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Handbook of Commercial and Industrial Facilities Management

William Wrennall

Quarterman Lee

Editors in Chief

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Handbook of Commercial and Industrial Facilities Management

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Foreword

McGraw-Hill, Inc., is to be commended for its initiative in publishing the *Handbook of Commercial and Industrial Facilities Management*.

Productivity as a profession and operational principles in all industrial and service-oriented operations have made marks over the last 30 years; this text gives us a foundation of the successes.

The Japanese organized their productivity effort beginning in the 1950's and the result over the years has been quite astonishing. It is needless to emphasize the strength of Japan's industry and global commercialization. However, less emphasis has been given to the global consequence of their efforts. Today the industrialized Far East (Taiwan, South Korea, Singapore, and quite recently Malaysia and Indonesia) show astonishing ability in implementing rationality and productivity management throughout their industrial operations.

Another consequence of the productivity skill of the East is that it has caused the United States, and to a somewhat lesser degree, Europe, to recognize clearly their shortcomings in industrial facilities management.

In Japan, implementation of productivity management was logically communicated through quality groups and constant modernization of their organizations within the corporations. The learning capacity and adaptation of skills from near and foreign sources have been paramount in productivity evolution and commercial elegance.

As the entire world now requires this knowledge of commercial and industrial facilities management, the *Handbook*, edited by William Wrennall and Quaterman Lee, is a much-needed and most timely gift to the world at large. The 18 chapters cover most of the principles and techniques for world class manufacturing and may, indeed, be a breakthrough in the educational and operational sphere of productiv-

ity management. The World Academy of Productivity Science finds it gratifying that this valuable contribution to our field of profession has been provided.

Martin T. Tveit, Ph.D., M.Sc., DIC
Chairman, World Confederation of Productivity Science

Preface

All of us have, at one time or another, struggled with the frustration of trying to perform world-class work in a building or with a layout that was unsuitable. This may have meant repeatedly walking long distances and trying to communicate with people and departments far removed. Or it may have meant managing an organization that was splintered and isolated by the physical boundaries of its buildings and land. Perhaps this Handbook can make a small contribution towards reducing such frustrations by providing organizations with ideas for facilities that enhance their productivity, profitability, and competitive advantage.

Facilities design has evolved from *edict* and *template shuffling* through *systematic layout planning* into a *strategic process*. It is no longer enough to be a “facilities planner.” Today’s business engineer knows that facilities are intertwined with processes, organization, and even the social systems of a firm. Facilities design cannot be divorced from socio-technical systems design, environmental engineering process design, or business strategy.

As you can see from scanning the Contents, the body of knowledge for this field is substantial. We are therefore pleased to have had the opportunity to edit this *Handbook of Commercial and Industrial Facilities*, the first comprehensive work on the subject.

The Handbook contains chapters on subjects from site selection to facilities maintenance, and from designing clean rooms to managing a construction project. It provides tools, techniques, ideas, and procedures that have been accepted and proven by world-class organizations. We want you to draw on it in designing or reviewing the contribution of your facilities to your total productivity.

We thank the 18 authors who have shared their knowledge and experience with us. They range from chief executives of large corporations to consulting firm partners; from simulation specialists to directors of quality in health care companies; from college professors

to consulting engineers. The authors' wide range of commercial and industrial experience has been invaluable.

Acknowledgments

All of us have drawn on the experience of our friends in government, industry, and commerce, and we thank them.

The editors wish to thank in particular the following individuals who have supported our efforts in teaching, managing, consulting, and researching this Handbook.

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We thank Diane Elston and Kathleen Bell of The Leawood Group staff, who have tolerated our impatience and supported us in preparing the manuscripts with their hundreds of figures. Their efforts in coordinating with our authors and publishers have earned our lasting respect.

*William Wrennall
Quarterman Lee*

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Facilities Design for World Class Competition

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The Importance of Facilities

Facilities provide the capacity for operations. They are an important strategic element for most businesses. They are among the most costly investments and compete with marketing, product development, and other business activities for scarce resources.

Facilities often require long lead times for construction. In a competitive environment, where new products and customers constantly emerge, timing becomes critical. A facility that is built too soon can drain a company's financial resources; a facility built too late can lose sales and market share and may relegate an otherwise fine product to permanent second place.

Facilities last for many years, usually much longer than either products or processes, yet their fundamental configuration is often permanent. A purpose-built facility designed around a specific process technology may become a white elephant when the technology changes. On the other hand, a plant designed for flexibility in

process and product may not compete well on cost with optimized, purpose-built facilities.

