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TECHNOLOGICAL AND ORGANIZATIONAL ADVANCES IN TEXTILE AND CLOTHING AND THEIR IMPLICATIONS FOR THAILAND

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INTRODUCTION

During the 1960s and 1970s, the newly industrializing countries (NICs) in Asia, accounted for more than 75% of textile-clothing exports from all developing countries with an average annual increase of more than 18% over that period. The dynamic impact on foreign exchange earnings, employment and investment of export success in the textile-clothing sector acted as a major stimulus to the broader pursuit of export-oriented industrialisation in these countries. In turn, the NIC experience persuaded other developing countries such as Thailand to pursue the establishment an export-oriented textile-clothing industry in the hopes that they could follow a similar path to export-oriented industrialisation.

These efforts have been successful. "Second tier" developing country exporters almost tripled their share of world exports of textiles and clothing from 7.8% in 1975 to 20.9% in 1985, achieving annual rates of growth of 31.1% over that period. Thailand's performance demonstrates this trend well. Between 1973 and 1985, it averaged a 25% annual increase in its clothing exports.

This pattern of rapid export growth, first by the NICs and then by other developing economies caused considerable problems for the industrially advanced countries (IACs). Their combined share of world exports dropped from 82% in 1965 to 55.1% in 1985 (from 65 to 40% in clothing). A substantial trade surplus in the 1960s evaporated into a negative trade balance by the mid-1970s, with the developing countries accounting for a sizeable share of this. By 1984, developing countries' clothing exports accounted for 50% of OECD imports, with 65% going to Canada and the U.S. and 29% to Europe. The U.S. alone imported $17.7 billion worth of clothes from the Third World in 1987, accounting for 23% of its domestic market.

This strong showing by the NICs and second-tier countries as internationally competitive clothing exporters has long been a source of tension in North-South trading relations. Consequently, starting in 1962, tariff and non-tariff barriers imposed by the IACs and directed at excluding textiles and clothes produced in developing countries from the domestic market have continually risen in level and scope. These restraints, initially directed at the NICs are increasingly being extended

and not in clothing, while the most important innovations have only recently begun to feature the extensive use of microelectronics and computing technology.

The full automation of clothing production in the North and the threat this would imply to developing country exports may still become a reality in the future. However it is unclear when this future will arrive - the fears of ten years ago that this would happen virtually overnight have proved unfounded. However, more importantly from the point of view of commercial and industrial policy, other factors and trends have emerged that are now of equal if not more importance than technical factors in determining international competitiveness in the textile-clothing sector and the pattern of North-South trade. There have been fundamental changes in the structure and nature of the market for both intermediate products (yarn and textiles) and final products (garments).

The transformation of the nature of demand has lead to a fundamental shift in the marketing and product strategies of retailers and manufacturers. This has in turn stimulated a wave of major innovations in the way production is organized within firms and in relationships between buyers and sellers. These organizational changes have already had a significant impact on the relative competitiveness of different firms and countries in the OECD. Developing country trading patterns are only just now beginning to be affected by them. What is surprising and encouraging is that unlike the genuine though still distant threat posed by automation, the implications of these new developments on developing country export prospects now and in the future are potentially positive.

The objectives of this paper are twofold. First it sets out to map the main features of the wave of technological and market-driven organizational change now occurring in the IACs. Second, it will briefly explore the implications of these changes for industrial policy and firm strategy in developing countries, with particular reference to Thailand. In Section One, technological developments in the textile industry are reviewed; while the same topic is explored for the clothing sector in Section Two. Section Three discusses the way in which changing market

preferences have hastened a fundamental recasting of the structure and organization of production and competitive strategies both at firm and sectoral level in the textile-clothing industry. The broad implications for commercial and industrial policy in Thailand are discussed in Section Four.

SECTION ONE

RECOVERING INTERNATIONAL COMPETITIVENESS THROUGH TECHNOLOGICAL INNOVATION IN THE TEXTILE SECTOR

In direct response to the threat posed by NIC and second tier country exports of textiles, the textile industry in the IACs, beginning in the late 1960s, embarked on a massive wave of investment in new technology coupled with structural change and a market driven industrial strategy. These developments have significantly enhanced their international competitiveness - while at the same time posing considerable challenges to countries such as Thailand who because they are so seriously constrained by quotas must seek ways to expand volume and add value.

The pace of automation among the western countries has been rapid involving sizeable investments in mechanized equipment for opening and mixing bales of fiber, in high speed-spinning machines, in robots that deliver materials and splice broken threads automatically, in shuttle-less looms that weave broad widths of cloth rapidly and reliably, and in computerized monitors that can spot breakdowns or slowdowns in all this automated equipment.

This wave of innovation has had multi-dimensional effects across three inter-linked areas of performance - the reduction of labour content in the production process; increased product quality; and much greater flexibility in production. Dramatic improvement in all these areas has taken place in all the main phases of textile manufacturing.

Technical Change in Textile

The sources of productivity growth and other performance improvements have been many and varied, covering a wide range of new technologies specific to textiles and dependent on innovations from outside the sector, particularly microelectronics and information technology more recently. These advances have occurred in both synthetic and natural fiber-based textiles with equally dramatic results. For ease of presentation, the discussion that follows concentrates primarily on

technological changes related to the manufacture of natural fiber textiles.

In the opening rooms, automatic equipment for opening, cleaning, picking and mixing bales of fiber are now being rapidly substituted for manual systems eliminating much of the onerous labour input previously required at this stage. In turn, slower carding systems are being replaced by high-speed chute feed systems which eliminate whole segments of labour-intensive activity including doffing, racking, manual transport to the card room and hanging the lap. Overall efficiency improvements of 200% have been recorded.

Improvements in opening room technology have had a profound impact on quality as well through allowing a better and more consistent mix of cottons leading to more uniform and stronger yarn. Likewise, technological change in carding has also had quality effects via the ability to make tighter, closer settings thus achieving a better integration of fibers and reduced weight variation. Yarn quality is also improved due to the presence of fewer broken threads and from the elimination of thick lap joints.

