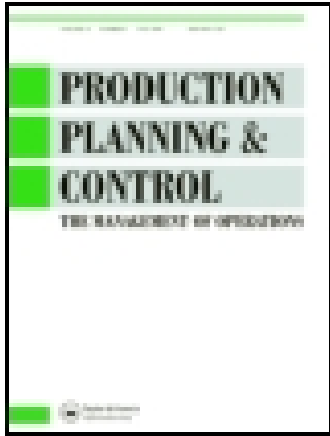


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Production management issues in developing nations

GODFREY C. ONWUBOLU, WILHELM HAUPT, GERHARD DE CLERCQ and JAN VISSER

Keywords production management, systems integration, value chain, change management, developing economies, contract manufacturing, concurrent engineering, theory of constraints

Abstract. Globalization has diluted the disparity between production management issues in developed and developing countries. Pronounced differences between production management in the first and third worlds still exists though. This paper points out both common issues and issues only detectable in developing countries.

Global competition has affected the way organizations now do their business. The customer is now the focus of all businesses. Businesses which enter global markets take these elements of value seriously. Production and operations management is an important activity in the value chain and helps to position a firm in the value chain system.

This paper examines the role the following activities play in production management in developing countries: value chain management; lead time compression; appropriate technology manufacturing systems; quality issues; the theory of constraints; supply chain and distribution management; contract design, manufacturing and marketing; concurrent engineering; configuration management and change management.

This paper concludes that production in developing countries is challenging and exciting.

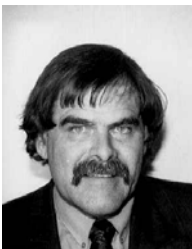
1. Introduction

The traditional decision criteria for determining whether a country is developed or developing include the ability of a country to manufacture most of the products consumed locally. Other criteria are the

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provision of education for people at all levels and the standard of health service that can be measured in life expectancy and infant mortality. The standard of infrastructure also comes into play and would include power, transport and communications systems. Other important factors include the pool of skilled labour, state of civil order, effectiveness of governance, extent and state of the established industry, and the strength of the economy. The strategic competition positioning model (Hines 1995) which is divided into five stages is appropriate for our purpose of positioning nations as developed or developing (figure 1).

It is interesting to note that the development of technology leading to the globalization of human activity has diluted the disparity between production management issues in developed and developing countries. Pronounced differences between production management in the first and third worlds can still be pointed out though. This paper aims to point out both common issues and issues only detectable in developing countries.

In considering the current state of production management and the path to be followed by developing countries, it is helpful to understand the developments that have taken place in manufacturing and marketing sectors over the last decades. Developing countries can avoid the mistakes made by their predecessors on the development path and can become competitive by leapfrogging into the future.

The post-war industrial nations used very low single technology techniques and offered little added value services. Customers generally accepted anything sold to them by their suppliers. Western industrialists from Europe and the USA had little option but to compete on a price basis. The market began to saturate in the

1980s and the Japanese seemed to outperform Western technology in the market. Emphasis shifted from price competition (stage 1 in figure 1) to quality competition (stage 2).

Deming (1982) and Juran (1991) took their quality campaigns to top Japanese managers, who accepted their arguments before their less gullible American competitors. The Japanese therefore took the lead in total quality programme, statistical process control tools, and in emphasizing quality product delivery to their customers. In the 1990s, the Japanese swiftly shifted through close co-operation (stage 3) to strategic partnership (stage 4). Since then, the West followed because of the reported successes of Japan. Close co-operation brought the theories of supply chain, customer chain, Kanban production and just-in-time (JIT) purchasing, advance manufacturing technology, activity-based costing, zero strike/industrial relations, and vertical integration to the fore. Strategic partnership emphasizes the supply chain up to the third tier. Kyoryoku Kai is a Japanese term for subcontractors at different tiers who meet regularly to discuss optimum servicing of industries.

Several forces have been identified which drive today's global market. These include: economic growth, supply chain perspective, regionalization, the technological explosion and general deregulation.

