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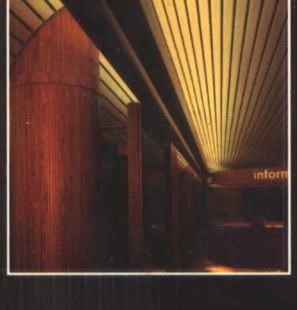
FACILITY DESIGN AND MANAGEMENT HANDBOOK



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ERIC TEICHOLZ

FACILITY DESIGN AND MANAGEMENT HANDBOOK

Eric Teicholz Editor-in-Chief
President
Graphic Systems, Inc.

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ABOUT THE EDITOR-IN-CHIEF

Eric Teicholz is president and founder of Graphic Systems, Inc., of Cambridge, Massachusetts, which specializes in all aspects of facilities management, including automation consulting, systems integration, market research, and training. He has specialized in facilities design and management for 25 years. A contributing editor of *Facilities Design & Management,* Mr. Teicholz lectures internationally, and has published hundreds of articles and nine books. He received his postgraduate degree in architecture from Harvard, where he has taught in the Graduate School of Design and served as Associate Director of the Laboratory for Computer Graphics and Spatial Analysis. He has written four other books for McGraw-Hill, *Computer-Aided Facility Management, CIM Handbook, Δ/E Systems Update,* and *CAD/CAM Handbook.*

PREFACE

" . . . as prefaces, though seldom read, are continually written, no doubt for the behoof of that so richly and so disinterestedly endowed personage Posterity (who will come into an immense fortune), I add my legacy to the general remembrance."

Charles Dickens, The Pickwick Papers, *1837*

RATIONALE AND THE CHALLENGE

This is the tenth book that I have written or edited. All of them have been concerned with technology and most have dealt with facility management. The first challenge for this book came from Wendy Lochner, my Editor at McGraw-Hill. She tried persistently to get me to expand the scope of the book beyond FM technology as an end in itself. These discussions led to the plan for a general handbook on facility management dealing with its various functions, the relationship between them, and an exploration of how technology pervades most of the diverse functions that comprise FM.

The next challenge was that most of my professional experience is associated with the technology side of FM, so I decided early to seek out the best authors possible to cover some aspects of technology as well as other innovative components of facility management. FM means so many different things to different people. FM tasks change in scope and importance based on the size of an organization, public vs. corporate ownership, leased vs. owned space, centralized vs. distributed management, single vs. multiple buildings and so forth.

The next hurdle had to do with the collaboration between chapter authors. Individual chapter authors, in some cases, addressed subjects that overlapped. Authors needed to communicate both to insure minimal overlap as well as to build on content in other chapters. This was accomplished by developing a collaborative project Extranet web site where it was possible to store documents, post various versions of chapters, biographical and contact information as well as host news, support email and so forth.

This effort was only partially successful. Although the software functioned well, most authors did not avail themselves of the software's collaborative aspects – something I thought held great potential for enabling authors to discuss ideas on-line. Additionally, most of the authors did their writing at home, using relatively slow modem connections to the book site. The site evolved into a relatively simple repository of documents. Even this function was extremely beneficial since many of the authors posted their own documents on the site as well as using it to communicate with other authors, the editor, and the publisher.

FM is changing at a rapid pace, not only in terms of technology (e.g., effectively using the Internet) but in terms of organizational issues associated with how buildings are designed, constructed and managed. The production period of the book itself has been one further challenge. The manuscript for this book was submitted to the publisher in July of 2000, with a scheduled publication date of March 2001. This means that the selected topics had to be ones that would be likely to remain relevant eight months beyond the time the manuscript was completed.

I hope that the resultant handbook provides a context for facility managers to understand how innovative organizational and technical practices can assist them in the practice of their profession.

FORMAT

The book attempts to organize the text into functional areas that follow the life cycle of a project: from planning, to design and analysis, to implementation. An introduction to facility management was added at the front and a technology section added at the back. In some cases, a subject matter might apply to more than one functional area. In such cases, the primary function area was used as the repository for the chapter. The 31 chapters that comprise this book therefore include five functional areas:

Section I: *INTRODUCTION* contains a single chapter, a general introduction to facility management theories, concepts and organizational models.