Spinning has traditionally been the labour-intensive heart of textile production, accounting for 50-70 percent of all yarn manufacturing costs. Open-ended spinning which first emerged in the mid-1960s eliminates a large number of steps in the spinning production process such as drawing and roving there-by greatly increasing labour productivity, while making change-overs easier as well.

This equipment, along with spinning attachments such as automatic loaders and yarn-splicers, developed and used extensively in Europe in particular, is now four or five times as fast as conventional ring spinning, as well as allowing the processing of a far lower grade of cotton. Quality gains arise here also because of self-cleaning mechanisms which keep rollers from getting dirty, computerized fault monitoring systems, less manual (more robotic) handling of materials and other improvements which produce higher yields of first quality cloth. Moreover, jet spinning, a relatively recent Japanese

innovation, spins yard even faster than open-ended spinning and does it fine enough for high quality shirting and blouse fabrics.

In weaving, conventional shuttle looms are being replaced by high-speed shuttleless looms (using missiles, rapier, water-jet and air-jets). These looms are now three to ten times more productive than conventional equipment via their much greater speed and an ability to produce broader widths.

Better quality is visible via dramatic increases in first quality woven cut lengths, twice as long as with conventional technology. Defects are eliminated through the automated removal of bad picks in the cloth, the repair of broken threads without leaving starting marks, and through perfectly woven, closed selvidges. The pace of change in weaving continues apace - a British firm has developed a high-speed multiple rapier machine that weaves from both ends, while a Czech firm has a machine that weaves two fabrics at once.

There have been less gains from computer technology so far in terms of flexibility in weaving but there are examples where it has been applied with great success - in one U.S. plant, computer control and automated materials handling devices allow production of 1.2 million yards of fabric per week in 300 different styles, compared to 300,000 yards a week and 100 different styles without the computer.

Radical technological change is visible elsewhere throughout the textile sector including, of course, the extensive use of computers in all phases of production management, financial matters, marketing, communication, etc. In some segments of the knitting sector, for example, automated knitting equipment capable of producing finished garments is increasingly common, as is the use of programmable knitting machines which allow changeovers to new styles to be accomplished in a matter of minutes.

Some of the most advanced applications of computer technology in the industry are to be found in the dyeing and finishing stages where firms are exploiting the flexibility of the technology to respond to growing demands for short re-orders and variation. One European firm has jet dyeing equipment that can handle lots under 500 yards whereas

the standard technology of only a few years ago could handle only a minimum of 10,000 yards. Computer-controlled dyeing has also greatly improved quality as well as allowing precise colour matching when moving from batch to batch or producing to reorder.

Other examples of current computer applications range from the increasingly extensive use of CAD in the design stage feeding through into direct instructions for weaving machines; to computer-controlled, automated carpet-tufting machines; and finally to fully automated inventory systems where computer-directed sensors and robots operate fabric warehouses by keeping track of thousands of items and automatically filling orders for despatch as they are received.

Rationalization and New Product Strategies

Pervasive technological change has been accompanied by equally extensive rationalization measures on the part of the industry that were in many cases facilitated by major programmes of government support for this adjustment process (and which also included substantial subsidies/incentives for investment in the new equipment that was being developed).

Apart from major investment programmes in new technology, the rationalization moves pursued by Northern textiles producers involved - better integration of design, spinning, weaving and finishing; the closure of old plants and dismisssl of workers when productive capacity outran demand; and finally a large number of bankruptcies.

The net impact of this wave of technical change and rationalization in the textile sector in industrialized countries has been impressive. In two two decades, textile employment in the has been reduced from 8.9 million to 6.8 million. In turn, because of the higher capital costs of new equipment - a shuttleless loom and ring spinning mill in 1982 were 3.5 times and 5 times more capital intensive per worker than in 1950. - the textile industry in the IACs

is now a capital intensive industry with value-added per worker in 1985 at $18,000 compared to $6,000 in developing countries.

Underlying these changes have been significant improvements in productivity. A modern spinning room is almost completely empty of people. Already by 1983, 7 out 8 of new looms installed in developed countries were shuttleless. As a result, in the U.S., during the fifteen year period between 1972 and 1987, labour productivity in textiles has risen by about 90 percent - roughly double the rate at which productivity grew in manufacturing as a whole. Consequently, U.S. unit labour costs now compare favourably with those of its European competitors and of Japan and in some cases have begun to reach the levels of lower cost Asian and Mediterranean economies.

Perhaps most importantly, OECD textile manufacturers also vigourously pursued a variety of new marketing and production strategies explicitly designed to improve their international competitiveness in the face of low wage competition from developing countries. These strategies all differ in specifics but mostly represent a shift away from mass production of standardized products to the production of smaller runs of more highly styled products.

Italy, West Germany and Japan all have textile industries that evolved from a mass production strategy to one based on shorter runs of more sophisticated products to serve highly defined niche markets. All are now highly successful exporters - with Italy and Germany now standing at first and second place in in the value of textile-apparel exports in the world. The U.S. textile industry has been slower than the Europeans and Japan to pursue a niche production strategy but has gone further than the others in exploiting computer technology to reduce unit costs in high-volume production. Nevertheless even here there is evidence of a fundamental ongoing shift in strategy. The changes in production and marketing strategy that have occurred in textiles are paralleled by developments in the clothing sector which are discussed in the next section.

SECTION TWO

INCREMENTAL INNOVATION IN THE CLOTHING INDUSTRY

In the clothing sector there is a unique but straightforward relationship between the product, the production process, industry structure and competitiveness. Clothes are made from "limp" fabrics that have unstable and highly variable handling characteristics that necessitate extensive manual positioning by the sewing machine operator. Because of this, it has historically proved extremely difficult to mechanize materials handling. The garment assumes a three dimensional character early in the assembly stage - skilled human operatives can cope with all the variations involved quite easily; machines cannot.

Thus neither technology nor scale economies have ever acted as a barrier to entry as they have in other sectors. At the national level, ease of entry means that the domestic industry is typically composed of many small firms and relatively few large firms.

A similar process underlies the international division of labour in the industry. Firms from both developed and developing countries enjoy equal access to the same range of techniques while also facing roughly similar materials costs. In this situation, unit labour costs become the key to competitive advantage in many products despite higher productivity enjoyed by developed countries.

