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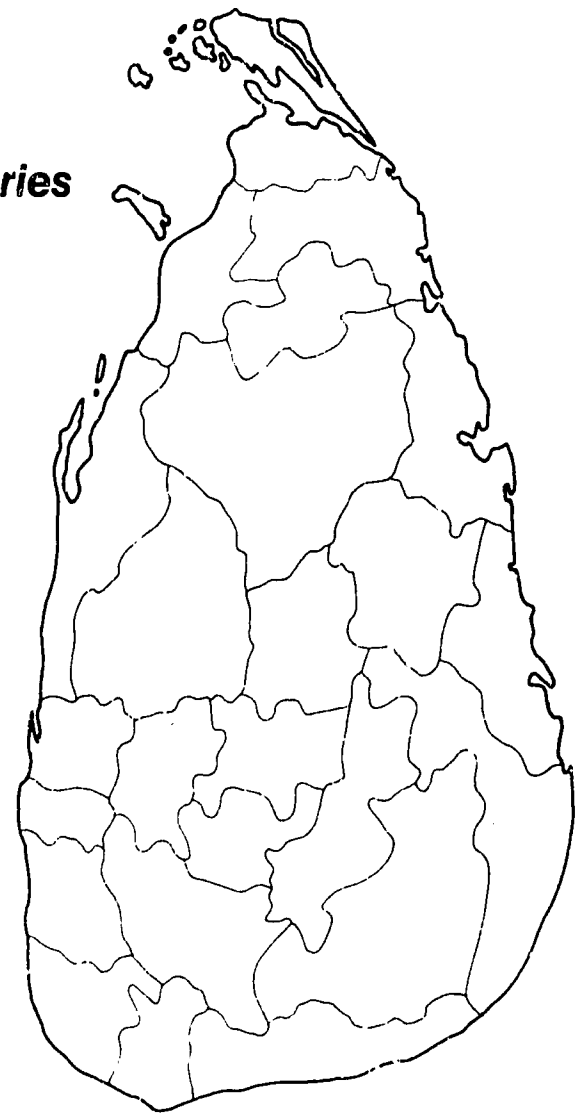
Coordinating Committee for Private Sector Development
August 1983

Developing Sri Lanka's Private Sector and Its Investment Opportunities

Volume 4
Opportunities in Manufacturing Industries



Arthur D. Little International, Inc.

Reference 88454

DEVELOPING SRI LANKA'S PRIVATE SECTOR AND ITS INVESTMENT OPPORTUNITIES

Volume 4

Opportunities for Development of
Manufacturing and Minerals Processing Industries

A Report Prepared by

Arthur D. Little International, Inc.

For the

Sri Lankan Ministry of Finance and Planning

and the Coordinating Committee for Private Sector Development

Commissioned by the

United States Agency for International Development

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August, 1983

Arthur D. Little International, Inc.

PREFACE

The present report - Opportunities for Development of Manufacturing and Minerals Processing Industries - is the last of four volumes comprising a larger study entitled: Developing Sri Lanka's Private Sector and Its Investment Opportunities.

Arthur D. Little International, Inc. was asked to undertake for the Ministry of Finance and Planning and the Coordinating Committee for Private Sector Development a study of means to strengthen and expand Sri Lanka's private sector and to identify key investment opportunities for private enterprise. The study, which occured from February to June 1983, was conducted by a team of Arthur D. Little consultants and industry specialists in cooperation with a counterpart team of Sri Lankan professionals.

Early in the project the study team identified several sectors of Sri Lanka's economy which, on the basis of a general survey, appeared to offer important commercial opportunities for the private sector. Equally important, development of these sectors could be expected to contribute in a significant way to the growth of Sri Lanka's productive capacity, national income, employment, and foreign exchange.

Seven sub-sectors were chosen for in-depth industry profiles. In the agro-industrial area, studies were conducted in fruits and vegetables, coconut products, the dairy industry and fisheries. The present volume presents the results of the three industrial sector surveys undertaken, namely, the rubber products industry, the light engineering industry (particularly as related to agriculture), and the minerals processing industry.

The other three volumes of the study are as follows:

Volume 1 - Summary of the Study

Volume 2 - Definition of the Private Sector and the Environment for its Development

Volume 3 - Opportunities for Agro-Based Industry Development

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CHAPTER 1

EXECUTIVE SUMMARY

SUMMARY PROFILE OF THE RUBBER PRODUCTS INDUSTRY

A. OVERVIEW

Natural rubber production in Sri Lanka is of vital importance to the country's economy, particularly as a source of of foreign exchange earnings and employment. At present, Sri Lanka is the world's fifth largest producer of natural rubber, producing about 125,000 tons per year. However, over the years rubber production in Sri Lanka has been steadily declining due to decreases in the area under tapping because of the poor replanting as well as delines in average yields. It is projected that Sri Lanka's rubber production will continue its decline for the next several years, but reverse this trend by 1985 as current replanting programs begin to show results.

To strengthen the rubber based economy, the government is considering a shift of emphasis from being a commodity exporter of raw natural rubber to that of a manufacturer and an exporter of intermediates and finished rubber products. To manufacture a broad range of fabricated and dipped rubber products, however, the industry must confront several constraints which currently weigh upon it, namely, a weak technological base, limited knowledge of markets and relatively poor management.

B. CONSTRAINTS

Over the years, the rubber products industry in Sri Lanka has been based on relatively rudimentary technology and production skills. Out of 145 rubber goods producers, including one major tire producer, only three to four companies have competitive technology, marketing and management strengths all of which have been acquired through joint ventures with foreign participants. Most rubber goods producers in the country manufacture consumer and industrial rubber products for local markets based on antiquated and obsolete technologies.

Although domestic consumption of natural rubber has increased over the years the total size of the domestic market for rubber products is still relatively small and likely to remain so. Therefore, the major development of the rubber products industry in Sri Lanka will have to be geared primarily towards export markets. Entering the international rubber products market in the 1980's will require careful strategic planning since Sri Lanka will be playing a "catch-up" game with its major competitors including India, Malaysia, Thailand, Indonesia, Taiwan and South Korea, all of whom are well entrenched in international markets. Sri Lanka will have to address its weaknesses and identify its specific competitive strengths. To this end, it is important to select specific product/business areas and identify market niches which provide long-term growth opportunities.

C. OPPORTUNITIES

Based on an assessment of Sri Lanka's natural rubber based industries as well as international markets, for natural rubber products, several opportunities emerge as possibly having long-term growth potential for Sri Lanka:

- Medical and Health-Care Related Rubber Products

  This opportunity stems from Sri Lanka's superior quality latex and latex crepe rubber which is used in producing a variety of dipped and fabricated rubber products for the growing world-wide health-care markets. Specific products include: surgical tubings, catheters, teats, adhesive plasters and tapes, sheeting, bottle closures, diaphragms, pacifiers, and other similar products.

  Sri Lanka will require foreign participation in developing these products. Specifically, the will need assistance in technology and production systems.

- Natural Rubber Based Composites

  Due to the unique physical and mechanical properties of natural rubber -- such as low hysteresis, high resiliency and good abrasion characteristics -- natural rubber in the form of composites, as with coconut coir fiber, presents an excellent opportunity. Although natural rubber/coconut coir fiber composites are currently produced in Sri Lanka of such products as cushions and mattresses, there are further opportunities in insulation, vibration isolation, sound deadening and similar engineering applications for the automotive, building, construction and industrial markets. The industry will require foreign participation primarily in the marketing area to identify specific end-use applications and market segments.

- Specialty Rubbers and Polymers

  Specialty rubbers and polymers is probably the fastest growing segment of the polymer industry to date. Like many synthetic rubber and plastic resins, natural rubber provides an excellent potential for conversion into intermediates such as granulated natural rubber, thermoplastic natural rubber and custom tailored natural rubber alloys and blends. Such intermediates are currently finding increased usage in many consumer and industrial rubber and plastic product applications, in replacing conventional rubber and plastic materials, and providing favorable cost/performance benefits.

  Sri Lanka can exploit such intermediates through its domestic market base and gradually expanding into international markets. However, due to the intricacy and proprietary nature of the technology involved in the production of such intermediates, local producers will clearly require foreign participation specifically in the areas of technology and market research.

SUMMARY PROFILE OF THE LIGHT ENGINEERING INDUSTRY

A. OVERVIEW

Sri Lanka consumes Rs 3-4 billion worth of Light Engineering products per year. Eighty-one percent of this demand is filled by imported products covering approximately 250 product areas. Domestically, there are an estimated 1000 registered metalworking companies and another 2,000 unregistered companies.

Significant opportunities exist for the development of Light Engineering products for agricultural uses. Agriculture has been targeted for a variety of reasons, including:

- Imports of farm equipment and implements are growing rapidly, while imports of other Light Engineering products show only slight growth or are declining.
- The country's agricultural land base is growing and farming employs a large portion of Sri Lanka's population.
- Agricultural yields could be improved through greater use of small scale mechanical products.
- Farm income will increase with increasing farm productivity, thus improving living standards in rural areas. This, in turn, will encourage the development of markets for other Light Engineering products.
- Such Light Engineering products generally require relatively small amounts of capital for development, permit use of available technology, and can be produced on a small scale in urban or rural areas.

B. OPPORTUNITIES

Manufacturing capabilities in Sri Lanka appear adequate for producing many Light Engineering products at appropriate quality and

price levels. There appears to be substantial excess capacity in much of the country's Light Engineering manufacturing, including casting, forging, sheetwork, welding, plating, machining, and press work. Manpower skills are generally adequate. Similarly, design engineering skills are suitable for tailoring current designs of products appropriate to Sri Lankan needs.

Domestically, agriculture represents an Rs 0.6 billion market for Light Engineering products. In addition, there appears to be a significant export potential for farm-related Light Engineering products at technology levels appropriate for Sri Lanka. Nearby developing countries import more than $4 billion worth of such equipment annually.

A number of Light Engineering products could improve the country's ability to capitalize on its agricultural base by encouraging further exploitation of available land. Such improvements could be made in various areas including planting, harvesting, processing, and storage.

Several specific product opportunities have been identified in this survey and can be classified according to three major product groupings:

- Currently available technology for widely-used products.
- New products for specific applications.
- Advanced products for wide use.

Development costs for each of these opportunities are estimated in the following paragraphs. Given the uncertainty of such factors as the status of available technologies, equipment requirements, design modifications, the amount of market testing required, such cost estimates are highly approximate, and must be tested through more thorough prefeasibility analyses.

1. Currently available technology for widely-used products.

- Moldboard plow/Unibar Ridger for animal draft and two-wheel tractors. Only a prototype is imported at the present time.

The market potential is high for a product of this nature which would cost approximately Rs 500. Its use would aid cultivation of a wide variety of crops, including rice. This plow could be developed for approximately Rs 1.0-2 million, and could be completely fabricated on the island.

- Hand-pushed seed drill, granule spreader, or fertilizer applicators. These products are not widely available on the island, being imported primarily for experimental purposes. The market potential is high, as this type of product has application regardless of the crop or the size of the holding. Development costs are estimated at Rs 1-2 million. Depending on the design, such a product could be sold for Rs 100 to 1000.
- Portable sprayers/applicators. Such products are imported now for broad use in agriculture, household, and industrial environments. The country's foreign exchange position would improve through domestic manufacture. Complete manufacture would be possible on the island. Depending on features, these products could be sold for Rs 100-2000 and developed for Rs 0.5-1 million.
- Mammoty and related products. This group includes the mammoty, axe, garden fork, rake, shovel, sickle, crowbar, and large knife. While these products are manufactured locally to some degree, a large number are imported. At present, approximately Rs 8 million worth of mammoties alone are imported yearly. A larger share of these products could be made locally and sold at Rs 100-150. Development costs should total Rs 500 thousand.

2. Products for Particular Applications

- Transportable winnowers, threshers/reapers. These products are mostly imported, with limited domestic manufacture. All

are useful in improving rice yields. Product development could be completed for about Rs 1 million. Products could be sold in the Rs 2,000-10,000 range.

- Bottling and packing. Such equipment is essential for the commercialization of fruits, and vegetable oils. Development efforts would be directed at tailoring existing system designs to the needs of Sri Lankan farm products and would cost about Rs 1 million. It is anticipated that bottling and packing systems could be sold for Rs 500-5,000.
- Screw-type river and shallow water pumps. Prototypes are being imported. In the future, the motor could be imported with the pump being made locally. Such engineered products would support further irrigation, and could be developed for Rs 0.5 million to sell for Rs 1500-2000.

3. Advanced Products for Wide Use

- Small diesel engines. This product has high market potential. Diesel engines are used with sprayers, crushers, and extractors, winnower/threshing/reapers, water pumps of all types, and generators and tractors. At present, there are approximately 50,000 internal combustion-driven water pumps alone, with annual sales in the 7,000-9,000 unit range. Life span of the engine-pump system has been estimated at 4 - 6 years, so there is an attractive market for replacements in addition to new equipment. The engines are now imported mainly from India and Japan. While no new product research would be required, manufacturing techniques on the island would have to be upgraded. Thus, this product could act as a vehicle for improving the country's overall manufacturing capabilities. Development costs could range from Rs 5-10 million; products could be sold for Rs 1,000-10,000.

- Small 4-wheel tractor (20 hp). Present two-wheel tractors are frequently overloaded, which shortens the tractor's limited life span. Unfortunately, available four-wheel tractors are too large and expensive for general use. Thus there appears to be a medium to high market for a small 4-wheel tractor. These could be manufactured completely in Sri Lanka, or with the engine imported, and sold for Rs 50,000-80,000. Development costs of Rs 5-10 million should be expected.

SUMMARY PROFILE OF MINERALS PROCESSING INDUSTRY

A. OVERVIEW

The minerals industry in Sri Lanka is heavily controlled by the government through ownership of the major mining corporations. These corporations are also chartered to process minerals and manufacture end-products. While it would appear that the industry is relatively closed to the private investor, there are nevertheless a limited number of private sector opportunities. In practice, these opportunities would in all probability have to involve joint ventures between foreign firms and the state corporations or possibly small local firms.

The principal minerals in Sri Lanka include graphite, heavy metal minerals sands, silica sands, cement, clays, dolomite and phosphate. Graphite, mineral sands, and phosphate industries appear to offer the greatest opportunity for further development based on Sri Lanka's reserve quality and international market growth.

Annual sales by the minerals industry are approximately Rs 1.4 to Rs 1.6 billion. Approximately Rs 1.3 billion is sold domestically while approximately Rs 230 billion is exported. The export is primarily graphite and mineral sands.

