NEW INDUSTRIAL ORGANISATION AND NEW TECHNOLOGIES: IMPLICATIONS FOR LABOUR, SKILLS AND TRAINING IN DEVELOPING COUNTRIES

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1. FLEXIBLE MANUFACTURING

1.1 Introduction

Japan's success in world trade, particularly in a number of industries in which she has achieved global dominance, has created much interest in her systems of industrial organisa- tion which replaced the conventional `mass production' system. These systems are now being applied elsewhere in both the developed economies (of America and Europe) and also the developing countries in East and South East Asia, and would appear to have considerable implications for other developing countries wishing to enter the global market for manufactured goods.

The Japanese began to compete successfully with the Western economies in the late 1960s and 1970s through the widespread introduction of lean or `flexible manufacturing'. Many would probably agree with Friedman when he states that "Japanese success in machinery and automobiles tends to confirm the view that the nation's competitive success was based more on product differentiation than on co-ordinated efforts to reduce the costs of standard goods" (1).

In general, the term `flexible manufacturing' has been used to describe new forms of industrial organisation which differ from mass production and are strongly oriented to a rapidly changing market, "which means combining the craftsman ability to make customised products with the economy of the assembly line" (2). "As the name implies, flexible specialisation overturns the industrial commitment to standardised products, and does so by producing smaller batches of differentiated goods through the use of general-purpose flexible machinery and new forms of work organisation" (3). In addition, the Japanese gave high priority to quality. The emphasis on quality is not a recent phenomenon. Indeed as early as 1940, Matsushita Corporation initiated a formal quality improvement campaign with a customer-focused approach.

The new forms of work organisation are frequently known as `lean production' which allegedly combines the benefits of craft and mass production, without their disadvantages. It delivers "quality and variety without the cost penalty of craft production and the large cost advantage of mass production. It uses half the factor inputs compared with mass production - half the human effort, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time" (1).

1.2 <u>Mass Production versus Flexible Manufacturing</u>

It is worth noting the contrast between the two systems because they have immense implications not only for the technology used but also for the skills and training required. To quote Friedman (1:15),

"Mass production is an attempt to produce a single good at the highest possible volume to reduce costs through economies of scale. Flexible production is the effort to make an ever-changing range of goods to appeal to specialised needs and tastes with tailored designs.

A mass production strategy thus carries several consequences. First, the skill level of the work force continually declines as each labourer becomes responsible for an ever more limited repertoire of operations. The more a good is standardized, the more limited individual responsibilities in the factory become. Second, production machinery becomes more specialized until gradually each piece of equipment is dedicated to a single manufacturing task along the assembly line. Hence as worker skill declines, the machinery becomes more specialized; the entire factory is itself dedicated to volume production of a single good . . . The mass producer thus runs its factory through a hierarchical system of management, adopting strategies that deskill the work force, require dedicated, single-purpose equipment . . .

A flexible producer, by contrast, would be crippled by the rigidities inherent in mass production. The essence of flexible manufacturing is to make a wide variety of goods tailored to specific needs. To do so, a flexible producer requires a high level of skill in the work force, to facilitate rapid changes in manufacturing processes . . . workers need to be able to make changes on their own, lest the burden on top management inhibit the firm's ability to meet or create new demand . . . Furthermore, because product designs are constantly changing, the flexible producer must rely on general-purpose machinery. Single-purpose machinery would be much too inflexible to permit rapid design shifts, and too costly . . . Finally, to coordinate parts for new products, or to make it possible to integrate a new part design into a finished product, flexible producers require very close technical contacts with other firms . . . In sum, a flexible firm adopts strategies that require a highly skilled work force operating with minimal supervision, general-purpose machinery, and close coordination with other producers".

The contrast between the two systems, is summarised in Box 1.

Box 1	Mass Production (Fordism)	Lean, flexible production (Post-Fordism)
Production:	Standardised products, economies of scale, low cost, ex-post quality, vertical integration	Diversified products, economies of scope, ex-ante quality at least cost, development of supply chains
Technology:	Specialised dedicated	General purpose machinery
Labour:	Narrowly trained, conception and execution separated and fragmented, routine tasks, narrow job classification, division of labour	Broadly trained, conception and execution integrated, multi-skilled and varied tasks, broad job classification, teamwork
Management:	Hierarchical and formal	Flat hierarchy, informal
Competition:	Strategy to control market	Fast adaptation to change
Institutional framework:	Centralised	Decentralised

Source: Based on Rhys Jenkins (5)

2. <u>THE JAPANESE SYSTEM</u>

Lean flexible manufacturing in Japan was aided by (a) the application of `hard' new technologies and (b) the introduction of `soft' technologies such as new organisational structures. This section describes the soft technologies and Section 3, the hard technologies.

The main features of the Japanese production system are:

(i) Just-in-time production (or time principal);

(ii) new inter-firm relationships (sub-contracting);

(iii) quality control (or zero defects principle);

(iv) team work (or quality circles);

(v) kaizen (or continuous improvement);

(vi) customer orientation.

2.1 `<u>Time to market' productivity</u>

JIT refers to a firm which "takes delivery of materials, parts and components just as they need them for production" (6). One definition of JIT is, "to produce the right quantity at the right time with the right quality. Putting this into practice means improving the flow of goods and cutting down on stocks . . . JIT seeks to eliminate waste - defective work, reworking, storing, waiting, inspection etc" (7:8). JIT refers both to buying of components from suppliers and also to the production of finished goods. JIT is not only applied within a plant (internal JIT), but also from suppliers to the plant (external JIT). Many firms in order to remain competitive have resorted to JIT, partly to keep stocks to a minimum, and partly to achieve faster contact with end-users.