These structural features indicate that technology-induced, trade reversal will only occur if the assembly stage can be automated. So far, even with the computer and robotics technology available today, this has <u>not</u> yet happened on a sufficiently pervasive scale to affect broad trading patterns. Concerns expressed in the early 1980s about the imminent loss of the Third World's low-wage based competitive advantage have not been fulfilled. Nevertheless there have been some significant developments in clothing automation - some of which represent state-of-the-art achievements not found in other sectors. In the discussion below, we shall concentrate on technological

developments in pre-assembly and assembly as these are the stages where the technology has had its greatest affect and where it will may have an even greater impact in the future.

CAD/CAM in Pre-Assembly

By far the most dramatic changes have occured in the pre-assembly phase where new, electronics-based capital goods firms have introduced computer-aided design (CAD) and computer-numerical control (CNC) technology. The CAD systems are used for grading patterns (making pattern parts for various sizes) and for marking (laying out the pattern parts as a guide for cutting). The other major innovation in the pre-assembly stage involves the use of CNC guided, fully automated cutting systems that replace manual cutting techniques used previously.

The CAD grading and marking systems and the CNC cutter offer a wide range of benefits. In the case of the CAD systems, while skilled labour input is reduced, by far the most important gains are faster turnaround time in grading and marking (imporved by a factor of 4-6 times) and improvements in fabric utilization (up to 15%) due to making "tighter" lays of the patterns on the cloth for cutting - very significant since fabric costs are 40-60% of total costs.

In the case of automated cutters, reductions in skilled labour usage (from 25-60%) are a much more significant benefit, along with better quality (more accurate cutting) and materials saving via closer cutting of more tightly fitting patterns. The biggest gains, however, are from greater output (200-300% improvement) due to faster cutting speeds and the ability to cut more layers of cloth at one time than was possible with manual methods.

These systems are expensive, with prices ranging upward from $100,000 for a single system to as much as $10 million for a multi CAD/cutter installation. Nevertheless, diffusion has been relatively rapid, and now over 50% of all clothes produced in the U.S. come from

firms using CAD systems and computer-controlled cutters, while more than 65% of all U.K. firms surveyed in a recent comprehensive diffusion study already have CAD systems and/or cutters installed or on order. Notably the U.S. government estimates that more than half of the annual 3% productivity improvement registerd by the U.S. clothing industry during the 1980s has been due to the use of automation technology in the pre-assembly stage.

Trade relocation rather than trade reversal. Even though they have had only limited effects on unit assembly costs, the increasingly widespread use of these techniques is beginning to have an impact on North-South trading patterns. This is occurring not via trade reversal but due to trade "relocation" from one region of the Third World to another. Growing market pressures on retailers to provide greater product variety are playing into the new competitive strengths of Northern users of pre-assembly automation.

Retailers are pushing suppliers to offer a rapid turnaround on reorders. The use of CAD systems and CNC cutters gives this responsiveness at the pre-assembly stage - reorders can be graded, marked and cut in a matter of hours. However, long assembly times and even longer transit times still posed a problem. In order to reduce turnaround times in the assembly stages, domestic producers who previously might have sent pre-cut pieces for assembly to Asia are now turning for offshore assembly to the Carribean and Mexico in the case of the U.S. and the low-wage countries of southern Europe, the Mediterranean and North African the case of Europe.

Wages in some of these countries may be higher than Asian locations - but the economic advantages derived from the use of pre-assembly automation are proving sufficient to tip the balance in their favour. Figures are difficult to come by but some analysts estimate that pre-assembly automation has already accounted for a 5-10% shift in the U.S. offshore assembly trade from Asia to the Caribbean. No comparable estimates exist for the scale of European trade relocation but it may even be higher. At any event, this technology-

induced sourcing shift denotes the growing importance of geographical proximately as a new competitive advantage for some countries.

Incremental progress towards assembly automation. Unlike the pre-assembly phase, the application of microelectronics technology to sewing has proceeded at a much slower, more incremental pace. The basic changes introduced have seen microelectronic-based control units added onto the sewing machine - but without any major redesign of the machine or of the principle of sewing two pieces of fabric together using a with needle and thread.

Though with these innovations, there are significant gains in machine productivity over conventional equipment via greater speeds (up to 60% faster) and more accuracy it is still the case that the critical one machine/one operator link has not been broken. With a few exceptions, the central determinant of international competitive advantage in the clothing industry remains largely unchanged.

This has important implications for developing countries. Rather than facing the rapid erosion of competitive advantage in one of their most important export sectors, assembly automation at the moment is in fact a barely visible phenomena. At least in terms of shifting trading patterns, assembly automation is unlikely to cause developing countries any significant worry in the short to medium term.

There are however some important indicators of ongoing developments that suggest clothing exporters in countries such as Thailand cannot afford to be complacent or assume that the situation will never change with regards to automation in the sewing room. We discuss these indicators of potential change briefly below.

The Possibility of Full Assembly Automation in the Future

There are three factors at work which suggest that the scope and pace of assembly automation may increase substantially in the future.

Growing concentration. The first of these is a tendency towards greater concentration among clothing manufacturers, in the U.S. as

well as Europe. One estimate is that by the end of the century, between 75 to 100 U.S. manufacturers could account for 75% of total output. This trend is significant. Small firms are risk averse and reluctant to invest in automation. However as concentraion increases, the large firms accounting for a growing share of total production should be more willing to invest the large sums in R&D and equipment purchase that will be necessary to automate the sewing room.

More innovative capital goods suppliers. Suppliers of production equipment to the clothing industry have traditionally been basically mechanical engineering firms. However, the structure of capital goods supply is beginning to change character. New, electronics-based equipment suppliers have entered the sector and are the major suppliers of CAD and CNC technology. Similar firms are beginning to take an active interest in assembly automation. At the same time, both the traditional equipment suppliers and large clothing producers have begun to target their R&D efforts on developing radical innovations in assembly technology. Together with the developments reviewed below, these forces represent an industry focus on assembly automation that has never happened before.

