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（影 印 版）

布莱克韦尔运筹管理百科辞典

EDITED BY

NIGEL SLACK

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Edited by Nigel Slack

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Foreword

It is a privilege to introduce this book and its contributors to a great new readership – the people of China.

In a transforming economy the challenge is to find new ways of managing and organising that harmonise with national culture. In meeting this challenge the most important tools are ideas and knowledge. This book is a toolbox containing a wealth of powerful and influential ideas. This is knowledge that has been influential in shaping how we think about what goes on in organisations, and which has stood the test of time. You will also find here ideas that are emerging as signposts for the future development of organisations and management. One major barrier to adopting this knowledge has been its restriction to the readers of specialist journals and books. This has led, over the years, to a great proliferation of specialist concepts and terminology – impenetrable jargon to the nonspecialist, making it unnecessarily difficult for lay readers to understand and get full value from the insights of scholars. The present volume solves this problem by providing a systematic inventory of key concepts, with clear explanations of them by a collection of the world's experts.

In a transforming economy like China, it is my hope that a book like this will be immensely valuable to

a) scholars and students who want a source book for key concepts, references to further reading, and linkages with other topics [cross references are indicated by words in SMALL CAPITALS]
b) business leaders and professionals who want clear explanations of management and organisational terms, and ideas about how to apply them in business settings

c) broad-minded and intelligent general readers who want quick digests of the essential academic knowledge on a given topic.

There are many ways of using a book like this. The cross-indexing system allows you to explore at will. If you pick a theme, you can follow a path of interconnected ideas
through the main areas of business and management. For readers in China, as a region in the

midst of radical economic and social change, so of these might be as follows:

1. **Management style**. What kinds of leadership seem to work best and why? What are the preconditions for effective authority?
[see, for example, entries on: CEOS; DELEGATION; ENTREPRENEURSHIP; LEADERSHIP, MANAGERIAL BEHAVIOR; MANAGEMENT STYLE; POWER; RISK-TAKING; STRATEGIC MANAGEMENT; SUCCESSION PLANNING; SUPERVISION; TEAMBUILDING; TOP MANAGEMENT TEAMS; TURNAROUND MANAGEMENT; WOMAN MANAGERS]

2. **Organisational design**. How do you get the best out of people through how you organise tasks, communication networks and decision-making systems?
[see, for example, entries on: BUREAUCRACY; COMMUNICATION; DECENTRALIZATION; FAMIL Y FIRMS; INFORMATION TECHNOLOGY; JOB DESIGN; MATRIX ORGANIZATION; MUL TINA TIONAL CORPORATIONS; ORGANIZATION DEVELOPMENT; ORGANIZATIONAL DESIGN; ORGANIZATIONAL EFFECTIVENESS; RESTRUCTURING; SOCIOTECHNICAL THEORY; TECHNOLOGY]

3. **Human Resource systems**. What is current accepted wisdom about the effectiveness of key practices and processes? How do you make them work best?
[see, for example, entries on: ASSESSMENT CENTRES; DISABILITY; HOURS OF WORK; HUMAN RESOURCE STRATEGY; JOB ANALYSIS; MANAGEMENT DEVELOPMENT; NEGOTIATION; PARTICIPATION; PAYMENT SYSTEMS; PERFORMANCE APPRAISAL; PSYCHOLOGICAL CONTRACT; RACE; RECRUITMENT; SAFETY; SELECTION METHODS; TRAINING]

4. **Individual performance and adaptation**. Under conditions of change, which methods work best and how do people's motives translate into productive action?
[see, for example, entries on: ABSENTEEISM; CHANGE METHODS; COMPETENCIES; CREATIVITY; ERRORS; GOAL SETTING; INTERPERSONAL SKILLS; MENTAL HEALTH; MOTIVATION; PERFORMANCE, INDIVIDUAL; PERSONALITY; PRODUCTIVITY; QUALITY CIRCLES; STRESS]

5. **The cultural context for management**. How can we best understand and analyse how values and practices adapt to different national and industrial contexts?
[see, for example, entries on: CRISES; CULTURE; DOWNSIZING; EXPATRIATES; GOVERNMENT AND BUSINESS; INTERNATIONAL MANAGEMENT; MANAGEMENT OF DIVERSI-

TY; ORGANIZATIONAL CULTURE; POPULATION ECOLOGY; PRIVATIZATION; TECHNOLOGY TRANSFER]

6. **Strategic decision making**. What are the hazards and opportunities for how business plans are formulated? How can groups and teams be used to best effect? what biases distort judgement?