The need to develop new markets to sustain growth was the primary force that motivated firms to seek customers abroad. Initially, they outsourced to neighbouring geographical regions. To promote regional trade and protect partners from distant competitors, countries began to formalize trade relationships and the signing of treaties. The forming of the European Economic Community (EEC) in 1957 and the Canada—United

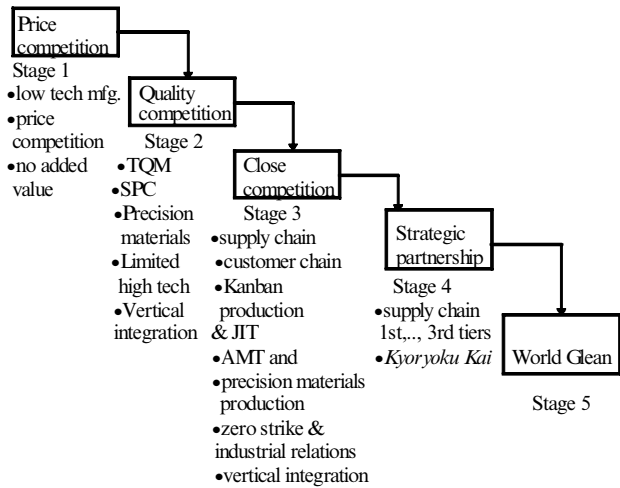


Figure 1. Strategic competitive positioning model (Hines 1995).

States Free Trade Agreement (FTA) of 1989 are good examples. Many others exist and some have already lost relevance.

The demographics of the major global regions of the immediate past are shown in table 1. Trade and gross domestic product levels are indicated. It is clear that a major triad of industrialized regions developed in North America, Western Europe and the Asia Pacific Rim. New players are emerging and old relationships started to change overnight. Global marketing and global logistic practice became the challenge of production management.

This paper is a discussion document based on a survey on production management issues that was conducted in newly industrializing countries (NICs) in Southern Africa. While no claim is made as to the extent to which survey results would correspond to studies performed in developing countries in Latin America, Eastern Europe, the Middle East, China and Oceania, it can be expected that similarities in position, challenges

and opportunities exist. The survey comprised a simple, but fairly open-ended, questionnaire sent to prominent figures in the automobile and steel sector, service sector, mining sector, telecommunication and energy sector, and consultancy sector. This tested the perception of industrialists regarding production management issues.

We found some commonality and some divergence between the perception expressed by these industrialists and the views of industrialists in developed countries, as published in the subject and excellence literature. The more sophisticated entrepreneurs and business leaders in macro or state-of-the-art enterprises gave invaluable information. On the other hand, it transpired that small and micro enterprises in many sectors seldom contemplate production factors not concerning business as usual. The remainder of this paper discusses perceptions on some of the production management issues studied.

2. Value chain management

The challenge of production management and manufacturing function is to deliver the value that meets customer requirements. The goal of a firm should be to achieve a quality cost combination of value that maximizes both customer benefits and the firm's profit. Recently, the issue of the value of a product as defined by the customer has become very important. Firms create value for their customers by the activities they perform. The measure of the value of these activities is the price the firm's customers are willing to pay for its products. The firm makes a profit if the price is greater than the total cost of all the activities the firm performs.

Porter (1985) introduced the concept of value as a competitive advantage paradigm. The value chain concept is a strategic competitive positioning of companies for their long-term success. Every firm is positioned in a

Table 1. Regional demographic and merchandise trade. Source: OEDC Economic surveys (country) Paris: Organization for Economic Cooperation for Economic and Development.

