

John Humphrey

1 INTRODUCTION

Researchers at the Institute of Development Studies are grouped into clusters. The industry cluster is composed of four Fellows (full-time academic staff) and a varying number of Visiting Fellows and research officers. The cluster is concentrating much of its attention on changing relations between firms and changing organization within firms in manufacturing industry. In the developed world, a considerable literature on these questions has emerged in recent years.

In this literature there tends to be a division between analysis of small firms and analysis of large firms. In recent years work on the activities of small firms has been given great impetus by the apparent success of the Emilia-Romagna area of northern Italy, the so-called Third Italy. In this region, networks of small firms appear to have gained a strong competitive position and a major presence in certain international markets. In other parts of Europe too, groupings of firms in industrial districts seemed to have weathered the recessions of the 1970s and 1980s relatively well.² The small firm literature, therefore, focuses predominantly on inter-firm linkages.

Studies of reorganization among large firms, the focus of this Bulletin, has been stimulated by the increasing dominance of Japanese industry and the attempts to introduce Japanese methods into Europe and North America. Japanese firms have been very successful in manufacturing, and a large part of this success has been attributed to the way large Japanese firms are organized - their management structures, their links with supplier companies and the way they organize production activities on the factory floor. Many Western firms are desperately trying to find out the 'secret' of Japanese success and adopt many elements of Japanese practices themselves. In this literature there is a varying emphasis on inter-firm and intra-firm organization. Major changes in relations between firms of all sizes are clearly taking place, and there is a considerable and long-established

literature on inter-firm links in Japan. A recent conference on inter-enterprise networks (IILS 1992) highlighted some of the changes taking place. At the same time, many firms are making great efforts to reorganize their internal structures and activities, and there is a large and rapidly-growing literature on this topic.

For those studying the Third World, there is a strong incentive to incorporate new ideas about industrial development. They can help to anticipate future developments and also provide a better basis on which to formulate policy. However, anticipating events in the Third World on the basis of new theories about the First has two major problems. Firstly, the characterization of trends in the First World may be inaccurate. Secondly, First World experience may not be relevant or applicable to the Third.

Industry cluster members have questioned the accuracy of new theories of inter-firm and intra-firm organization (Schmitz 1992; Humphrey 1992), but it is the question of the relevance of such theories to the Third World which is currently the centre of attention of a number of the cluster's members. A recent issue of the IDS Bulletin (Rasmussen and Schmitz 1992) was dedicated to considering Third World evidence on relations between small firms. It examined the clustering of small firms in a wide range of Third World countries.

This current issue of the IDS Bulletin aims to do the same job for reorganization in large firms. It is based largely on work carried out or coordinated by industry cluster members. The four articles on Brazil arise out of a research project led by John Humphrey, while the articles on Zimbabwe and Mexico are derived from a research project and from doctoral research carried out under the direction of Raphael Kaplinsky. Humphrey and Kaplinsky have also written an article each for the issue.

¹ The author wishes to thank Raphael Kaplinsky and Hubert Schmitz for comments on an earlier version of this Introduction, and the ODA for support for editing this Bulletin.

² For an overview of industrial districts in Europe see Sengenberger and Pyke (1991). For a review of the policy conclusions which can be drawn from these experiences, see Schmitz and Musyck (1993).

The focus of this Bulletin is the transformation of the organization of production within firms and the consequences this has for suppliers. Clearly, this means that such important areas as industry policy, trade policy, education and training policies, and macroeconomic adjustment will only be touched upon indirectly. This is a deliberate choice. There are so many misconceptions about intra-firm reorganization that the priority at the present time is to establish that important changes are taking place and to understand better what the consequences of such changes might be. Examples of a more directly policy-oriented approach to organizational change in large firms by industry cluster members can be found in Fleury and Humphrey (1992) and UNCTC (1993).