[see, for example , entries on: BEHA vIORAL DECISION THEORY; CONSULTANCY INTER VENTION METHODS; DECISION MAKING; DIVERSIFICATION; GROUP DECISION MAKING; INNOVATION; MERGERS & ACQUISITIONS; NETWORKING TOTAL QUALITY MANAGEMENT]

7. **Ethics**. What do we know about how principled business can be achieved in demanding market environments? How can employees be encouraged to act as good corporate "citizens" and businesses as socially responsible forces?

[see, for example, entries on: BUSINESS ETHICS; CONFLICT, CORPORATE SOCIAL PERFORMANCE; DISCRIMINATION; JUSTICE; LEARNING ORGANISATION; MORAL DEVELOPMENT; ORGANIZATIONAL CITIZENSHIP; POLITICS; VALUES]

This list is not exhaustive. There are almost as many ways of using this book as there are entries. For this reason it is my hope and belief that Chinese readers will find their own special interests served by its rich contents.

Nigel Nicholson
London Business School
September 1999

—— Preface ——

Operations management is the set of tasks which manages the arrangement of resources in an organization which is devoted to the production of goods and services. This is a broad definition of the subject which has an application to all types of organization. However, this was not always the case. At one time it seemed that the glory days of operations management (or factory management as it would probably then have been called) were from the post-war period through to the 1960s. This was when the problems of supplying markets hungry for manufacturing products was clearly an important issue and, furthermore, subject to systematic, and often mathematical analysis. Few richer grounds existed for the application of these quantitative models whose development roughly coincided with the same period. Indeed, up until the early 1970s, operations management was barely distinguishable from operations research and management science. It was a collection of techniques, methods and models, a sort of all-purpose tool-box for the solution of complex manufacturing problems. Essentially, operations management was merely an aggregation of these models that focused on the provision of prescriptive solutions for such 'problems' as stock control, quality control, facilities layout, replacement of machine parts, maintenance and repair policies and so on.

In reality, this influx of quantitative models was overlaying an earlier set of models developed during the emergence of mass industrialization in the late nineteenth century. These models and methods were formalized during the (with hindsight naive) scientific management movement. In fact, the scientific management era had already laid the foundations of work–study and industrial engineering-based techniques upon which the quantitative modellers built.

Given its preoccupation with technique-related problem solving, it is not surprising that by the 1970s operations management was sometimes looking uninspired, irrelevant, or both. It was a subject largely devoid of intellectual excitement, seen as closer to the technical minutiae of engineering than to management, and having little to say on the emerging issues of competitiveness and strategic positioning.

But no longer. Twenty years can make a lot of difference and operations management is once more at the forefront of management thought and fashion. From what was once the neglected function in management studies, it has regained a position such that academics, students, and consultants are willing to take it seriously. So what has changed? What has impacted on the subject and so radically enhanced its status? In truth, no single development can be held responsible for the transformation. Rather it was the coincidence of a number of factors, the implications of which have influenced this encyclopaedic dictionary.

'Operations' Has Extended Beyond Its Conventional Boundaries

Increasingly, operations management is seen as involving consideration of resource management beyond the limits of the core transformation system. In the limited sense, this involves extending the definition of operations management to include all value stages, including initial design of products and services, the purchasing of bought-in materials, and the logistics considerations involved in transporting products and services to customers. Beyond organizational boundaries, it involves setting internal operations in the context of a larger supply network. The entries on supply chain

management, design chain management and design for manufacture, for example, all reflect this influence.

Operations Has Become More Strategic

There is clearly a distinction, now well accepted, between *'operations'* and *'operational'*. The former is concerned with the management of resources for the creation of products and services. The latter implies short-term, detailed, and localized decisions. Thus, operations management is not necessarily operational management. The implication of this is that the concept of 'operations strategy' is not the contradiction it once seemed. Thus, the entries on operations strategy, manufacturing strategy, service strategy, for example, would not have even been included in a work of this kind until relatively recently.