2.2 Sub-contracting

A key element of JIT is the sub-contracting system which is widespread in Japan. Toyota and Nissan began to use sub-contractors on an extensive scale, which in turn began to implement similar `flexible' strategies. The auto firms were quickly followed by the electronic (Toshiba and Matsushita), and machinery (Mitsubishi) firms. The degree of sub-contracting varies according to the type of industry. Electronics, autos and telecommunications which depend heavily on components use the sub-contracting system, but even within the garment industry, there has been a shift from mass production to flexible production, ie. from large mass orders to small orders with short delivery periods, and consequently extensive sub-contracting.

The distinctive feature of Japan's sub-contracting is the system of layers, which can go as far as five layers below the principal and each layer is responsible for the work of the layer below. For example, Toyota has a hierarchical supplier structure which is headed by 168 first-tier suppliers. In some industries such as electronics, "Much of the supply chain management is devolved onto first tier suppliers . . . These have their own organisations of sub-contractors" (8).

2.2.1 Reasons for sub-contracting

A 1982 survey of manufacturing industries in Japan (4:158) into the reasons for sub-contracting elicited the following responses:

- Sustain a long-term relationship 73%
- High-quality products 61%
- Use technology of vendor 42%
- Good delivery times 39%
- Low cost 30%

Responses according to industry. In the case of the machinery industry, it was found varied in an earlier survey (1968) that "Technology (60 per cent) and equipment and labour-skill (72 per cent) were more important reasons for sub-contracting than low wages". In general, the major factors are long-term relationships quality of product (and hence quality of workforce, technology and cost).

(i) Long-term relationship

Close contacts between parent and suppliers has introduced a new form of inter-firm relationship. Whereas under mass production, relationships tended to be adversarial, under flexible manufacturing there is a high degree of co-operation.

"As inter-industry linkages increase, the role of ancillaries and sub-contracting assumes greater importance. This places greater responsibility on both the sectors to make the relationship mutually beneficial, in the interests of the economy . . . In Japan, sub-contracting is regarded as an essential role of the parent company and the parent-sub-contractor relationship is not lightly cut off on the basis of short-term judgment alone. The sub-contractors also do not look upon themselves as mere suppliers" (9).

(ii) Technology

Since the supplier is "under great pressure to meet quality standards, delivery times and requests for cost improvements", the close relationship between `parent' companies and suppliers often includes measures to improve the capability of the latter. "The buyer will often assist with technological improvements, staff training and even with finance . . . Technological relationships with suppliers are particularly important. In many cases, company investment in R&D is not just for application within the company but on behalf of its whole supply chain" (10).

(iii) Cost

Most large Japanese companies depend very heavily on a mass of small and medium-sized enterprises which sub-contract to the larger firms. "The system of small-firm support [in Japan] also affected product innovation in existing enterprises because the diffusion of flexible firms in Japan made it less costly even for large and established manufacturers to adopt new designs or ideas. Most large firms spread production among smaller-scale suppliers, each of which was pursuing . . . flexible production strategies" (4:21).

Large firms which tend to pay higher wages also bear the cost of non-wage costs of employment (such as pensions, holiday pay, health and safety conditions). The sub-contracting small enterprises are noted for low pay, few benefits, poor conditions of work and no security of employment. Hence, by sub-contracting, the larger firms can maintain and increase their competitive edge by reducing the burdens of labour costs.

2.2.2 Factors influencing sub-contractual arrangements in LDCs

It is not only the parent companies that establish overseas sub-contractual arrangements: many first tier suppliers follow if not precede. "The importance of large first-tier suppliers is illustrated by the fact that the largest supplier of the largest Japanese electronics principal went in advance to an Asian country, where the principal was planning a foreign investment, to organise a local network of suppliers . . . Interestingly, large suppliers in the Japanese system were expected to anticipate their principal's wishes in these regards rather than waiting to be asked" (8). `Parent' companies and first-tier suppliers seeking sub-contractors in LDCs consider a number of factors, viz: political stability, low wage rates, economic incentives (e.g. tax holidays), geographical location (foreign domestic markets) and a skilled and dependable labour force.

The paramount factor is reliability of supply (in terms of quality and delivery). It is noticeable that the Japanese are highly selective about joint-ventures and sub-contractual arrangements in Third World countries. They cannot afford the damage to their brand image of a faulty batch of components or irregular deliveries which impede the production flow in the parent companies. Suppliers who fail to deliver products on time, simply lose customers. "Despite the risks suppliers have little choice but to gear their delivery to their customers' JIT schedules. In a recent study of European manufacturing firms, McKinsey found that timely and reliable delivery was deemed more important than service, price or brand; only the producer's specification ranked more highly. In a bid to cut costs and perhaps shift more of the burden of stock control on to their suppliers, many firms are demanding that deliveries be hyper-efficient" (11). Speed and quality considerations would also seem to be true of investment in some Mediterranean countries (e.g. Tunisia, Cyprus, Malta) which can rapidly supply parent companies in Western Europe.

Distance from the main assembly plant is another important factor. Under the JIT system, "Proximity between suppliers and assemblers is key, otherwise there is little prospect of maintaining tight delivery schedules and low inventories". Countries which are far from the main industrial centres will most probably be adversely affected. The adoption of JIT is likely to lead to a reduction in off-shore manufacture in `distant' countries and an increase in off-shore production in countries close to the industrial core countries. In Southeast and East Asia, there are many examples of Japanese firms, joint ventures and domestic firms sub-contracting to Japan. For example, Mitsubishi makes car parts in different parts of Asia, for example, doors in Malaysia and transmissions in the Philippines (12). Indeed it is claimed that, "Japan's big businesses no longer distinguish between Japan and the rest of Asia when they make investment and marketing decisions".