Section II: *PLANNING* contains six chapters, dealing with Benchmarking, Strategic Planning, Business Transformation, Financial Management, Customer Service, and Disaster Recovery Planning.

Section III: *ANALYSIS AND DESIGN* contains nine chapters, including Alternative Workplaces, Facilities Conditions Assessment, Thinking Globally–The Competitive Edge, Sustainable Design, Smart Buildings/Intelligent Buildings, Lighting, Ergonomics and Workplaces: Managing the New Healthcare Real Estate Portfolio (case study), Implementing Technology at Rocketdyne (case study).

Section IV: *IMPLEMENTATION* contains eight chapters, including Project Management and Implementation, Real Estate Portfolio Management, Supporting the Mission of the Organization: An Approach to Portfolio Management (case study), The Design and Construction Process, Space and Asset Management, Operations and Maintenance, Energy Management, Security.

Section V: *TECHNOLOGY* contains seven chapters including Overview and Current State of FM Technology, Integrating the Internet into Facilities Management, The Birth and Development of a Collaborative Extranet for the A/E/C Industry, Technology at the Architect of the Capitol (case study), Michigan State University Facility Management Master's Level Certificate Program (case study), Space Management at the University of Minnesota (case study), Teaching Technology at the University of New South Wales (case study).

A detailed summary of each chapter associated with a particular section appears at the beginning of that section.

Eric Teicholz

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I received a great deal of help and support in designing and producing this book. First, there was the technical support provided by Brian Giuffrida and his colleagues at Framework Technologies in setting up and initially hosting their collaborative project web software. When Graphic Systems took over the hosting of the software, they then trained Cara Rodgers from my staff to take over all management of the software. I am extremely grateful to Cara for maintaining that role throughout the writing and production stage of the manuscript. She communicated with authors, taught them how to use the site, and handled most of the administrative tasks associated with production.

Bob Boes, a personal friend of mine, helped formulate content and recommend authors for some chapters. I am also indebted to Francoisé Szigeti, another author, for assistance in recruiting international authors and in helping determine the organization of the book. Likewise, BOMI provided support and assistance in defining content.

Two other staff from Graphic Systems deserve considerable credit for production assistance. First is Deana DiMenna, who had primary responsibility for formatting and printing the final document, and second is Deb Theodore, a professional writer as well as GSI's comptroller, who edited a number of book chapters.

Finally, I would like to thank my colleagues and co-authors who spent many hours discussing subjects, content, format and administrative aspects of the book and many more hours writing and editing their chapters.

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INTRODUCTION

CHAPTER 1 FACILITY MANAGEMENT—AN INTRODUCTION

1.1 Introduction

1.2 FM Principles and Theories

The underpinnings of the discipline of facilities management (FM) are found in the intersection of work, workers, and workplace. This section traces the evolution of the theories of facilities management and shows how FM deals with a wide variety of information and traditional professions, but in a unique way—as it affects what people do and where they do it. The role of FM in influencing the workplace has a direct affect on performance and productivity. Several key studies of the impact of workplace on performance are summarized and discussed. Also included in this section is a discussion of FM clients, both internal and external; the role of FM in most organizations; how FM relates to and can support organizational business strategy; and approaches to managing the FM function.

1.3 FM Organizational Models

The roles and responsibilities of FM organizations vary depending on the nature of the organization they serve. This section examines differences across broad categories of organizations and how those distinctions influence the way in which FM identifies, procures, and uses resources to plan, deliver, and manage workspace. The discussion focuses on differences between public and private sector organizations; single versus multiple locations; owned versus leased space; large versus small facilities; and in-house versus outsourced or entrepreneurial organizations.

1.4 FM Orientation by Company/Space Type

The nature of the business in which an organization is engaged will influence the roles, responsibilities, and organizational "home" for the FM function. Just as medicine is different from software engineering, so too are facilities that support these activities. These factors, in turn, influence the nature of the FM organization and the emphasis placed on particular activities and services. This section discusses five models of FM and the responsibilities, organization type, and industry in which they are most commonly found.