Public sector-supported initiatives in R&D. This resurgence in R&D aimed at assembly automation is linked to a major set of government financed R&D initiatives with the same target. These projects, taking place in the U.S., Japan, Sweden and the EEC are the most significant new element to be injected into the innovation process in the clothing sector for the last 50 years. All are focusing on cracking the assembly automation problem through the investment of substantial resources in R&D carried out on a collaborative basis with clothing manufacturers, equipment producers, and automation specialists.

The U.S. project is a joint initiative between the textile-clothing industry and the government known as the Textile & Clothing Technology Corporation (TC2). The objective of TC2 is to produce a system using computers and robots that could automatically load, fold

and sew limp fabric into a finished garment.

It is still far too early to judge the technical and commercial success of this initiative. On the technology side, a variety of prototype machines involving automated assembly of sleeves, coat backs and trousers and the automatic pick-up and positioning of a single fabric ply. have been developed and subcontracted to equipment manufacturers for further commercial development. At the same time, the deadlines for achieving some of the more ambitious technical goals have been postponed. Nevertheless the commercial results of TC2s work are eagerly awaited by the industry.

The Japanese project, sponsored by MITI, was planned with a longer term perspective, greater funding and more industry co-operation than the U.S. initiative. Established in 1983 with a 7-10 year timetable and $100 million of government and industry support, the Japanese Automated Sewing System project (involving 3 research institutes and 28 companies) covers the whole assembly process from design through cutting to sewing, pressing and finishing and retail.

Its objective is to cut manufacturing time by at least 50% by developing elements of a flexible manufacturing system (FMS) for pre-assembly, assembly and finishing. The ultimate vision driving the Japanese approach is even more revolutionary - to develop a system in which a salesman in a clothing store would take a hologram of customer's body, and digitally controlled machines would then tailor-make an article of clothing!!

The commercial aim of the project is not solely or primarily to revitalize the Japanese apparel industry - but to develop commercially viable systems that can be sold worldwide. Prototypes are expected early in 1990 with full-scale commercial production of the equipment expected to start some time in the early 1990s.

No matter what progress has already been achieved, there are still major technical, structural and attitudinal obstacles to be overcome by the automation initiatives currently underway in the industrialized countries. These should not be underestimated for they

have so far stymied assembly automation efforts. Thus there is a great deal of uncertainty still surrounding the question of when and with what effect the automation of the assembly room will arrive and its eventual implications for developing countries.

Other dimensions of computer-based technological change in the assembly stage

Computer technology is making significant inroads in other areas of assembly room activity in clothing production that shold be noted. For example, computer-based materials transport systems known generically as unit production systems (UPS) have become increasingly popular, particularly among large firms. Work flow and component movement between work stations can be optimized and directed centrally while garments are moved automatically from station to station by means of a computer-directed overhead delivery system linked up to terminals that can also monitor operator performance.

The advantages offered by such a system are much greater flexibility, reduced inventories, less handling time and greater control. There are regular reports in the industry press that UPS has among, other benefits, allowed firms to cut production times for individual garments from weeks to days and slashed 40-70% off work-in-progress inventory figures.

UPS systems do have problems however in terms of having enough flexibility to met the needs of the small manufacturer while they are still quite expensive on a workstation basis ($3900-$4500). This will restrict their use to large firms - but they could nevertheless spread rapidly among these in the future as the technical problems are overcome and as unit costs come down.

Another aspect of computerization involves electronic communication within the firm which is rapidly emerging as the technological heart of the advanced clothing manufacturer's technological strategy. Increasingly sophisticated, yet lower cost

computer-based management information systems are beginning to diffuse rapidly through the clothing industry in developed countries.

For larger firms either using CAD systems in pre-assembly or already having central computer facilities, these can now be used to estimate costing as well as do cut-order planning and production scheduling. At the smaller scale end where most firms operate, cheap micro-computers are being equipped with software and peripherals that carry out many tasks previously done manually such as the preparation of work dockets, stock control and fabric sourcing sheets.

Perhaps the most far reaching innovations are occurring in the area of computer-based production control systems (such as MRP II or its variants) that allow "real-time" monitoring of work-in-progress on a continuous basis and assist in production planning, line balancing and work measurement. One of the largest U.K. producers, Courtaulds, have introduced these techniques into 24 out of 40 companies and in one division producing nightware, sales have risen by 50%, "seconds" have been cut to 1% and raw material stocks have been reduced by 30%.

These systems have begun to come down in price substantially and along the way have started to accumulate a positive "track record" in terms of cost-effective results. This trend is bringing these systems more within the reach of small firms. Small firms, constrained by limited managerial resources, should find these systems will prove a great help in reducing unit costs, improving flexibility and shortening lead time.

The same technology also allows electronic communication between firms thereby facilitating much greater buyer-supplier responsiveness. When linked up to electronic point of sale systems (EPOS) at the retail end, in-house computer links with manufacturers allow instant communication of production, product and delivery requirements. As discussed in Appendix 1, the now classic and oft-cited example of this is the way the Italian clothing firm, Benneton operates.

While

However there are other forces at work in the industry which deserve much more immediate attention and which have major implications for policy in the short run. We turn to these in the next section.

SECTION THREE

MARKET-LED CHANGES IN RETAILING AND MANUFACTURING STRATEGIES IN THE INTERNATIONAL TEXTILE AND CLOTHING INDUSTRIES

Fully automated clothing production still lies some time in the future. Nevertheless, fundamental changes are currently taking place in international clothing and textile markets and in the domestic industry in the main importing countries. These changes demand more immediate attention from firms and policy makers in developing countries than do the technological developments reviewed above. Basically a new set of market conditions have emerged driven by demographic changes and rapid income growth. The market is now composed of a large number of differentiated segments with consumers in each expressing a preference for individual choice, constant variation and higher style content across product categories.

In essence what had previously been a stable market allowing mass production of standard products is now both fragmented and sophisticated - characteristics previously only found in the upper reaches of haute couture. The main thrust of retailing strategy now is to target very narrowly defined market segments with a wide array of products thus giving customers the opportunity to build their wardrobe according to individual tastes. This shift towards differentiated markets and wider variety has been coupled with a speeding up of the traditional cycle of fashion "seasons" on which the whole industry - retailing and production - used to base its operation. Seasons are now shorter and more frequent, increasing in number from two to three to as many as 6 to 10 per year.