Other important aspects of the recent work of the IDS industry cluster are also unrepresented in this issue. A major strand of the cluster's work has been in the operational field, working on policies for particular countries, including Cyprus (Murray 1992), the Dominican Republic (Kaplinsky 1991), Jamaica and South Africa. Work on macro and sectoral level policies has been complemented by the active involvement of cluster members in the implementation of organizational reform at the plant level.

In the course of 1993, a workshop and further publications will bring some of the results of this research into the public domain. The cluster will be pursuing research on both large and small firms, and on the macro industry and trade policies needed for large and small firms to prosper in changing national and international environments. Collaboration will continue with researchers from Europe and the Third World, doctoral students, international organizations and the private sector. This issue of the Bulletin also reflects part of this mix of contacts and collaboration, having articles from members of the cluster, doctoral students (one recently completed, one continuing), recent Visiting Fellows at the Institute, and Third World nationals who are collaborating with industry cluster research.

The remainder of this Introduction will present the views of just one of the cluster's members about the main issues raised by the various contributions to this volume. Inevitably, some of the discussion of reorganization within firms includes some rather technical language. At the end of this Introduction there is an Appendix which provides brief defini-

tions of a number of the more specialized terms used here and in the succeeding articles.

2 ARE LARGE PLANTS IN THE THIRD WORLD REORGANIZING?

The nature of this reorganizing is discussed in Sections 3 and 4 of this Introduction, but the brief answer to the question just posed is 'yes'. In fact, organizational change seems to be viable in a wider range of economies than might, at first, be imagined. The case studies from Zimbabwe and India show that JIT/TQC is not restricted to the Newly Industrializing Countries of East Asia and Latin America. The articles in this volume on Brazil, Argentina and Mexico suggest that the introduction of JIT/TQC is both rapid and extensive. Major transformations of industry are taking place, yet they have hardly been documented at all.

However, the articles in this Bulletin also make clear that elements of JIT/TQC can be adopted in very different ways. Evidence of the use of techniques such as kanban or SPC (see Appendix) by no means indicates that a company is becoming highly competitive or efficient or has adopted a total package of improvement. In other words, it does not appear to be the case that firms in the Third World are adopting wholesale a tightly-linked model of related innovations, as would be suggested by the proponents of Lean Production (Womack, Jones and Roos 1990). A discussion of what might be the basic elements of JIT/TQC and a possible minimum package of innovations follows in the next two Sections.

3 WHAT IS INVOLVED IN REORGANIZATION?

Reorganization has many facets. Inside the firm, reorganization can involve not only the way in which production is carried out, but also shifts in managerial structures, changes in the relationship between design and production, and new relations with suppliers. It is for this reason that Hoffman and Kaplinsky (1988) characterize the changes taking place as a shift from machinofacture to systemofacture. In some companies, at least, there is a systemic change, involving all aspects of company activities. Relations with other firms may also be transformed as companies seek more reliability of supply (both in quality and in delivery) and more cooperation in the development of new products.

The articles in this Bulletin are concerned with the reorganization of production, particularly changes designed to raise productivity and quality. These changes are often referred to as Just-in-Time (JIT) and Total Quality Control (TQC).³ The key elements of JIT/TQC can be viewed from many different angles. Here four elements will be highlighted:

- 1 An emphasis on improved flows of production, using kanban (see appendix) or other pull systems of production control, manufacturing cells, stock reduction and smaller lot sizes. The ultimate ideal is for products and parts to flow through the factory without stopping.
- 2 Tracing quality problems back to their origin and resolving them at that point. The later quality problems are detected, the costlier they are to rectify. Quality should be achieved by (i) systematically tracing problems back to source and trying to resolve them, and (ii) giving production workers and managers responsibility for quality. Inspection is not abandoned (in many TQC factories it is intense), but quality control is no longer separated from production activities.
- 3 Worker Responsibility and Involvement. JIT/TQC places greater responsibility on direct production workers. They have to produce the right amount of goods at the right time with the right quality. They may also acquire jobs formerly done by others, such as quality checking and routine maintenance. This gives them greater responsibility, but it is often accompanied by greater supervision and control - regular appraisals, intensified surveillance, and a clear attribution of goals and errors.
- 4 Continual improvement (kaizen, see Appendix). JIT/TQC systems tend to institutionalize the search for continual improvements in the efficiency of production.

