

Shop Floor Control Systems

From design to implementation



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A. Bauer, R. Bowden, J. Browne, J. Duggan and G. Lyons



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PREFACE

In recent years there has been a tremendous upsurge of interest in manufacturing systems design and analysis. Large industrial companies have realized that their manufacturing facilities can be a source of tremendous opportunity if managed well or a huge corporate liability if managed poorly. In particular industrial managers have realized the potential of well designed and installed production planning and control systems. Manufacturing, in an environment of short product life cycles and increasing product diversity, looks to techniques such as manufacturing resource planning, Just In Time (JIT) and total quality control among others to meet the challenge.

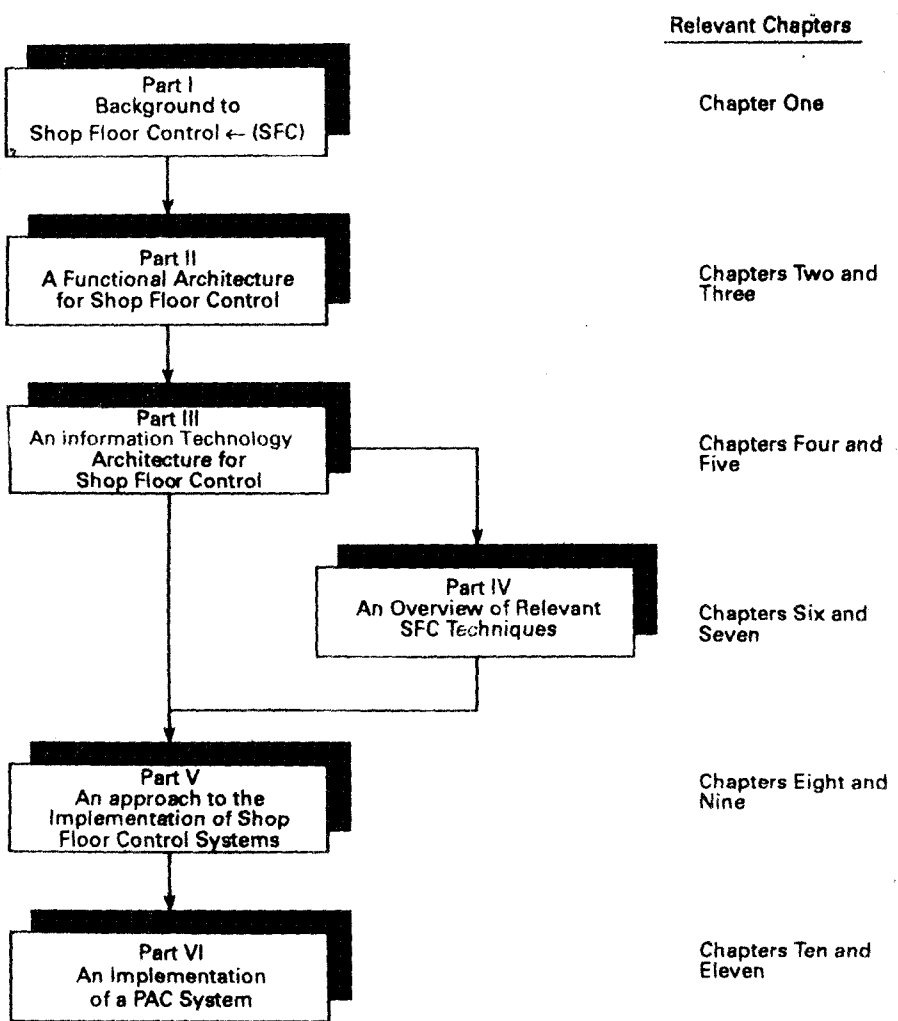
Customers are demanding high quality products and very fast turn around on orders. Manufacturing personnel are aware of the lead time from receipt of order to delivery of completed orders at the customer's premises. It is clear that this production lead time is, for the majority of manufacturing firms, greatly in excess of the actual processing or manufacturing time. There are many reasons for this, among them poor coordination between the sales and manufacturing function. Some are within the control of the manufacturing function. Others are not.

This book is concerned with manufacturing lead time, i.e the time from when a batch enters the shop floor to the time it leaves manufacturing as a finished part or product. Typically this manufacturing lead time is 10 to 20 times the actual processing time. It is our contention that this manufacturing lead time must be reduced to a level comparable to the actual processing time. Further this can be achieved by the use of sound operational planning and control systems. Hence the focus of our book is on operational level production planning and control systems; normally referred to as shop floor control systems. Our experience suggests that conventional commercially available computer based systems are very weak on this aspect of production planning and control.