Adoption of these strategies is most pronounced in the upper and middle segents of the womens and mens market. As is now well-known, *Bennetton* of Italy pioneered the new marketing strategy by targeting the youth segments of the market and by offering a wide variety of styles and colours that can be combined in many ways. However, they have gone beyond simply catering for narrowly defined submarkets by

developing an innovative retailing, production and distribution system (See Appendix 1) which allows them to rapidly adjust ouput to the specific pattern of sales in any particular region. In effect, apart from the initial ordering, the system only produces garments in specific combinations (of style, colour, size distribution, etc) in direct response to actual sales in their shops. Thus the company can respond almost immediately to quite different patterns of consumer and location specific demand.

The strategy has been remarkably successful. Sales have grown from from only 33 billionn Lire in 1970 to over 900 billion Lire in 1986. The company has progressively extended their unique approach throughout Western Europe, the U.S., Japan and even into a large number of developing countries. By 1986, the company had 4000 outlets in 57 countries. Certain elements of the Benneton successful strategy have been quickly copied by other firms in their segment both in Italy and abroad such as Next and Hepworths in the U.K. More importantly, these strategies are now also becoming increasingly visible throughout the whole of the sector including mass marketing/multi-outlet firms such as C&A and Marks and Spencers in the U.K. and Sears and K-Mart in the U.S.

These changes at the retail end of the market (particularly market segmentation and rapid response) are having a series of "knock on" effects on the way the whole textile complex is organised. Retailers are being forced to fundamentally alter their sourcing strategies while both clothing and textile producers are in turn recasting their own relationships as well as reorganizing their manufacturing practices.

Two aspects of the retailer-clothing-textile chain have been particularly affected by the emergence of these market-driven innovations in retailer strategy - buyer-supplier relationships; and the organization of production at factory level. The discussion that follows briefly describes the main features of these changes.

Appendices 1-4 present case study material that documents these developments at the firm and sectoral level.

Changes in Relations between Buyers and Suppliers - From confrontation to co-operation

Leading textile and clothing firms in the IACs are beginning to realize that the responsiveness and competitiveness of the textile-clothing complex can be strengthened significantly by the attainment of closer links within the industry between the major actors. The implications of this realization are becoming apparent in the actions of the industry in a variety of ways - almost all of which have relevance for developing countries.

Firstly, the design relationship has altered substantially. Before, the design process was entirely separate from the manufacturing process. Designers rarely came into direct contact with clothing manufacturers or textile firms during the design process. Now there is a pronounced trend towards more extensive consultation between these groups during the design phase. Rapid style change means the retailers simply cannot cope with the design demands and planning requirements on their own. So they are beginning to select fabrics on a joint basis as well as interacting on the development of entire ranges. In some cases they are entering into informal and sometimes formal committments to cover cloth purchases and set up costs. These new relationships are beginning to be seen even among retailers who have historically had a much looser and more traditional "arms-length" relationship with suppliers such as Woolworths and Richard Shops.

Second, a parallel development in buyer-supplier relationships is the growing necessity for manufacturers to be able offer a greater variety of product lines. Most significantly this means they must be able to switch production between styles rapidly in response to short term trends. Consequently, lead times for the supply of products

right across the board in the clothing industry have become much shorter than was ever thought possible before - from an average of 15 to 22 weeks in the U.S. and Europe to between 2 to 8 weeks respectively. The Benneton production system can respond to re-orders from its domestic and foreign shops in only ten days.

Typically, retailers will now only finalize a portion of their order (30-70% on average) at the beginning of the season and place additional orders as sales data indicate which lines are selling the best. To allow this, retailers dealing with independent manufacturers now increasingly reserve a fixed amount of production time or capacitiy (over the course of a year) with producers and and then allocate it among styles as the season progresses.

Correspondingly, these increases in variety and seasons and the reduction in lead times inevitably mean the production runs have become much shorter. Before orders would only need to be produced in thousands of dozens, now the order can be for 50 to 100 dozen, with specialist retailers such as NEXT averaging only between 1000 to 3000 units per style. Small lot sizes and short lead times also imply greatly reduced inventory levels since the whole thrust of Quick Response is to eliminate the need for stock ordering and production. When turnaround times are reduced to a matter of 10 days to 2 weeks, there is no longer any need for inventories.

Third, and finally, in order to provide the foundation for the much altered "rules of the game" governing buyer-supplier relationships, a new element of stability and trust is deliberately being sought in the contractual linkages tying buyers and sellers together. One way this is emerging is by retailers being prepared to work with fewer suppliers on a longer term basis. At the same time, the retailers expect the manfacturers themselves to become more independent than previously, with a more diversified customer base. It is now commonplace for the larger manufacturers to keep their dependence on any one customer to well below 50% of their business.

In the industry literature and among industrialists and consultants, the three elements described above are now commonly subsumed within the the concept of "Quick Response." This is simply the textile -clothing industry's specific term for what is commonly known throughout the rest of the manufacturing sector as "Just-in-Time" (JIT) production . As with JIT systems, the thrust of Quick Response is to tighten links all along the producer-supplier chain, to keep inventories to a minimium and substantially reduce turnaround time. It recognizes the reality that particulalry in the clothing sector, no one knows what will sell until the products actually get into the store. Having a Quick Response system in place makes it possible for retailers to start a season offering customers a broad selection with only few units in stock. As stocks of particular items get low, the retailer can reorder and expect fast delivery - while having only a very small exposure on slow moving items.

For clothing and textile manufacturers, the locus of competition and co-operation is thus beginning to shift, with contracts being increasingly awarded on the basis of quality, ability to change at short notice and reliability of delivery rather than on price alone. At the same time, less dependence between buyer and supplier has benefits for both groups - manufacturers are less susceptible to monopsonistic pressure from retailers, while their competitive edge in design and response has to be cultivated to secure a wider customer base, conseuently making them less vulnerable to competition. Retailers are in turn strenghtened in the marketplace, are more willing to look to domestic suppliers, and no longer carry full responsibility for the survival of individual firms. Both sides benefit from being able to greatly reduce their inventory carrying costs. Price is still important but there is now an assumption that by creating a degree of contractual stability between producers and users, producers will be able to better improve efficency and thereby reduce costs that can in turn be passed on to the retailer.