This core of organizational change is a subject of the articles by Kaplinsky, Posthuma, Ruas, and Franzoi and Rodrigues. But these changes are related to many others. Marx considers how changing policies by large automotive firms in Brazil affect small components producers. Similarly, Ramirez considers the impact of JIT/TQC in Northern Mexico on the Mexican car industry as a whole and on the

position of Mexican suppliers to the major multinational assembly companies. Fleury considers the changes in company culture which can arise from new production methods, and Roldán puts change in production into the wider context of debates on deregulation, industrial restructuring and gender relations. Humphrey puts the drive for quality improvement in Korea in the context of macroeconomic pressures and government policy. Inevitably, other relevant areas such as design, marketing and increasing cooperation between large companies have had to be ignored.

4 IS THERE A SINGLE JIT/TQC MODEL?

Much of the discussions of new forms of production organization argue that JIT/TQC has to be adopted as a single, comprehensive package. The authors of a key text on the topic, Womack, Jones and Roos (1990), lay out a model of 'lean production' which includes manufacturing, design and supplier relations. According to Cooke:

The essentials of Toyotism [lean production] cannot satisfactorily be implemented either piecemeal or isolated from each other. They are, as Jones (1990) has put it in describing lean production, 'only fully functionable when all elements are in place and working together' (Cooke 1992: 5).

In contrast to this, the articles in this Bulletin show a wide degree of variation in the implementation of JIT/TQC, which is the production-oriented side of the broader lean production model.

In part, these variations can be accounted for by differences in production processes. Leaving aside dimensional industries, such as chemicals and steel, the technologies required in industries making discrete products vary considerably. A machining or forming operation has very different characteristics from assembly activities. JIT/TQC principles will be operationalized in different ways according to the processes used. However, the differences found in this Bulletin go beyond this. Roldán argues that in Argentina there is a continuum from high-level JIT in large, technically-advanced firms through to low-level JIT, which is much more limited in scope. Similarly, Ruas contrasts the use of elements of JIT/TQC in metalworking and in more traditional sec-

³ See the Appendix to this Introduction.

tors such as footwear and furniture; and Posthuma's analysis of organizational change in Zimbabwe shows how firms adopting JIT remain a long way below international standards of excellence.

How are these findings to be interpreted? One strategy is to discount such findings by arguing that less comprehensive versions of JIT/TQC are transitory: either firms adopting such versions will go on to adopt full-blown JIT/TQC, or they will be forced out of business by other firms adopting the full JIT/TQC package. This writer takes an alternative view. There are significant differences by sector and size of firm. It has to be proved rather than assumed that deviations from an ideal model of JIT/TQC are less efficient. Even if they are less efficient, the market will only eliminate non-adopters or imperfect adopters very slowly. In short, the variations in JIT/TQC found in the articles in this volume are likely to persist for a very long time.

The appropriate analogy here is with Fordism and Taylorism. Over half a century after Ford had introduced the assembly line and Taylor had developed his system, significant parts of industry had either been left untouched by these developments or had adopted them in a variety of different forms. The same unevenness and differentiation is likely to characterize the spread of JIT/TQC. Even though manufacturing industry is much more internationalized and internationally competitive now than it was 70 years ago, a similar unevenness of spread of innovation across sectors of industry, sizes of firm and countries will be observed. This unevenness will reflect both differences in efficiency - some firms will adopt JIT/TQC with greater effectiveness than others - and also variations in the appropriateness of particular JIT/TQC techniques in different sectors.⁴

5 IS THERE A MINIMUM PACKAGE OF JIT/TQC MEASURES?

If there is no single JIT/TQC model, is there a minimum set of changes which firms must adopt to make JIT/TQC effective? The case studies in this volume point to some basic elements:

- some reorganization aimed at improving the flow of production and achieving quality-at-

source. Kanban and SPC are two means of achieving these goals, but they are by no means the only ways of doing so.