	Population		Export		Import (FOB)		1989 GDP Value
	Million 1990	% Change 1980–1990	Value 1990	% Change 1980–1990	Value 1990	% Change 1980	
North America	275	1.0	525	6.0	641	7.0	6 474
Latin America	451	2.0	148	3.0	133	0.5	950
Western Europe	438	0.5	1613	7.0	1685	6.0	7 092
Central/Eastern Europe & USSR	407	1.0	182	0.0	187	0.0	161
Africa	645	3.0	94	2.5	93	0.0	368
Middle East	126	3.0	132	5.0	103	0.0	185
Asia	2903	1.5	791	9.5	765	8.0	4 864
Total	5245	1.5	3485	5.5	3607	5.5	20 094

value chain system as a supplier value chain, organizational, channel value or customer chain. Porter showed that the chain activities of a value chain are linked at a number of points to form a value chain system. The systemic approach emphasizes the fact that activities in the value chain should not be carried out in isolation. However, Porter's concept of the value chain system has been criticized by Hines (1995) as placing too much importance on company profit rather than consumer welfare. Hines claims that the model shows a rather divisional network, both internally and between the different value chains in the system, and that the wrong functions are highlighted as important both in the primary and secondary activities.

The issue of value chain is now emphasized as a production management issue in developing countries. Firms agree that they can only survive in today's competitive market place if they develop a long-term partnership with suppliers outside their geographical neighbourhood in order to satisfy customers.

All the firms covered during our survey confirm that supply chain management is a major issue in their business. Some work has been done to investigate supply chain management in the pulping industry, showing that the pulping industry trading in commodity pulp products has been ranked with steel and petrochemicals as being exposed by some of the fiercest competition (Swann 1993, Pallett and Hugo 1997). Pallett and Hugo conclude that achieving an integrated supply chain relies on the development of partnerships across functional and divisional boundaries, and on orientating the production process towards the needs of the customers. However, they conclude that in the Southern African pulping industry, the current level of supply chain integration is low. However, the level of supply chain is high in the automobile sector since they rely on their supply chains within the global context.

3. Lead-time compression

The use of lead-time compression as an order winner is not only employed by manufacturers and service delivery systems in developed countries, but also in developing countries. Time-to-product and time-to-market determine the competitive edge of manufacturers. This is now compelling entrepreneurs in developing countries to pay attention to lead-time compression as intensely as entrepreneurs anywhere else.

The effective use of time is a key competitive factor in most businesses (Stalk and Hout 1990). Delays in any system may be caused by many of the operation factors for the system. These factors can be managerial, technical and process oriented. A few samples can be cited: increas-

ing production batch size to minimize set-up delays may introduce queuing delays for other products, for example. The application of queuing theory is needed to analyse throughput.

Some delay can be attributed to the presence of hand-offs between several functions, delays in decision making, and inadequate technical and operative skills. Both technical and managerial factors have the effect of lengthening the total time from customer order to receipt. This total time has different components, and managers should take time to isolate and reduce them. The total product delivery lead-time is made up of design lead-time, sourcing lead-time, manufacturing lead-time, distribution lead-time and order lead-time. Time-in-process can be shortened by eliminating non-value-added time, by launching smaller batches resulting in reduction in total time per activity, and by introducing concurrent activities. Management lead-time can be compressed (Hammer and Champy 1994) by integrating the elements that constitute the process in order to reduce hand-offs, or by executing decision processes in a non-delaying fashion with respect to core processes.

4. Appropriate technology and manufacturing systems

Many manufacturing firms in developing countries use low technology manufacturing techniques and materials, and offer little value-added services. They provide basic products which can hardly compete with products manufactured using high technology manufacturing techniques.

Many manufacturing firms in developing countries have job-shop environments. They are reluctant to change despite an awareness of the drawbacks of outdated manufacturing systems. In job-shops, production flow is jumbled up. This has adverse effects on operating costs. Job-shops are known for excessive materials handling, large work-in-process inventory and extensive set-up and lead-times. This has adverse effects on operating costs. The general effect on client satisfaction is negative, but in countries with high percentages of joblessness, the labour intensiveness of such environments is viewed as positive. Labour unions are likely to support resistance to modernization.

Applicable knowledge of group technology is essential to transform job-shops into cellular manufacturing systems. Studies have been conducted with the potential of dealing with practical, industrial situations (Onwubolu 1998). Because the techniques used in these studied works are based on metaheuristics, they are able to cope with practical problems in manufacturing firms which typically will consist of hundreds of machines and

hundreds of parts. Non-metaheuristic techniques which have appeared in the literature over the years are too simplistic and can not deal with real life problems encountered in the manufacturing environment. Appropriate modern machinery, coupled with appropriate manufacturing systems, are needed by developing countries to move from stage 1 to stage 2 of the strategic competitive positioning model shown in figure 1.