Operations Includes the Production of Services as well as Products

Even though in most developed nations the largest part of GDP has for decades been accounted for by service industries, the serious study of how services are produced dates only from the 1970s. Now, by contrast, operations management is deemed to include all those issues pertinent to the creation of either products or services. Indeed, it is widely accepted that most organizations produce a bundle of products and services, and while the tangible or intangible may predominate, relatively few businesses are solely concerned with the production of either products or of services alone. The entries on service operations, service innovation and service processes all reflect this shift.

Operations Includes Both Concepts and Techniques

Building a set of concepts which allow us to articulate the similarities and differences between various types of operations is a task which has dominated much of the academic development in the subject over the last few years. Some of these concepts attempt to bind together seemingly disparate operations. For example, the entry on transformation models reflects this desire. Others reflect a particular approach to the management of operations. Many of these latter concepts, although radical when first introduced, have now, at least partly, been subsumed within the constituent elements of operations management. The entries on just-in-time and total quality management are typical of these concepts.

Operations Has Relevance in all Parts of a Business

Any function or department within a business can be viewed as having two types of task – a technical task that involves exploration of the underlying logic of the decisions it is making, and an operations task that involves the production of its internal services. So for example, within the marketing function, technical decisions involve such things as pricing policy, promotional strategy, market positioning and so on. These are clearly not directly the concern of operations management as such. However, its other set of tasks are concerned with the production of plans which embody these technical decisions. In doing so it is, in effect, producing services for internal customers, hopefully to an appropriate level of quality, responsiveness, reliability, flexibility, and cost. As such the marketing (or any other) function can be judged as an operation. For example, the entry on business process re-engineering is a reflection of this idea.

Inevitably, when a subject reaches the stage of development which operations management has, there are different ideas as to how it should move forward. Some see the subject becoming subsumed within concepts they regard as larger scale, such as supply chain management. Others see developments in strategic management, such as resource based theories of the firm, as creating alternatives to the more strategic aspects of operations management. Yet others hold that only by creating a centre of study for service management independent of either operations (or any other conventional functional study for that matter) can the differences between manufacturing and service businesses truly be explored. This work represents a compromise. We hope that all major topics within the subject are addressed and apologize if some topics, regarded as important by some readers, have been missed out because of lack of space. Some of the entries are relatively short, little more than

extended definitions, others are several thousand words long. These longer entries could have been broken down into their constituent parts. However, the judgement of the contributors was that this would reduce the coherence necessary for a reasonable understanding of the topic. Hopefully, with judicious use of the 'see also' sections at the end of each entry and the index the reader should be able to find their way to whatever aspect of the topic interests them.

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ABC analysis *see* PARETO ANALYSIS

acceptance sampling *see* STATISTICAL QUALITY TECHNIQUES

advanced manufacturing technology Advanced manufacturing technology (AMT) is an umbrella term used to describe a wide range of automation and related technologies which have emerged during the past two decades as a consequence of developments in information technology (IT). The label "advanced" derives from the perception in the 1970s that IT applied in manufacturing would open up radically different ways of doing things and would require a different approach to its management. It was widely expected that such a "revolution" in manufacturing technology would have an equally powerful impact on productivity and performance – and as a result there was strong pressure on firms to adopt this new generation of technology.

Underpinning this was the growing recognition that the emergence of IT would accelerate developments along three important paths in manufacturing:

- It would open up dramatic new possibilities in the automation of manual tasks.
- It would facilitate the integration of such automation.
- It would be applicable across a wide range of manufacturing sectors.

Originally mechanization was aimed at substituting manual labor with mechanical equipment; as the pace of industrialization grew so did the attempt to take this one stage further and replace the monitoring and control activities in manufacturing by some form of automatic device. This trend was limited by the availability of suitable technology until the emergence of electronics. Experiments during the Second World War gave a considerable boost to automation, and the development of digital computers in the 1960s enabled a new generation of automatic control. These systems were originally applied only in large, capital-intensive industries, but diffused more widely as computing power became more easily available. With the development of the microprocessor it became feasible to automate individual machines and functions. Diffusion of such automation accelerated rapidly during the 1980s, and spread across from large capital-intensive firms through to very small and specialized applications and sectors. For some, microelectronics-based automation became something of a solution looking for a problem.