- a commitment to change from top management. This seems to be essential for change to succeed. The importance of a commitment by top management is stressed consistently in the literature. Kaplinsky's study in this Bulletin also highlights this point, as did research in Brazil (Fleury and Humphrey 1992). Similarly, Posthuma in this volume shows the negative effects of top management not being committed to thorough-going change.
- reorganization of management structures. The need to reorganize management structures is most clearly outlined in Fleury's article. Relations between different departments have to be reorganized and management hierarchies flattened if new production systems are to work.
- training and involvement. Training for production workers seems to be an essential feature of JIT/TQC. This training will contain technical and motivational aspects. Workers have to be both equipped with the understanding required to implement JIT/TQC techniques and be motivated to put them into practice. This motivation may be based on consent or compliance (see below).

In addition to these commonly-found features, it is also possible to find firms examining their position in the market and redefining their strategies, as shown by Kaplinsky's analysis of Compton Greaves Ltd in India. The depth of change undertaken by this company is striking - examination of markets, managerial reorganization, new product and process strategies, extensive motivation of labour and clear goals for continuing improvement - and it is seen relatively rarely in the literature. Roldán's notion of high-level JIT implies a similar comprehensive change, and some of the Brazilian firms described by Fleury are also making deep changes. However, many of the firms studied in this volume did not reorganize so extensively, as shown by the articles by Marx, Ruas and Posthuma.

⁴On the issue of 'national' variants of Taylorism and its spread across the world, see Montmollin and Pastré (1984). Wood (1991) argues that a core of JIT/TQC practices, which he calls 'Toyotatism', should be distinguished from the employee relations and supplier relations

associated with them. He argues that the introduction of Fordism into Europe was not accompanied by the social relations seen at Ford's plant in Detroit.

6 THE IMPACT OF JIT/TQC ON LABOUR

The impact of JIT/TQC on labour is a controversial question. Some writers argue strongly that the need for worker involvement and multi-skilling is bound to provide significant benefits for labour. Equally, critics of Japanese management systems have argued that labour will be subjected to oppressive control and increasing intensity of work. A number of the articles provide evidence on this issue, although it should be borne in mind that little of the research involved direct interviews with workers.

Roldán's article argues that workers' position improves only in the transnationals and large locally-owned firms which have an international orientation. In other companies, change is often forced on unwilling workers by fear of unemployment. She also argues that there is a strong gender dimension to the impact of JIT/TQC on labour. Women are concentrated in those firms which are not upgrading labour, and within firms they lose out relative to men. In factories employing both men and women, the introduction of multi-skilling and functional flexibility (see the Appendix to this Introduction) tends to lead to men being given formerly female tasks in addition to their own, with a consequent displacement of female labour. In one all-female plant, Roldán argues that a reluctance to invest in training for women acted as an obstacle to JIT/TQC.

These findings were not confirmed by the Brazilian case studies. Although gender issues are not explicitly raised in them, a number of the factories described by Fleury employed women workers. In at least two, multi-skilling and extensive training had been extended to female workers as well as male. Roesch (1991) describes significant investment in female training in a Brazilian firm introducing JIT/TQC. Clearly further work needs to be done on this question. The sexual division of labour is not likely to be undermined by changes in the development of JIT/TQC. Indeed, the language of JIT/TQC is suffused with notions of skill which are highly gendered (Jenson 1989). However, it is less clear precisely how gendered divisions of labour will be altered by the concrete application of JIT/TQC and what impact these will have on the level of female employment and the type of work done by women.