Successful implementation of group technology leads to improved design, systematic design review improvement, reduced raw material consumption and purchases, simplified production planning and control, improved routing and machine loading, reduced set-up time, reduced levels of work in progress and shorter production time.

5. Quality issues

In the last decade, emphasis has been placed on the importance of product and service quality in the market place. Customers now take it for granted that their suppliers will supply a quality product or service. Quality is not only an important factor in determining value, it is an order winner, which qualifies a country moving from stage 1 to stage 2 of the strategic competition positioning model. Six levels of quality have been identified (Dale and Lightburn 1992). From the survey, the result of the use of total quality management (TQM) in less industrialized regions (Onwubolu *et al.* 1998) revealed that most manufacturing firms are positioned between stage 6 and stage 4. The best TQM implementations in developing countries do not seem to have risen to stage 3. Most leading manufacturers in developed countries have gone past stages 3 and 2, and have reached stage 1, which is at the peak of the mountain-race to supply quality product to customers. Many firms in developing countries are struggling to gain ISO 9000 system series registration, without the vision, objectives or plans to be involved in quality improvement programmes.

Results of the survey also show that a good number of companies are familiar with and are using TQM strategies, e.g. employee participation, TQM teams, quality circles, customer-driven, quality function deployment and benchmarking. The effectiveness of both the TQM strategies and tools were measured for the companies surveyed. The conclusion from the survey is that although companies are becoming aware of the importance of TQM, there is still much to be done in adopting this philosophy.

In developing countries, many industrialists have studied TQM, and have implemented ISO 9000 on a flavour-of-the-month basis. In these instances, results are not forthcoming, as emphasis is placed on the process

rather than on the expected results. It happens that all conceivable TQM techniques are applied to all aspects of an organization, leading to unwarranted effort and subsequent frustration. Changes in mind set that are not simply taught, but that spread because of contagiousness, are necessary to deliver results.

6. The theory of constraints

The theory of constraints (TOC) is a systems-management philosophy developed by Goldratt (1990). It hinges on the fact that constraints determine the performance of a system, and that any system contains only a few constraints. Constraints may be physical or non-physical. Constraints determine the systems throughput (the rate at which the system generates money through sales) and should therefore attract serious attention from managers.

Physical constraints may include equipment and space limitations. Non-physical constraints may include management style, policies, procedures or market demand. The key definitions of TOC are in terms of money made or consumed by different activities in a business organization. By computing the overhead of each resource based on the market potential, it is possible to identify the capacity constraint resource.

TOC has five focusing steps to guide the process of continuous improvement. Because most production planning and control systems in developing countries are over-constrained, TOC offers an alternative useful technique to adopt. Geysler (1991), South African National Productivity Institute Director of Special Project, asserts that if operations in developing countries are to capture world markets, they have to begin by thinking in a very different fashion as to what TOC offers.

Good production management must identify the constraint that prevents maximum throughput, and subject everything else to it and ensure that this constraint does not continue to bottle up the flow of value. It is clear that production management based on this principle is subject to a very important strategic choice. The product mix that will yield the maximum value must be applied.

Recent developments in technology made it possible to apply the theory of constraints widely in many enterprises and not only in the production management environment of one enterprise. A global decision support architecture in the form of a computer system configures to integrate the traditional functional areas, e.g. purchasing, planning, production, distribution, transport, finances and sales. This technology effectively concentrates all functional aspects of even an international conglomerate into one office, as was previously only possible in small and micro enterprises. Such a system enables the company to process orders, material requirements, cal-

culated capacity information, and other integrated managerial requirements within seconds. Product mixes, product contributions, resource constraints and linear programming are but a few of the planning mix ingredients.