B. CONSTRAINTS TO THE INDUSTRY

There are several constraints confronting development of Sri Lanka's minerals industry, namely the following:

- Technology: Sri Lanka does not possess the necessary technology needed to process minerals. The number of trained technical personnel required for plant operation is also limited. Foreign interests appear necessary to bridge the technology gap.

- **Marketing:** Current marketing efforts are limited and passive. Sri Lanka is in need of marketing channels which foreign interests could provide.
- Management: Under government ownership, the pay scales for management are not competitive with private industry. The industry is faced with the problem of retaining well trained managers.
- Finance: Projects within the industry are capital intensive. The financing of processing plants will have to come from foreign sources.
- Cost Control: The industry is hampered by inflation, productivity declines, and large inventory carrying costs. Production costs have been rising, making it difficult for Sri Lanka to price competitively.
- Exploration: There is a Geological Survey Department, but its activity is limited. To develop the industry, a stronger exploration program is needed.

C. RECOMMENDED STRATEGIES

The Sri Lankan industry should follow two strategies for further development. The first would be to achieve greater market penetration with existing products, thereby obtaining higher economies of scale. The second effort should be to integrate forward into processing and the manufacturing of end-products. This strategy would be best implemented through joint ventures with foreign firms. Turnkey purchases of plants and technology are not appropriate since Sri Lankan personnel currently have limited training to operate these facilities once construction is completed.

D. PRIVATE SECTOR OPPORTUNITIES

While project opportunities are limited in number, there are several which would appear to be viable for joint ventures.

Graphite

- Upgrading of Graphite to Flake

  Cuska Graphite Ltd. is currently trying to create a subsidiary to process graphite into a flake product. A foreign joint venture could possibly qualify for tax holidays related to exports thereby increasing overall returns on investment. The investment would require Rs 70-90 million generating Rs 46 million in annual sales with after-tax margins of 15-20% and a payback in four to five years.

- Joint Venture to Produce Carbon Brushes and Electrodes

  Ceylon Pencil Co., Ltd. is seeking a foreign partner to incorporate a new company to produce carbon brushes and electrodes. The capital required is around Rs 80 million. Yearly revenues are estimated at Rs 44-50 million with a pre-tax margin in excess of 50% and a return on investment after tax of 18%.

- Refractories

  Another opportunity lies in carbon brick refractories. There are several joint venture opportunities. There already exists a company in refractories which could be one candidate, as well as the State Mining Corp. and other local investors. Capital requirements are estimated at Rs 230 million with yearly revenues of Rs 345 million. Operating profit is estimated at 23% with a return on investment of 34%.

Mineral Sands

The one opportunity reviewed was the construction of a synthetic rutile and titanium dioxide pigment plant. This would be a major joint venture requiring a large foreign partner. Capital requirements are Rs 3 billion. Yearly revenue is estimated at Rs 1.4 billion with a pre-tax margin of 47% and a return on investment of 23%.

CHAPTER 2

INDUSTRIAL OVERVIEW

In the initial survey of Sri Lanka's small private industrial sector, an analysis was undertaken of the breadth of private industry to determine those sectors which had more than average potential for growth. Several criteria were used in this screening process to select sectors which could contribute to private sector development as well as to the country's long-term economic growth. Opportunity areas were assessed on the basis of:

- Commercial viability
- Comparative advantage either in domestic or foreign markets
- Employment generating potential
- Favorable foreign exchange impacts
- Strong linkages to other industries
- Positive impact on rural development

On the basis of these criteria, the team decided to focus on two manufacturing areas, namely, rubber-based products and light engineering products related to agriculture. The minerals processing area was also included for study because of the country's natural wealth in some key minerals.

The number of sectors surveyed was limited by time and resources. Several other areas with interesting development potential were also considered. The following pages outline some of the principal opportunities and constraints associated with these sectors.

Rubber-based Products

Opportunities

- Processing offers significant opportunities for increased value-added of this export product. Exports of raw rubber rank among the country's most important but only 1% of Rs 2,914 million of exports are in the form of finished products. Processing offers important opportunities for increased foreign exchange earnings.

- The raw material component represents a significant portion of the cost of the final product. Sri Lanka is in a position to use low cost, locally supplied raw material. It enjoys a large advantage in selected product areas such as casters, molded rubber product, and dipped rubber products.
- There is opportunity for considerable employment for both skilled and unskilled workers.

Constraints and Needs

- The capital requirements of the rubber products industry are sizable. Joint venture arrangements are probably required for these product areas to succeed.
- Access to international markets is difficult without use of a joint venture or a trading company for marketing and distribution. Small and medium sized firms would require coordinated marketing mechanisms because of volume requirements for efficient production.
- Research/technical assistance/quality finishing is needed and probably attainable only through joint venture and/or incentives for increased cooperation and information exchange among existing firms and/or expanded capacity of existing research institutes.
- Competition from synthetic rubber products is severe, meaning that Sri Lanka should concentrate on specific natural rubber product opportunities.

Light Engineering

Opportunities

- There is a large and growing domestic market for a wide variety of mechanical and metal products including pumps,

motors, agricultural equipment, agricultural implements, tools, household implements, appliances, and particularly spare parts. Sri Lankan currently imports:

- Rs 3,144 million of machinery
- Rs 1,961 million of electrical machinery and equipment
- Rs 1,589 million of iron and steel articles
- Rs 159 million of tools and implements

- Small scale, light engineering offers substantial opportunity for employment generation in both rural and urban areas, for unskilled, semi-skilled and skilled workers.
- Generally, the capital investment requirements are moderate, especially as related to value-added to production or to job creation.
- Some technological expertise is required but in most cases only of moderate sophistication.
- There are opportunities for development of exports for selected product areas, particularly small agricultural machinery and implements.

Constraints and Needs

- Incentives are needed to encourage investment in these product areas. Tax incentives and import protection are probably required.
- Investment capital must be channeled to small and medium sized enterprises for start-up expansion.
- Technical assistance is required to provide training and support including extension services to aid in solving manufacturing problems.

Electrical and Electronic Products

Opportunities

- There are opportunities for increased exports and employment from such products as electrical motors, small electrical appliances (blenders, juicers, hair dryers, can openers, etc.), generators, semi-conductors, and electronic assembly.
- Opportunities are apparent for import substitution for such unsophisticated products as coils, cables, fittings, fixtures, plugs, switches, and so forth.
- Low labor rates and a competent, trainable work force provide a distinct advantage.

Needs and Constraints

- Technical assistance and expertise are needed in selected product areas. Access to foreign markets must be acquired through joint ventures with foreign investors.
- Regional competition is severe from nearby countries that have already acquired considerable technical expertise and have acquired linkages to producers and distributors. New product areas that can take advantage of low labor rates must be found.
- These industries have no linkage to Sri Lanka's resource base. The only local input is manpower. There are some linkages to related industries such as plastic molding and fabrication.
- The country's small domestic market restricts opportunities for many products.

Wood Products

Opportunities

- Product opportunities include furniture, wood implements, and toys.
- Sri Lanka has the advantage of skilled craftsmen.
- Wood industries have strong linkages to rural areas and offer expanded employment in these regions.

Needs and Constraints

- Dwindling supplies of commercially exploitable forests.
- Need for improved timber processing and finishing capabilities.
- High freight costs place exports at competitive disadvantage.
- Strong international competition particularly from veneers.
- Improved information on design, quality and product requirements is needed.

Jeweling

Opportunities

- Potential opportunities exist in both high quality/hand crafted jewelry and costume jewelry.
- Sri Lanka has an abundance of domestically available raw materials (precious and semi-precious gems).
- There are opportunities for increased export earnings and employment generation.

Constraints and Needs

- Machinery for gold, silver and other metals must be imported as well as all materials for settings.
- There is limited knowledge of design requirements and limited access to international markets.
- International competition is strong.
- Skilled craftsmen are in short supply.

Handicrafts

Opportunities

- Product opportunities include: batiks, handlooms and handloom textiles, crafted metal and wood products, and basket weaving.
- Handicrafts provide strong linkage to rural areas and stimulate employment, particularly among women.
- Export earnings, while modest, could be significant if marketing well organized.

Needs and Constraints

- Market knowledge and access are limited.
- It is difficult to ensure quality standards across a broad group of small producers.
- There is a need for a central, coordinated collection, marketing and distribution system.

CHAPTER 3

RUBBER-BASED PRODUCTS SECTOR

I. SUMMARY

This portion of the study, a "profile" of the rubber products industry, was conducted in Sri Lanka, with the following specific objectives:

- To assess Sri Lanka's naturalrubber-based industry and identify the country's major competitive strengths and its major constraints and limitations;
- To select product/business areas, based on Sri Lanka's specific strengths, to promote the rubber products industry, specifically in international markets

The scope of this study involved definition and characterization of the rubber-based industry and its technology, markets, and operations. The study team identified the following major competitive strengths and limitations or constraints as pertinent to the development of Sri Lanka's rubber products industry.

Major Competitive Strengths:

- Abundant availability and supply of natural rubber;
- Favorable current domestic price (compared to world standards) of natural rubber;
- Inexpensive, trainable labor

Major Constraints or Limitions:

- Underutilization of available technological base;
- Inconsistent quality of field latex;
- Relatively higher prices for compounding materials;
- Poor knowledge and use of quality control standards, tools, and equipment;
- Availability of production tools, dies, and related accessories;

- Limited knowledge and use of modern marketing tools and techniques;
- High capital investment requirements in plant and machineries;
- Poor infrastructural facilities;
- High rate of labor absenteeism, resulting in lower labor efficiency and productivity.

The study team selected the following product/business areas as having important potential for promoting the rubber products industry in Sri Lanka, specifically in international markets:

- Medical and health care related rubber goods;
- Natural rubber-based composites; and
- Natural rubber-based specialty polymers and alloys.

II. INTRODUCTION

Although Sri Lanka is currently the fifth largest natural rubber producer in the world--about 125,000 tons of rubber annually, its natural rubber production is small in absolute terms and accounts for only 4% of total world consumption. Malaysia produces the most natural rubber, about 1.55 million tons annually, followed by Indonesia's 1.01 million tons, Thailand's 520,000 tons and India's 150,000 tons.

Natural rubber is vitally important to Sri Lanka's economy. Next to tea, natural rubber is the most important commodity export in terms of foreign exchange earnings. Today, the natural rubber sector accounts for about 15% of Sri Lanka's total gross export foreign exchange earnings and employs about 500,000 people.

Sri Lanka's 1982 natural rubber production of 125,000 tons marks a continued declining trend beginning in 1979 when rubber production reached a peak of 153,000 tons. This drop in production has been due to a combination of decreasing acreage under tapping and a lower average yield. The acreage under tapping is projected to decrease for several more years owing to relatively poor past replanting performance. The study team's projections indicate that Sri Lanka's rubber production will continue its decline and level off at about 85,000 tons by 1985, then reverse its downward trend and rise to a production level of about 190,000 tons by the year 2000. This will be due largely to the current acceleration of replanting.

Since Sri Lanka currently consumes only a small portion (15%) of the natural rubber it produces, the rubber products industry should offer several commercially viable development opportunities. There is good potential for Sri Lanka to increase the local consumption of natural rubber by manufacturing a broad variety of rubber products--tires as well as non-tire rubber goods in the country, primarily for the export markets.

However, before Sri Lanka makes any major commitment to shifting its strategic thrust from being an exporter of raw natural rubber to being a manufacturer and exporter of finished rubber products, the country needs to understand the broad spectrum of the rubber products industry. In particular, it is important to understand the structure of the industry including the following: growth rate, market share distribution, ease of entry, technology, market potential, and competitive structure.

III. INDUSTRY DEFINITION AND CHARACTERIZATION

A. HISTORICAL BACKGROUND AND REVIEW OF NATURAL RUBBER CONSUMPTION

The rubber tree (Hevea Brasiliensis) is indigenous to South America, especially the Amazon Valley, but because of its susceptibility to South America leaf blight, commercial production in South America is limited. Before 1860, the demand for natural rubber was small, and most of it was met by the Indians of the lower Amazon regions. As demand grew and price increased, the idea of planting and cultivating Hevea rubber trees in the Far East developed new interest. In 1876, Sir Henry Wickham collected Hevea seeds from Brazil and planted them in Ceylon, Malaya, and Singapore. Thus, natural rubber has been in existence in Sri Lanka for the last 100 years.

During 1888, an invention that would have an enormous future impact on the rubber industry was announced when the first useful pneumatic tire was made by John Dunlop in England, making possible a new era of movement by bicycle and then by motor car. By 1922, Southeast Asia plantations produced 93% of the world supply of natural rubber, and in 1932, production had increased to 98%.

In 1940, as war became imminent, the United States began stockpiling natural rubber a a strategic material. By 1942, Japanese occupation of Southeast Asia shut off nearly 90% of the world's normal source of natural rubber, leading to the development and commercialization of synthetic rubbers during World War II.

Prior to 1945, the role of natural rubber producing countries was strictly limited to the production and export of raw natural rubber to the industrial world, leaving its customers the task of converting the material into useful finished products. Today, Sri Lanka still continues this role and exports most of its raw rubber, leaving only about 15% for domestic consumption.

From the end of World War II until the early 1970s, the world rubber economy enjoyed a period of rapid and steady growth. The world

consumption of elastomers (natural, as well as synthetic, rubbers) increased by 7% per year, fostered by greater use of motor vehicles in industrialized countries--particularly the U.S., Western Europe, and Japan. The production of natural rubber during this period, however, expanded only 2-3% per year, thus creating a "gap" that had to be filled by synthetic rubbers regardless of technical and economic aspects. The increased use of synthetic rubbers led to a significant drop in the market share held by natural rubber--over the years, a decline of from 75% to about 31% today.

Since the early 1970s, the oil crisis and its ramifications slowed down the world economy and gave the world rubber industry its first severe jolt. While the drastic increases in crude oil prices meant major cost changes for synthetic rubber, natural rubber was less affected directly. According to Arthur D. Little's rubber consumption forecast, world demand of natural and synthetic rubbers is expected to continue its growth through the 1990s, but at a much slower rate than in the 1960s and 1970s.

During the 1980s, the growth path of world rubber demand will continue to be shaped largely by the growth of the world motor vehicle industry. Since the motor vehicle industry consumes more than half of world total rubber production and more than 65% of natural rubber production, restructuring of this industry, particularly in the developed nations of North America, Western Europe, and Japan, will largely determine the growth pattern of the natural rubber consumption. Nonetheless, world demand for total rubber is projected at 15.2 million tons by 1985 and 17.5 million tons by 1990. Further, synthetic rubber is estimated to maintain its compounded annual growth rate of 3.4% per year, while natural rubber will show a modest growth of 2.8% per year through 1990.