Much of course will depend on the type of product. Where the product has a high transport-to-value ratio, greater emphasis will be placed on proximity to the ultimate market, because of the time factor in long-distance shipping. On the other hand, where the transport-to-value ration is low, then air transport can be used and proximity to markets becomes relatively less important.

Other factors, organizational structures, ability to master new technologies will influence location. "Without the use and adaptation of new processes and techniques, the consequential organizational arrangements, the location of new industries in developing countries may present greater difficulty. At the same time, the inadequate technological infrastructure, particularly the lack of human skills, may constitute a major constraint in such localization" (13:3).

In short, a local enterprise has to acquire technology in order to become a supplier or sub-contractor but such acquisitions depend on the confidence of a foreign manufacturer in (a) the country and (b) the enterprise.

"The transfer of industrial technology implies the transfer of specialised production and management know-how between different parties which are generally industrial enterprises . . . As distinct from the sale of machinery and equipment which embodies technology, the transfer of technology in most cases calls for a substantial relationship between two enterprises over a period of time, so that the receiving enterprise can produce the product with the desired level of quality standards and cost-efficiency" (14:411).

The relationship between large (foreign) firms and local suppliers will be strongly influenced by the ability of the latter to introduce quality controls into their manufacturing system.

2.3 Product quality

The JIT structure based on zero-inventories can only operate if parts arrive without defects. Therefore JIT regimes zero-defect policy.

"The primary function of inventories in the Fordist system was to protect against any possibility of disrupting production - inventories were a buffer just in case anything went wrong. So if a move was made to zero-inventories, it became imperative that enhanced quality-control procedures be introduced. Nothing can be allowed to go wrong since there were no inventories to back up the system" (15:15).

To implement a zero-defect policy, it was necessary to introduce a rigorous system of total quality control (TQC).

"Zero-defects - total quality control system assures that by strict control of quality, from purchasing of inputs through to production and final assembly, none of the firm's products are rejected for failing to meet quality standards" (6).

Hence, TQC requires quality checks in the production process rather than afterwards. It involves, "tracing quality problems to their origin and resolving them at that point" (16:3), in contrast to the US system of detecting quality defects at the end of the production run, which was separated from the production activity.

"The TQC principle requires separate quality control departments to be abolished and control of quality to be carried out within the production area. Each work station is simultaneously a point of quality control" (7:45).

2.4 Quality circles

TQC places greater responsibility on production workers for quality control, since it requires the worker to be responsible for quality rather than a quality control unit. Production workers are required to detect problems and deal with the defects as they arise. "By its nature quality control - and more important the rectification of errors - necessitates decision-taking . . . at the base of the production hierarchy". In order to ensure a high degree of quality, (ie. a very low defect rate), the Japanese formed `quality circles', small groups of workers at each stage of production to monitor quality and make the necessary decisions. In several case histories of firms, it was found that the team concept was popular among workers and that there had been "a precipitous drop in grievances, absenteeism and lost time accidents" (17), and also much lower labour turnover.

2.5 Kaizen

Workers are also expected to adopt a policy of `kaizen', which is the practice of continually seeking improvement. `Kaizen' or continuous improvements depend on workers having sufficient incentive to propose ideas on technology or process improvements. Such ideas may be labour-saving and therefore detrimental to their own job prospects. To overcome this problem, Japanese firms encourage the multi-skilling of workers, so that "If workers are skilled at more than one task before technical change occurs, and if the change increases demand for workers in other jobs at the firm, it is in the firm's own interest *ex post* to transfer these workers to other jobs. It follows that multi-skilled workers will co-operate with labour-saving technical change in cases where singly-skilled workers will not" (17). In Japan, workers will volunteer suggestions for improved technology, if they know that they will be redeployed rather than replaced.

3. <u>NEW TECHNOLOGIES</u>

An important dimension of the transformation of global manufacturing has been technological advance, which is a major determinant of production patterns. Micro-electronics is at the core of the technological revolution and characterises the new technology. The new flexible manufacturing system could not have taken place without the new technologies. "The key to production flexibility lies in the use of information technologies in machines and operations. These permit more sophisticated control over the production process . . . one of the major results of new electronic and computer aided production technology is that it permits rapid switching from one part of a process to another and allows the tailoring of production to the requirements of individual customers" (18:116).

Rapid progress in micro-electronics has led to the extensive use of automation in manufacturing industry, in particular the use of numerical-controlled (NC) or computer-guided machinery. It was the Japanese who took the lead in the application and in particular the dissemination of the new technologies. "A handful of electronic and machinery firms made their initial NC products in the early 1960s religiously copying American designs. But Japanese manufacturers concentrated on developing small, easily programmable general-purpose machines catering to small-scale, flexible operations. US manufacturers all but ignored this market; they viewed NC equipment as a big ticket speciality item for large clients who could afford the price. At home and abroad Japanese NC machine tools turned out to be a smash hit" (4:27). The use of automated technology has enabled the Japanese to reduce costs, raise quality and develop new models more rapidly and given them a strong competitive edge over their US and European rivals.