The articles on Brazil are somewhat divided on the question of the impact of JIT/TQC on labour, and this division is typical of the literature as a whole. Fleury suggests that organizations are changing and workers are benefiting. Power relations are being modified and workers are being viewed as a valuable resource. This is also the message from Kaplinsky's article on India. Quite opposite to this is the position taken by Franzoi and Rodrigues. They argue that the gains to labour are non-existent and that Brazilian managers are only interested in increasing profits, without much concern for either workers or consumers. They argue that a closer inspection of firms show that the apparent gains to workers in terms of training and stability of employment have not in fact materialized. Between these two positions lies the article by Ruas. He paints a more complex picture and suggests that the attitudes of trade unions towards JIT/TQC are beginning to change.

These differences cannot be resolved here. In part, they are differences of perspective and outlook. The Brazil articles are, in some cases, referring to the same firms and are derived in part from the same research project. What is seen by one commentator as an improvement on the past is seen by another as a failure to fully transform the basis of work. Franzoi and Rodrigues compare organizational innovation in Brazil to that in Japan, Sweden and Germany and find Brazil woefully inadequate. This comparison may expect too much of Brazilian firms and also be based on a mistaken view of what really happens in the developed world. The tendency for the literature to establish dichotomies between the new and the old - Lean Production versus Mass Production, for example (Womack, Jones and Roos 1990) - encourages researchers to expect to find more radical transformations of work than are actually taking place.⁵

Problems of interpretation also arise because the impact of JIT/TQC on labour is complex. It can provide opportunities for more training and more varied work. It can also increase the pressure of work and the degree of control and surveillance exercised by management. Differences will arise because JIT/TQC can be introduced in a variety of different ways even in the same industry, as was noted in Section 4. Firms will be influenced in their

⁵ The Director of Personnel at Nissan UK, has argued that Nissan is a still a mass producer, albeit a lean one, and that in spite of worker involvement assembly line work remains 95 per cent externally

controlled (Wickens 1992). Hence, lean production will not lead to a total transformation of work.

use of JIT/TQC by such varied factors as the education and training available for labour, the industrial relations situation (see Humphrey's article), competitive strategies (Ruas), and the age of capital equipment and the opportunities for replacing it (Posthuma). These differences might vary from firm-to-firm, or be sector-specific, or influence JIT/TQC implementation across a whole country.

7 INTER-FIRM RELATIONS

Much of the work carried out on JIT/TQC is based on case studies of forms or groups of firms. In many cases, leading firms are studied, because it is in these firms that the process of change is likely to be most advanced. Case studies have, almost inevitably, to focus on these leading firms. However, this creates a bias in understanding.

Part of this bias arises out of the fact that JIT/TQC is often associated with a process of contracting out of peripheral services and changes in supplier relations. Firms increasingly rely on a network of suppliers of goods and services. Therefore, a full understanding of the impact of JIT/TQC requires study of the suppliers of goods and services. These may be large companies providing services such as security, canteens, cleaning and maintenance, or small enterprises (sometimes created by former employees) providing specialist services. In addition to this, companies using JIT/TQC are reorganizing their existing supplier networks and demanding improved quality procedures and systems. Marx's article in this Bulletin examines the way small firms respond to this pressure.

It is at this point that the literature on small firms and industrial districts, as exemplified by the recent IDS Bulletin on this topic (Rasmussen and Schmitz 1992), comes into direct contact with the literature on JIT/TQC in large firms, which is the focus of this Bulletin. While much of the literature on small firms has focused on the relations between small firms and their grouping in industrial districts, Schmitz (1992) has shown that in the Baden Württemberg region, it is large firms which are at the centre of inter-firm networks. These large firms may promote organizational change within their suppliers, who may be small or large.