World demand of natural rubber, in particular, is projected at 4.4 million tons by 1985 and 5.1 million tons by 1990. Even though the natural rubber market share will fall from its current 31% to about 29% by 1990, its growth rate has to be increased from the existing 2.52% to about 2.8% to meet the projected demand. Increased

demand for natural rubber can only be met by making significant long-term investments to bring more acreage into production.

To compete successfully in the international markets, Sri Lanka will need to improve the quality of its natural rubber. It is widely recognized that the "market potential" for natural rubber is probably greater now than at any point in the last two decades, thus providing Sri Lanka with an excellent opportunity to identify and carve a significant niche to strengthen its natural rubber-based economy.

B. STRUCTURE OF NATURAL RUBBER INDUSTRY SECTOR

The natural rubber industry is defined and characterized as an agroproduct industry. Figure 1 shows a typical structure of Sri Lanka's natural rubber industry based on this definition.

Natural rubber has been primarily traded in Sri Lanka as an agriculture commodity alongside tea, cocoa, coffee, etc. However, over the years, the industry has been changing. Although natural rubber still remains basically an agroproduct, its role has been perceived more as an industrial material. Positioning of natural rubber as an industrial material is illustrated in Figure 2.

To exploit natural rubber's potential as an industrial material, Sri Lanka needs to understand the dynamics of the polymer industry in general and the elastomers industry in particular. In the future, Sri Lanka's natural rubber will not only compete against natural rubber produced by Malaysia, Thailand, and other countries, but will compete with synthetic counterparts such as polyisoprene and styrene butadiene rubbers. Therefore, to expand the role of its natural rubber in the world, Sri Lanka must respond to market needs and analyze buyers' perceptions, which are primarily determined by:

- Quality
- Breadth of product line
- Price
- Packaging and presentation
- Availability

FIGURE 1

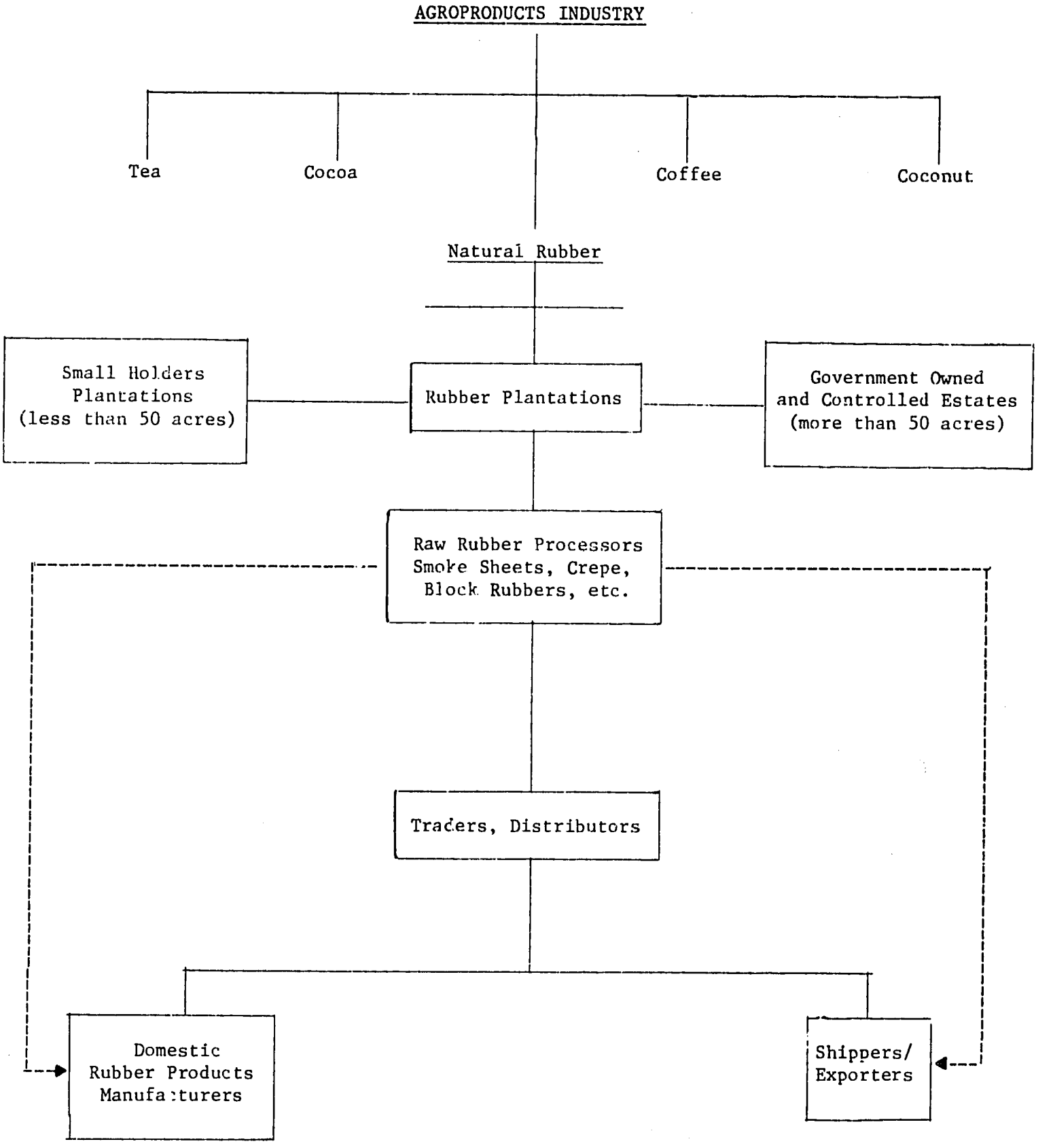
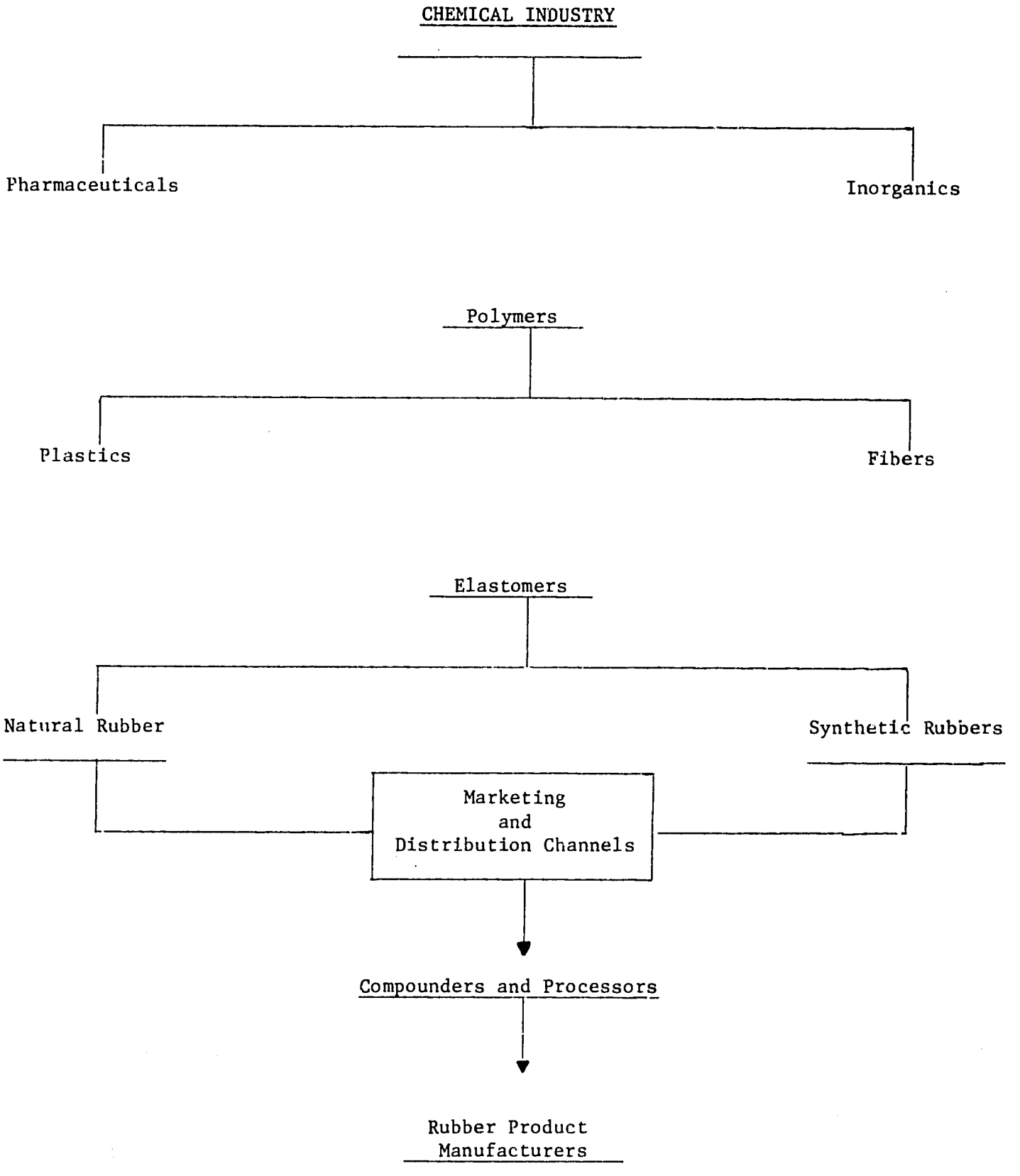

AGROPRODUCTS INDUSTRY
Tea
Cocoa
Coffee
Coconut
Natural Rubber
Small Holders Plantations (less than 50 acres)
Rubber Plantations
Government Owned and Controlled Estates (more than 50 acres)
Raw Rubber Processors Smoke Sheets, Crepe, Block Rubbers, etc.
Traders, Distributors
Domestic Rubber Products Manufacturers
Shippers/ Exporters

FIGURE 2


CHEMICAL INDUSTRY
Pharmaceuticals
Inorganics
Polymers
Plastics
Fibers
Elastomers
Natural Rubber
Synthetic Rubbers
Marketing
and
Distribution Channels
Compounders and Processors
Rubber Product
Manufacturers

On the basis of cost/performance considerations, the world rubber market will continue to be divided into three segments: one-third would go to natural rubber primarily because of its technical superiority in certain applications, one-third to synthetic rubbers because of their inherent technical advantages in specific areas, and one-third to be determined by economics, assuming that the technical competence of natural and synthetic rubbers are comparable.

While significant achievements have been made by Malaysia, Indonesia, and Thailand in improving quality, packaging, presentation, and, to some extent, breadth of product line, Sri Lanka still remains behind its major natural-rubber-producing competitors. Further, Sri Lanka has been lagging behind, particularly relative to Malaysia, in producing natural rubber specifically tailored or modified to match the performance of its synthetic counterparts. Progress in this area would be desirable, especially if Sri Lanka wishes to expand its potential market share in product areas where economics is a determining factor.

The changing technological and economic environment of the world elastomer industry can be expected to lead to new research and development through the 1980s and 1990s, resulting in significant developments in the natural rubber usage in both traditional as well as new applications.

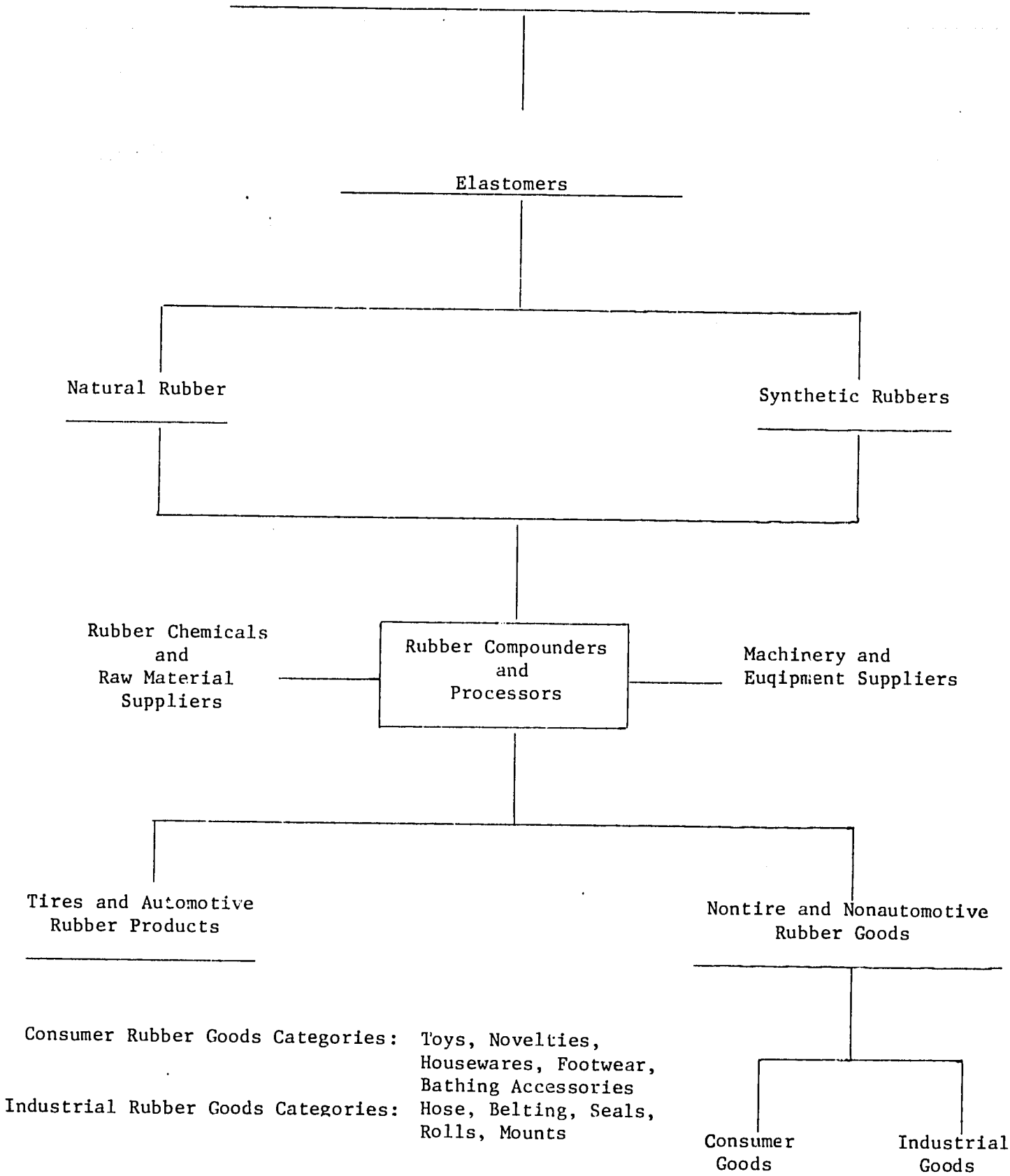
C. STRUCTURE OF RUBBER PRODUCTS INDUSTRY SECTOR

The rubber products industry sector, in general, can be broadly classified as tires and nontire rubber goods segments, as illustrated in Figure 3.