The application of computer-aided designs (CAD), computer-aided manufacturing (CAM), have greatly assisted the change in production processes. Moreover, "A wide range of studies shows the significant competitive advantages arising from the incorporation of electronics in products and processes" (15:17). Computer-integrated manufacturing (CIM) "permits new products to be produced very quickly once they have been designed . . . It also permits manufacturers to respond rapidly and flexibly to the specifications of customers and to changing market conditions" (6). For example, each cash register in Benetton's 3,200

sales outlets in 57 countries is linked by satellite to its Italian headquarters. Daily information on sales provides instant feedback to the firm's sub-contractors, and production is adjusted accordingly.
Flexible manufacturing systems (FMS) integrate all these elements: NC, CAD, CAM and CIM.
"Measured against some of the machinery they replace, flexible manufacturing systems seem expensive. But the direct comparison is a poor guide to the economies that flexible automation offers. Flexible automation's greatest potential for radical change lies in its capacity to manufacture goods cheaply in small volumes ... Flexible manufacturing brings a degree of diversity to manufacturing never before available" . . . The strategic implications for the manufacturer are staggering. "Under Fordism, the greatest economies were realized only at the most massive scales. But flexible automation makes similar economies available at a wide range of scales . . . Manufacturers can keep up with changing fashions in the market place . . . Many more options are available for building a new plant . . . (freed) from the tyranny of large-scale investments . . . thus allowing construction of smaller plants closer to markets" (19).
Faster computers and better telecommunications have reduced the optimum size of businesses. With such new technologies, manufacturers do not have to mass produce in order to maximise profits. With computer-controlled flexible manufacturing, it is possible to tailor `batches' to changing customer needs and still earn high profits.
The shift towards flexible specialisation tends to favour smaller firms. Much of the work undertaken by small and medium-sized firms in East Asia is sub-contracted, the extent of which varies considerably according to the industry. Many small firms in developing countries are handicapped by the limited use of numerically controlled machine tools (NCMTs) and the lack of computer based systems (for co-ordinating planning and production). However, this is beginning to change. Fong's study of industry in Malaysia (20) found that many Malaysian firms were adopting micro-electronic technology mainly to improve product quality and competitiveness. A crucial aspect of the introduction of the micro-electronic technologies is the workers' acceptance. Where such technologies are perceived to be a major threat to job security, then resistance will be strong. The Japanese system of emphasising broad-based skills and job redeployment rather than displacement seems to have overcome such opposition.

4. <u>IMPACT ON LABOUR</u>

"Technological innovations are bound to have far-reaching repercussions not only on the number of jobs available on the labour market but also on the content and organisation of work and hence on skills and qualifications required of the workforce" (21).
This section examines the impact of technological change and industrial organisation on labour, skills and training.

4.1 **Implications for Employment**

Several scholars have discussed the effects of micro-electronic (ME) technology on employment. In Malaysia, Fong found "The net gain in employment created by additional output generated by the ME equipment in many cases more than compensates the labour `saved'" (20:41). Firstly ".... ME technology is likely to improve the user's labour productivity, particularly among the small firms in the electronics and electrical and general machine manufacturing sub-sectors. Secondly, it will increase linkages between small and large firms in these sub-sectors through the promotion of sub-contracting" (20) and that these linkages would lead to employment expansion. Elsewhere, labour displacement created by labour productivity gains is not always compensated by expansion of total output and generation of additional employment. For countries which have adopted an export-led manufacturing strategy, there appears to be little choice.As Fong states, "For many export-dependent industrialising Third World countries, the popularisation of ME equipment represents a development dilemma. ME equipment is capital-intensive and its adoption will reduce employment generating opportunities, particularly the need for unskilled labour. However, failure to adopt ME equipment will constrain the country's exports of its manufactured products to the advanced countries since increasingly advanced economies are requiring standards in products and services which could be met only by ME-based production processes" (20).

4.2 **Implications for Skills**

There is considerable debate on the implications of new technologies and organisation on skills. "Some commentators have been expecting deskilling and redundancies . . . some anticipate polarization within the workforce, while some suggest that there is a need to upgrade skills at all levels" (22:82). Obviously in the case of rapid technological change, some skills will become obsolete while other new skills will emerge (see 23). The results of a study in Brazil for the application of new technology and systems of production indicated that "there will be an increasing demand for more highly skilled and qualified workers, while job opportunities for unskilled labour will diminish" (22:82), a finding that appears to be fairly common.

Under mass production system, price was the dominant form of competition and therefore the cost of labour had to be minimised. Under the new flexible manufacturing systems, "innovation is the most important competitive attribute and labour is seen as the primary source" (2). In short, the quality of labour, rather than the cost of labour is increasingly seen as a critical factor. What had until recently been regarded as an asset, will probably become a liability. Labour costs are becoming less important in manufacturing as a portion of total cost. Subsequently the earlier emphasis on low-cost labour has already begun to decline. Hence, countries with large pools of unskilled labour are unlikely to attract foreign investment in manufacturing.

4.2.1 A question of machinery

Much will depend on the type of machinery introduced. Bhagavan (24) makes the distinction between `specific purpose' and general purpose machinery and the skill implications of using these different types of capital goods.

"The capital goods that are designed to mass produce one, or at most a few, specified parts are called specific-purpose equipment. To minimise the cost of production, and at the same time to maintain a certain standard in quality, special purpose equipment is so designed and arranged in a line flow that the labour of the workers attached to it is reduced to the repetitive performance of a few fragmented operations (repetitive part work). . . . "Such specific-purpose machinery requires mainly unskilled and semi-skilled workers.

"Multi-purpose equipment (also called general-purpose equipment) is designed for jobbing or batch production that is, to manufacture different products in small numbers. They are used mostly in engineering industries for the making of machines or parts of machines. The most common examples of multi-purpose equipment are machined tools. Skilled workers are more in demand in engineering processes that use multi-purpose equipment.

