, and facility design features. Control is seen as the mechanism to permit the workplace to "flex" and change as required by changes in the organization. We explore the concept of environmental control in the next chapter and throughout this volume.

CHAPTER 2

The Biological Systems Model

"Influencing behaviour is almost all of what management is about, and buildings influence behaviour." J. Seiler, 1984

In Chapter 1 we discussed the characteristics of the Biological Metaphor. In this metaphor the design of office work environments is aligned with the purpose, or business mission of the organization, rather than by other issues that cannot be shown to directly support business objectives. In this way, the design and function of the system are "pulled" or aligned to organizational mission and purpose. Effective work is thus a natural outcome of an organization and workplace designed to support the biological metaphor. When workplaces are not designed with this larger viewpoint in mind, the design process runs the risk of being sidetracked by issues such as: using workplace to reflect hierarchy, the inertia of existing workplace standards, or short-term cost considerations.

In order to create a viable office work environment strategy it is necessary to understand the entire organization as a system, to determine how the workplace can be designed to effectively support the organization's purpose. Thus, the creation of a workplace design does not begin with designing the features of the work space -- rather it begins with an understanding of the objectives of the group or business unit using that space. These business objectives in turn should drive the design requirements for the social, technical, and workplace subsystems that support those objectives.

In this chapter, we begin with a detailed discussion of the functions and processes of the biological metaphor. Thus the metaphor is translated into a working model that reveals the dynamic nature of the biological system and how it reflects the behavior of organizations, and workplaces, over time. The chapter concludes with a summary of characteristics of the model and how it can be applied to the workplace design process.

I. DESCRIPTION OF THE MODEL

The components and processes of the Biological Systems model are graphically depicted in Figure 2.1. This model emphasizes the flow of input (in knowledge work, this is raw data or information), and the transformation of this information into a knowledge product that has value to a customer, and that creates value to the organization. Ultimately, this product (or output),

of the system furthers the business mission of the organization. This model can be applied at the level of an entire organization, or at smaller units, such as the department of workgroup. The model is probably of most practical value when applied to the department or workgroup levels.

The model itself includes three major subsystems: the social subsystem, the technical subsystem, and the environmental subsystem (see Figure 2.1). Note that the workplace (environment) subsystem contains within it, the social and technical subsystems. This is because the social and technical aspects of work, as well as work processes, occur within the context of the physical work environment (see Figure 2.1).

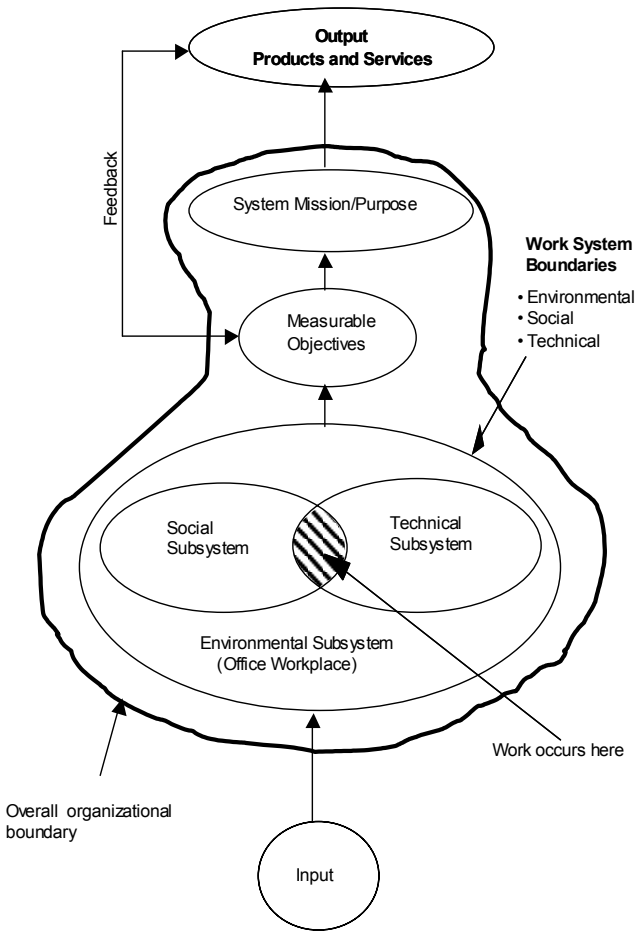

Figure 2.1 The Biological Systems Model (Author)

A. Elements of the Biological Systems Model

1. System Mission/Purpose

A critical element of the model "purpose" of the organization (see Figure 2.1). In business organizations, the "purpose" is the business mission. Because the biological model is a *purposeful* system, its main activity is to transform "inputs" to the system, into "output," the output being products or services that generate economic value to the organization, its shareholders and customers. This output is aligned with the purpose. The purpose of the system will also influence organizational culture, values, and other characteristics.