The world rubber products industry is considered a mature industry, primarily characterized by its state of development in the industrialized nations, namely, North America, Western Europe, and Japan. Over the years, the industry has been growing at a slower pace, mainly because of the saturation of its major markets, the

FIGURE 3

RUBBER PRODUCTS INDUSTRY SECTOR



transportation and construction industries. The performance of the world rubber products industry during the past several years has been dismal as a result primarily of the oil crisis followed by global recession. Although the rubber products industry should improve somewhat as a result of the recovery of the automotive and construction industries, the industry, as a whole, will remain relatively stagnant for the foreseeable future.

For developing countries like Sri Lanka, however, the rubber products industry shows some growth potential. Although the industry is generally mature, the increased demand for motor vehicles and other consumer and industrial products in the rapidly growing countries of Southeast Asia, Africa, and Middle East, implies expanding regional markets for rubber products. However, currently, the rubber products industry in Sri Lanka is rather primitive and relatively unequipped to tap these growing markets. Since, traditionally, Sri Lanka has continued to export the bulk of its rubber in raw form while importing tires and nontire rubber goods for local consumption, the industry has remained largely undeveloped.

Sri Lanka currently has only one tire producing company, the Sri Lanka Tire Corporation, a state corporation operating in technical collaboration with B.F. Goodrich and serving mainly domestic markets. In the non-tire sector, Sri Lanka has approximately 145 companies, 90% of which are classified as small- to medium-size industries operating in the private sector and producing a wide variety of consumer and industrial rubber goods. Out of these 145 companies, about 10 to 15 large rubber goods producers are engaged primarily in manufacturing tire retreads, automotive components, footwear, latex thread, rubber gloves, flooring, and other similar products.

The development of the rubber products industry in Sri Lanka, over the years has been based primarily on its indigenous know-how and skills. By world standards, Sri Lanka's rubber products industry remains highly unsophisticated and requires modernization in the areas of technology, marketing, and management. In fact, modernization of

the rubber products industry is essential if the country is to enter international markets and compete with such nations as India, Malaysia, Thailand, Indonesia, South Korea, and Taiwan. Modernization will require that the government pursue a focused and consistent industrial policy to attract the necessary foreign participation in the areas of technology, marketing, and management.

However, before Sri Lanka can attract foreign participation to develop and modernize its rubber products industry, it is important that the government identify and select industry segments that will offer long-term commercial opportunities in a generally mature industry. To assure long-term commercial success, Sri Lanka will have to select carefully those industry segments which could utilize the country's limited strength and resources and achieve the maximum competitive impact in the international markets.

Obviously such a selection can be made only after careful assessment of the country's competitive strength and resources, specifically in the areas of technology, markets, and operational infrastructure.

IV. TECHNOLOGY

A. DEFINITION AND CHARACTERIZATION

Technology plays a vital role in the industrial development, particularly in the early stages (embryonic and growth) of the industry maturity cycle. Technology can be defined as a practical application of scientific or engineering knowledge that can be successfully transformed into a product. In general, two types of technologies are embodied in a fabricated product: material-related technology and manufacturing process-related technology.

Rubber products are primarily composed of several distinct identifiable material and process-related technologies. These largely include formulations, compounding, mixing, molding, extrusion, calendering, and vulcanization. Each of these technologies plays an important role in providing a significant competitive impact--with regard to quality, performance, and service life--on the end product, which may be tire, rubber glove, engine mount, or just a simple rubber band.

Since the rubber products industry is in the mature stage, the technologies embodied in tires as well as various nontire rubber products are well-established. Except for minor modifications and changes in the material- and process-related technologies like formulation, molding, vulcanization, extrusion, etc., very little technological innovations are occurring that could rejuvenate this rapidly aging industry.

For Sri Lanka, however, the industry is still in its infant or embryonic stage. This is also true for other developing countries that have begun to industrialize and are expected to grow rapidly during the next several decades.

B. ASSESSMENT OF SRI LANKA'S RUBBER-BASED TECHNOLOGIES

1. Material-Related Technology

Material-related technologies, particularly those based on natural rubber, are weak, despite the fact that Sri Lanka has been one of the leading producers of natural rubber for the past 100 years. Unlike Malaysia, where natural rubber-based technologies have been well developed and commercialized successfully, Sri Lanka has failed to exploit its available technological base through its Rubber Research Institute, Ceylon Institute of Scientific and Industrial Research (CISIR), and other similar institutions to expand the potential of natural rubber as an industrial material. This, plus the small size of most of the companies, has constrained the development of natural rubber-based industries.

As a polymer, natural rubber contributes the backbone of a wide variety of fabricated rubber products. Because of its desirable inherent properties such as resiliency, low hysteresis, and abrasion characteristics, natural rubber is widely accepted as the most suitable material for tires as well as for many nontire rubber products.

Furthermore, formulation of natural rubber compounds are critical in extending the capability of natural rubber for many end-use applications. Selection of an appropriate grade and type of natural rubber, followed by identification, screening, and selection of suitable compounding ingredients, constitute important tasks in developing a formulation best suited for a given application. Besides obtaining desired processibility and required physical and chemical properties, the formulation of natural rubber compounds must be developed to provide the highest quality, optimum performance, and expected service life of the end product.

Sri Lanka, for instance, produces probably the best latex crepe rubber in the world, which is highly desirable for various nontire rubber products. However, because of its poor and limited technological capability in the areas of formulation, compound design, and product applications, Sri Lanka has failed to understand the maximum potential of its latex crepe and to exploit it favorably in many industrial products, specifically in medical and health-care-related rubber products.

Thus, to develop natural rubber-based industries, Sri Lanka will need to strengthen its material-related technologies, especially formulations, compound design, and product applications. These technologies could provide Sri Lanka with significant competitive advantages in international markets.

2. Process-Related Technology

Process-related technologies (compounding, mixing, molding, dipping, calendering, extrusion, vulcanization, etc.) play an equally important role in the manufacture of tires and various nontire rubber products. Generally, the types of process technologies involved in a specific rubber product depend heavily on the characteristics and the types of natural rubber or natural rubber compound used. For example, the manufacture of a rubber balloon or a rubber glove would involve Latex "dipping" technology, whereas the manufacture of a bicycle tire would require conventional "molding" technology. In any event, the primary consideration in the selection of a process-related technology should be quality, particularly the uniformity, the consistency, and to a limited extent, the cost of the finished product.

Since process-related technologies are linked directly to the equipment or machinery employed in the manufacturing operation, technologies such as calendering and molding are poorly developed. Moreover, because of limited indigenous capability in design and fabrication of various rubber processing machinery, Sri Lanka has continued to rely on imports of such machineries, further restricting

development of process-related technologies in the country.

Although indigenous development of process-related technologies may not be feasible at the large-scale production level, such development would most certainly be practical at the laboratory and pilot-plant level. Since process-related technologies directly contribute to production efficiency and manufacturing cost savings, Sri Lanka will, in fact, need to explore and gradually develop modern process-related technologies to enhance its competitive advantage. For example, molding of automotive components from natural rubber compounds has been traditionally carried out in Sri Lanka on standard compression molding equipment. However, if the country wishes to manufacture various automotive components and promote them in international markets, it may require developing process technologies based on modern injection molding machines. Such development would not only aid in producing superior quality automotive components, but would also provide a favorable cost structure.

Development and commercialization of such process-related technologies at the laboratory and pilot-plant level can best be carried out through the Industrial Development Board, a government agency set up to help small- and medium-scale rubber industries. Because of growing competition in the international markets, economics will continue to play a significant role in the manufacture of various rubber products. Therefore, to enhance the country's already favorable cost position provided by its cheap labor, it will need to explore and gradually develop process-related technologies that would best suit its own conditions.

V. MARKETS

A. DEFINITION AND CHARACTERIZATION

Markets for rubber products are highly fragmented and are therefore difficult to define and characterize. However, the global markets for rubber products can broadly be defined based either on their geographic location, such as North America vs. Southeast Asia vs. Middle East, or on their specific consuming industry sectors, such as automotive vs. consumer products vs. construction vs. health care.

Geographically, North America, Western Europe, and Japan account for the vast majority of rubber products consumption. Industrially, however, the automotive industry accounts for more than 60% of the rubber products consumption, specifically products made from natural rubber. Examples of some of the specific rubber products for these various markets are tires, tubes, footwear, toys, flooring tiles, hose, belting, packings, and other similar consumer and industrial rubber products.

B. MARKET SIZE AND TRENDS

The size and trend of the total rubber products market and, specifically, the products based on natural rubber are extremely difficult to estimate, especially because of its fragmented nature. However, this task can be greatly simplified if the markets are divided into two primary segments: tire and automotive-related rubber products, and nontire and nonautomotive-related rubber goods.

The automotive industry is by far the largest consuming industry sector for natural rubber products. Tires, tubes, and many extruded and molded rubber components that are used in the automotive industry account for approximately 70% of natural rubber consumption. However, with the downsizing of automobiles and the changing nature of motor vehicles, specifically in the industrialized nations, tires and other

automotive components have also been downsized, reducing the materials and weights involved. This trend should continue in the future, adversely influencing the growth of the tire and automotive-related rubber products in the industrialized nations. According to Arthur D. Little's recent projections, the tire and automotive-related rubber products segment in the developed nations should grow at an average annual rate of 2.8% through the year 2000.

On the other hand, non-tire and non-automotive-related rubber products, which are generally influenced by overall economic growth and, specifically, by the growth of their particular consuming industry sectors, are projected to grow much faster. Nontire and nonautomotive-related rubber products in the developed nations should grow at an average annual rate of 3.6% through the year 2000, with certain sectors growing as fast as 6.9%.

While this scenario is for the industrialized nations such as North America, Western Europe, and Japan, the developing nations of Southeast Asia, Africa, the Middle East, and Latin America portray a different picture. These nations are expected to enjoy a considerably higher growth rate than four times that of Western Europe and two and one-half times that of North America over the next 20 years. With such an increase in growth rates, demand for rubber products--tires and automotive-related rubber products as well as nontire and non-automotive-related rubber products--should grow substantially. The total rubber products market in these developing nations is projected to grow at an average annual rate of 3.9% through the year 2000.

C. ASSESSMENT OF SRI LANKA'S COMPETITIVE POSITION

The growing markets for rubber products in developing and less developed countries provide good commercial opportunities for countries like Sri Lanka, with its special assets in natural rubber. Because of the relatively limited size of its own market, Sri Lanka

would primarily have to rely on these growing export markets for its rubber products industry. Although the market for rubber products has been growing in Sri Lanka, fostered by the rapid growth of consuming sectors such as automotive, building, and construction industries, the total size of the domestic market is small and cannot provide the desired economy of scale.

Geographically, Sri Lanka is well situated to tap the growing markets of Southeast Asia, the Middle East, Africa, and the Far Eastern countries. However, several other natural rubber producing countries in the same region (namely, Malaysia and India) had already perceived this growth pattern in the 1970s. At that time, they made major strategic decisions to prepare for these rapidly growing markets by setting up marketing and distribution systems and operational infrastructures. Moreover, these countries used their own domestic markets to gradually develop their rubber products industry and are therefore better positioned than Sri Lanka today to supply quality rubber products at competitive prices to these markets.

Since Sri Lanka would be entering these growing international markets relatively late, it will be playing a "catch-up" game, especially if it intends to penetrate major consuming sectors such as the automotive, building, and construction industries. Furthermore, since Sri Lanka has traditionally served its own market, it is rather weak in understanding and practicing modern international marketing tools and techniques such as product testing and evaluation, market research, and analysis that are essential to penetrating these markets.

Thus, the country is in a weak competitive position in a generally mature rubber products industry. It suffers from a negligible market share of the total rubber products market, unfavorable economics of production, and a very narrow breadth of product line.

Strategically, Sri Lanka will not be able to survive independently and profitably in the long term in the global rubber products market unless it can achieve the following:

- Obtain major foreign participation;
- Identify specific market segments with respect to product areas as well as countries;

VI. OPERATIONS

A. ASSESSMENT OF SRI LANKA'S PHYSICAL INFRASTRUCTURE

Power, water, telecommunications, and transportation are major physical infrastructures that play a crucial role in the operation of the rubber products industry. Although the Sri Lankan Government over the past several years has tried to develop the necessary infrastructure to provide a suitable industrial environment for promoting the growth of the rubber products industry, Sri Lanka still lags behind its major potential competitors.

Availability of an adequate water supply for industrial applications is a major requirement for the operation of rubber products industry. Water is often not accessible to some rural and urban locations because of poor distribution of water lines and facilities. Therefore, the government should consider developing industrial zones only in those regions where water is both plentiful and easily accessible.

The availability and price of electric power have been of some concern in Sri Lanka and have adversely affected the operations of rubber products industry in the country. Since electricity is generated primarily from "hydro" sources and is linked directly to the monsoon season, the supply and the prices of electricity have been significantly influenced by the amount of rainfall in a given year. Furthermore, since the supply of electricity is controlled by the Electricity Board, any increase in the power surcharge or tariff by the Board (as happened during the past several years) can have a negative impact on the rubber products industry. Therefore, to create a favorable industrial environment, a consistent, predictable pricing policy and an uninterrupted supply of electricity are desirable.

Generally, internal transportation facilities in Sri Lanka such as road and rail transportation services are available at low prices. These facilities are efficient and are linked throughout the nation.

International transport facilities are generally adequate. Ocean freight rates, however, which have a major impact on the export price of rubber goods, are highly uncompetitive in Sri Lanka compared with its major competitors such as Thailand and Indonesia.

B. ASSESSMENT OF SRI LANKA'S FINANCIAL AND HUMAN RESOURCES

Financial and human resources play a vital role in operating a rubber products industry, particularly in the early stages of industrial development.