The ILO has also observed that whereas "the earlier literature tended to emphasise the de-skilling effect of micro-electronics . . . recent research provides limited supporting evidence. NCMTS, for example, may, in principle, be operated by machinists with less qualification than was required for earlier machines. In practice, however, managers generally prefer to allocate highly qualified staff to work with NCMTS because they are much more expensive, more productive, more vulnerable to possible misuse and more costly to keep idle in case of malfunction". The more integrated and automated production systems require efficient maintenance and rapid repair to reduce lost production time. Indeed, there is a steady shift towards skills for what might be described as `operation-cum-maintenance' tasks. Hence in manufacturing processes which have adopted micro-electronic innovation, there is a decline in demand for low-level skills, and an increase in demand for multiple skills" (25).

4.2.2 Flexibility and Multi-skilling

Under the new system, firms have to be flexible to respond to rapidly changing needs and hence labour has to be sufficiently flexible to meet specific and varied orders. "Mass production and flexible production require different skills in the factory, different strategies for using labour and machines" (1:15).

Box 2 Impact on Labour Mass Production Versus Flexible Production

1. Mass Production
A mass-production strategy carries several consequences. First the skill level of the workforce continually declines as each labourer becomes responsible for an ever more limited repertoire of operations. The more a good is standardised, the more limited individual responsibilities in the factory become . . . The mass producer thus runs its factory through a hierarchical system of management adopting strategies that deskill the workforce.

2. Flexible Production
A flexible producer requires a high level of skill in the workforce, to facilitate rapid changes in the manufacturing process . . . workers need to be able to make changes on their own, lest the burden on top management inhibit the firm's ability to meet or create new demand. Hence worker supervision is much less extensive than under mass production and the number of tasks a worker must master is always expanding.

Source: Friedman (1: 16-17)

JIT systems require flexible and multi-skilled labour. "JIT production is most efficient when flows of material are simple and straightforward. This is mainly achieved by means of production layouts which require multi-tasking or multi-skilling of labour. Such labour can rotate between jobs and carry out quality control and preventive maintenance. This leads to a high degree of intensity of work" (7: 45).

Firms require `flexible' workers in order to reduce the costs of constant adjustments to frequent design and product changes. Hence workers with a broad basic technical knowledge and the skill to understand and adapt to new production technologies are to be preferred. In order to obtain improved quality and flexibility it is necessary to not only redesign work organisation but also the inputs of workers, which can be called `behavioural reform'. `All rounders' are in demand in a wide range of activities from the small automotive workshops, where mechanics with additional skills of panel beating and paint spraying are required, to the garment factories where workers familiar with different garment machines are highly prized, and the electronics industry where technicians are expected to service a wide range of machines. Japanese sub-contracting small firms "started to rotate workers on the assembly lines and to give them a large degree of autonomy, in order to make it possible for the firm to make new products or to meet changing demands for existing goods. Sub-contractors had to encourage high skills and worker autonomy to meet the changes that contractors sought as they began to modify their own production systems" (1:156).

In Malaysia, Fong (20) found that the introduction of micro-electronic technology led to a significant shift in the profile of the workforce in the firms that introduced the technology. Many had to take on "expansion of job responsibilities". In some countries (eg. Singapore), this has led to the development of hybrid skills such as `mechatronics'.

4.2.3 Quality circles and greater worker responsibility

The introduction of total quality control and `kaizen' (continuous improvement) requires workers to work in teams with minimal supervision. Friedman, on the basis of his work in Japan, is quite emphatic: "A flexible firm adopts strategies that require a highly skilled workforce operating with minimal supervision" (1:16).

The `team approach' means closer collaboration between companies and suppliers, between managers and workers and among workers in quality circles. The lack of a team approach is, in the opinion of some Japanese industrialists, the reason for the industrialised West's decline and "there is nothing you can do about it because the reasons for your failure are within yourselves. With your bosses doing the thinking while the workers wield the screwdrivers, you are convinced deep down that this is the right way to do business. For you the essence of management is getting the ideas out of the heads of the bosses and into the hands of labour. For us, the core of management is the art of mobilising and putting together the intellectual resources of all employees in the service of the firm" (26). Under flexible production systems, the role of management is also changed. "Managers must be team leaders and facilitators and be competent at planning and co-ordinating production rather than at directly overseeing the workplace. Workers must be flexible, well trained and motivated" (27:19).

In Cyprus, the `requirements' for different levels of workers in manufacturing industries have been assessed. These consist of multi-skilling, familiarity with technology, team work, continuous improvement etc. (see box 3).

Box 3

Impact of New Technology and Work
Organisation on Education and Training

The Need for Different Kinds of People

It is the quality of its labour force that will determine a firm's competitiveness and success, and the reorganised factory of the future will need different kinds of people at all levels of the hierarchy. Three levels of personnel are discussed, below: production workers, supervisors and engineers/technicians.

(a) Production workers

- The workers must be given sufficient training and guidance to do their job properly. Quality and performance standards for the job must be clearly defined. They must be well-equipped to do their job and encouraged to ask for help or even additional training.
- The new practices require the worker to be multi-skilled and to develop multi-functional capability if production bottlenecks are to be avoided and if production losses due to frequent design and product changes are to be minimised. The skill base thus has to be both broadened and deepened.
- The workers must be able to operate in groups and to have responsibility for deciding among themselves on issues such as work organisation and solving a range of problems which arise during production.
- Creativity and initiative are essential for the solution of these problems. This will only emerge when workers are encouraged to offer suggestions. In quality circles, and to suggest schemes for product development and for improvements in process, quality, productivity and working conditions.
- Workers must be adaptable to continuous change and be prepared for frequent job changes.

(b) Supervisors

- The supervisors must learn that their primary responsibility in production is to support and facilitate the workers rather than to assume a dictatorial attitude.
- Supervisors must be retrained to have quality as their main objective and not to see their primary function as squeezing more output out of workers.
- They must be able to take quality problems to management and expect action.
- They must eliminate fear in the workplace and be able to communicate and cooperate freely, both vertically and horizontally.
- Supervisors must be people of initiative and creativity, and be able to inspire their fellow workers.
- They must have a very good knowledge of the new work practices, production planning/control and reorganisation of production.
- They must be multi-skilled and multi-functional.
- Supervisors must be up-to-date on technological developments.