1.5 Placement of FM within Corporate Structures

Because organizational structure is unique and specific to particular organizations, the FM function is not commonly found in the same place in every organization. In some circumstances, FM may not be used to identify facilities' roles and responsibilities. This section examines the historical evolution of FM as a corporate function, the relationship of FM duties to other corporate units, and several of the more common reporting and communication channels for FM.

1.6 FM Strategic Plan and Mission as a Reflection of the Corporate Vision and Mission

The broader corporate or organizational vision and mission are the foundation for the direction in which the organization is headed. This section discusses elements, methods, and outcomes of strategic planning, and the ways in which FM needs to structure its strategies, plans, and activities to support, enable, and reflect the broader corporate strategy.

1.7 Characteristics of a Successful Facilities Manager

Effective FM requires a broad and diverse set of skills and knowledge. Several organizations and researchers have examined and profiled FM professionals. This section presents the results of those examinations and discusses the background, education, skills, and experience of successful facilities managers.

1.8 Summary

CHAPTER 1
FACILITY MANAGEMENT— AN INTRODUCTION

Timothy Springer
President
Hero, Inc.
E-mail: hero_inc@ameritech.net

1.1 INTRODUCTION

Facilities management (FM) is a multidisciplinary or *transdisciplinary* profession drawing on theories and principles of engineering, architecture, design, accounting, finance, management, and behavioral science. These disciplines each have a rich history of theory, research, and practice. Facilities management, as a new discipline, builds on this foundation to create a new set of theories and practices.

1.2 FM PRINCIPLES AND THEORIES

In its original definition of the roles and responsibilities of facilities managers, the International Facilities Management Association (IFMA) identified 41 responsibilities under eight headings. According to the IFMA, the scope of Facilities Management covers real estate, planning, budgeting, space management, interior planning, interior installation, architecture and engineering services, and building maintenance and operations (see Table 1.1).[1] In a study of how successful companies manage their facilities, Wilson (1985) reduced that list to five: real estate, long-range planning, building projects, building administration, and office support.[2]

During the latter half of the 1970s, Herman Miller, Inc. established the Facilities Management Institute (FMI). This organization helped establish the new profession of FM and gave birth to IFMA. In viewing the underlying model for facilities management as a profession, FMI developed a three-element model of people, process, and place.

1.2.1 FM as People, Process, and Place

The diagram (Figure 1.1) of three interlocking circles represents the important role facilities and facilities management play in integrating employees, work processes, and workplaces into a coherent, productive, holistic system. FM serves to coordinate the interface between *what* people do and *where* they do it. Thus, FM touches on elements of human resources, process engineering,

TABLE 1.1 IFMA Classification of FM Roles and Responsibilities

Maintenance Operations	**Architectural/Engineering Services**
Furniture maintenance	Code compliance
Finishes maintenance	Construction management
Preventive maintenance	Building systems
Breakdown maintenance	Architectural design
Exterior maintenance	
Custodial/housekeeping	**Real Estate**
Landscape maintenance	Building leases
	Site selection
Administrative Services	Acquisition/disposal
Corporate artwork	Building purchases
Mail services	Property appraisals
Shipping/receiving	Subleasing
Records retention	
Security	**Facility Planning**
Telecommunications	Operational plans
Copy services	Emergency plans
	Strategic plans
Space Management	Energy planning
Space inventory	
Space policies	**Financial Planning**
Space allocation	Operational budgets
Forecasting needs	Capital budgets
Furniture purchase	Major financing
Furniture specifications	
Furniture inventory	**Health and Safety**
Interior plans	Ergonomics
Furniture moves	Energy management
Major redesign	Indoor air quality
Trash/solid waste	Recycling program
Hazardous materials	Emissions

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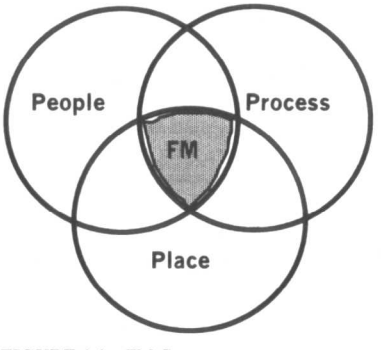

FIGURE 1.1 FM Components.

ergonomics, architecture, and interior design. Consequently, critical components of FM include planning and maintaining, and providing the assets, both large and small, that support the endeavor of people at work.

