



## Book Selection

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### Cellular Manufacturing Systems Design, Planning and Control

N Singh and D Rajamani

*Chapman and Hall, London, 1996. x + 277 pp. £45.00.  
ISBN 0 412 55710 X*

There are various standard approaches to arranging machines in a manufacturing plant. The most recent is group technology (GT), which was proposed in the UK by Burbidge in the 70s. The aim is to overcome the problems of batch and job-shop manufacturing, namely high product variety and small lot sizes. This is done by grouping products into families, and assigning each family to a group of machines, which, together with the appropriate material handling equipment, form a cell: hence, cellular manufacturing.

The first question then, if this approach is to be adopted, is to decide how the products are to be grouped into families so that they can be fully processed within a cell. This is the cell formation part of the cell design problem. In a series of five chapters it is fascinating to see how a wide range of OR techniques are applied to this problem. When the only knowledge is whether a part is processed on a particular machine or not, a number of algorithms, including the bond energy algorithm, rank order clustering and direct clustering, are used to form cells. Alternatively, similarity coefficients can be used in various clustering algorithms such as single linkage, complete linkage, average linkage and linear cell to create cells. Or various mathematical programming methods (p-median, assignment, quadratic programming, graph theoretic and non-linear programming models) may be used. And, not surprisingly, the new heuristics, called novel methods here, simulated annealing, genetic algorithms and neural networks, also can be utilized.

Once the groups are determined, the cell design problem is completed by considering the layout of the machines in the manufacturing plant. In broad terms there are three choices: flow line, cell or centre layout. The first is appropriate when all parts assigned to the group follow the same machine sequence, the second permits parts to move from any machine to any other machine, and the third is suitable when product-mix changes frequently. A range of mathematical programming approaches to this problem is presented.

Once the cells have been created and the machines laid out in each cell, the next stage is to consider how the production is to be planned and controlled. A chapter is devoted to this issue, in which some attention is given to combining effectively MRP and GT. Brief comments are made on demand management, aggregate production planning, the master production schedule, rough-cut capacity planning, MRP, detailed capacity planning, order release and shop-floor scheduling and control. Mathematical models are presented which take advantage of group set-up times. A final chapter on control of cellular FMS, which has been written by JS Smith and SB Joshi, includes examples of the application of Petri nets.

The authors say that the book is directed towards first and second year graduate students in Management and Industrial and Manufacturing Engineering. In my view it is too specialized to be of interest to Management, or indeed OR/MS Masters students. The typical MBA student would be completely floored by the level of quantitative skills required. A MSc in OR manufacturing module would use a more general text, though the book may well be of interest for staff teaching such a course. Most chapters include many solved examples and conclude with other problems to be solved. I could find no hint in the book that a Teachers' Companion was available. One would certainly be useful.

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GK Rand

### Intertemporal Production Frontiers: With Dynamic DEA

R Färe and S Grosskopf

*Kluwer Academic Publishers, London, 1996. xiv + 202 pp. £56.95. ISBN 0 7923 9709 6*

Almost all human activity is dynamic. Today's activities virtually always have implications for the state of the world tomorrow. Moreover, many of today's actions are affected by expectations about the future. Yet, in spite of the intrinsic importance of the time dimension to almost all managerial decisions, many of the models developed by management scientists are completely static, and even those that claim to be dynamic often treat time in a cursory manner.

One of the most persistent and legitimate criticisms of conventional data envelopment analysis (DEA) has been that it ignores the time dimension. Implicitly the model treats the production process as if it were an instantaneous transformation of a flow of inputs into a flow of valued outputs. Yet, for example, although physical capital stock is an important input to almost all activity, few DEA authors have grappled with the conceptual problems that arise when using a stock rather than a flow as an input. (Indeed this criticism could be extended to much of the conventional microeconomic theory on which DEA is based.)

Most researchers in efficiency measurement will be familiar with the work of Rolf Färe and Shawna Grosskopf, who have done much to ensure that the development of production theory has been on a secure foundation, and that theory is linked to practical application. This admirably concise book is in a sense a summary of their work to date. The book starts with the conventional static model of production, and then introduces various means of measuring efficiency within that model. Intertemporal considerations are introduced by allowing the technological frontier to change over time. The implications for intertemporal budgeting are then discussed. The book ends with a truly dynamic model, based on a network representation of technology, in which time periods are linked by the production of intermediate goods. Each of the five substantive chapters introduces the theoretical material concisely yet rigorously, describes an empirical application to illustrate the principles, and ends with a guide to further reading.