While development banks and refinance institutions exist in Sri Lanka to assist the start-up of industries, these banks do not normally function in an effective activist mode. To a large extent, they depend heavily on the private sector to identify specific projects for commercial investments. Unfortunately, however, private firms usually lack critical marketing information essential for such investment decisions. The development banks, in particular, should assist firms in providing this information.

The cost of capital is the major constraint at the present time. Since Sri Lanka has recently experienced a period of high inflation and high interest rates, the terms and conditions for borrowing for capital investments in plant and machinery are severe, particularly for small- and medium-size companies. Normal interest rates on term loans are currently around 18%, which is high for the mature rubber products industry whose average earning potential is generally low. Furthermore, this interest rate is higher than Sri Lanka's major competitors, and, therefore, a major constraint for developing a competitive rubber products industry.

Regarding human resources, supervisory and skilled and unskilled workers are readily available. Furthermore, these people are relatively well educated and are highly trainable, therefore providing a major competitive strength to Sri Lanka. However, they generally lack the necessary training. Primary reasons for poor management

efficiency are the inadequate availability or inferior quality of support services such as technical and management training institutions, research and development equipment, tools and facilities, and infrastructure facilities.

Regarding skilled and unskilled factory workers, vocational training is critical, especially in the production of high-quality, high-performance, premium rubber products for the medical, health-care, or electronics industries. Better training facilities need to be initiated by either the government or the industry.

VII. PRODUCT OPPORTUNITIES

A. FORMULATION OF A DEVELOPMENT STRATEGY

Sri Lanka, like many developing countries, has been pursuing a "broad-based" development strategy, primarily driven by broad objectives of the government without any specific development plan. For instance, Sri Lanka has been encouraging the rubber products industry to manufacture a host of consumer and industrial rubber products primarily targeted for the developed nations of North America and Western Europe. Specifically, the government has been encouraging foreign participation in manufacture products ranging from automobile tires and tubes, to rubber bands, rubber gloves, latex thread, and footwear as well as a broad variety of extruded and molded components. Such a "broad-based" development strategy has proved to be commercially unsuccessful.

The government, as a result of promotional efforts, has been able to attract foreign participation in setting up several companies in Investment Promotion Zone. The majority of these companies, however, have been manufacturing commodity-type consumer rubber products such as rubber bands, latex thread, rubber footwear, etc., which are prone to cyclical consumer demand and and greatly influenced by the global recession during the past several years. Because of the prolonged recession, many of these companies have either failed or will fail if such a consumer-led recession persists for an extended period.

Therefore, to achieve some long-term commercial viability, the industry will have to get away from its "broad-based" development strategy and gradually pursue a more selective strategy for the rubber products industry.

Furthermore, formulation of such a selective strategy must be congruent with the primary strategic thrusts of the country, which are:

- Utilization of natural resources, such as natural rubber;

- Improvement of foreign exchange earning capacity, primarily through increases in export earnings;
- Generation of higher employment;
- Increased value-added to production;
- Strengthening of long-term commercial viability of new ventures.

B. SRI LANKA'S MAJOR COMPETITIVE STRENGTHS AND CONSTRAINTS

The following major competitive strengths and constraints were identified in the course of the study:

Major Competitive Strengths:

- Inexpensive, trainable labor;
- Abundant availability and supply of natural rubber;
- Favorable current domestic prices (compared to world standards) of natural rubber.

Major Constraints or Limitations:

- Inconsistent quality of field latex;
- Relatively higher prices for compounding materials;
- Poor knowledge and use of quality control standards, tools, and equipment;
- Poor supply and availability of production tools, dies, and related accessories;
- Poor knowledge and use of modern marketing tools and techniques;
- High capital investment requirements in plant and machineries;
- Poor infrastructural facilities;
- High cost of financing;
- High rate of labor absenteeism, resulting in lower labor efficiency and productivity.

C. SELECTION OF COMMERCIALLY VIABLE PRODUCT/BUSINESS OPPORTUNITIES

Based on the assessment of Sri Lanka's major competitive strengths and constraints, the following products and business areas are presented as possible opportunities for private sector investment. These opportunities are specifically based on domestic utilization of Sri Lanka's natural rubber and targeted primarily for the export markets.

Identification of three specific areas of opportunities has been based on a preliminary screening without in-depth investigation. They areas will therefore require further study before any decision is made to pursue these investment opportunities.

The approach in arriving at these opportunities involved selectively screening tire/automotive-related rubber products and nontire/nonautomotive-related rubber products. On the first screening tire/automotive-related products were eliminated altogether. This was primarily due to the fact that Sri Lanka's strengths and resources do not appear to fit in with the highly competitive global automotive markets. In the nontire/nonautomotive-related products; consumer oriented rubber products like footwear, rubber bands, latex threads, etc., were eliminated. These consumer products markets are highly unpredictable and prone to the cyclical consumer demand and therefore present an uncertain future.

Ultimately, this process led to those product/business opportunities which not only provide long-term growth potential but also accord with Sri Lanka's major competitive strengths. The final selection included three such areas, namely, medical- and health-care-related rubber products, natural rubber-based composites, and natural rubber-based specialty alloys and blends.

The profile of each of the selected business areas is discussed here and briefly outlines the technology, the specific products, the markets, the competition, and the financial structure. The financial structure, as outlined in these profiles, is based on preliminary cost

estimates using the information obtained during the interviews with the local industrialists and bankers. Profitability of these selected product areas, however, is based partially on the experience of businesses operating in other rubber producing countries similar to Sri Lanka.

MEDICAL- AND HEALTH-CARE-RELATED RUBBER PRODUCTS

Examples of specific products:	Adhesive plasters and tapes, surgeons' gloves and aprons, ice- and hot-water bags, surgical tubings, catheters, teats, hospital sheetings, bottle closures, diaphragms, pacifiers, and other similar products
Base polymer:	Natural rubber latex and latex crepe
Primary technology:	Dry and latex natural rubber compounding, formulations, dipping, molding, sheeting, vulcanization
Major existing markets:	North America, Western Europe, Japan
Potential growing markets:	China, Southeast Asia, Far East, Middle East, African countries
Sri Lanka's existing major competitors:	North America, Western Europe
Sri Lanka's potential competitors:	Malaysia, Thailand
Sri Lanka's competitive position:	Favorable
Financial structure:	• Capital investment : Rs. 55-80 million • Production capacity: 1200-1600 tons/year • Annual turn-over : Rs. 100-150 million • Expected return on investment : 15-20% • Expected pre-tax profit on sales : 8-11%

Capitalization structure:	Public limited
Developmental impacts/unit:	• Employment generation: 400-500 • Natural rubber consumption: 800-1000 tons/year
Recommended initiators and promoters:	• Large domestic firms with strength and resources in managing international business • Joint-venture partner, preferably small foreign companies associated with health-care industry

NATURAL RUBBER COMPOSITE PRODUCTS

Examples of specific products:	• Natural rubber - coconut coir fiber • Natural rubber - modified bitumen • Natural rubber - cork • Natural rubber - cotton, synthetic, and glass fiber composites
End-use applications:	Water proofing, gasketing, insulation, sound-deadening, vibration damping, paneling, sheeting, etc.
Base polymer:	• Natural rubber latex, T.S.R. • Smoke sheets
Primary technology:	Rubber formulation, compounding, composite blending, sheeting, vulcanization
Major existing markets:	North America, Western Europe, Middle East
Potential growing markets:	Southeast Asia, China, Far East, African countries
Sri Lanka's existing major competitors:	India, Malaysia
Sri Lanka's competitive position:	Favorable-strong

Financial structure:	• Capital investment : Rs. 40-50 million • Production capacity: 1000-12,000 tons/year • Annual turn-over : Rs. 45-55 million • Expected Return on investment : 15-18% • Expected pre-tax profits on sales : 13-16%
Capitalization structure:	Public limited
Developmental impacts per unit:	• Employment generation: 400-450 people • Natural rubber consumption: 600 tons/year
Recommended initiators and promoters:	• Large local firm with strengths and resources in natural rubber, coconut coir, and international marketing • Joint-venture partner, preferably building material manufacturer/supplier or distributor

SPECIALTY RUBBERS AND POLYMERS

Examples of specific products:	Thermoplastic natural rubber, granulated natural rubber, custom-tailored natural rubber alloys
End-use applications:	An intermediate material for a variety of consumer and industrial rubber and plastic products
Base polymer:	Dry natural rubber, specifically technically specified rubber with controlled viscosity; rubber latex
Primary technology:	Rubber and polymer formulations, compounding, and granulations
Major existing markets:	North America, Western Europe, Japan
Potential growing markets:	Southeast Asia, Middle East, Far East, African countries
Sri Lanka's existing major competitors:	United Kingdom, Malaysia
Sri Lanka's potential competitors:	India
Sri Lanka's competitive position:	Favorable-strong

Financial structure:	• Capital investment : Rs. 20-30 million • Production capacity: 1500-2000 tons/year • Annual turn-over : Rs. 45-55 million • Expected return on investment : 25-40% • Expected pre-tax profit on sales : 12-18%
Capitalization structure:	Public or private limited
Developmental impacts per unit:	• Employment generation: 100-120 people • Natural rubber consumption: 700-1000 tons/year
Recommended initiators promoters:	• Large local firms with strengths and and resources in basic material (T.S.R.) and international marketing • Joint-venture partner, preferably specialty polymer and rubber manufacturing companies or marketing/distribution agencies

VIII. RECOMMENDATIONS

The success of new ventures in the rubber products industry will largely depend on the actions taken by the promoters/investors in the government and the private sector. Although specific actions required to make a given venture successful will depend on many factors, including the type of foreign participation involved, the government can also play a major role and lay the groundwork for assuring long-term commercial success of these ventures in the rubber products industry.

Specifically, the government should make a concerted effort to establish and aggressively pursue a favorable industrial policy that will improve the competitive position of local producers. This policy should involve the following key elements if Sri Lanka intends to increase its presence in international markets for rubber products:

- Provide favorable tax and financial incentives to promote quality natural rubber production.
- Coordinate activities among various ministries involved in the rubber industry.
- Allocate proper resources to government institutions and agencies, specifically to further growth of rubber products industry sector.
- Provide favorable incentives and attractive terms to invite foreign investments, technology, and markets.
- Acquire modern marketing tools and techniques.
- Strengthen rubber research, development, and marketing activities, specifically with a view to export promotion.
- Establish and pursue long-term favorable natural rubber pricing and supply policies to promote rubber-based industries.
- Improve infrastructure facilities to bring them up to par with major competitors.

CHAPTER 4

LIGHT ENGINEERING SECTOR

I. INDUSTRY CHARACTERIZATION

A. INTRODUCTION

In Sri Lanka, Light Engineering is a loosely defined and highly fragmented industry that encompasses a wide variety of non-complex mechanical products. In 1981 the domestic market for these products was approximately Rs 3.6 billion. A large number of local Sri Lankan firms account for 20% of this figure while the remaining 80% is imported from foreign producers. Despite the predominance of imports, the indigenous Light Engineering industry is growing. Historically, this production has been concentrated in three areas, as shown in Table 1.

B. DOMESTIC PRODUCTION

In 1981, domestic Light Engineering production totaled Rs 700-800 million. These figures are based on data from the Central Bank of Ceylon and the Ministry of Industries. Each institution uses somewhat different definitions; the Central Bank's data are for the category, "Fabricated Metal Products, Machinery and Transport Equipment," while the Ministry of Industries' data are for the category 416, "Basic Metal Industries and Machinery."

Through 1978 the Ministry of Industries required that all companies submit detailed annual operating data. Since then, the ministry has asked for data, but collection has been incomplete. Thus the Ministry of Industries has not published detailed data since 1977. Information for 1981 on 47 of 176 registered firms is in the Ministry files in their data category 416 for 1981.

Besides registered companies, there are many unregistered firms in Sri Lanka. The Technonet-JICA Joint Research Project of the Small and Medium Scale Metalworking Industries, Phase II, estimated that there were twice as many unregistered metalworking firms as registered

TABLE 1

TYPICAL LIGHT ENGINEERING INDUSTRY PRODUCTS BY MAJOR INDUSTRIAL SECTOR SERVED

Major Industrial Sectors Served	Typical Light Engineering Products
Farm- Related	
• Food	* Tractors, sprayers, harvesters, threshers, hullers, grinders, pumps.
• Non-Food	* Rollers, expellers.
Construction-Related	
• Building	* Tools, mixers, vibrators, screws, nuts and bolts, locks, fittings.
• Home and Office Equipment	* Appliances, safes, cabinets, fans
General Industrial	* Small engines, compressors.

ones. While these are generally quite small, their combined impact on the economy is important.

Central Bank statistics indicate that the Light Engineering industry accounts for 3.4% of total domestic industrial production, as defined by their "fabricated metal products" category shown in Table 2.

C. IMPORTS AND EXPORTS

Sri Lanka imports Light Engineering products valued at approximately five times domestic production. Exports of local production, on the other hand, are quite small. According to detailed 1981 import and export statistics available at the Ministry of Finance for their import categories 82, 83, and 84, imports of Light Engineering products amounted to Rs 2,925 million, while exports were only Rs 38 million. As indicated in later sections of this chapter, there is potential for export expansion in certain areas.

Markets for Light Engineering products are closely related to three major sectors of Sri Lankan industry: farming, construction, and general industry. The first two sectors may be further broken down as follows:

Category	Sub-Category	Typical End Products
Farming	Food	Tea, dairy, animal husbandry, coconut, and other food products.
	Non-food	Rubber, timber.
Construction		Nails, screws, nuts and bolts.
	Home and Office Equipment	Metal office furniture, household appliances.

TABLE 2

INDUSTRIAL PRODUCTION - 1981 LEVELS

Category	Sales (Rs Mil)	Value Added (Rs Mil)	Ratio (Value Added/Sales)
1. Food, beverages and tobacco	4,496	1,891	42%
2. Textile, wearing apparel and leather products	3,040	513	17
3. Wood and wood products (including furniture)	315	169	54
4. Paper and paper products	626	264	42
5. Chemicals, petroleum, coal, rubber and plastic products	12,015	2,098	17
6. Non-metallic mineral products (except petroleum and coal)	1,250	593	47
7. Basic metal products	428	80	19
8. Fabricated metal products, machinery and transport equipment	782	406	52
9. Products n.o.s.	58	16	28
Total	23,010	6,030	26

Source: Central Bank of Ceylon

Table 3 shows the total market in Sri Lanka for Light Engineering products by sectors served, by imports and exports. Over 30% of domestically produced Light Engineering products are used by the farm sector, while only 13% of the imported Light Engineering products are used in farming.

