Computer-Integrated Manufacturing Handbook

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McGraw-Hill Book Company

New York St. Louis San Francisco Auckland Bogotá
Hamburg Johannesburg London Madrid Mexico
Milan Montreal New Delhi Panama
Paris São Paulo Singapore
Sydney Tokyo Toronto

Library of Congress Cataloging-in-Publication Data

Teicholz, Eric.
Computer-integrated manufacturing handbook.

(The McGraw-Hill designing with systems series)
Bibliography: p.
1. Computer integrated manufacturing systems.
I. Orr, Joel N. II. Title. III. Series.
TX155.6.T45 1987 670.42'7 86-20825
ISBN 0-07-047774-4

1234567890 DOC/DOC 893210987

ISBN 0-07-047774-4

The editors for this book were Harold B. Crawford and Galen H. Fleck, the designer was Naomi Auerbach, and the production supervisor was Thomas G. Kowalczyk. It was set in Auriga by Techna Type. Printed and bound by R. R. Donnelley & Sons Company.

THE McGRAW-HILL DESIGNING WITH SYSTEMS SERIES
Eric Teicholz *Consulting Editor*

Daryanani *Building Systems Design with Programmable Calculators* (1980)

Stitt *Systems Drafting: Creative Reprographics for Architects and Engineers* (1980)

Stitt *Systems Graphics: Breakthroughs in Drawing Production and Project Management for Architects, Designers, and Engineers* (1984)

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Radford and Stevens *CADD Made Easy* (1987)

Teicholz and Orr *Computer-Integrated Manufacturing Handbook* (1987)

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Preface

CIM—computer-integrated manufacturing—can be achieved today. There are no technological obstacles to overcome before we can build computer-controlled factories that "run themselves." Automation professionals have little difficulty in designing fully automated facilities.

So why are there not more of them? Because the goal is easier to define than the process for attaining it. All manufacturers have an investment in plant and people, and it is not at all obvious what is to become of them under CIM.

There are many current efforts to refine system analysis methodologies for use in the factory. Before automation can be implemented, an organization must understand what it currently does, what it will do under automation, and the steps leading from one situation to the other.

Ignorance of how manufacturing organizations *really* work is the most troublesome obstacle to CIM. Our problem is that we don't know what we're doing! That is, workers know their jobs and managers know what they're supposed to manage—but the details of individual operations, and their interrelations, are hidden from company strategists by sheer numbers and by the pressure to produce.

On the other hand, although defining a "factory of the future" with current technologies is not difficult, nuts-and-bolts implementation must confront the issue of obsolescence. Since the change process will take time, how can the agents of change set a course that will avoid having to discard the new equipment before it is installed?

Implementation of CIM requires an appreciation of the way things are, a vision of how they are to be, and a clear plan for getting "from here to there" with minimal trauma to the manufacturing organization and its people.

The Gulliver that is CIM must be tied down by many small strings, including technologies, methodologies, and the experiences of others, anchored to the stakes of common sense. An overview, some case studies,

and a discussion of obstacles to CIM open this handbook. Part 2 explores the technologies and their relations to one another. Methodologies for planning CIM are discussed in Part 3, and Part 4 deals with implementation issues by examples, narrative, and formulas.

The authors of this handbook are both practitioners and observers of CIM. Their points of view are not identical, but all of them have the authority of experience. There is no single best approach to CIM; you must work out your own path.

If you are contemplating CIM, read this book through from cover to cover. Then use it as a reference during the implementation process. It will give you a framework into which you can integrate CIM information, and it will provide you with inspiration and encouragement.

Eric Teicholz
Joel N. Orr

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Introduction

CHAPTER 1

CIM Industry Overview

Eric Teicholz

Joel Orr

1.1 Introduction

"Computer-integrated manufacturing" (CIM) is the term used to describe the complete automation of the factory, with all processes functioning under computer control and only digital information tying them together. In CIM, the need for paper is eliminated, and so also are most human jobs. CIM is the ostensible evolutionary outcome of computer-aided design and drafting and computer-aided manufacturing (CADD/CAM).

Why is CIM desirable? Because it reduces the human component of manufacturing and thereby relieves the process of its most expensive and error-prone ingredient. But CIM is, for the most part, an unrealized dream. The application of computers to the activities that make up the manufacturing process occurred in bottom-up fashion; that is, the potential utility of automation was recognized at the working level of organizations long before it came to the attention of management. CADD/CAM was first applied to numerical control (NC) programming on the production side of the factory and to analysis on the engineering side. Later, it began to be used in detail drafting, and now it is being applied to conceptual design. The result has been "islands of automation" in which individual processes are automated without concern for compatibility with one another. The sought-after productivity has been deferred.

What decisions must management make to implement CIM? Automation in the factory is still very much a process of enhancing islands of automation, and few efforts have been made toward their integration. The situation will persist until management deals with the four greatest obstacles to integrated automation:

- The pressure of the pyramid
- The prerogatives of the priesthood
- The personality of the power tools
- The powerlessness of the person

1.2 The Pressure of the Pyramid

How does a factory work? Figure 1.1 is a simple schematic diagram of the entities and processes. Most CADD vendors and many manufacturing executives believe that this diagram is a reasonable abstraction of the factories with which they come in contact. It depicts well-defined areas of responsibility and authority with simple flows of information, goods, and services. The automation of such a factory would be fast, easy, and interesting—even enjoyable.

However, the diagram has a slight flaw. This minor imperfection does little to decrease the popularity of the viewpoint represented by the diagram, but its elucidation will yield important insights into our first CIM obstacle. The flaw is simply this: The diagram is meaningless because it bears no relation to reality. It is worth as much to an organizational analyst as Fig. 1.2 is worth to a physician.

In reality, the factory is a seething caldron of emotion, perspiration, nobility, foolishness, greed, sincerity, selfishness, idealism, vanity, and generosity. It is a far uglier sight than a beehive or an anthill, and it is far more difficult to comprehend. Its actual operation is almost impossible to diagram because it is shrouded in a fog raised by the heat of human activity.

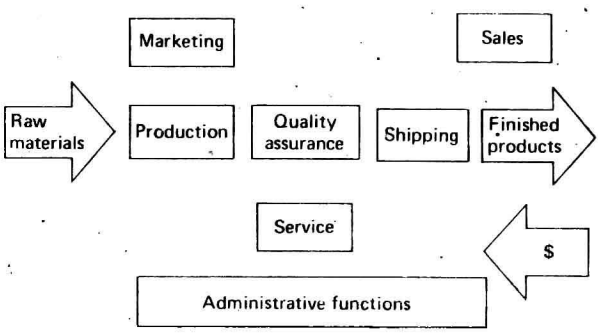

Figure 1.1 Factory functional block diagram.