The authors are to be congratulated on producing a well organized and well written book. Of course, while they have made every effort to present their material in simple and lucid terms, I guess that the mathematical language used and the undeniable complexity of the issues tackled will limit the audience. However, I would unreservedly recommend the book for specialist graduate courses and research students. This is not the last word on dynamic production processes, but it takes us a lot further than

hitherto, and will undoubtedly be an important stimulus for researchers in the future.

*University of York*

PC Smith

### Management Science: An Anthology Volumes I–III

S Eilon (Ed)

*Dartmouth Publishing, Aldershot 1995. 1740 pp. £195.00. ISBN 1 85521 516 0*

This is a massive work in three volumes over 1500 pages. It is presented as a collection of seminal papers in Management Science and Operational Research which have been published over the years and which have contributed to the development and historical perspective of the subject. Let me say at the start that it has given me great pleasure to read. There are inevitably reservations but these are personal and do not detract from the significance of these volumes.

The first volume is concerned with history and philosophy, planning and strategy, corporate performance and production and inventory. Volume 2 covers distribution, finance and forecasting and the final volume covers decision theory, the public sector, techniques and methodology and industrial applications.

In the work Professor Eilon has set himself there are many difficulties. The most daunting is that of any one person knowing the whole field and clearly the field from which the selection has been made is vast indeed. The second problem is that of classification. The above summary of contents shows how Eilon has approached it and hence I regret that the case study coverage is relatively small. It may be considered that case studies are all *special* cases, offering interest but not illumination. However in my own experience I have gained many insights and inspirations from the practical work of others and the unpublished research carried out in industry, commerce and government, never fails to fascinate. In what I maintain is a subject whose reason for existence is to be useful and to increase the common good, a more extended coverage of seminal practical work could have been valuable. Perhaps Eilon could be persuaded to produce another set of volumes of an applied nature?

A third task facing the sector is that of coherence and the common thread. Given the diversity of the subject as it now stands this is an impossible task. The difficulty manifests itself at ORS conferences where it is rare indeed for a hard OR person to attend a soft OR session and for a mathematician to attend a practical session without seeming patronising. Eilon rightly does not grasp this nettle. Very largely the thread uniting the papers is that most appeared in journals classified as OR or MS. This is a pity since today most OR/MS seems to be carried out in the absence

of that formal label. The major consultancies, perversely ignored by the ORS are totally absent. An anthology by definition is a collection of the written word. But much more is going on in the world than appears in OR/MS journals.

But what of the dominant problem, how do the papers actually look on the page? Since no one in their senses, except an innocent reviewer, would sit down and read these volumes from beginning to end, the test is the jackdaw test, opening the books at random how often is one's attention grabbed and interest roused? It has to be said that the scoring rate is very high indeed. In almost every case of the jackdaw snatch there was something fascinating. Many of the milestones are there, Blackett, Larnder, Ackoff, Cook, Rosenhead, Charnes, Cooper and dozens of others fall into view. Interestingly some of them do not make me as angry as they once did, which shows how I have absorbed their messages. For most of the time we only get angry when we are on the brink of changing our mind or are faced with a truth we would rather ignore. So many wise and perceptive papers; indeed one moment of delight was turning over a page and finding a paper written with wit, elegance and wisdom and discovering that I had indeed written it myself and equally finding a paper selected for inclusion that I had no memory of writing.

It is significant that there is so much of Ackoff. No one has attracted so much controversy and even anger, but also no one has had such effect. Ackoff actually gets involved with the grime of racism and poverty. He was never one to pass by on the other side and his example of personal involvement is a lesson to all those who look on OR as just a collection of techniques. It is also a tragedy that there is so little of Stafford Beer, indeed there is nothing by Beer. His influence has been immense and the pilgrim's progress of his thinking as revealed in book after book in which he together with Ackoff, pioneered the concept of the system is immensely impressive.

But for this reviewer the best moments belonged to Tocher. It is trite to remark in obituaries that someone 'will be greatly missed'. This volume brings this home in a very sad way regarding Tocher with whom I seemed to spend a large portion of my professional life laughing and arguing. For Tocher the foe was folly and his weapon wit. There is one lovely exchange over the usefulness of utility theory. Tocher's first note that the theory was pretty useless ('I am always grateful to people who leap to defend utility theory because every defence betters my understanding of its irrelevance to modern society') met with a riposte by one writer. Tocher's response to this was then dealt with by two cooperating writers and his third rejoinder attracted a letter composed by no less than four utility theorists. It was like watching Errol Flynn in a rapier fight with four swordsmen. The Tocher papers remind us of the age when OR was enjoyable, a spirit which now seems to have left us in a grim grey world.