There is no reason to suppose, however, that small firms will benefit from this process. Marx's article underlines the exploitative nature of the relations between large and small firms in Brazil, while Ramirez discusses the consequences for local firms of the implantation of JIT systems in transnational car companies in Northern Mexico. There is clearly a danger of small firms being excluded from supplier relations, either because large firms concentrate supplies in a much smaller number of more technologically and organizationally able companies (Marx on Brazil) or because the large firms bring in their own established suppliers when they set up new plants (Ramirez on Northern Mexico). This is an area which requires more research.⁶

8 CONCLUSIONS

The articles in this Bulletin indicate that many firms in different countries are experimenting with JIT/TQC. There are gains to be made in a wide variety of industries and in countries with varying levels of industrial development. JIT/TQC is not limited to sophisticated firms in advanced economies. The pressures to introduce elements of JIT/TQC in Third World industry are likely to increase over the next few years. Increasingly demanding customers in export markets and the threat of increased competition from foreign producers entering into liberalizing domestic markets will force firms to seek improvement in quality and productivity. JIT/TQC is one of the clearest and most widely-proclaimed strategies for achieving such improvements.

This presents a number of challenges for Third World countries. Posthuma's analysis of firms in Zimbabwe shows that some limited gains can be made relatively easily. But to go beyond limited one-off gains and embark on a company-wide search for continual improvement may take much greater efforts. These efforts are almost certainly intensive in management and engineering skills, which are often in short supply in developing countries. As Marx's article on small firms in Brazil notes, small firms may not even have the minimal managerial systems required to analyze processes and keep track of performance and costs.

⁶ For a critical assessment of the problems of small suppliers working for large companies in advanced countries, see Semlinger (1989).

The development of JIT/TQC beyond a core of leading firms will present a major challenge for governments in Third World countries. In order to take full advantage of the potential for JIT/TQC firms will need educated labour, access to new technologies, improved management systems, and a better infrastructure of transport and services. The industry cluster will continue working on these questions, and on the links between micro reorganization and macro policies for industry, trade and education.

JIT/TQC poses threats as well as opportunities. Negative impacts on women workers are highlighted by Roldán, while Franzoi and Rodrigues are extremely sceptical about the benefits of quality programmes in Brazil for both workers and consumers.

The articles by Marx and Ramirez point to the dangers of smaller firms being marginalized by the process of supplier upgrading. JIT/TQC may create a marginalized sector of second-class firms. It may also deepen divisions in the labour force between those who benefit from increased skills and responsibility and those who are excluded.

The articles presented in this Bulletin show clearly that JIT/TQC is affecting significant portions of manufacturing industry in the Third World. Its impact is likely to increase rapidly in the next few years. The industry cluster at IDS intends to remain at the forefront of research on this issue, linking increasingly work on small firms with work on large firms and examining the wider policy implications of the changes currently taking place.

REFERENCES

Cooke, P., 1992, 'The experiences of German engineering firms in applying lean production methods', Paper presented to forum on 'Lean production and beyond - labour aspects of a new production concept', Geneva: ILS, November

Flcury, A. and Humphrey, J., 1992, 'Recursos Humanos e a Difusão e Adaptação de Novos Métodos de Qualidade no Brasil', Working Paper, Brasília: IPEA, (a revised version of this Report will appear as an IDS Research Report in 1993)

Hoffman, K. and Kaplinsky, R., 1988, **Driving Force**, Boulder: Westview

Hradesky, J., 1988, **Productivity and Quality Improvement**, New York: McGraw-Hill

Humphrey, J., 1992, 'New technologies, flexible automation, work organization and employment in manufacturing', **Technology and Employment Programme Working Paper No 225**, Geneva: ILO

IILS, 1992, **Is the Single Firm Vanishing? Inter-enterprise Networks, Labour and Labour Institutions**, Forum Series on Labour in a Changing World Economy, No 1, Geneva: International Institute for Labour Studies

Jenson, J., 1989, 'The talents of women, the skills of men: flexible specialization and women', in S. Wood (ed.), **The Transformation of Work?**, London: Unwin Hyman

Jones, D., 1990, 'The further development of the Toyota Production System: the age of lean production', Paper presented to International Operations Management Association conference, Warwick, June