The extent and rate of diffusion of these new relationships in the IACs is hard to estimate at the current time. Nevertheless, industry leaders are aggressively pursuing these strategies. In the U.K. for example, NEXT, Marks and Spencer, Woolworths, C & A and Richard Shops have, to various degrees, introduced these changes into all of their supplier relationships. In the U.S., big retailers such as Wal-Marts and K-Mart, manufacturers such as Levi Strauss, Kellwood and Lee, and textile firms such as Greenwood and Milliken have adopted a similar tactices. Experience suggests that in time, these new buyer-supplier relationships will be a general feature of the clothing and textile industry in the advanced countries. More detailed empirical information is provided on these aspects in Appendix 2.

Intra-firm Changes in the Organization of Production

These changes in market demand and buyer-supplier relations have begun to erode the economic advantages of long-run garment (and textile) manufacture by shifting the focus of competition from price to variety, style, flexibility and rapid response. This is having major implications for the way manufacturers organize their production Clothing manufacturers in particular (but also textile firms) have begun to discover a common wisdom that is also being embraced by industrialists in other sectors. Rather than seeking enhanced flexibility through the use of automation, the necessary response capacity is being sought in the redeployment and retraining of their assembly workforce, and in a basic reorganization of their production line.

This is evident in a number of changes currently being introduced to standard manufacturing practice. For example, machinists are being trained to be proficient in a variety of sewing tasks rather than just one. In addition as discussed above, lot sizes are typically gradually reduced via elimination of the "progressive bundle" system (which required an operator to perform the same task on a large number

of workpieces contained in the bundle). As noted, the aim here is to strive for reduced in-plant inventories, thus allowing work to be produced and delivered on a "just-in-time" basis.

In order to achieve lot size reduction, the physical configuration of machinery, the actual pattern of workflow and the organization of workers is being recast according to unit flow, "group" technology and "quality circle" principles. This means small lots of garments are assembled from start to finish by small groups of workers. Along with this change, operators are also increasingly being given responsibility for quality control, for making suggestions to improve efficiency and for planning their work schedule.

Payment and incentive structures are being altered as well. Whereas before uniform piece rates were the norm, now the pay scales for individual workers go up as they acquire additional skills through in-house training. At the same time, the basis for calculating payment is shifting from the piece-work performance of the individual to the completed product performance of the group. Some examples of the effects of these new organizational practices are given in Appendix 3.

Finally, some companies have sought to alter their overall approach to problem solving and management-workforce relations. Previously if difficulties arose in the areas of quality or productivity, management would simply have blamed the workforce for the problems and placed them under pressure to perform better and work harder. The new approaches require instead that quality and productivity problems are tackled immediately through team efforts. These seek to identify the genuine underlying sources of the difficulties - which experience has shown are almost always due to poor management practices and not the fault of the operators.

Given human nature, these are not surprisingly the most difficult of all problems to tackle because a degree of openness and honesty and willingness to admit mistakes is required that is not normally found in the workplace. Yet in one U.S. textile firm where this approach

was adopted, quality improved by an order of magnitude, savings related to efficiency improvements were between five and ten percent of sales, and absenteeism and employee turnover virtually disappeared as a problem. A case study on this firm is presented in Appendix 4.

It should be noted that the large majority of OECD clothing firms have not yet begun to alter their approach to production organization nearly as far as the above suggests. However, there is little doubt that these changes in work practices and production organization in OECD clothing firms are occurring and that the rate and scope of change will increase and expand in the future.

The diffusion of organizational innovations within the IACs A key factor determining the rate of diffusion of these organizational innovations across firms in the clothing and textile industry is the degree of awareness of firms of the benefits that can arise from their introduction. Once this "threshold of awareness" is reached diffusion could be rapid. Indeed there are some observers who claim that this is already beginning to happen in the U.K. clothing industry which next to the U.S. had the highest overall rate of import penetration from developing country products of some 35% by 1981.

Individual examples abound - for example, Claremont, a large supplier to Marks and Spencers, has seen a regeneration in its fortunes and profitability due to a combination of the introduction of the new production methods and pre-assembly automation. It is now able to finish a garment in in eight hours compared to four weeks, it has the highest margins of all Marks and Spencers suppliers, and it has boosted its return on capital employed to over 50 percent.

This sort of improvement at the level of individual firms has translated to a much improved trade performance. Up until 1989 when trading conditions in Europe worsened due to exchange rate movements, export penetration had been reduced slightly and stabilized at around 31% overall; while there has been a pronounced shift in the composition of imports away from developing countries towards Western

Europe - the share of developing countries in U.K. imports fell from 45.7 % in 1980 to 38.9% in 1985 while that of the EEC and Western Europe rose from 26.2% to 36.2%, with the imports concentrated at the upper end of the market where quality and design count for more than price alone.

These changes have not been confined to the U.K. Countries such as Switzerland and Austria have also registered similar shifts in the composition of imports away from low-cost garments towards higher priced, higher style products. Italy, as is well known, has been at the forefront of OECD contries who have benefitted from these changes in market preference.

The Italian clothing industry is characterized by products with a high design content, extreme flexibility (Italian firms can deliver garments in under two weeks even at the busiest time of this season) and a unique industry structure that features both close links between retailers and small producers and an extensive degree of regional co-operation between small producers in areas such as fashion forecasting, market research and technological information.

The advantages offered by these structural features has catapulted Italy in the space of 10 years into the position of world leader in textile and clothing exports. In 1987, the Italian industry registered a trade surplus of $10.2 billion, a remarkable feat considering that wage costs per direct employee (including social costs) are nearly twice those in the U.K., four times those in Hong Kong and twenty times those in countries such as Sri Lanka. A further discussion of some of the unique sructural features of the Italian and Japanese clothing and textile industry is presented in Appendix 5.

The implications of the developments reveiwed in this section for developing countries and Thailand in particular are discussed inthe next section.