From the late 1970s the trend towards integration began to accelerate. There were distinct limits to what could be integrated mechanically, but the potential of IT to communicate in a common language of electronic signals enabled the emergence of integrated systems for monitoring and controlling industrial applications. At first this was confined to simple integration of functions within a particular item of equipment; then it spread to linked applications within a sphere of activity, after which it began to open up integration between functional areas and beyond. Significantly this moved the emphasis from what might be termed "substitution innovation" (doing what had always been done but a little better, for example faster or more accurately), towards doing completely new things or doing old things in radically new ways. This opened up the possibilities for using AMT strategically, for

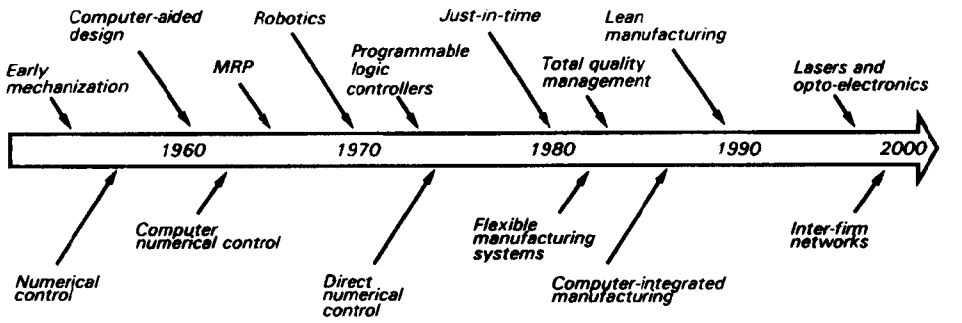

Figure 1 Convergent streams in AMT

example, in making the business more flexible, faster, or more customer responsive.

IT offers radical improvements in the processing, storage, retrieval, and communication of information. Because much of manufacturing involves information activity there is considerable scope for improvement through IT. Recognition of the huge possibilities in applying IT led to its being seen as heralding a new Industrial Revolution, with electronics playing the role which steam power had done in the eighteenth century.

Nature of AMT

AMT is not simply the application of IT but its combination with several other technologies to enable a particular set of applications. It can be usefully represented as a convergent stream which continues to develop, as shown in Figure 1. Characteristic of these component technologies is a three-stage process, moving from discrete automation of individual tasks, through increasing integration of functions to a final stage in which the basic configuration is adapted and extended to suit widely different applications.

The emergence of AMT can be seen through considering some particular elements which illustrate these trends.

FLEXIBLE MANUFACTURING SYSTEMS (FMS) are the archetypal manifestation of AMT, at least in engineering-based manufacture, although their component parts are themselves applied much more widely in other industries. ROBOTICS are used to manipulate parts, tools and materials, AUTOMATED GUIDED VEHICLES (AGVs) are used to transport materials or assemblies, and PROGRAMMABLE LOGIC CONTROLLERS (PLCs) are used to monitor and control most types of process. All can be integrated to different levels of sophistication (*see* COMPUTER-INTEGRATED MANUFACTURING) (CIM). Other applications of AMT, which demonstrate the same pattern of evolution from discrete automation and "substitution" innovation towards integrated and more strategic innovations, include COMPUTER-AIDED DESIGN (CAD) and computer-aided production management systems, based on versions of MATERIAL REQUIREMENTS PLANNING. Other elements in the AMT convergent stream include "mechatronics" (the convergence of mechanical and electronic systems), laser and other optical technologies, and the increasing use of new materials and forming processes.

Managing AMT

AMT appeared to represent a perfect marriage between technological potential and the manufacturing challenges of the late twentieth century. Industrial experience in a variety of applications confirmed the powerful advantages which could be used technically and also strategically. But in the late 1980s evidence began to accumulate about problems with achieving these advantages. In a few extreme cases the considerable investment made in AMT failed completely; but in most cases what was reported was a general feeling of expectations not being fully met. It became clear that unlocking the full potential offered by AMT involved more than simply adopting the technology.