1.2.2 The Impact of Environment on Productivity

The role of the physical work environment on performance and productivity has been the subject of many studies over the past 15 years. In a compilation of over 40 studies of productivity improvement, changes in performance and productivity were shown for everything from reduction in glare (3–5%) to total facility redesign (18%).[3] Included in this compilation are three key studies that examine multiple factors in the environment. These studies demonstrate with great consistency that the physical place of work has a significant impact on people's performance. For example, adequate space was shown to have a positive impact in each of the three studies, while noise or lack of speech privacy had a negative effect.

Table 1.2 summarizes the results of the three key studies. The plus and minus signs next to the variables in the Aetna study (#3) reflect the weights given those variables. For example, space adequacy and ease of circulation and order are positive influences, whereas storage, speech privacy, and ability to concentrate—or the lack of each of these—are negative influences.

In Table 1.2, the first column shows performance mandates for buildings taken from the American Institute of Architects (AIA) *Building Systems Integration Handbook*.[4] These mandates are elements that a building must provide. They serve as useful categories for looking at variables in each of the three studies listed:

- The first study (Springer, 1982) was conducted at a major insurance company. The research examined the impact of the physical work environment on the performance and productivity of computer terminal operators. In a simulation laboratory that painstakingly recreated all work conditions, the study found that an optimized working environment yields a 10–15% improvement in

TABLE 1.2 Environment and Performance: 10 Years' Data

BSIH[1]	Springer[2]	BOSTI[3]	Aetna[4]
Performance mandates:			
Spatial	Floor space	Floor area, enclosure	(+) Space adequacy
	Aisle width	Layout	(+) Ease of circulation
	Storage	Storage—personal	(−) Storage
	Work surface	Relocation frequency	(+) Order
		Work surface width	
Acoustical	Noise	Noise	(−) Speech privacy
		Ease of communication	(−) Ability to concentrate
Visual	Lighting for VDT	Glare	(+) Lighting for VDT
	Glare		(−) Glare
			(+) Appearance
Thermal		Temperature fluctuation	(−) Temperature
Air quality			(−) Air quality

Sources:

1. Rush, R. (Ed.). 1986. *The Building Systems Integration Handbook*. John Wiley & Sons.
2. Springer, T. J. July 1979. *CRT Furniture Requirements*. State Farm Insurance Companies.

2a. Springer, T. J. 1982. *Visual Display Terminal Workstations: A Comparative Evaluation of Alternatives*. State Farm Insurance Companies.

3. Brill, M., et al. 1984. *Using Office Design to Increase Productivity*. Workplace Design and Productivity, Inc.
4. Sullivan, C. July 1989. Employee productivity and satisfaction as a result of the home office renovation. The Aetna Casualty and Surety Company.

performance when compared to the traditional workplace. Improvements included changes to the lighting, spatial configuration, furniture and support equipment, and seating.[5]

- The second study was conducted by the Buffalo Organization for Social and Technological Innovation (BOSTI, 1984). This research looked at the workspace as a collection of 18 facets, including physical enclosure, esthetics, privacy, furniture, status, communication, and thermal control. The research involved some 6,000 workers in 80 organizations. The results suggest improvements in the workplace have a reasonable result of an improvement in productivity of ~5%. The upper limit of benefits reported was 15%, while the average reported was 12%.[6]
- The third study (Aetna, 1989) was conducted by another large insurer. This research looked at the full range of environmental elements, including space, acoustics, visual quality, thermal comfort, and air quality. A comparison of traditional workplaces with a new workplace where environmental elements, such as space, light, adjustments, and configuration were optimized, yielded an improvement in performance of 10–15%. In other words, the new "improved" environments allowed people to be 10–15% more productive when compared with traditional work environments.[7]

Clearly, the consistency of these results over time shows that design and management of the physical work environment is a critical contributor to the performance and financial well-being of organizations. From seemingly minor elements, such as reducing glare, to major elements, such as the design or reconfiguration of entire buildings, the physical facility can either impede or enhance worker performance. The research shows that when done well, investments in facilities can yield returns on investments that contribute to the business bottom line. The workplace is a tool that when appropriately configured and designed to fit the people who work there and the work that they do, can yield direct and measurable impact on the performance and productivity of the entire organization. Thus, FM and the role it plays in planning, design, and management of workplaces is key to business success.