The names of the authors bring back a lost era. Those early years were those in which there was no secure future in the subject, OR was what we did and there were no protocols and no definitions and no courses. It attracted larger than life characters who were willing to hazard their careers for what looked like being fun. Inevitably it attracted excellent dynamic people as well as charlatans who recognised a band waggon when they saw one. Personally I regret the demise of the charlatans, they were good company and kept us on our toes.

The main omission in these volumes however is that of the soft area which receives not a mention. As a hard OR man myself I find this a pity. There is much in soft OR which makes me unsteady, not least the almost born-again enthusiasm of the proponents. But Tocher himself anticipated the need for a soft approach 'Of course in many situations the decision maker is a myth. There is no one person who determines the future course of events: the efforts of one to obtain his goals however well he understands them, is frustrated by others with differing objectives' and 'any analysis of a conflict situation must allow not only for people's beliefs about what is true and their desires for what will be true, but also their hopes for what can be made true'.<sup>1</sup>

This gap is a pity for it ignores so much of the subject. The fact that I personally find soft OR unconvincing, as I suspect Professor Eilon does also, is not a reason for excluding it. But these reservations aside, these volumes are a massive achievement. As the old saying goes we have to live life forwards but can only understand it backwards. These volumes are rather like climbing a fell in the Lake District. On the way up one is conscious of the effort of climbing and has no time or energy to look around. But at the top we can look back and see the path we took and which was not apparent at the time. I would put these volumes as an essential prerequisite to understanding our subject and as such they should be in every OR/MS group, or rather every group which is practicing OR whether or not so called.

## Reference

- 1 Tocher KD (1978). Reply to French. *J Opl Res Soc* 29: 180–182.

BHP Rivett

## Meta-Heuristics Theory and Applications

IH Osman and JP Kelly (Eds)

*Kluwer Academic Publishers, London, 1996. x + 690 pp. £124.25. ISBN 0 7923 9700 2*

This book is composed of a refereed selection of 41 papers presented at MIC-95, the first international conference on Meta-Heuristics held in Breckenridge, Colorado, in July

1995. Its objective is to further the understanding of basic principles and new developments in a relatively new area which is receiving increasing attention for its potential in solving hard combinatorial optimisation problems.

The opening chapter, by the editors, provides a useful overview of the area with an extensive reference list, which should be accessible to practitioners. It is general in nature, however, and does not directly relate to the contents of the book. Indeed there are meta-heuristics mentioned there which receive little or no further coverage. Thus unlike many of this type, the reader has nothing to guide him/her through the collection. The remaining chapters are divided into seven sections of varying length: genetic algorithms (4 papers), networks and graphs (3 papers), scheduling and control (7 papers), simulated annealing (4 papers), tabu search (15 papers), travelling salesman problems (3 papers) and vehicle routing problems (4 papers). The distinction between the sections is not rigid as several papers in the 'applications' sections discuss tabu search or simulated annealing approaches. Applications generally are to generic rather than specific problems; the papers of Abada and El-Darzi and of Toth and Vigo being notable exceptions. As might be expected in a collection of this type, the papers are aimed at the research community and are unlikely to be accessible to the general reader. They are of good quality in general but there is little which stands out from the abundant literature. This is a case of building blocks rather than landmarks. Does the book achieve its objective? Yes, but only to a limited audience of researchers who can persuade a library to buy it for their use. The price is extremely high for a book produced from camera ready copy, with the chapters using a variety of fonts, point sizes and line spacing. The general reader will find neither this nor its content appealing. I seriously question whether this format is an appropriate one to disseminate academic research.

*University of Leeds*

L Proll

## Quantitative Methods in Business

A Curnock

*Stanley Thornes, Cheltenham, 1996. viii + 438 pp. £17.99. ISBN 0 7487 2083 9*

This textbook provides an elementary mathematical treatment of a wide range of topics of interest to people who will one day become business analysts, economists, or OR people. It aims to be useful 'at a time when universities and colleges are moving from formal lectures towards a more student-centred learning environment'; and to provide support for 'hard-pressed lecturers as their work load

increases'. When I think of the patience displayed by my own lecturers 25 years ago, as I struggled to an OR degree without a strong maths background. I must admit that I find this description rather chilling! Students could, with perseverance, learn some of the theory from this book but only on highly stylized problems and with little understanding of the practical difficulties of formulating problems in the real world.