The work environment can be designed as a means of achieving the purpose of the organization. In our discussion of the work environment throughout this volume, we frequently express the notion that the work environment can be used as a tool to support the work effort toward a specific purpose. Thus the design criteria or guidelines for the work environment must align with the organizational purpose, and must be viewed as being open to continuous change.

Change will surely appear from one of a number of business change drivers (discussed in a following section of this chapter). In general, change to organizations can be driven by political, cultural, and economic drivers. These change drivers can "push" against the boundaries of the system, compelling change to subsystems, and even forcing a redefinition of organizational purpose.

2. Values

The purpose of the organization implicitly reflects its values. Value statements may be a blend of existing characteristics and values to which the company strives. From the perspective of workplace design, a value statement such as "Employees' families are important to us" suggests facility design or policy possibilities such as internal day care, on-site dry cleaning, food service, telecommuting programs, and others.

3. Measurable Objectives

Business objectives will relate to the purpose of the organization, and may contain statements such as yearly production targets, number of new products developed in a given time period, or other strategic issues such as employee retention, attraction, and the like (see Figure 2.1). Objectives are measurable goals that are generally stable over time. In many cases it is possible to

develop workplace design guidelines that support business objectives, directly or indirectly. For instance, design guidelines can be developed that create behavioral change (for instance, increased feelings of community or belonging to the company) that in turn support higher level business objectives, such as retention.

As another example, assume a business objective is to bring a certain number of new products to market in a given period of time. In order to accomplish this goal, collaboration between disparate teams and departments may need to significantly increase. Thus, workplace design guidelines could specify different design solutions that could be employed to enhance communication and collaboration. Like the business objectives, the success of these design objectives can be assessed through measurable outcomes such as a change in communication and collaboration through observations or self-report surveys. Measures in behavioral change can also be linked to the business outcomes themselves. Detailed discussion of our measurement model and approach, as well as case studies having these types of measures, can be found in Chapter 4 of this book.

4. Feedback System

The biological model has a built-in feedback system that connects information pertaining to quality of output with the objectives of the organization (see Figure 2.1). In a true biological system, such as at the level of groups (networks) of brain cells, a built-in feedback mechanism is required to maintain and optimize the behavior of the system (O'Neill, 1991).

In workplaces and organizations we discuss a related concept, that of "environmental control." Control is a mechanism by which information from the feedback loop is acted upon and used to quantitatively change the form and behavior of the physical and social subsystems.

Feedback and control are central elements of the biological model and are discussed in greater detail in later portions of this volume.

5. Scalability

The overall model is "scalable," that is, it can be applied to predict and understand behavior at different levels of the organization and workplace, including the individual/small group, team/business unit, or the entire organization. This scaleability permits us to apply concepts of the biological model to different scale design problems (individual workstation, group spaces, facility scale layout), and also permits the creation of measurement strategies to assess work effectiveness at those different levels of analysis.

6. Input

Input to the system can come in the form of data, ideas, or knowledge that form the building blocks of value-added products or services. Because our biological system is scalable the content of the input will vary depending upon the scale of the organization being modeled.

"Input" is shaped by the external environment, which is the political, cultural, and economic context within which an organization finds itself (Figure 2.1). The external environment may also act as a filter to block certain types of input from entering the system (to the benefit or detriment of that system). The input will vary depending upon the desired output. Thus, an R&D group process in which the outcome is a new product will have quite different inputs than that of a business unit that conducts consulting engagements. Thus, while "input" is a general term, it can be thought of as either a physical or intangible element that has the potential to be acted upon or transformed into something of greater value for a customer.

The input enters the social, technical, and environmental subsystems, in which some series of transformation events (business and work processes) act on that input (see Figure 2.1).

7. Output

In a well-designed organization, the output of the system (products or services offered by the company) should be consistent with the objectives (see Figure 2.1). In other words, a company having the goal of making great ice-cream will typically not attempt to offer computer software as a product. Because the focus of the biological system is on the output, we view the creation of workplace design as a means of facilitating the work activities and business processes that are required to create the output. This design may be at the level of managing adjacencies and block planning or decisions relating to consolidation of multiple locations, or it may be at the level of designing appropriate meeting and individual workspaces.

8. Throughput or Flow

Once we understand the purpose of the organization (or business unit, or department), we can move to understanding the transformation of "input" to the system into "output" (product). Figure 2.1 shows how input flows through the system, which includes the input, transformation, and output phases (note arrows through the system). As part of "throughput," multiple business processes cross departmental or group boundaries and are supported by the social, technical, and work environment subsystems.

B. Boundaries

Boundaries are related to the limits of responsibilities of the organization (Taylor and Felton, 1993). Different organizations will have different boundaries. The overall boundary of an organization can be thought of as its "sphere of influence" in the marketplace, with its customers, employees, government, and competitors. There are four types of boundaries in our biological systems model, including: throughput, physical, social, and time.