APPENDICES

Appendix One: BENNETON - FLEXIBLE INNOVATION IN PRODUCTION AND DISTRIBUTION IN A TRADITIONAL INDUSTRY

The overwhelming success of the Italian clothing group, Benneton has attracted considerable attention in recent years and has been well documented. Sales increased more than 30 times between 1970 and 1985; exports rose from 5% to 59.9% of total sales; the number of foreign outlets grew from 0 in 1970 to more than 2000 in 56 countries by 1985. More importantly, as discussed in Section Three, Benneton has been one of the principle architects of the retailing revolution in clothing that is having such profound effects on the sector as a whole.

Benneton's success is commonly attributed to single factors such as its marketing strategy or its sophisticated use of EPOS technology to plan production. In fact, the Benneton formula for success is multifacited with its elements and thrust changing over time. If there is a single unifying theme in the Benneton story it is that management has been able to introduce a continuous stream of innovations over time in all aspects of its operations including production, marketing, distribution, technology and financing. The Group has choosen not to simply exploit a single angle - such as its undoubted design flair in the area of new products - but to deliberately create its own unique set of competitive advantages. Below we give some examples of the Benneton innovations across different aspects of its operations.

Franchising From the beginning of its expansion, the Group has pursued a retailing strategy based on franchising. In the Benneton case, franchisees do not pay royalties but have to accept very strict terms of operation from the parent in terms of product mix (no other

firms products may be sold), location, store layout and display, price, and selling system.

Clearly a great deal of thought, experimentation and design flare has gone into the development and perfection of the Benneton approach to setting up retail outlets. For example only high street locations are utilized and the stategy is to satuarate any particular area with shops serving slightly different markets. Benneton shops themselves are characterized by colour, window displays and open shelves.

This approach to franchising has meant meant that the parent group receives a higher percentage of the selling price than its competitors (61% compared to 54%) while unit profits are also higher for the shop owners. It also of course guarantees the degree of integrated control by the parent over the management of its shops and the informaion they generate on market trends that has been critical to the success of Benneton.

Production The Benneton Group in Italy (which still provides the majority of products to Benneton shops worldwide) has developed privileged relationships with 10 major suppliers who provide the majority of its inputs. These relationships are based either on equity or on a monopsonistic buying relationship that yields Benneton advantages in terms of price, quality and reliability.

On the production side, Bennetton has built on the tradition of "putting out" in the Italian clothing industry to organize an elaborate subcontracting network composed of 300 firms (average size of 20-40 employees who perform 40% of group knitting, 60% of garment assembly and 60% of finishing operations and who work only for the Group. Among the subcontractors are those with equity participation by Benneton, "affiliated" firms formed by previous employees with the encouragement of Benneton, homeworkers and independents.

Benneton provides extensive technical and operational to these firms to aid their productivity as well as a profit sharing system and long term stability in terms of ordering. It allocates work among different stages of the production process and different subcontractors based on a very detailed system of costing for each phase and performance assessment of each subcontractor. This mode of operation means that Benneton saves on overheads particularly on managerial costs, generates a 40% saving in unit labour costs and maximizes its flexibility.

Benneton has developed a highly responsive method for organizing and scheduling production by its subcontractors. Basically Benneton only produces on the basis of orders and re-orders from its shops. Responsiveness is enhanced for some knitted products because Benneton uses a "post-dying" method for dying completed garments in response to orders. This approach minimizes time delays, optimizes the production cycle and increases capital utilization. Likewise inventories are reduced - the shops themselves do not carry inventories relying instead on the rapid turnaround capacity of the production system to meet product demands on a just-in-time basis in precisely the product mix demanded by the market.

Information Management and Information Technology Retail shops are the sensors from the Group's information system. In the 1970s, the group managed the above described production system on the basis of information (re size, colour, type, shop location) contained on duplicate labels of purchased clothes that were returned regularly to headquaters by the shops. Decisions were then taken on the allocation of production among its subcontractors. This system (remarkably similar to the Japanese Kanban system of inventory control) lent itself ideally to computerization in the 1980s via the use of EPOS systems.

Now all information about each item purchased is recorded on automatic cash registers and transferred daily to headquarters to be analyized both for production planning and for determining market trends. Production scheduling from its own factories and 200 subcontractors is therefore tied directly to actual orders from the shops with deliveries facilitated in Italy and the U.S. by a fully automated warehousing system.

The technological dimension is impressive - but it must be remembered that the actual model for information transmission and production planning was already developed and in place in the 1970s well before information technology was applied. Management deserves the credit for the competitive advantages generated - not information technology.

Indeed we would argue that it is this management capacity for continuous and pervasive innovation that sets Benneton apart from most firms in developing countries such as Thailand. These firms typically see their market strengths as determined largely by low wages and they therefore put very little . Management in these firms therefore puts very little effort into developing and introducing changes in established practices, thus remaining vulnerable to changes in the external determinants of competitiveness.

Appendix Two: Examples of Quick Response in Textiles and Clothing

In this appendix we want to provide some examples of how the moves towards closer buyer-supplier links and the more formal introduction of the "Quick Response" system described in Section Three are working out in practice. The advantages of these new approaches are most visible within the U.S. industry which has traditionally been much more committed to a mass production approach to textile and clothing manufacture than European firms, and where buyer-suppleir relations were short term and based strictly on price competition. U.S. firms are now realizing that closer links within the industry can lower costs more effectively than investing in machinery for mass production as well as introducing stability into the system - both aspects giving an edge to domestic producers.

For example, consider the case of Greenwood Mills, a large U.S. textile firm tha specializesin the production of denim. Until 1985, Greenwood shopped around between four suppliers to drive fiber prices down; Greenwood in turn was on the receiving end of similar tactics from its garment customers. This situation was unstable and reduced profits dramatically. Now Greenwood buys from two suppliers on the basis of quality, service and innovation. All parties are committed to long term relationships. One example of the benfits is that Greenwoodnow knows (via a computer link) when the truck leaves its suppliers' the plant, what it contains and where it is headed. As a result, Greenwoods fiber inventories have been cut from three weeks to 2 days;

Greenwood has worked to get the same relationship with its customers. For example they now pre-sort their deliveries and guarantee quality so that deliveries can be unloaded directly to

customers's cutting rooms as needed with no inspection. As a result they have allowed their customers to cut their inventories from 4 weeks to 3 days in one case and in the case of another allowing warehouses to be done away with entirely. Greenwood has never missed a shipment under this system, while its own inventory turns have risen from nine a year to thirty, and it can hold $40 million less in inventory.