Several studies showed that two key features are associated with successful implementation of AMT. The first is that the investment needs to be made within the context of a clear strategic framework. Rather than selecting and investing in CIM because it is fashionable, successful firms have a clear understanding of their business, knowing where they want to be in the marketplace and how they plan to compete, and the implications this has for manufacturing. They also know their present strengths and weaknesses within their manufacturing operations (in terms of equipment, facilities, experience, and skills) and can plan a step-by-step strategy which builds up to highly integrated automation in a series of stages rather than in a single step. This underlines the importance of MANUFACTURING STRATEGY as a precursor to investment in AMT.

The second key point is that successful firms recognize that they need to make significant and far-reaching changes to the way production is organized and managed. Using a "revolutionary" technology such as CIM requires a similarly radical degree of organizational change along a number of dimensions, including the skills profile, the functional and hierarchical structure, the philosophy of management and control, and the underlying culture of the organization. The nature of the organizational changes required depends on the scale of technological shift (small changes can often be absorbed with only slight variations on the existing pattern, whereas larger shifts require a fundamental rethink of the way the organization operates). Equally, technologies which span more than one functional boundary are likely to pose problems of organizational integration; for example, one of the major requirements in effective CAD/CAM utilization is the organization of the multidisciplinary, multifunctional design process to enable close co-operation and integration.

The dimensions of such change vary with each application but there is a general trend towards a new model for manufacturing organization. This includes elements such as more emphasis on skills and on training, more team working, more decentralized autonomy, flatter structures, and closer integration between different functional areas. AMT provides a catalyst for moving towards this kind of model since it is unlikely to deliver its full benefits without such changes.

The lists below indicate typical dimensions of change in organization design (Bessant et al., 1992).

Work organization:

(1) from single skill to multiskill developments;
(2) from high division of labor to integrated tasks;
(3) from long skill lifecycle to short skill lifecycle;
(4) from skill life = employee life to skill life < employee life;
(5) from individual work/accountability to team work/accountability;
(6) from payment by results to alternative payment systems;
(7) from supervisor-controlled to supervisor-supported;
(8) from low work discretion to increased flexibility/autonomy.

Changes in management organization:

(9) from sharp line staff boundary to blurred boundaries;
(10) from steep pyramid to flat structure;
(11) from vertical communication to network communication;
(12) from formal control to "holographic adjustment";
(13) from functional structures to product-/project-/customer-based;
(14) from differentiated status to single status
(15) from rigid and non-participative to flexible-participative.

Inter-organization relationships:

(16) from tight boundaries between firms to blurred boundaries;
(17) from "arm's length dealing" to co-operative relations
(18) from short-term to long-term relationships;
(19) from confrontational to co-operative relationships/partnerships;
(20) lack of customer involvement to "customer is king."

Significantly, much of the evolution of this alternative model for manufacturing organization took place in parallel with the emergence of AMT. Concepts like JUST-IN-TIME, TOTAL QUALITY MANAGEMENT, and cellular

manufacturing were applied with increasing frequency and it became clear that many of the benefits offered by AMT could also be realized (at lower cost and with less organizational disruption) through the adoption of new organizational forms. A key theme in lean manufacturing (see just-in-time) is that many of the differences between "best practice" plants and others lie in work organization and production management, rather than in levels of AMT being deployed.

The emerging prescription for successful AMT implementation is one which combines the two themes of technological and organizational change, and employs AMT to augment rather than supplant a skilled workforce organized around high quality, customer-focused, flexible teams. There is no conflict but rather a complementarity; the nature and direction of organizational change (new LAYOUT patterns, new WORK ORGANIZATION, new organization structures, etc.) are precisely those which are needed to support more advanced and capital-intensive applications of AMT. This model should be seen not simply as the extension of technical integration but rather as the convergence of two streams (new IT-based equipment and systems and new approaches like just-in-time and total quality management). Rather than simply computer-integrated manufacturing, perhaps a better term would be "total integrated manufacturing."

See also **process technology; service innovations; human-centered CIM**

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JOHN BESSANT

after-sales service *see* CUSTOMER SUPPORT OPERATIONS

aggregate capacity management Aggregate capacity management is the activity of setting the capacity levels of an organization in the medium term. The important characteristic of capacity management here is that it is concerned with capacity measured in aggregated terms. Thus aggregate plans may assume that the mix of different products and services will remain relatively constant during the planning period (*see* CAPACITY MANAGEMENT).