(c) Engineers/Technicians

- Engineers must be not only multi-skilled, but also multi-disciplined. Ideally, they should have electrical, mechanical, electronics and computer knowledge.
- The role of the engineer is often seen as white-collar and managerial, whereas engineers in the new practices are expected to be constantly involved in solving problems on the shopfloor in support of production workers. They must be ready to dirty their hands.
- They must be constantly concerned with improvements in the production process to increase performance, to improve quality and to suggest ways for product development.
- Engineers must be up-to-date on technological developments.

Source: adapted from Siekker (28)

4.3 Dual Labour Market

In boom conditions, production is raised through not only the use of overtime but also sub-contracting and recruitment of `temporary' labour. The parent company tends to keep its workforce numerically constant, whereas the sub-contractor uses numerical flexibility, ie. varying the number of workers employed according to demand conditions.

Privileged workers are carefully `cultivated'. The development of a "more multi-skilled workforce requires a fundamentally different attitude by capital towards labour which has to be seen more as a resource than a cost. It also militates towards stability amongst core workers" (15:17). For example, under the `Nenko' system, close cooperation is encouraged with key workers so as to retain their skills in industries in which technology is changing rapidly, and hence `in house' retraining is required. In contrast, peripheral factory workers often suffer from long hours, minimal training, low pay, poor working conditions, and sex discrimination, which has led to considerable labour unrest.

As a result of the expansion of the system of sub-contracting and multi-skilled work, there is beginning to emerge a dual workforce of `privileged' or `core' workers (with relatively higher wages, better working conditions and fringe benefits), and a `peripheral' workforce with low pay, no security of employment and few benefits. The `core' workers tend to be employed by the large enterprises whereas the `peripheral' workers are employed by the small and medium-sized sub-contractors. Hence, "The JIT/JER/TQC model is based on a dual economy in which workers in central firms receive high wages and stable employment, while the same benefits are denied to workers in peripheral firms. This consolidates segmented labour markets" (29).

4.4 <u>Labour Shedding</u>

In many of the smaller sub-contracting firms, there is little protection for the workers. In order to avoid outright retrenchment which creates adverse publicity, some firms adopt a practice of job enlargement whereby "workers now have to do more work or a greater variety of jobs with a concomitant expansion of responsibilities" (30). Another device to reduce labour costs is `temporary shut downs' which " in the name of stock-taking have also been very common (in Malaysia). While this helps the plant to tide over and adjust to short-term difficulties, it has severe repercussions on the income and subsistence of the women workers who are only paid on the days they work" (30). Management also adopt the tactic of job rationalisation which "involves the reduction of indirect labour (clerical, supervisory and even lower management workers)".

A widespread practice is the use of recontracting. "What this means is that after workers have been retrenched, they are then re-hired (when the need arises) on contract, for example for three months. The past experience of the factory worker is not taken into account when she is re-employed", which may mean a substantial drop in wages. "After the end of the three month contract the firm has the flexibility of not signing another contract with these workers if production orders do not warrant it. This eliminates all responsibility for redundancy and retrenchment compensation. Also the company need not provide the other allowances and benefits received by staff on its normal payroll. As a result of these activities, employment agencies specialising in recontracting labour have sprung up. Such practices are linked to the use of JIT where flexibility is of the utmost importance and the objective of saving costs . . . by eliminating surplus workers easily" (30).

Nevertheless, it does seem in East Asia that unfettered labour markets have led to an increase in real wages and have done more to improve the economic welfare of workers than the government or union regulation.

4.5 Systematic Recruitment techniques

The traditional practice of recruiting at the factory gates which suited the Fordist approach is being replaced with a much more rigorous selection process, which includes a series of screening tests (physical aptitude and psychological as well as in numeracy and literacy) and interviews to identify suitable workers. Successful candidates are then further assessed for their ability to learn to work in teams, solve problems and maintain commitment. For example, applicants for jobs in Toyota (UK) undergo assessments for a total of 16 hours.

4.6 Implications for Labour Unions

Sub-contracting in several developing countries is frequently conditional on the lack of strong trade unions that could (a) increase labour costs and (b) prevent flexibility in organisation and the use of manpower. For example in Korea, during the 1960s and 1970s, the labour unions were suppressed to the extent that there was no organisation to represent the workers' interests, improve working conditions nor generally prevent exploitation.

In the larger firms, union structures will have to change "The old craft unions which characterized many of the Fordist systems and which reflected the trend towards the increasing division of labour are widely considered to be no longer appropriate. Enterprise-firm or sector-wide unions are probably essential if multi-tasking and multi-skilling work is to be introduced. Second, the old system of confrontation in work can no longer apply where co-operation and the two-way flow of information are essential" (15:17).

5. IMPLICATIONS FOR TRAINING

There is no blue-print for the type of training required, apart from the tenets of an industrial culture - concepts of time, regularity and reliability. The ILO noted that "traditionally education has emphasised knowledge and training has emphasised skills but neither has given sufficient attention to developing personal characteristics. In traditional manufacturing, this omission has not been disadvantageous...but in the future, through development of appropriate personal characteristics - for example the ability to work as a member of inter-disciplinary team - to communicate effectively and to learn will be at least as important as competency in knowledge and skills" (26:21). Much depends on the mode of production and the emphasis placed on certain skills. Repetitive work requires little training. On the other hand, flexible production requires a greater variety of skills and hence a broad based, good quality education, upon which specialised (but not narrow) occupational skills can be developed.