Kaplinsky, R., 1991, 'Progress note on Dominican Republic industrial strategy', mimeo, University of Sussex, Brighton: IDS

Montmollin, M. and Pastré, O. (eds.), 1984, **Le Taylorisme**, Paris: La Découverte

Murray, R., 1992, 'Flexible specialization in small island economies', in F. Pyke and W. Sengenberger (eds), **Industrial Districts and Local Economic Regeneration**, Geneva: International Institute for Labour Studies

Roesch, S., 1991, 'New technology, functional flexibility and the problem of labour retention at the enterprise level', mimeo, Porto Alegre, Federal University of Rio Grande do Sul, Postgraduate Programme in Administration,

Schmitz, H., 1992, 'Industrial districts: model and reality in Baden-Württemberg, Germany', in F. Pyke, and W. Sengenberger (eds), **Industrial Districts And Local Economic Regeneration**, Geneva: International Institute for Labour Studies

Schmitz, H. and Musyck, B., 1993, 'Industrial districts in Europe: policy lessons for developing countries', **Discussion Paper**, forthcoming

Schmitz, H., Rasmussen, J. and Van Dijk, M-P. (eds), 1992, 'Flexible specialization: a new view on small-scale industry?', **IDS Bulletin**, Vol 23 No 3

Semlinger, K., 1989, 'Stellung und Probleme kleinbetrieblicher Zulieferer im Verhältnis zu grossen Abnehmern', in N. Altmann and D. Sauer (eds), **Systemische Rationalisierung und Zulieferindustrie**, Frankfurt: Campus

Sengenberger, W. and Pyke, F., 1991, 'Small firms, industrial districts and local economic regeneration: research and policy issues', **Labour and Society**, Vol 16 No 1

Tenner, A. and DeToro, I., 1992, **Total Quality Management**, Reading, Massachusetts: Addison Wesley

UNCTC, 1993, 'Transnational corporations and the transfer of new management practices to developing countries', forthcoming

Wickens, P., 1992, 'Lean, people centred, mass production', Paper presented to forum on 'Lean production and beyond - labour aspects of a new production concept', Geneva: ILS, November

Wild, R., 1990, **Essentials of Production and Operations Management** (3rd edition), London: Cassell

Womack, J., Jones, D. and Roos, D., 1990, **The Machine that Changed the World**, New York: Rawson Macmillan

Wood, S., 1991, 'Japanization and/or Toyotism?', **Work, Employment and Society**, Vol 5 No 4

Yamashina, H., Matsumoto, K, and Inoue, I., 1991, 'Prerequisites for implementing CIM - moving towards CIM in Japan', in **Computer-Integrated Manufacturing: Perspectives for International Economic Development and Competitiveness**, UNECE/UNIDO

APPENDIX: GLOSSARY OF TERMS

batch size A batch is the number of the parts produced by a machine or process before a different part is produced. A large volume of production may be processed in separate small batches. (See set-up time.)

functional flexibility The ability to switch workers between tasks. This may be horizontal - switching between different tasks of the same basic nature (switching between different assembly jobs, for example) - or vertical, in which workers accumulate different types of tasks, such as production work, quality control and maintenance.

greenfield site A factory built in a new, non-industrial location - hence the allusion to green fields. In contrast, existing factories, or factories built in existing industrial areas may be referred to as brownfield sites.

ISO 9000/4 'The International Organization for Standardization has developed a series of standards for total quality management. ISO 9000 provides guidelines for their selection and use. ISO 9001 covers **product** design, development, production, installation and servicing. ISO 9002 covers production and installation, and ISO 9003 covers final inspection and testing. ISO 9004 includes all elements of standards 9001-9003' (Tenner and DeToro 1992: 241). Countries which adopt similar standards should be able to have them recognized by other countries and in theory, this mutual recognition of standards should lead to freer trade. However, some countries at GATT, particularly the less-developed, fear that imposition of complex and exacting standards for imports to more developed countries will act as a barrier to their exports.