Other examples of the benefits of Quick Response relationships can be cited in relation to retailers and garment manufacturers. Val-Mart stores after experimenting with Quick Response re-ordering schemes with two major apparel firms that its sales of men's slacks were up 31% and inventory turns and gross profit margins were up by 30 percent. Similarly J.C. Penney, using Quick Response with some of its suppliers, reported increased sales of 59% and inventory turns up by 90% compared to control stores. By using EPOS linkages, it has been able to achieve replenshment of basic styles in two weeks and fancy styles in three weeks leading to a 20% reduction in inventory, reduced markdowns and improved customer service.

Appendix Three: Organizational Change within a Clothing Firm

A large Brazilian clothing firm, Alpergatas, producing footwaer, shirts, jeans, pants and textiles provides one of the best available examples of the use of Just-in-Time (JIT) production methods in the clothing sector. In the mid-1980s, management of the firm decided to introduce a JIT system of operation after visiting factories following similar practices in the U.S. and Japan. The system put in place in Alpergatas works in the following manner.

The approach used. In each factory (average size - 1300 employees, average output 25,000 units/day) operators are organized into groups who decide together the quickest way (in terms of work allocation and line set up) to meet the day's production targets. Group size is approximately 14-15 people for jeans; 20-22 people for shirts.

Cross training of operators is essential in this system. This is done within a family of operations - for each product there might be three or four families of operations. Within each family, different but related skills are required and the operators are intended to master them all. This allows them the flexibility needed to move back and forth between tasks and work stations to ensure line balance.

This cross training is linked to each employee's base rate so there is incentive to learn more than one task - the more skills that are mastered, the higher the base rate. The pay rate for each operator is determined by the productivity of each group - providing an addtional incentive for the group to work together. When unit performance reaches 110% of the day's goal, each operator gets paid for the number of hours worked times 110% of her base rate.

Importantly, each production unit only gets paid for quality work so each operative is very quality concious.

Another important feature of the approach adopted by Alpergatas is the circular configuration of workstations. This allows work to be passed from one workstation to the next without indirect labour. It is the responsibility of each operator needing work to reach back to the preceeding operator to collect just finished work.

So far the benefits accruing to the firms from its adoption of JIT methods are impressive. Firstly, the firm is much more flexible than previously. When it is necessary to introduce a change in the product mix or in fabric or thread type, it is not necessary for the all of production to be changed over - only one or a few groups may be involved.

Second, excess work-in-progress has been eliminated. The overall cycle time is down from weeks to days, and from days to weeks. workplace engineering is not required because products are assembled within two days or less of coming out of the cutting room. The average throughput time is now 2 days.

Third, productivity has increased enormously. Before the system was introduced, the output per worker was approximately 1½ shirts per day. Now the average is 3½ shirts per day and management is confident that it can reach 6½ per day on average - with no additional investment in labour saving machinery.

Finally, there have also been significant workspace savings. Before introduction, each woirkstation used to occupy 70-80 sq.ft. of factory space. Today that figure has been reduced to 30 sq.ft. per workstation.

So far the system has proven successful in the assembly of shoes, and shirts, and is currently being extended to the assembly of plabts and jeans.

Appendix 4: Introducing New Approaches to Problem Solving and Management Labour Relations in a Textile Firm

Malden Mills, A U.S. manufacturer of synthetic, high pile fabrics was on the verge of bankruptcy due to poor labour relations, high costs and poor quality in 1981 when management decided to completely overhaul its own approach to production along the lines suggested by one of the "gurus" of the new management practices - W.Edward Deming. The Deming method stressed first that the continual and immediate resolution of quality problems was critical to reducing costs; and second that management was 85% responsible for problems and labour only 15% responsible. Quality problems were not to be tackled by blaming the workers but by setting up teams composed of everyone involved in the process, to identify the causes of problems and design and implement solutions.

One example of how this approach worked involves a problem of "blade scrapes" which generated defective fabric and alone accounted for over a .5% defect rate in one division. Operators and engineers jointly identified and explored over 15 possbile causes of the blade scrape problem over two months. A solution was finally found that was linked to the coating on the blades themselves and the need to clean these regularly. By specifying different blade coatings, the defect rate registered an immediate reduction from .638 percent to .064 percent. The annual savings gained were 25 times the cost of the new blades.

Multiplied throughout the division, this team approach to immediate problem solving generated over $1 million in savings in just 8 months. The company also trained its supervisors, engineers and line operators in that division in simple techniques of statistical

quality control - and in the first year saved $2 million on an investment of $50,000 in training and consultants' fees.

Simulatneous with this new approach to problem solving, management also set out to eliminate the main sources of worker grievances which had lead to annual staff turnover rates of 250% and very high absenteeism. Most of the workers problems were dealt with remarkably easily once management had decided to actually listen to what their employees were saying about working conditions in the plant. Training was inadequate, numerical goals were unrealistic, equipment was in poor repair, the plant itself was cluttered and dirty, part carts were broken, etc. These problems were easily taken care of.

However, the most difficult problem to overcome was the very negative relationship that existed between supervisors towards workers - this was treated by giving supervisors training and operators. Previous;ly mangement has pressed supervisors to meetoutput targets at any cost, and supervisors had pressured workers to do the same. Only the problems created by the pressure lead to a reduction in output not an increase.

So management first changed its own approach and began to stress to supervisors that the way to increased output was to co-operate with workers in removing obstacles to them being able to do their job well. (as discussed in the above paragraph). It also gave supervisors training in human relations so that they could adopt to the attitudes expectedof them towards the operators. The net result of this change in tactics was that employee turnover was reduced tenfold to only 25% and absenteeism declined from 6.5 to 2.5 percent.