In this book we present an overall approach to the development and installation of sophisticated shop floor control (SFC) systems. This is achieved by offering a functional architecture for SFC, outlining a corresponding information technology architecture, offering some ideas on how SFC systems should be installed – essentially adapting a sociotechnical approach to design and installation – and developing a set of software tools to support the development and installation of SFC systems. The overall approach is verified by an industrial case study which concludes the book.

Our book is concerned primarily with the control issues within SFC and how these can be resolved using state-of-the-art software tools. We address implementation issues in terms of the approach, which we believe should be adapted to implementation. We do not, for instance, discuss implementation in terms of the devices which might be used to capture data from the shop floor.

The structure of the book is as shown in the following figure. Initially we present a short overview of the various approaches to production planning and control, position SFC below the requirements planning stage and suggest that it involves two major activities, factory coordination and production activity control (Part One). We present functional architectures for each of these sub-systems and outline in detail the building blocks within each subsystem. The functional architecture is also documented using the SADTTM (Structural Analysis and Design) approach (Part Two). In Part Three we outline an information technology architecture which matches the functional architecture presented in Part Two. Part Four presents a short summary of the state of the art in the various techniques associated with factory coordination and production activity control. (This part breaks the flow of the book but we believe it is important to offer the reader an overview of the state of the art in important relevant topics such as group technology, scheduling etc.) We discuss the design and implementation of these systems in Part Five and in particular present some ideas for an application generator for the design and development of PAC systems. We are very conscious of the difficulty of implementing such systems in practice, and thus we emphasize the importance of an implementation approach which involves likely end users from the beginning. Finally in Part Six we present a case study of the use of the software tools and the implementation of our ideas in an industrial plant.



The structure of the book

FOREWORD

The modern environment of discrete parts manufacturing is sophisticated and intensely competitive. It is characterized by short product life cycles, high product diversity, and customers' demands for both excellent quality and timely delivery. If the production operation is capable of responding to these challenges, manufacturing can be a source of real competitive advantage for the business. Otherwise, the manufacturing process could become an inflexible and expensive corporate liability, and business strategists might do well to consider external sourcing of company products.

For manufacturing managers, then, the challenge is to develop a finely tuned process, capable of meeting the cost, quality, variability and time pressures imposed by the marketplace. Our primary objectives must include the reduction of manufacturing lead time to the minimum possible, and achievement of a high level of process control. The benefits accruing from such efforts should include: greater flexibility and responsiveness, better use of manufacturing resources, reduced inventory levels, and faster turn around on customer orders.

Fortunately, advanced information technology now brings the realization of such objectives within reach. It makes explicit and feasible the desire to reduce manufacturing lead time to a level approaching the actual time spent in material conversion on the shop floor. However, the application of sophisticated technology alone is unlikely to yield a durable and efficient shop floor strategy.

There is a need for a well-defined and consistent architecture which describes the production management environment within which shop floor activities take place. On the shop floor, there is a need to link and re-focus all of the discrete stages which make-up the process, so that the total manufacturing operation can be optimized. Furthermore, there is a need to understand the organizational implications of new shop floor control (SFC) technologies. Only by integrating the capabilities of manufacturing personnel, process

technologies and advanced information technology can manufacturing continue to contribute to business competitiveness.

This book provides a balanced and pragmatic view of the capabilities of advanced SFC principles and their implementation in real manufacturing environments. It draws together a wealth of information technology knowledge, manufacturing experience and an appreciation of the organizational impacts of SFC designs and technologies, within a sociotechnical framework. It thus makes an invaluable contribution to the education of manufacturing professionals, who find it difficult to keep abreast of such a diverse, and yet critical, amalgam of disciplines.

As a manufacturing manager I am delighted to be associated with this book. While my contribution is limited to this Foreword, I am happy to have been involved in the development of the manufacturing operations at Digital's Clonmel facility, described in the text. Much of this book is based upon research work completed under the auspices of the European Commission sponsored ESPRIT programme. This programme not only assembled the critical mass of five authors which gave birth to this book, but also brought them into close collaboration with colleagues from other European manufacturing industries, most notably COMAU S.p.a. (of Turin, Italy) and RENAULT Automobiles (of Paris, France). I believe the breadth of experience, manufacturing strategies, technologies and corporate cultures observed in all of these industries has been distilled in this text.

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