The American steel industry, for example, had the world's largest capacity in open-hearth furnaces at the end of World War II. But the introduction overseas of basic oxygen furnaces rendered much of this capacity obsolete. In response, United States Steel built a huge integrated mill in Burns Harbor, Indiana, in the 1960s, with the entire site being designed around the basic oxygen process. Shortly thereafter, integrated steelmaking with basic oxygen was rendered obsolete by specialized minimills using electric arc technologies. This illustrates the hazards of making facilities decisions without considering marketing, changes in technology, and the larger environment.

The best facilities are an integral part of their company's financial, marketing, and product strategies. When properly designed within the strategic framework, they can support and enhance the firm's competitiveness. When designed around purely technical considerations, they can drain a firm's financial and managerial strength and erode the competitive position.

The Historical Development of Industrial Facilities

Industrial facilities are the product of the Industrial Revolution. The Industrial Revolution gained momentum during the middle years of the eighteenth century and dominated the nineteenth century. It was a unique phenomenon in the history of humankind, and its repercussions have spread throughout the world.

The Industrial Revolution

It was much more than a revolution in technology—the techniques of making things; it was a revolution whose cultural, social, economic, and environmental implications altered the way in which people thought and lived. Our society's prosperity is based on over two centuries of progressive industrialization, during which cottage industries were replaced with factories. The evolution of industrial facilities is tabulated in Fig. 1.1.

The term Industrial Revolution was coined in the 1830s or earlier. Britain was the first industrial country; the reasons why are not agreed upon by historians. What appears to have taken place is that about the middle of the eighteenth century Britain reached a point of "take off into self sustained growth"¹ based on radical changes in methods of production. These changes, occurring over a relatively short period, had widespread effects on society, the national economy, and the landscape.

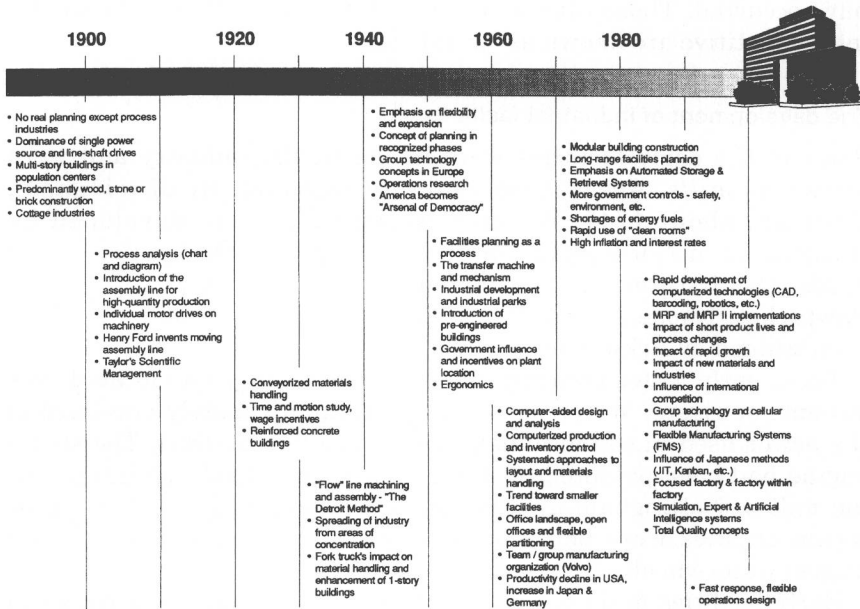


Figure 1.1 Facility planning chronology.

The Industrial Revolution has been described as a technological revolution in which new manufacturing machines were driven by new sources of power in new large-scale units called *factories*. The year 1830 is considered by Cossons to mark the end of the Industrial Revolution and the beginning of the period of true industrialization. Railways were beginning to gain acceptance, and Michael Faraday produced a continuous electric current in 1831.

The first Industrial Revolution resulted in the British factory system. This was followed by the new methods of production in the United States called *mass production* or the Ford, or Detroit, method. The economic benefits in the United States followed a similar pattern to those that occurred in Britain, resulting in the United States becoming the most powerful country in the world.

The facilities required for the new manufacturing were very different from the early European designs. With more sophisticated technology in equipment and supporting services, and more demanding environments, factory layouts were adapted to suit. Since World War II, other countries have industrialized and re-industrialized to what Doll² calls the "Post-Industrial Stage." The introduction of group technology (GT) and team building in Europe was followed by just-in-time (JIT), or the Toyota system. With the design of fast-response biotechnical zero-defect systems, further changes in facilities design