More recently, Mike Brill and his colleagues at BOSTI have begun to release the results of research conducted since 1994 that examined the impact of workplace on individual performance, team performance, and job satisfaction. Preliminary results are consistent with earlier results. A rough rank order of workplace characteristics that have the greatest effect on performance includes the following:

1. Acoustic privacy
2. Support for spontaneous collaboration and impromptu meetings
3. Support for face-to-face meetings, one-on-one, in individual's workspace
4. Support for administrative services, office chores
5. Sufficient storage—a place to put your "stuff," much of which is paper
6. Group space that is distraction-free
7. Taking a break
8. Dedicated project rooms
9. Appropriate ergonomics and physical comfort
10. Accommodating technology[8]

1.2.3 Defining the Client: Internal and External Customers

One of the difficulties facilities managers face is defining exactly who their clients are. Different client groups want different things from a facility. Internal clients, those who are part of the organization, have different criteria and needs than external clients, those who are not part of the "host" organization.

From a purely financial perspective, the company or organization that occupies a facility is the primary client of FM. Yet, even that distinction is not as simple as it sounds. Companies are owned by shareholders, run by executives, managed by managers, and staffed by employees. Each may have a different set of expectations and requirements for the facility.

In general, FM clients are distinguished as internal or external. Internal clients or customers include all the people who use the facility. This group includes employees, managers, and executives of the organization; contract employees in areas such as maintenance or security; customers of the business itself; and those people who come to the facility to conduct business with those who work there. Increasingly, the challenge facilities managers face in satisfying internal customers is the demand for quick response and quality service.

It is important to understand that frequency of request for service may not be an indicator of the importance of the service provided. For example, on a day-to-day basis facilities managers will spend considerable time responding to requests and the needs of employees and staff. They may be asked to adjust the heat, replace light bulbs, fix a squeaky door, or clear snow from the parking lot. However, the few times a year that the facilities manager reports to senior management may determine the size of staff and budgets; approval of projects, both major and minor; and what services are kept in-house or outsourced.

Facilities managers must serve the needs of employees and managers of the organization in a way that enhances their ability to perform. In addition, facilities managers must meet these goals while simultaneously keeping an eye on the efficiency and effectiveness of the building itself and the expenditure of resources, both human and capital. Financial accountability while maintaining quality work environments is a key challenge facing facility managers.

External customers of FM include the general public, investors and shareholders, and government agencies. The general public has concerns over appearance, safety, and environmental responsibility. Consequently, the facilities manager must ensure that his or her organization is a good corporate citizen. This could mean taking extra care in maintaining an attractive and appropriate facade for the buildings, ensuring the grounds are well kept, providing space for community activities, minimizing noise and disruption during construction projects, or finding environmentally friendly ways of dealing with waste.

Investors and shareholders want a good return on their facility investment while expecting the facility to represent the organization. The buildings an organization owns and occupies are the physical manifestation of that organization. It is the job of the facility manager to insure the buildings reflect the corporate culture while maintaining and operating them in the most cost efficient manner. The facility manager can meet these requirements by implementing cost savings practices that can include energy efficient building systems and products, as well as using durable and attractive, low maintenance materials.

Government agencies monitor compliance with standards, regulations, and statutes. To serve these customers, the facility manager must be familiar with laws, codes, and regulations. Familiarity with the requirements imposed by such regulations as fire safety codes and the Americans with Disabilities Act (ADA) will help the facilities manager ensure their buildings comply with government regulations.

1.2.4 Customer Service and Quality

Consumers of services (i.e., customers) have become more sophisticated, informed, and demanding. With experience comes knowledge of what is needed and what is possible. With this knowledge comes the ability to better express and explain customer requirements. As customers become better at expressing what they need and want, the quality and value of products and services must improve. Accompanying this expectation for improved value and quality is the need for continuous improvement in service and process delivery.

A large and rapidly growing body of knowledge has evolved around the topic of customer service and quality improvement. Total quality management (TQM) and continuous quality improvement (CQI) are but two of the many terms and acronyms associated with the national and global