Production management issues now change from targeting high output objectives, towards a focus on the following part of an optimal production plan. The technology can only support skilled planners effectively though. In developing countries, the required expertise is, unfortunately, in short supply.

7. Supply chain and distribution management

Another aspect presently receiving attention in industries is that of supply chain and distribution management. The emphasis is placed on traditional areas of operation that bring massive savings in the shortest time. Although at heart not different from what was discussed above, it focuses on rationalizing purchasing and distribution. It can be explained by using a pharmaceutical chain as an example.

Computer technology makes it possible to analyse business data across many branches. These data could concern suppliers, moving products items, destination listings, etc. The rationalizing and strengthening of relationships amongst suppliers, distributors and customers clientele can result in major savings. Cost savings is a result of improvement in the ratio that exists between the average order size and the cost to process such an order. Electronic analysis of the data can facilitate the relationship management to ensure that this average order size to order processing cost ratio increases. If the average ratio is sufficiently high, the ordering process can be regarded as effective and the total supply chain can usually be shortened.

8. Contract design, manufacturing and marketing

In developing countries, economy of scale is hard to achieve and production runs are often low key and short lived by world standards.

These countries are often not ready to utilize world markets to overcome their offset problems. They are hampered by under-developed marketing skills and infrastructure, or simply by long distances and bad roads. On the other hand, developed countries find it relatively easy to include these countries as part of their global market, very often as a dumping ground for sub-standard product or excess stock. Governments tend to attempt to limit the impact of such dumping by introducing trade control

regulations. Such regulations inhibit free trade, though, and tend to exacerbate the problem in the long term, by isolating the economy. The only real solution is for such countries to find innovative ways to overcome their time to market and other marketing shortcomings in order to build sustainable enterprises.

One solution is to adapt the concept of the extended enterprise (Childe 1998). The 'extended enterprise' is viewed in the literature as a bond of narrower co-operation between the supply chain, manufacturer and (maybe) officially independent marketers. In developing countries, increasing use is made of a matrix-like further extended enterprise, with encouraging results. The concepts of Contract Design, Contract Manufacturing and Contract Marketing come to bear.

Bearing Howe's Law in mind (Every man has an idea that will not work), it is still wasteful that the proposer of an attractive novel invention often has a limited ability to benefit from such an idea. Financing agencies, being local financiers, foreign financiers or even governmental research and development sponsoring agencies, offer lucrative rewards or royalty contracts to the proposers of such (in practice often even unpatented) inventions. Brokers step in to facilitate co-operation. The idea is then offered to known developers, e.g. engineering consultants or university departments. These departments have the ability to produce fully industrialized prototypes with all systems engineering documentation within a reasonable time-span. In the process, they generate much needed funding for teaching and to reward staff more equitably.

The funding agency brokers meanwhile separate contracts with contract manufacturers (Hijbeek 1998). These manufacturers are either established specifically to compete for these contracts (albeit with widely diverse policies and capabilities) or offer excess capacity to these brokers to offset sunk and fixed costs. Similar contracts are entered into with marketers.

In developing countries, the concept of Contract Manufacturing is extended in width as well. Fairly simple sub-systems are given out to previously trained and tested individuals to assemble on a basis of free competition at home and leisure, no large contracts, no commitment. What gets delivered gets paid and the statistical performance of the market carries the system.

9. Concurrent engineering within the contract manufacturing framework

It must be pointed out that the whole interdependent chain of contracts is normally established within a closely-knit community of mutually familiar and trusted concerns. The contracts are put together soon enough to facilitate a measure of concurrent engineering, meaning

that the manufacturer and marketer form a partnership with the developer to ensure mutually acceptable standards and practices. In the intense, dynamic, global market, the combination of innovative products and quality as well as quick development and market entry is crucial for any measure of success (Fischer 1995). Products must also delight customers.