The first two sections of the book deal with basic skills. They cover the collection and presentation of data, a review of basic arithmetic, and the concepts of linear and non-linear models. I found myself frustrated with the latter chapter. The author describes breaking down production costs into fixed and variable elements but then moves into the contentious area of the labour markets to illustrate the intersection of supply and demand! It would have been better to stick to micro-economics and look, for example, at the break-even point for a firm, so building on the cost example and showing a practical result from the work. In general there are many case studies, but many of them are trivial and not enough are developed to any depth or realism.

The next two sections build up methods of statistical analysis: probability, hypothesis testing, correlations and time series. The latter includes moving averages and linear extrapolation with seasonal correction factors. There is also a chapter on interest and the time value of money tucked into this section. Overall, the choice of topics is good though I am never sure just how much formal statistics really gets used in business.

The final section covers decision making and deals with linear programming and critical path analysis. These are described quite well but it's difficult to see how a student who in one chapter needs to be reminded of arithmetic (yes, subtraction and addition are explained!) could cope with the simplex method just a few chapters later! Throughout, I found many such 'leaps' which I would have found difficult to bridge.

Throughout the book, examples of using Excel and Minitab are described, together with instructions for solving some problems using a scientific calculator.

Altogether then, the book provides an adequate background to many mathematical methods that are used within the business environment. I am not in education, and on the back cover of the book there are positive reviews from some who are, but I wonder just who really would benefit from a book of this nature. It should either attempt to cover less ground, but include more discussion of practical issues, or it should be seen as a mathematics book providing back-up material for students who are struggling with particular issues. Unless students really are much cleverer than they were, I cannot believe that it provides 'a self-sufficient text to allow students to learn independently'.

*Freelance Consultant*

M Mytton

## Scheduling Computer and Manufacturing Processes

J Blazewicz, KH Ecker, E Pesch, G Schmidt and J Weglarz  
*Springer, Berlin, 1996. x + 491 pp. DM 170.00. ISBN 3 540 61496 6*

The area of scheduling has received a great deal of attention from researchers in recent years and a sizeable amount of good literature has appeared.<sup>1</sup> This book is intended to present both recent and classical work in the area of deterministic machine scheduling using both theoretical and application oriented analysis.

This book is presented as a continuation of a previous book,<sup>2</sup> which was well received, by four of the authors. Reviews of the two editions of the previous book have appeared in JORS.<sup>3,4</sup> Rather than treating this book as a third addition the authors decided to treat it as a completely new book, changing the title by putting the emphasis on *processes* rather than *systems*. The authors are well known in the field of scheduling with much experience of tackling machine scheduling problems.

This book deals with deterministic machine scheduling problems, but the authors are quick to stress that this does not rule out dynamic problems (problems in which ready times are unknown in advance).

Throughout this book the reader is presented with the algorithms under discussion in Pascal-like code. This is of great appeal to both the researcher and practitioner alike as it enables quick implementation of the theory.

The mathematical aspect of the book starts in Chapter 2 where extensive definitions are given and the reader is introduced to a number of important concepts. The chapter covers complexity issues, graphs and networks, enumerative methods and approximation and heuristic approaches (including tabu search, simulated annealing and ejection chains). The classification of deterministic scheduling problems and the motivation for studying them is given in Chapter 3. Computing and manufacturing are presented as being the two main areas of interest, as one may expect from the title of the book. Chapters 4 and 5 deal with scheduling on single and parallel processors respectively. The chapters are broken down into subsections concentrating on specific objective functions (flow time and due date

criteria). Communication delays and multiprocessor tasks are presented in Chapter 6. Chapters 7 and 8 focus on flow and open shops, and job shops respectively. The authors cover these two chapters using the same two subsection topics: exact methods and approximation algorithms. A good collection of recent work is presented in both chapters. Chapter 9 deals with scheduling under resource constraints, in particular scheduling multiprocessor tasks and scheduling with continuous resources. These problems are much more complicated than the problems tackled in previous chapters as additional scarce resources need to be scheduled. The subject of Chapter 10 is Flexible Manufacturing Systems (FMS). The reader is given a detailed insight into scheduling flexible flow shops, scheduling dynamic job shops, simultaneous scheduling and routing in some FMS and batch scheduling in flexible flow shops under resource constraints. The final chapter, Chapter 11, deals with computer integrated production scheduling. This is a more applied view of machine scheduling with many useful suggestions and comments.

Overall the book is readable if rather mathematical, a reader new to the area would certainly have to be selective about which chapters were read first. By focusing on a more application oriented approach, as well as keeping the mathematics, I believe the book to be a step in the right direction from the previous two editions. There is a good index and many excellent references.

## References

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- 4 Potts CN (1996). Review of scheduling in computer and manufacturing systems. *J Opl Soc* **47**: 592–593.

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