D. LEVEL OF VALUE ADDED IN INDUSTRY

Although no definitive figures exist to show the levels of value added in the Light Engineering sector, the ratio of value added to sales in various industrial product areas is shown in Table 2. The fabricated metal products sector has the second highest ratio of value added to sales which is substantially above the industry average.

Income statements for those companies on which complete 1978 and 1981 data were available at the statistics division of the Ministry of Industries are presented in Table 4. While the cost of materials varies by product and by year, it represents no more than 50% of sales. Wages are at least 18% of sales in six of the twelve product categories. This indicates high levels of value added in a number of product categories.

A third measure of the potential for attractive levels of value added is indicated in data from the Technonet-JIC research report on small and medium scale metalworking industries, based on survey data on metalworking companies in Sri Lanka. Table 5 shows that 66.3% of the companies covered had average annual returns on fixed assets of 100% or more.

Sales per employee for various medium-sized Light Engineering companies apparently ranged from Rs 150,000 to Rs 220,000 per year. Approximately 12% of the employed population are now in manufacturing industries, up from 9% in 1971.

TABLE 3

TOTAL DOMESTIC MARKET FOR LIGHT ENGINEERING PRODUCTS

Industrial Sector Served	Import (Rs Mil)	Domestic Production (Rs Mil)	Export (Rs Mil)	Total Domestic Market (Rs Mil)
1. Farming				
Food	265.8	183.2	19.1	429.9
Non-Food	113.6	37.0	-	150.6
Total Farming	379.4	220.2	19.1	580.5
2. Construction				
Building	385.5	-	4.6	380.9
Equipping	324.1	90.5	1.9	412.7
Total Construction	709.6	90.5	6.5	793.6
3. General Industry	1835.6	394.9	11.9	2218.6
Total	2924.6	705.6	37.5	3592.7

Source: Arthur D. Little estimates based on 1981 Ministry of Industry and Import/Export Data.

TABLE 4

INCOME STATEMENT COMPARISON 1978-1981
SELECTED PRODUCTS AND COMPANIES IN BASIC METAL AND METAL PRODUCTS
(PERCENT OF SALES)

	Galvanizing		Foundries		Tea Mach.		Hullers & Grinders		Mist Blowers & Knapsack Sprayers		Water Pumps		Major Appliances (Refrigerators & Deep Freezers)		Sewing Mach.		Textile Mach. Parts		Rubber Mach.		Oil Pressing & Refining		Weighing Machines	
	1978	1981	1978	1981	1978	1981	1978	1981	1978	1981	1978	1981	1978	1981	1978	1981	1978	1981	1978	1981	1978	1981	1978	1981
Sales	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	N.D.	100	N.D.	100	N.D.
Costs																								
Material	88	86	39	34	17	36	39	9	113	68	46	80	72	63	54	85	40	50	35		86		27	
Wages	3	4	39	20	18	28	25	19	49	22	10	10	17	13	20	10	20	12	14		38		27	
Power	1	2	3	6	0	1	4	5	2	2	1	1	3	2	2	2	5	7	7		1		8	
Other	2	3	8	23	41	74	11	7	41	3	4	6	9	13	13	16	7	5	3		0		8	
Total	93	95	89	83	76	79	79	40	204	95	62	97	101	91	89	113	80	69	58		101		70	
Profit before Tax	7	5	11	17	24	21	21	60	(104)	5	38	3	(1)	9	11	(13)	20	31	42		(1)		30	
Plant & Machinery	6	3	21	38	14	2	n.a.		31	14	11	10	8	4	12	7	64	38	14		39		67	

Source: Arthur D. Little International, Inc. and Ministry of Industry

TABLE 5

AVERAGE ANNUAL RETURN ON FIXED ASSETS FOR SMALL TO MEDIUM METALWORKING COMPANIES - 1979-1980

Multiple of Fixed Assets	% of Firms
1	32.4
1-2	33.0
3-4	11.3
5-6	5.5
6^{+}	16.5
No Answer	1.3

Source: Technonet-JICA.

E. INDUSTRY FRAGMENTATION AND COMPETITION

The metalworking industry is highly fragmented and competitive. Annual sales of the estimated 3000 metalworking companies average Rs 235,000. The Technonet-JICA data in Table 6 shows the small size of many companies. Mean company size in this survey was Rs 853,460; 87.4% of the companies had no more than 30 employees; and 89.3% of the companies were less than 20 years old.

Competition is from foreign as well as domestic producers. If the estimated 3000 companies supplied products in all 250 imported product categories, domestic competitors would average 12 per category. Since not all products imported are also made in Sri Lanka, in many product categories the number of domestic competitors is even higher. There are at least 250 foreign competitors, since few foreign manufacturers supply products in more than one category.

TABLE 6
METALWORKING COMPANY SIZE AND AGE

a. Age of Company

Years	Firm Age %	Age of Main Production Facility
2	14.2	16.2
2-5	19.7	24.6
6-10	32.7	33.7
11-20	22.7	17.2
21-30	8.1	
31+	2.6	4.5
No answer	0.0	3.9
	100.0	100.0

b. Company Distribution by Number of Employees

No. of Employees	%
5-10	59.2
11-30	28.2
31-50	6.5
51-99	3.6
100-199	2.6
200+	0.0
	100.0

c. Mean Company Size by Technology Utilized

	Mean Rs (000)
Casting	1,068
Forging	167
Sheet work	464
Plating	704
Mach. Assembly	3,431
Machining	577
Press Work	1,100
Mean Total	853

Source: Technonet-JICA.

II. MARKET OPPORTUNITIES

A. INTRODUCTION

The markets for Light Engineering products are large (Rs 3.6 billion in 1981) and diverse, with sales to three major sectors of the economy. With 82% of the domestic market supplied by imports, there are commercially attractive opportunities for import substitution in equipment for food production. Such opportunities would be of substantial direct benefit to the country by increasing value added to agricultural output and increasing farmers' income. Other benefits might include the potential for exporting Light Engineering products to other developing countries as well as providing a multiplier effect for other subsectors of Sri Lankan industry.

B. AGRICULTURAL MARKETS

Agriculture accounts for one quarter of Sri Lanka's Gross Domestic Product (GDP), 80% of the country's export earnings, and between 45% and 51% of the country's work force.

Yet despite its importance, agricultural yield losses have been estimated at 25-35% and yield per acre is well below yields of other countries.

At present, agriculture is primarily manual. Table 7 shows the typical farming processes for seven farm products. For these crops, the seed bed/planting/tilling/preparation phase is largely manual, with hand labor supported by two-wheel tractors for vegetables and by two and four-wheel tractors for rice. All crop areas depend primarily on rain while rice and sugar cane depend heavily on river and irrigation systems. Agrochemicals are applied manually to rice and vegetables. Harvesting/threshing/transport are also basically manual with some tractor support. Processing/utilization of agricultural by-products is rudimentary.

TABLE 7

FARMING PROCESS BY PRODUCT TYPE

	Major Farming Steps	Rice (Paddy)	Sugar Cane	Mango	Coconuts	Citrus Fruits	Vegetable-All	Cashew
A	Seed Bed) Planting) Tilling) Preparation)	Manual Manual, Animal Power Two-wheel tractor 4-wheel tractor	Manual	Not complicated. Bearing after 3 years Done at domestic level Hardy trees.	Not complicated. Bearing 3-5 years. Hardy trees Manual operations.	Not complicated, bearing after 3-6 years. Hardy trees. Manual operations.	Hard labour essential Two-wheel tractors	Hardy Trees bearing after 3-6 years. Manual operation.
B	Irrigation	Rain fed. River & government supported systems (Mahaweli etc.)	Rain fed & public service system	Rain fed.	Rain fed.	Rain fed.	Rain fed, water pump Pump (lift irrigation) Very problematic. Tube wells	Rain fed.
C	Agrochemicals	High use (Manual)	Fairly low (Manual)	Fairly low (Manual)	Fairly low (Manual)	Fairly low	Very high	Low
D	Harvesting) Threshing) Transport)	Manual Animal Power Tractors, Animal Power	Manual Animal Power Tractors	Manual	Manual	Manual	Manual	Manual
E	Processing & utilization of by-products	Paddy - Rice Milling: Manual & Rice Mill Paddy Hull Ash used with lime as cement. Potential for	Factory in Kantalai (Not doing well) Small scale crushers are not available now.	Local eating consumption without special process. Bottling and canning done-not sufficient.	Coconut milk for domestic, coconut oil, by-product as animal food (Mills) desiccated coconut for biscuits. Coconut fibre for mattresses.	Juice, manually extracted. Pickles made manually.	Without processing	Cashew nut edible-potential for processing.
	Growing Area	All over the Island	Restricted Areas	Restricted Areas	Coastal Areas-Flat Lands	All over the Island	All over (Auber-East Coast ginen Okra, Chillies) Red Onions, Soya bean, species)	
	Cost of Cultivation and Harvesting	Rs 2500/Acre	Rs 2000/Acre	Rs 3000/Acre/ Annun.	Rs 10,000/Acre/ Annum.	Rs 10,000/ Acre/Annum	Chillies: Rs 8000/Acre irrigated. Rs 2000/Acre Rain fed.	Rs 5000/Acre/ Annum.

Source: Dr. P. Jegatheswaran of CISIR and ADL

It is evident that there are a number of opportunities where the country's Light Engineering products could improve the productivity of agriculture. Such areas include:

- Improved processing in virtually all product areas.
- Better application of agrochemicals.
- Partial automation of threshing/harvesting for improved yields.
- Provision of equipment that is widely used in various process steps at lower costs than imported products.

C. OPPORTUNITIES IN LIGHT ENGINEERING PRODUCTS IN FOOD PRODUCTION

The opportunities for Light Engineering products in food production are indicated in the import trends shown in Table 8. Imports of products for farm production increased nearly 40% in 1982, while imports by other sectors shrank, with the exception of construction equipment, which showed modest expansion.

With the country's economic well being largely tied to the effective and efficient use of its agricultural base, incremental improvements in agricultural productivity can have a major impact on much of the population. Increasing productivity of the sector will have a multiplier effect on other segments of the Light Engineering industry as well.

While the export potential for Light Engineering products related to agriculture can be developed only after penetration of the domestic market is under way, it is important to note that there are substantial markets for such products at appropriate technology levels in other developing countries.

According to the UN's 1980 Yearbook of International Trade Statistics, more than U.S.$4 billion worth of farm machinery is imported by nearby countries (see Table 9). Table 10 shows units of farm machinery imported or manufactured in selected developing countries near Sri Lanka.

TABLE 8

GROWTH TRENDS IN IMPORTS OF LIGHT ENGINEERING PRODUCTS

Rs Million

	Net Imports*		
	1982	1982	Growth
Farm Related			
Food	246.7	344.1	39.5%
Non-Food	113.6	100.1	(11.9)
Total Farm	360.3	444.1	23.2
Construction Related			
Building	380.0	201.6	(47.1)
Home & Office Equipment	322.2	350.6	8.1
Total Construction	703.1	552.2	(21.5)
General Industrial/Other	1823.7	1164.6	(36.2)
Totals	2887.1	2160.9	(25.2)

*Imports less Exports

Source: Import/Export Statistics, Sri Lanka

TABLE 9

EXPORT POTENTIAL FOR SRI LANKAN FARM EQUIPMENT

	AFRICA DEV'D MARKET	AFRICA DEV'G MARKET	ASIA DEV'G	MIDDLE EAST	INDIA	IRAQ	PAKISTAN
Agricultural Machinery exc. tractors	34,922*	225,391	299,415	-	-	66,803	-
Cultivating Machinery	9,487	50,683	86,870A	53,808*	399	4,658	2,707
Harvesting Machinery	16,941	83,189	96,660	-	-	23,284	-
Other Machinery for Special industries (inc. Tea Leaf cutting or rolling equipment)	-	578,233	1,690,448	621,284	19,621	99,824	-

* 1980 Data

** 1978 Data

Source: 1980 Yearbook of International Trade Statistics, UN.

TABLE 10

LOCAL MANUFACTURE AND IMPORT OF FARM MACHINERY FOR 1979, 1980, 1981

INDONESIA

Farm Machinery	Imported			Local Manufacture			Total		
	1979	1980	1981	1979	1980	1981	1979	1980	1981
Tractors	5730	4339	–	143	176	–	5873	4515	–
Two-wheel tractors	–	–	–	486	970	–	486	970	–
Farm engines	–	–	–	21086	56706	–	21086	56706	–
Tillage implements	–	–	–	823	27	–	823	27	–
Seeders & Planters	–	–	–	–	–	–	–	–	–
Irrigation pumps	75655	113037	–	4609	–	–	80264	113037	–
Sprayers (Hand)	209749	227189	–	3000	4744	–	212749	231933	–
Sprayers (Power)									
Weeders	4637	6107	–	–	–	–	4637	6107	–
Harvesters	–	–	–	–	–	–	–	–	–
Threshers	–	–	–	443	500	–	443	500	–
Post-harvest eqpt	–	4919	–	2674	2698	–	2674	7617	–
Hand tools	550759	838964	–	325	411	–	551084	839375	–

PAKISTAN

Tractors	18323	15793	17261	–	–	–	18323	15793	17261
Two-wheel tractors	←	877	→	–	–	–	←	877	→
Farm engines	2599	3103	364	–	–	–	2599	3103	364
Tillage implements	243	451	541	–	–	–	243	451	541
Seeders & Planters	19	5	10	–	–	–	19	5	10
Pumps	–	–	–	–	–	–	–	–	–
Sprayers (Hand)									
Sprayers (Power)	3504	1100	2443	–	–	–	3504	1100	2443
Weeders	–	–	–	–	–	–	–	–	–
Harvesters	79	87	127	–	–		79	87	127
Threshers	–	–	–	–	–	–	–	–	–
Post-harvest eqpt	–	–	–	–	–	–	–	–	–
Hand tools	–	–	–	–	–	–	–	–	–

PHILIPPINES

Tractors	1224	687	728	–	–	–	1224	687	728
Two-wheel tractors	2063	1417	1252	3226	819	1649	5359	2993	2901
Farm engines	71106	19312	35731	–	–	–	71106	19312	35731
Tillage implements	653	381	428	426	226	243	1079	607	671
Seeders & Planters	36	68	324	–	–	–	36	68	324
Pumps	1099	807	387	3107	1658	1845	4206	2265	1873
Sprayers (Hand)	48175	9240	45860	–	–	–	–	–	–
Sprayers (Power)	53221	54411	36461	–	–	–	–	–	–
Weeders	12	23	169	–	–	–	12	23	169
Harvesters	5	5	5	–	–	–	5	5	5
Threshers	27	–	11	2979	2401	1126	3006	2401	137
Post-harvest eqpt	631	754	680	277	497	910	908	1251	179
Hand tools	2150000	1890000	1330000	–	–	–	2150000	1890000	1330000