5.1 Skills Required

Job specific skills will need to be supplemented with other general skills which enable the worker to adapt to changing technology and organisations. According to a Brazilian study (24), the skills (or attributes) most needed for flexible automation and organisational techniques are as follows:-

Flexible automation	Organisational Techniques
- logic	- initiative to resolve problems
- ability to learn new skills	- identification with firms' objectives
- general technical knowledge	- ability to learn new skills
- responsibility for production process	- responsibility for production process
- initiative to resolve problems	- logic
- concentration	- general technical knowledge
- discipline	- discipline
- identification with firm's objectives	- oral communications

Written and motor communication, oral communication and manual dexterity, although important, nevertheless were low on the employers' priority listings. The findings of CBI Task Force in the UK (31) on `desirable common learning outcomes' emphasised effective communication, application of numeracy, applications of technology (especially the role of information technology), working knowledge of computers, understanding of basic economic ideas (wealth creation, growth and competition), personal and interpersonal skills (to identify responsibilities and undertake a variety of roles), set targets for personal self-development, problem-solving and a positive attitude towards change.

5.2 Knowledge Required

The areas of knowledge required by workers in manufacturing industries according to the Brazilian study (24) are in descending order:-

Flexible Automation	% of Respondents	% of Respondents
Organisational Techniques		(firms)
Informatics	82	65

Electronics	73	
Global production process	72	87
Functions of machines	70	
Maintenance	58	
Electrics	58	
Mechanics	57	
Statistics	44	70
General knowledge	42	68
Management of production	42	74

5.3 Training Systems

The production of flexible workers requires flexible training systems. Under mass production systems "time based, standard curriculum-driven vocational training programmes were the order of the day... enterprise-based training was limited to short-term objectives (i.e. meeting immediate and specific skills needs). In a rapidly changing world, however, continuous adoption of training programmes to meet changing demand has become a major challenge".

In the Brazilian study (24), vocational training and general education were "perceived as the most important means by which these skills and areas of knowledge might be best acquired. Work experience while considerably less important than either of the other two was also perceived as relevant by 75 per cent of the firms . . . In house training institutions were ranked as the most important . . . closely followed by external training institutions, `on-the-job' training and finally courses provided by the suppliers of equipment." (Although there were differences according to industrial sector.)

On-the-job training is an important component of industrial training and will become increasingly important as LDCs switch resources to manufacturing industries. As Senker (32) argues, "In an environment of more rapid technological change, extensive vocational training to national standards may no longer be the most effective route to economic competitiveness. In this environment, in-house training by firms to meet their own specific and changing needs may be more effective from an economic point of view."

Not infrequently foreign companies (particularly Japanese) will send more specialized workers to Japan for an intensive two to six week training programme. Sometimes this is supplemented by `attachment' to Japanese parent companies for longer periods, to acquire Japanese production methodologies and in particular working practices, through observation, formal instruction and experience of belonging to quality control teams. Fong (20) also found that much of the training in ME equipment was undertaken by suppliers and in the case of subsidiaries or joint ventures by the parent companies. Furthermore, much of the `follow-up' training was also provided by suppliers and parent companies.

In many countries, however, governments have accepted the burden of vocational training programmes in order to increase the supply of trained manpower and to assist pupils in making the transition from school to workplace. It would appear that in general the private sector is overdependent on state-financed training programmes. This passive role could well impede the development of skills during a very critical period of economic development. Moreover, there is no compelling reason why the state should be burdened with the total expense of technical training, particularly where the beneficiary is private industry. The government should therefore impress upon the private sector the importance of `in plant' training, since it is industry (not the government) that knows best what skills are needed. Furthermore, it is industry (not the government) that gains direct information on technological changes (in their respective industries) and their implications for the appropriate skill-mix and subsequently training. Although as Woodhall points out (33:422), it is difficult to differentiate between general and specific training, the distinction is useful because "it is likely to determine at least in part the extent to which employers are willing to finance vocational training". Hence, different methods of finance are required for different `types' of training. The more transferable the skill required, the more the government should be involved in the financing. Similarly, the less transferable a skill, the greater should be the employer's contribution.

Many medium and small firms are reluctant to train because of their greater vulnerability to `poaching' of skilled workers. Even in the absence of such a threat, most are too small to finance, administer and run their own training programmes and, therefore, depend heavily on the state for skilled manpower. Where the state wishes to achieve a more equal share of the burden, it can assist in setting up group training schemes which cater specifically for a particular industry or locality and which is partly funded by industry either through a levy or other contributions, to the capital costs and/or share of the recurrent costs.

Further training

Further training comprises upgrading and retraining. The upgrading courses are "usually run in-house and target particular company needs or policies" (26:28). Retraining, however, tends to involve the government which is expected to assist in preparing workers for industrial restructuring and creating employment opportunities. In the area of further training, it is therefore suggested that private firms should be encouraged to undertake training which leads to an upgrading of skills and the public sector to take greater responsibility for retraining programmes.

`Lean' Training

Greater emphasis on training does not require an expansion in training departments. On the contrary, they require `lean' training systems. Lean organisations which employ adaptable skilled workers require lean support systems. Hence training departments, whether in-house, private or state run, also have to adhere to the `lean' approach of doing more with less. "Lean training departments deliver training as it is needed and when it is needed. A lean training department fulfils its mission only if it consistently delivers training on demand which usually means at short notice." (34). But just as firms are increasingly contracting out (or buying in) specialised services, so too should training departments. If training departments are to deliver programmes as quickly as possible (in response to rapidly changing demand), it is preferable to outsource training by developing a "network of professionals such as independent consultants and college professors and crosstrain them to deliver core training programmes as needed". Similarly with training equipment, where possible it should only be delivered as and when required. Inventories should be kept to a minimum.