1. Throughput

The throughput boundary starts at the point at which input enters the system and ends at the point where the output is delivered to the customer (see Figure 2.1). This is the defining boundary for the organization, since it involves the transformation of the input into the product or services offered by the organization (output). The quality of this throughput process must be closely aligned with the overall purpose of the system. Established roles and work responsibilities within the business processes supporting technology "throughput" are critical for success.

2. Physical

The physical boundary of the system is defined by the workplace occupied by the people doing the work. The biological system itself is anchored in the physical space. This space may occupy one floor within a large building, a campus of buildings, or a far flung network of corporate facilities, home offices, sales centers, and vendor and customer work locations around the world. Member obligations and responsibilities may go beyond the boundaries of a particular space or group of physical spaces. Given the distributed nature of knowledge work and the use of networked communications technology, the physical space may appear tangential to the work process. In other situations, the physical space in which work occurs may be controlled and occupied by other organizations.

However, far from minimizing the importance of the physical environment on business process, these trends in technology and work styles make understanding and effective use of office workspace even more important to success of organizations. Companies are beginning to understand the impact of workspace as a tool for communicating and enhancing corporate community, enhancing attraction and retention, and even for "branding" corporate identity to vendors, customers, and their own employees.

3. Social

This boundary is defined by the people directly involved in the work processes and the interaction between individuals and groups. Today, this "people" boundary is increasingly difficult to define since there are many classifications of workers, including: part time, freelance workers, workers on retainer, individual consultants, and external vendors that work to support the goals of the organization. To understand the social boundary of an organization, it is best to focus on understanding the roles that groups or individuals play in support of organizational goals, and not to use the existence of formal employment as a criterion for inclusion within the social boundary.

The social (or people) boundary is defined by the workers directly involved in the throughput of the system. In the case of knowledge work, the people involved would include not only technical and professional workers but their managers as well. The social boundaries of a manufacturing place would include production employees and their work group leaders. For all work, the social boundaries become extended and somewhat blurred with the inclusion of consultants and small service providers that work temporarily within the social boundary on a project basis. The social boundaries within the knowledge work systems grow and shrink along with the life cycle of projects existing within the current throughput of the system.

The dynamic nature of the social boundary has implications for the capabilities of the physical boundary in terms of accommodating frequent shifts in number of people at their work process, and supporting identification with the company and the role clarity of groups.

4. Time

The time boundary has to do with the time demands or constraints placed on the system in terms of producing timely output or product. The time boundary is greatly influenced by the purpose of the system. The time boundary of a system when the mission is to produce a seasonal product (snowmobiles) will be different from a system designed to exchange securities at a daily profit. The criteria for design of physical office space is influenced not only by the goals of the organization, but by time boundaries that influence effective work.

II. CHANGE DRIVERS IN BIOLOGICAL SYSTEMS

Our discussion of the components of the Biological Systems model has thus far focused on the internal systems, processes, and goals of the organization. This model also incorporates the natural pull toward the future expe-

rienced by all living systems, and the external drivers of change that can cause radical shifts in the "rules" of a biological system overnight.

Our integration of the these change drivers is intended to make the model more robust in terms of understanding and predicting organizational and facilities change. A biological systems perspective allows us to consider external drivers of change that may affect the growth of a business, and ongoing business processes.

The notion of "environment" includes everything that lies outside the various boundaries of the system that we have described. An important goal of system design is to enhance the fit between the system and its environment, which includes the market and external stakeholders (such as customers, shareholders, suppliers, the local community, etc.). When the expectations between these stakeholders, and the activities of the system conflict, it may be time to re-examine the purpose of the system, its subsystems, or boundaries. When conflicts arise between parts of the system and some aspect of the environment, it may signal an opportunity to take the system in a new direction.

The role of change in our biological systems model exists on the "outside" of the organization, affecting the design of the system, which, as we have discussed, has dynamic but well-defined boundaries. At this point we consider what happens "outside" the boundaries of the system (see Figure 2.2). We will briefly discuss the types of conditions that are causal agents to change. Any one or more external conditions can serve to act as a "change agent" to the natural system. We discuss several business change drivers, including: globalization of markets, borderless finance and the migration of capital, and competition through growth, technology, and demographics (see Figure 2.2). These change drivers "push" against the boundaries of the system.

A. Globalization of Markets

We live in an era in which modern capitalism has become globalized. The process of globalization consists of companies investing capital in foreign countries. This investment can take the form of buying existing assets, building new offices or manufacturing facilities, buying other companies, or other approaches. The business logic of commerce and capital has overcome established political boundaries and social orders, and is transforming nations (Greider, 1997). This economic revolution is fueled by invention and technology, and a desire to grow and accumulate wealth. Established rules of politics, respect of national borders, social protocols, and allegiance of country cannot stop the change toward a global market. The economic policies