SRI LANKA

Tractors	2032	1312	1927	–	–	–	2032	1312	1927
Two-wheel tractors	2788	2529	195	–	–	–	2788	2529	195
Farm engines	6000	6500	7000	–	–	–	6000	6500	7000
Seeders & Planters	–	–	–	–	–	–	–	–	–
Pumps	–	–	–	6000	6000	6000	6000	6000	6000
Sprayers (Hand)	3500	3500	4200	6500	6500	7800	10000	10000	12000
Sprayers (Power)	700	700	875	1300	1300	1625	2000	2000	2500
Weeders	–	–	–	2000	2000	3000	2000	2000	3000
Harvesters	–	–	–	–	–	–	–	–	–
Threshers	–	–	–	25	300	250	25	300	250
Post-harvest eqpt	–	–	–	–	–	–	–	–	–
Hand tools	–	–	–	319000	254000	206000	319000	254000	319000

THAILAND

Tractors	3348	3892	–	–	–	–	3348	3892	–
Two-wheel tractors)									
Farm engines	156701	66977	–	–	–	–	156701	66977	–
Tillage implements	14222	12320	–	–	–	–	14222	12320	–
Seeders & Planters	–	–	–	–	–	–	–	–	–
Pumps	132718	196140	–	–	–	–	132718	196140	–
Sprayers (Hand)									
Spryers (Power)	82.58	170253	–	–	–	–	82058	170253	–
Weeders	–	–	–	–	–	–	–	–	–
Harvesters	13	18	–	–	–	–	13	18	–
Threshers	2	2	–	–	–	–	2	2	–
Post-harvest eqpt	3335	486	–	–	–	–	3335	486	–
Hand tools	1110	864	–	–	–	–	1110	864	–

The report of Thailand does not give the quantities produced for the last three years for each category of farm machinery. However, it has given the approximate annual production and the number of firms engaged for each category of equipment which is presented in table (left)

Source: RNAM Newsletter Issue 15 - 1982

III. DESIGN AND MANUFACTURING CAPABILITY

A. INTRODUCTION

Sri Lanka's manufacturing capability is generally adequate to produce many Light Engineering products at appropriate quality and price levels. Product design skills are appropriate for adapting existing products for Sri Lankan needs. While product development efforts have not always been successful, the failures indicate a lack of appropriate market feedback during design, rather than a lack of design capability.

Various central services are available on the island. The industry does not fully utilize the design and manufacturing support services available at some government institutions. The reason appears to be a lack of responsiveness to industry needs by many of these institutions.

B. MANUFACTURING CAPABILITY

Although it covered only about 10% of the estimated metalworking companies on Sri Lanka, the Technonet-JICA study represents the most comprehensive assessment of the country's manufacturing capability. This capability is summarized in the following paragraphs.

1. Process Technology

In addition to machine assembly, six basic technologies are in evidence: casting, forging, sheet work and welding, plating, machining, and press work. Sheet work and machining are the two technologies most broadly employed, as shown in Table 11.

Ferrous and non-ferrous casting facilities are available. Natural sand molds manually formed, using wooden patterns in the factory floor, are predominant. According to Technonet-JICA, 56.8% of

TABLE 11

PROCESS TECHNOLOGY

Overall Primary Process Technology by Firm

Casting	13.9
Forging	4.5
Machining	30.4
Sheetwork	34.3
Presswork	8.5
Mach. Assembly	5.5
Plating	2.9
Total	100.0

Casting

Cost of Castings Pound

Category	%
Less than 4 Tk/Rs	1.2
4-5 Tk/Rs	3.7
5-7 Tk/Rs	9.9
8-10 Tk/Rs	28.4
11-14 Tk/Rs	28.4
More than 14 Tk/Rs	28.4
Total	100.0

Forging

Maximum Capacity of Hammer/Press Used

Category	%
None	89.5
Below 1/4 ton	3.0
1/4-1/2 ton	3.0
1/2-1 ton	1.5
1-2 tons	0
Above 2 tons	3.0
Total	100.0

Machining

Maximum Diameter Job Turned In Lathe

Category	%
None	0.6
300mm dia. or less	11.8
300-600mm dia.	70.6
600-1200mm dia.	15.9
Over 1200mm dia.	1.2
Total	100.0

Presswork

Biggest Press Capacity

Category	%
Hand operated	27.1
Below 10 tons	20.8
10-50 tons	37.5
51-100 tons	10.4
101-300 tons	4.2
Over 300 tons	.0
Total	100.0

Thickness of Metal Sheets Commonly Used

Category	%
Above 24 gauge	9.4
24-20 gauge	16.1
19-16 gauge	32.3
15-8 gauge	15.1
7-1 gauge	24.5
Thicker than 1 gauge	2.6
Total	100.0

Sheetwork and Welding

Type of Metal Sheets Commonly Used

Category	%
Scraps	8.9
Standard sheet	85.4
Special order sheet	5.2
Coil stock	0.5
Total	100.0

The Kind of Steel Used

Category	%
None	5.7
Scrap	2.6
Galvanized/tin sheet	8.9
Cold rolled/hot rolled sheet	76.0
Stainless steel	2.1
Others - specify	4.7
Total	100.0

Source: Technonet Asia - Japan International Cooperation Agency, "Small and Medium Scale Metalworking Industries, April 1979-March 1980.

the castings cost between Rs 8-14/pound. Furnaces and support equipment are sized for small batches and are often used less than one week per month; 89.5% of the forging in Sri Lanka is performed using human power, while 7.5% uses presses rated at one ton or less.

More than 75% of the steel sheet used in sheet work is cold or hot rolled sheet. Galvanized sheet represents 8.9%, and there is a limited amount of expertise in stainless sheet. Most of the sheet is standard, 88.6% of it between 1 and 24 gauge. Arc welding is typically used to fabricate sheets.

Lathes, milling machines and other cutting machines typically work on cast iron or low carbon steel. Cutting tools of high speed steel or braised carbide tips are common. The Technonet-JICA study indicates a wide range of lathe sizes available; 68.7% of the companies with presses have maximum capacities in the 10-100 ton range, while 27.1% have only hand-operated presses.

2. Capacity Utilization

While 84.8% of the metalworking firms have some form of mechanization according to the Technonet-JICA study, only 1.3% are classified as "mechanized"; the rest are "semi-mechanized". This finding is reinforced by the data in Table 4, which show the value of plant and machinery as less than 40% of sales in 10 of 12 product areas.

In such a context, where most costs are composed of "variable" direct labor and direct material costs, one would expect capacity utilization to be high. The Technonet-JICA study found 80.9% of the factories running at better than 50% utilization. There appears to be more excess capacity now; typical responses to the informal survey conducted in the current study placed capacity utilization in the 40-60% range. Thus excess capacity appears to be available to address market growth for Light Engineering in farm products.

3. Human Resources

Wage rates in Sri Lanka are low by world standards, as indicated in Table 12. Consequently, the country has had an exodus of skilled workers in recent years. Nevertheless, with its educated population and present level of mechanization, there appears to be adequate human resources available. At present, 12% of the employed work force is in manufacturing.

TABLE 12

ROUGH COMPARISON OF HOURLY WAGES FOR COMPARABLE SKILL LEVELS

	Sri Lanka	Malaysia	Singapore	Japan	U.S.
Typical hourly wage as expressed as a multiple of Sri Lanka wage	1	2	6	23	50

Source: Arthur D. Little estimates.

4. Process Control

Appropriate controls are employed for making non-complex mechanical products. In general, the controls are suitable for small batches and limited operations per batch (see Table 13). More sophisticated process scheduling procedures are available on the island where they are needed.

TABLE 13

PROCESS CONTROL PARAMETERS

Average Monthly Rate of Production

Category	Sri Lanka Freq.	%
Less than 11 pieces	16	5.2
11-150 pieces	69	22.3
151-300 pieces	56	18.1
301-600 pieces	50	16.2
601-1500 pieces	48	15.5
More than 1500 pieces	70	22.7
Total	309	100.0

Process Schedule Control Practices

Category	Sri Lanka Freq.	%
Rough Scheduling	219	70.9
Man-hour Distribution	18	5.8
Man-hour Distribution & Utilization Rates of Facilities	30	9.7
Others (specify)	1	3
Total	309	100.0

Maintenance Practices of Machines

Category	Sri Lanka Freq.	%
During Break-downs	91	20.4
Unplanned	93	30.1
Periodic	106	34.3
According to Manual	12	3.9
Total	309	100.0

Type of Measuring Tools Employed

Category	Sri Lanka Freq.	%
Scale	69	22.3
Calipers	60	19.4
Vernier Calipers	70	22.7
Micrometer	75	24.3
Dial Gauge	35	11.3
Others	0	0
Total	309	100.0

Common Tolerance of Products

Category	Sri Lanka Freq.	%
1" or rough tolerance	1	.3
0.5"	16	5.2
0.1"	141	45.6
0.001"	148	47.9
0.0001"	3	1.0
Total	309	100.0

Type of Work Instruction

Work Instruction	Sri Lanka Freq.	%
Sample/Rough Sketch/Verbal Instruction	289	93.5
Technical Drawing	15	4.9
Own Design Technical Drawing	4	1.3
Others (specify)	1	.3
Total	309	100.0

Source: Technonet Asia-Japan International Cooperation Agency, "Small and Medium Scale Metalworking Industries," April 1979-March 1980.

5. Quality/Part Tolerances

Parts are typically measured from drawings or sample parts. Drawings seen in shops as part of this study were clear and non-complex, and measuring tools were appropriate for the tolerances dealt with. Government support organizations are available for testing parts but are not fully utilized. While there is no definitive information on the reasons for this, private companies frequently cited lack of responsiveness in service or timing.

6. Design Capability

Few Sri Lankan companies have the extensive engineering capabilities to design and test products from the conceptual stage through product development, introduction, and refinement. To obtain such capabilities, some companies supplement their own engineering staffs through liaisons with foreign companies and such organizations as UNESCO, the International Rice Research Institute (IRRI), and others.

Unfortunately, designs developed by groups for use elsewhere must frequently be modified for use in Sri Lanka. An example is the IRRI-developed rice thresher; it was not originally designed for the varieties of rices Sri Lankan farmers grow.

The capability of realizing that such designs might need modification, and the skills to understand and perform appropriate engineering analyses to guide design modifications are not widely available on the island. In the case of the rice thresher, the unmodified machine was introduced about four years ago and failed. Another company modified the product design on the basis of a two-year market test. Acceptance of the second company's product is reported to be growing as customers find that it works satisfactorily. Throughout the introductory phase for the modified equipment, however, substantial engineering field support was required to assure proper use and acceptance.

While government support in product development consultancy and product testing is available at the Ceylon Institute of Scientific and Industrial Research and the Industrial Development Board, these services do not appear to be used to their full capacity.

IV. FINANCIAL ENVIRONMENT

A. INTRODUCTION

Long-term finance remains a critical problem for Light Engineering companies. High rates of interest and financial institutions' lack of confidence in small businesses combine have created a serious obstacle for new or expanded ventures. While these factors affect all companies, they are especially difficult for the small and medium sized firms that make up most of the Light Engineering industry. Development of Light Engineering for agriculture needs a supportive banking environment that includes project analysis and business planning support.

B. CURRENT FINANCIAL ENVIRONMENT

The Light Engineering industry in Sri Lanka operates largely on a cash basis. More than 78% of the companies pay cash for raw materials, as indicated in Table 14. Investments in equipment and product development are often made on a cash, rather than credit basis. With such a strong emphasis on cash payments, it is very difficult for businesses to grow. Margins of small to medium sized firms may be attractive, but they may not yield enough cash to support rapid growth in inventory, equipment, and employment.

Raising cash through debt has been difficult for Light Engineering companies for various reasons. High security requirements, capital share requirements, and detailed documentation are frequent conditions placed on loans by commercial banks. High interest rates are another very significant problem. In recent years private finance companies have offered yields of up to 30% for deposits. With low risk investments yielding such attractive returns, there is little incentive for a manufacturer to put cash into equipment and other fixed assets whose returns may be longer in coming

TABLE 14

DISTRIBUTION OF METALWORKING COMPANIES ON BASIS OF RAW MATERIAL PURCHASING TERMS

	% Companies
Cash	78.3
Credit	
Less than 1 month	13.3
2 months	3.6
3 months or more	3.9
Materials exchange	1.0
	100.0%

Source: Technonet-JICA.

and certainly riskier. If money for business expansion is borrowed at high rates for business expansion, a significant amount of income is required for debt service in addition to debt repayment, which raises the company's overall business risk.

Small to medium sized businesses frequently lack credibility with financial institutions. Few of these companies have the sophisticated business planning capability required to justify their needs to the banking community's satisfaction. Furthermore, commercial banking facilities in rural areas are often inadequate or are not accessible to rural entrepreneurs. The difficulties that Light Engineering companies encounter in obtaining loans is reflected in the DFCC's outstanding loan profile in Table 15; only 6% of their loan portfolio, and 2.5% of equity investments were in Engineering and Metal Products as of March 1982.

TABLE 15

INDUSTRY DISTRIBUTION OF LOANS, ADVANCES AND SHARE INVESTMENTS BY THE DEVELOPMENT FINANCE CORPORATION OF CEYLON AS OF 31st MARCH, 1982

Industry Group	Rs Millions			
	Loans	Investments	Total	Percent
Chemical Products	66.38	3.38	69.76	13.99
Textiles	39.17	9.63	48.80	9.79
Electrical Products	19.67	0.13	19.80	3.97
Tourism	113.70	26.91	140.61	28.22
Building Materials	17.36	0.88	18.24	3.66
Readymade Garments	42.70	6.24	48.94	9.82
Food	16.10	0.20	16.30	3.27
Engineering	18.78	1.51	20.29	4.07
Rubber Products	35.83	6.25	42.08	8.44
Printing & Packaging	20.70	1.84	22.54	4.52
Agriculture	0.67	0.11	0.78	0.16
Beverages	13.70	0.42	14.12	2.83
Metal Products	7.14	--	7.14	1.43
Miscellaneous	24.65	4.43	29.08	5.83
TOTAL	436.55	61.93	498.48	100.00

Source: DFCC.