Time-based competition is the flavour of the month, and of some years to come. This is one reason for the entrenchment of concurrent engineering principles. The other reasons are the curtailing of rework and the assurance of continuity despite possible staff turnover. While these needs are heavily emphasized in a contract manufacturing context, they are of equal importance in all manufacturing. In many companies in underdeveloped countries, the principle of concurrency is being established uncomfortably slowly. A serial way of doing things has been entrenched too well. In Africa, there is a sub-culture of tardiness that is detectable in many communities across the continent. What is called 'African Time' bears a similar connotation to the word 'manana', but does not carry the same sense of extreme urgency.

10. Configuration management

Developing countries are not in the financial position to stay abreast of the consumerism of industrialized countries. This means that production runs, although less voluminous, might extend over longer periods. Because of design and industrialization delays (and often the practice of re-engineering), production may also commence later than similar production in developed economies. Components or sub-systems used in production runs are often sourced from industrialized countries. When such components become obsolete at source or are withdrawn from the market for commercial or political reasons, slight alterations and redesigns are effected and production is continued in factories far afield. It is then difficult to keep track of which modifications apply to which product batches for maintenance purposes.

This problem is severely aggravated by the fact that information technology marches on as fast and furiously as any other, leaving a lot of debris in its wake. No matter how diligently a small manufacturer has kept his records on floppy disk five years ago; it will not be accessible to his current computer with a 3¼ inch stiffy disk. The latter will be unusable in the future anyway, as the second generation of CD-ROMs has come and gone. In economies that can not afford the luxury of rejecting and replacing, keeping track of configurations is a definite problem.

11. Change management

It must be realized that developing countries are developing in all areas, not only in engineering, manufacturing and economic terms. In a country like South Africa, literally all laws have been rescinded and rewritten during the 1990s. The same holds true for many other developing countries where strong political development is taking place. Production in an environment where economic realities and labour law and taxation legislation are all changing rapidly requires open-minded management styles.

Applying logical tools, e.g. JIT-management and Kanban systems can easily be rejected in favour of belt-and-braces warehousing in an environment where industrial action can cripple a different part of the supply and delivery chain on many consecutive days. Changing value systems and unpredictable deviations in needs can have devastating effects on industry.

Armcor was the one South African manufacturing concern to thrive and retain an international competitive edge despite intense sanctioning of the South African economy by the international community during the Apartheid era. During the 1997/1998 financial year (Armcor 1998) a deficit was logged (of approximately US\$1 million) for the first time in many years. The CEO cites the *ad hoc* withdrawal of major state contracts as the uncontested reason for a secure profit position to rapidly change into a deficit. While this phenomenon is certainly not restricted to developing countries, the occurrence of such incidents is less predictable in such countries, and the effect, in terms relative to the size of the economy, is more pronounced.

12. Conclusions

The decline in economic growth in the 1980s in industrialized countries occurred at about the same time manufacturing and logistics productivity began to increase as a result of new technology deployment. This resulted in excess capacity. From this position, improvement of the rate of return on investment certainly requires globalization. This globalization includes the capturing of untapped markets and the utilization of sources of cheap labour, both of which pertains to developing countries.

The quest growth by developed countries therefore affects developing countries. This influence has positive and negative aspects. While untoward exploitation takes place, development of third world economies also takes place.

The product trade cycle regards a relationship between production, consumption, trade and the product

life cycle. The cycle shows that production of mature products with stabilized technologies tends to relocate from the industrialized to the developing countries of the world. As firms take advantage of lower wage and other factors, even the least developed countries get involved. As companies from developed countries have relocated their production base to developing countries, developing countries started to take cognisance of the production issues which were hitherto restricted to the developed countries. To this, they have added their own tailor-made production management solutions in order to facilitate leapfrogging and to address custom issues.

Ethics are more difficult to handle in developing countries. Taking a stand on bribery is a much greater responsibility for manufacturers and marketers, as revenue often has to be sacrificed today to ensure that trade within normal civilized constraints will not be impossible tomorrow. In the same government, officials requiring financial side-incentives for any action at all are working side-by-side with officials ready to react vehemently against any hint of corruption or offer of tips from industrialists. While legislation is mostly clear and in place, pragmatics may militate against their fair application.

All in all, production in developing countries is challenging and exciting.

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