Just-in-Time (JIT) One definition of JIT is simply 'to produce the right quantity, at the right time with the right quality'. Putting this principle into practice means improving the flow of goods and cutting down on stocks. The fastest and cheapest way for a product to pass through a factory system is for it to move by as short a route as possible through all the stages of the production process, never stopping or waiting. Everything else is waste. JIT seeks to eliminate waste - defective work, reworking, storing, waiting, inspection, etc. JIT is often thought of in terms of supplier relations - suppliers deliver small lots frequently, direct to the line without incoming inspection (right quantity, right time, right quality). But JIT is probably more extensive and important as a principle of organization **within** plants. 'Internal' JIT is more extensive and probably a precondition for effective use of 'external' JIT.

kaizen Continual improvement. All processes can be improved. Kaizen is the practice of institutionalizing the search for improvement. This can be done by forming groups of workers (Quality Circles, small group activities) and management task forces to seek better (less costly) ways of doing things. Kaizen works best when (i) JIT and TQC have simplified production systems so that their workings are transparent, and (ii) workers are organized into teams and have some knowledge of jobs other than their own.

kanban Kanban is a form of inventory and production control using simple manual and clerical procedures. At each stage of the production process, levels of stocks are controlled by kanban cards which are attached to containers holding parts. When an operation uses up stocks of inputs, the empty containers and the cards are sent back to the preceding operation. This acts as an instruction to produce one more container of parts. In this way, production is

'pulled' forward by the demand of the next station in the chain. Kanban cards are just one means of implementing a 'pull' system. Kanban works best when there is a steady demand for a limited range of products. If demand is variable or product range great, centralized planning, using a production planning package such as MRPII, may be the best way to obtain low-stock, integrated production (Yamashina *et al.* 1991).

lot size The number size of products to be processed at one time. A lot can be defined as a group of products which are moved around or stored together - a bin of parts, for example. (See batch size.)

mini-factories To operationalize JIT and TQC, large plants can be divided into smaller units, mini-factories, each with full responsibility for production, maintenance and quality. Mini-factories may produce different parts of a single final product (axle assemblies for vehicles, for example), or they may be devoted to different product ranges (for example, men's moccasins and women's fashion shoes).

Quality Assurance Schemes in which companies specify and check the production and quality procedures in supplier companies so that supplies can be accepted without incoming inspection.

set-up time The time taken to switch equipment or machinery from producing one product to another. If set-up times are long, then it is costly to produce small batches because shifting from one product to another takes a lot of time and effort. Hence set-up time reduction is one way of making production of small batches viable. (See batch size.)

Statistical Process Control (SPC) In spite of its name, SPC is '10 per cent statistics and 90 per cent management action' (Hradeskey 1988: 1) The visible part of SPC involves using simple statistical techniques, mainly charting of means and variances, to monitor production processes. The less visible part involves, firstly, making sure that processes are sufficiently under control to be monitored effectively in this way and, secondly, to have in place the problem-solving techniques, training, motivation and planning required to respond to the problems which are located.

throughput time The time taken to transform a product from raw material to finished product, or, alternatively, the time between receipt of an order

and despatch to the customer. Both indicators measure the flow of production and the speed of response to customers. The term 'lead time' can also be used to refer to the time elapsed between order and despatch, although it can also be used to refer to the time taken to bring a new product into production.

Total Quality Control (TQC) TQC philosophy involves being concerned with all the aspects of quality which are of concern to the customer, including the original quality of the product, servicing, after-care, etc. The whole of the organization should be dedicated to achieving quality. Among the key points of a TQC strategy, as defined by Deming, the originator of the concept, are reduction in the number of suppliers, recognition of production systems and workers as being sources of faults, improvements in on-the-job training, use of statistical methods and improved communication (Wild 1990: 346-47). TQC is often referred to as TQM, Total Quality Management, as this emphasizes the difference between the new approach to quality and the old style.