5.4 Education

The introduction of new organisational techniques make it necessary for workers to have numeracy and communication skills. Consequently the general educational system will have to assure that standards of literacy, numeracy and reasoning are improved, so that workers have a good standard of education. According to the I.L.O. "Basic education at the pre-employment stage will require new structures, curriculum and methods of teaching and assessment . . . Secondary education will also need to include vocational training as well as further academic study, and develop appropriate personal characteristics" (26:23). Much more emphasis will have to be given to science, mathematics, computer studies and data processing. Also, as Oshima argues (35), "Much greater emphasis should be put on work education or work ethics in the primary and secondary schools (as is done in East Asia) in addition to mathematics and the sciences . . . work education needed for modern production can be taught without the conversion of social values."

According to management sources in the Malaysian semi-conductor industry (30), "The production worker unlike in the past, when she merely did repetitive tasks, today may tend from eight to thirty machines . . . the worker has to judge when a particular process is not done correctly . . . and rectify it on the machines. In contrast to the worker of the first phase of the semi-conductor industry, she controls her own quality and has some concept of the final use of the products she makes. She is also capable of some simple programming. The companies now need girls who have completed at least basic secondary schooling because manual dexterity is increasingly being replaced with judgmental qualities and sophistication in dealing with machines."

If the educational system can provide the `general framework', ie. a knowledge of the changing patterns of industry and good communication skills, and if the vocational training systems (preferably `in house' rather than external to the companies) can provide the industrial skills (outlined above), the workforce should be able to implement the new systems and thereby not only improve their own productivity but also that of the enterprise.

6. RELEVANCE TO THIRD WORLD COUNTRIES

Export-orientated firms in countries faced with rising wage costs and increasing labour shortages will be forced to reconsider their product lines, production technologies, location, market strategies and in particular organisation, in order to remain competitive in global markets. Competition goes beyond the more static and traditional notions of price of manufactured goods. With increased product differentiation and customisation to niche markets, price comparisons are often meaningless without regard to quality and timeliness of delivery. Hence competition is a multi-dimensional concept which relates to the ability to absorb and use new technology, re-organise firms and sourcing to cover such diverse factors as components, parts, sales networks and after-sales service. "Export-led industrialization stressed the importance of competition on the world market as a way of becoming competitive and earning foreign exchange. Recently the flexible specialization concept stressed that specialization and flexibility are key elements for industrial competitiveness. The new competition strategy may be considered as an integration of the export-led and flexible specialization strategies" (36).

The micro-electronic revolution, industrial restructuring, JIT, quality control, etc. is not restricted to the industrial economies; it also applies to the Third World, particularly to those countries that wish to lock into the international sub-contracting system. As Kaplinsky argues "access to many global markets has become increasingly dependent on the ability to achieve the non-price attributes in production which are associated with flexible production" (38). Countries which wish to embark on export-led manufacturing should realise "that competitiveness requires the capacity to adapt to disruptive circumstances. This applies to LDCs even more than to advanced countries. This is likely to continue, since LDCs are now integrated into the world economy to an unprecedented degree. This integration makes the concern with flexible specialisation . . . more urgent. The trouble is that most existing large-scale industry in LDCs is rigid and unable to respond to new external and internal markets, even worse it is rarely able to adapt to the frequent interruptions in the supply of inputs. Existing small-scale industry is more flexible but often trapped in low profit /low innovation competition. In order to become flexible and innovative, new forms of industrial organisation seem to be required in LDCs" (37).

LDCs can no longer rely on low-cost labour; greater emphasis will have to be given to technological acquisition and improved quality. Highly skilled personnel are required in LDCs to absorb, adopt and apply the imported technologies and industrial organisations. In addition, a well-trained workforce is required to assimilate and diffuse the new technologies and work systems. As Humphrey reminds us "in Third World countries the degree of technological competence which is required to introduce just-in-time, total quality control etc. is often underestimated . . as is the managerial competence that these systems require. These are things that are in short supply in many developing countries" (3:122). Only a few LDCs have technical and organisational capacity and developed infrastructure to adopt JIT in order to lower production costs and attract foreign investment. Japanese investment for example "is going to places where the local workforce is receptive to Japanese ideas about management, meaning that workers can make `zero defects' their guiding principles" (39) such as Malaysia, Thailand and Indonesia. Hence, greater emphasis will have to be given to the provision of industrial vocational skills which are sufficiently flexible to respond to rapid changes.

Much will depend on the markets. Kaplinsky (38) is of the opinion that, "TNCs are unlikely to utilize developing country production platforms for the world market to the same extent as during the past two decades, since both the new economics and politics of production lead to the optimum locale being at the point of the final market. The obvious exception to this, however, is where the changing determinants of global market access specifically promote location in developing countries", i.e. to make use of their quotas into the markets of the developed economies. However, developing countries in close geographical proximity to the core economies of the US, Europe and East Asia can expect considerable TNC investment in `production platforms'.

Overall, the U.N.'s advice has to be taken seriously,

"The application of CAD/CAM flexible manufacturing systems and computer-integrated manufacture have introduced an element of precision and dynamism in design and engineering and in production processes in most fields of manufacture. If developing countries are to face global competition effectively, they must review their industrial strategies and introduce new technological processes into their production sectors . . . The use of CAD/CAM and FMS requires the development of new skills and extensive retraining facilities in developing economies" (13:11).

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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.

Just-in-time 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 a 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 organisation **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 organised into teams and have some knowledge of other 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 on 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).

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 the 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.

* adapted from Glossary in IDS Bulletin, Vol. 24, No. 2, 1993.