Typically, in aggregate capacity management, operations managers are faced with a forecast of demand which is unlikely to be either certain or constant. They will also have some idea of their own ability to meet this demand. Nevertheless, before any further decisions are taken they must have quantitative data on both capacity and demand. So step one will be to measure the aggregate demand and capacity levels for the planning period. The second step will be to identify the alternative capacity plans which could be adopted in response to the demand fluctuations. The third step will be to choose the most appropriate capacity plan for their circumstances.

Measuring Demand and Capacity

Demand forecasting is a major input into the capacity management decision. As far as capacity management is concerned there are three requirements from a demand forecast. The first is that it is expressed in terms which are useful for capacity management, which means it should give an indication of the demands that will be placed on an operation's capacity, and expressed in the same units. The second is that it is as accurate as possible, and the third that it should give an indication of relative uncertainty, so that operations managers can make a judgment between plans that would, at one extreme, virtually guarantee the operation's ability to meet actual demand, and, at the other, plans that minimize costs.

In many organizations aggregate capacity management is concerned largely with coping with seasonal demand fluctuations. Almost all products and services have some seasonality of demand and some also have seasonality of supply.

The Alternative Capacity Plans

There are three "pure" options for coping with supply or demand variation:

- Ignore the fluctuations and keep activity levels constant (level capacity plan).
- Adjust capacity to reflect the fluctuations in demand (chase demand plan).
- Attempt to change demand to fit capacity availability (demand management).

In practice most organizations will use a mixture of all of these "pure" plans, although often one plan may dominate.

In a level capacity plan, the processing capacity is set at a uniform level throughout the planning period, regardless of the fluctuations in forecast demand. This means that the same number of staff operate the same processes and should therefore be capable of producing the same aggregate output in each period. Where non-perishable materials are processed, but not immediately sold, they can be transferred to finished goods inventory in anticipation of sales at a later time period. This can provide stable employment patterns, high process utilization, and usually also high productivity with low unit costs. Unfortunately, it can also create considerable inventory. Nor are such plans suitable for "perishable" products, products which are tailor-made against specific customer requirements, or products susceptible to obsolescence.

Very high underutilization levels can make level capacity plans prohibitively expensive in many service operations, but may be considered appropriate where the opportunity costs of individual lost sales are very high, for example, in high-margin retailing. It is also possible to set the capacity somewhat below the forecast peak demand level in order to reduce the degree of underutilization. However, in the periods where demand is expected to exceed planned capacity, customer service may deteriorate.

The opposite of a level capacity plan is one which attempts to match capacity closely to the varying levels of forecast demand. Such pure "chase" demand plans may not appeal to operations which manufacture standard, non-perishable products. A pure chase demand plan is more usually adopted by operations which cannot store their output such as service operations or manufacturers of perishable products. Where output can be stored the chase demand policy might be adopted in order to minimize or eliminate finished goods inventory.

The chase demand approach requires that capacity is adjusted by some means. There are a number of different methods of achieving this, although all may not be feasible for all types of operation.

Overtime and idle time. Often the quickest and most convenient method of adjusting capacity is by varying the number of productive hours worked by the staff in the operation. The costs associated with this method are overtime, or in the case of idle time, the costs of paying staff who are not engaged in direct productive work.

Varying the size of the workforce. If capacity is largely governed by workforce size, one way to adjust capacity is to adjust the size of the workforce. This is done by hiring extra staff during periods of high demand and laying them off as demand falls. However, there are cost, and possibly also, ethical implications to be taken into account before adopting such a method. The costs of hiring extra staff include those associated with recruitment as well as the costs of low productivity while new staff go through the LEARNING CURVES. The costs of lay-off may include possible severance payments, but might also include the loss of morale in the operation and loss of goodwill in the local labor market.

Using part-time staff. A variation on the previous strategy is to recruit staff on a part-time basis, that is for less than the normal working day. This method is extensively used in service operations such as supermarkets and fast food restaurants, but it is also used by some manufacturers to staff an evening shift after the normal working day. However, if the fixed costs of employment for each employee, irrespective