V. GOVERNMENT POLICY

A. INTRODUCTION

Since 1977 Sri Lanka's economic policies have undergone radical changes, including import liberalization and exchange rate reform. While these policy changes have resulted in positive impacts on a number of industries, the Ministry of Industries notes in its 1983 publication ("The Growth of Private Sector Industries since 1977 and Future Prospects") that successful investments in the following sectors are remarkably low:

- Basic metal industries and machinery (including Light Engineering)
- Metal products other than machinery
- Transport equipment and spares.

These subsectors report the lowest number of successful investments, i.e., 81 units out of 420, or 19%.

B. IMPORT REGULATION

To date, the government has not adapted its tariff structure in a sufficiently selective manner so as to give appropriate incentives or protection to priority Light Engineering sub-sectors. This is the case in spite of generally supportive attitude toward the industry expressed in official government statements such as the one quoted below:

> "No sizeable program of industrialization can get underway as long as machines, spares, and accessories continue to be imported. While the scope for import substitution of the heavy machinery needed for the large scale units is slight, a wide range of spares, accessories and simple machinery offers possibilities in the capital goods market."

Other import measures also serve to impede the development of the industry. Without regulations on import quality, Sri Lanka will continue to be susceptible to the import of inferior goods. Without antidumping controls, it will be difficult to protect or increase employment in those domestic industries which must compete with international industries selling below costs of production.

Tariff structures affecting Light Engineering have changed since 1977. During the late 1970s, tariffs on raw material imports often exceeded those for finished goods in a number of products. While this may no longer be true in some Light Engineering product areas, certain products are still affected, as indicated in Table 16. Imported inputs for mammoties are subject to a duty 15%-18% higher than the imported finished product because:

- Production of mammoties requires machinery that cannot be made in Sri Lanka which is subject to the turnover tax and customs duty just as the imported finished mammoties are.
- Turnover tax and customs duty must also be paid on raw materials imported for domestic production of mammoties.
- Finished mammoties made on the island are also subject to a turnover tax.

Companies that re-export products which contain imported inputs are given favorable incentives in the form of duty rebates whereas firms that export products that include domestically produced intermediate products receive no such incentives.

The frequency of policy changes has also affected the development of the Light Engineering industry. An uncertain environment increases business risk, which in turn discourages entrepreneurs from making the capital investment need to develop industry. As shown in Table 17, 65% of the Basic Metal Industry and Machinery subsector surveyed by the Ministry of Industries was either not in production or undecided. While some of this inactivity is attributed to other considerations, 35% of the "undecided" companies stated they were "awaiting better tariff protection".

TABLE 16
PRESENT TARIFF STRUCTURE ON MAMMOTIES
Payments to Sri Lanka Government for 1 Million Mammoties
(Rs Million)

	Turnover Tax	Customs Duty	Total Paid to Government	
Imported Finished Product	6(1)	6(2)	12	
Sri Lanka Produced Product				
• Imported Production Equipment	2.4(3)	2.4(4)	4.8	
• Imported Raw Material	4.5(5)	4.5(5)	9.0	13.8-14.1(7)
• Finished Product	3.4-4.8(6)	-	3.4-4.8	

Notes:
(1) 5% of Rs 120/mammoty selling price
(2) 5% of Rs 120 selling price
(3) 7.5% of Rs 32 million for equipment
(4) 7.5% of Rs 32 million for equipment
(5) 7.5% of Rs 60/mammoty for raw materials
(6) 4% of Rs 85-120/mammoty selling price for domestic product
(7) Sum of tax payments less adjustment for raw material and finished product turnover tax.

Source: Ceylon Steel Corporation.

TABLE 17
STATUS OF SURVEYED OPERATIONS

(1) Sub-Sector	(2) Total Surveyed	(3) In pro- duction	(4) 3 as a % of 2	(5) About to Start	(6) 5 as a % of 2	(7) Not in Pro- duction	(8) 7 as a % of 2	(9) Unde- cided	(10) 9 as a % of 2
401—Meat, Fish & Milk Products	10	02	20%	01	10%	0	0%	07	70%
402--Fruit & Vegetable Products	06	02	33%	—	0%	—	0%	04	66
403--Confectionery & Bakery, Cereal Prod.	70	22	31%	07	10%	04	06%	37	53
404--Spirits, Alcholic Beverages & Aerated Water	12	05	41%	01	8%	00	0%	06	50%
405--Other Food Products & Tobacco	14	05	35%	01	7%	00	0%	08	57%
406—Petroleum, Petroleum Products & Petro Chemicals	357	189	53%	34	9%	23	6%	111	31%
409—Salt and Salt Based Chemicals	--	—	--	—	—	—	--	--	--
410--Other Chemicals	12	00	0%	01	8%	00	0%	11	92%
411--Pharmaceuticals, Medical Supplies & Cosmetics	17	13	76%	03	17%	01	06%	00	0%
412--Soap, Oils & Fats	329	99	30%	59	18%	136	41%	35	11%
413—Leather & Rubber Products	195	115	59%	33	17%	05	02%	42	21%
414--Wood Paper & Pulp Products	388	123	31%	25	6%	137	49%	53	13%
415--Clay, Sand & Cement Products	404	170	42%	32	8%	130	33%	72	17%
416--Basic Metal Industry & Machinery	115	37	32%	03	2%	46	40%	29	25%
417—Metal Products other than Machinery	420	81	19%	13	3%	77	18%	252	60%
418--Transport Equipment	207	43	21%	04	2%	134	65%	26	12%
419--Electrical Goods	215	114	48%	18	7%	57	24%	47	20%
420--Optical & Precision Photographic goods	58	16	27%	15	25%	22	36%	05	09%
	2859	1036		247		822		745	

Source: Ministry of Industry and Scientific Affairs, "The Growth of Private Sector Industries since 1977 and Future Prospects".

C. DATA AVAILABILITY AND SUPPORT FOR BUSINESS PLANNING

A number of government agencies interact with portions of the Light Engineering industry. Such agencies include, but are not limited to, the Ministry of Industries and Scientific Affairs, Urban Development Authority, Local Industries Approval Committee, Industrial Development Board, Export Development Board, Ministry of Finance, Greater Colombo Economic Commission, Ministry of Rural Industrial Development, National Engineering Research and Development, Ceylon Institute of Industrial Research. In addition, there are various ministries related to the operations of specific industries, such as textiles or fishing.

Such a dispersed network of government agencies tends to cause service gaps and duplication. Frequently basic data sources are incomplete or are not up to date; for example, 1978 was the last year companies were required to submit survey information to the Ministry of Industries. Without such data, it is difficult to construct effective business plans and evaluate risks, develop consistent strategies, and raise required capital. Comprehensive, up-to-date information must be available for business planning.

D. RESPONSIVENESS OF STATE CORPORATIONS TO NEEDS OF THE LIGHT ENGINEERING SECTOR

Customers for industrial products from state corporations frequently stated that the lack of adequate notice of changes in production schedules and product offerings from the state corporation is disruptive to production schedules requiring the private compaines to operate with significant buffer inventories. Erratic production behavior of the corporations, regardless of how strong or steady demand is, creates considerable uncertainty and risk for private entrepreneurs.

Similarly, product development in state corporations is not always optimal. An example of this is an ox cart developed by one corporation in 1979-1980. To date, only about 40 carts have been sold, apparently because of a misfit between market needs and the product developed.

VI. RECOMMENDATIONS FOR DEVELOPING THE LIGHT ENGINEERING INDUSTRY

A. INTRODUCTION

The development of the Light Engineering industry will require the coordinated implementation of two major strategies.

- Selectively focusing on high leverage products for agriculture.
- Providing a positive regulatory and banking environment.

Several product areas have been identified in this survey as having high potential for Sri Lankan production and marketing. Prefeasibility studies should be performed on these product opportunities to determine the best prospects within this group. Based on the results of the prefeasibility phase, full feasibility and product development efforts should follow.

B. SELECTIVELY FOCUS ON HIGH LEVERAGE PRODUCTS FOR AGRICULTURE

While Light Engineering serves three major sectors of the Sri Lankan economy, it is recommended that the development of the industry for agricultural equipment be specifically encouraged. The reasons are summarized as follows:

- Imports of farm equipment are growing rapidly, while imports of other Light Engineering products are not.
- Agriculture occupies a large portion of the country's land area and is the country's largest employer.
- Farm yields could be improved through the use of specific Light Engineering products.
- Farmers' income should be increased through the increase of farm productivity. This will improve the country's standard

of living and encourage the development of markets for other Light Engineering products.

- The Light Engineering products identified generally require relatively small amounts of capital for development, use locally available technology, and can be produced on a small scale in urban or rural areas.

A preliminary projection of land use by crop is shown in Table 18. While the country's land utilization has improved over the years, yield losses in harvesting, storage, and processing amount to an estimated 25-35% of potential production. Such losses result mainly from the manual farm processes presently used. The value provided by Light Engineering products to agriculture is reflected by the Rs 580 million market for such products (Table 3) and the 40% growth rate in imports shown in Table 8.

While the country's future crop mix is uncertain, rice, coconuts, subsidiary food crops, minor export crops, and fruits and vegetables will probably represent areas of rapid growth in future production. Many of these farm products have historically not been commercial crops, and farming methods have not developed beyond simple manual systems. Thus, in a number of cases there are neither domestic nor foreign suppliers of suitable Light Engineering products in Sri Lanka, as will be discussed later in this section, in considering specific product opportunties. This product vacuum will be gradually filled by imports unless suitable domestic products are developed. Where suitable products cannot be imported, product vacuums will remain, and yield losses will continue. On the other hand, foreign companies are currently supplying products that serve a number of crop areas. Sales of such products are also expected to grow rapidly, unless a domestic equivalent is available or encouraged.

Nineteen product opportunities have been identified in the course of the study classified according to three major groupings and high or medium potential:

- Currently available technology, widely used products.
- New products for specific applications
- Advanced products for wide use.

TABLE 18
AREA REQUIREMENTS BY CROP, 1990
(Preliminary Order of Magnitude Estimates)

	Current	1990 (Hectares)	Change
Tea	215,000	190,000	(25,000)
Rubber	205,000	205,000	0
Coconuts	453,000	475,000	22,000
Minor Export Crops (includes sesame)	95,000	140,000	45,000
Rice	580,000	605,000	25,000
Subsidiary Food Crops (excludes sesame)	230,000	300,000	70,000
Fruits and Vegetables	95,000	110,000	15,000
Other Classified	125,000	140,000	15,000
	1,998,000	2,165,000	167,000

Source: Arthur D. Little International, Inc., estimates.

1. Currently available technology, widely used products

High Potential

- Moldboard plow/Unibar Ridger for animal draft and two-wheel tractors. Only a prototype is imported at the present time. The market potential is high for a Rs 500 product for cultivation of a wide variety of crops including rice. Such a plow could be developed for approximately Rs 1-2 million, and completely fabricated on the island.
- Hand pushed seed drill, granule spreader, or fertilizer applicators. These products are not widely available on the island, being imported primarily for experimental purposes. The market potential is high because this type of product is useful regardless of the crop or the size of the holding. Development costs are estimated at Rs 1-2 million. Depending on the design, such a product could be sold for Rs 100 - 1000.
- Portable sprayers/applicators. Such products are imported now for broad use in agriculture, household, and industrial environments. The country's foreign exchange position would improve through domestic manufacture. Complete manufacture would be possible on the island. Depending on specific features, it appears that products could be sold for Rs 100-2000, and developed for Rs 0.5-1 million.
- Mammoty and related products. This includes a group of products including the mammoty, axe, garden fork, rake, shovel, sickle, crowbar, and large knife. While these items are manufactured locally to some degree, approximately Rs 8 million of mammoties are now imported each year. A larger share of these products could be made locally and sold at Rs 100-150. Development costs should total Rs 500,000.

Medium Potential

- Crushers (200-300 kg/hr juice and oil extractors. Imported and a few locally produced products are available. The market potential is moderate, being a function of agricultural production, which might be sugar cane, coconut, gingelly, fruits or certain nuts. Additional research and development will be required to arrive at suitable products. An estimated Rs 1-2 million will be required for development.
- Heavy trailer for four-wheel tractors. While imported and local products are available for agricultural and industrial transport, design improvements can be made using medium technology. The price range for such products would be Rs 10-20,000. Development costs of approximately Rs 1 million are expected.
- Bullock cart trailer for two-wheel tractors. Significant design improvements are possible in this locally manufactured product. Its use is broad and would sell for Rs 2,000 to 5,000. Anticipated development costs are approximately Rs 1 million.

2. Products for Particular Applications

High Potential

- Transportable winnowers, threshers/reapers. These products are mostly imported, with limited domestic manufacture. All are useful in improving rice production yields. Product development could be completed for about Rs 1 million. Products could be sold in the Rs 2,000-10,000 range.
- Bottling and packing. Such equipment is extremely valuable in improving yields and transportability of fruits and

vegetable oils. No new research would be required. Development efforts would be directed at tailoring existing system designs to the needs of Sri Lankan farm products, and would cost about Rs 1 million. Bottling and packing systems could be sold for Rs 500-5,000.

- Screw-type river and shallow water pumps. Prototypes are being imported. In the future, the motor could be imported and the pump made locally. Such engineered products would support further irrigation, and could be developed for an estimated Rs 0.5 million to sell for Rs 1,500-5,000.

Medium Potential

- Huskers for coconut, ground nut sheller. Such products are not available on the island but would be useful on coconut estates or for ground nut cultivation. Medium potential is anticipated for products selling in the Rs 2-5,000 range. Product development would require new research and development and cost about Rs 1-2 million.
- Solar dehydrator, gasifier, wind machine. Suitable products are presently available only at the research level. An estimated Rs 0.25-1 million is required to complete development. Use would be for specific agricultural products, and thus a low total potential is projected.
- Rice hull-ash cement mill. A hand and power operated product would be useful in rural areas for construction. It is anticipated that a low to moderate potential could be realized by a product selling for Rs 2-3,000. Such a product should cost about Rs 1 million to develop.
- Manual brickmaking press. Few are available on the island now. They could be made completely in Sri Lanka with no new research and development. The anticipated potential is low. The approximate development cost is Rs 0.25-0.5 million.

3. Advanced Products for Wide Use

High Potential

- Small diesel engines. This product has very high market potential. Diesel engines are used with sprayers, crushers and extractors, winnower/threshing/reapers, water pumps of all types, as well as generators and tractors. There are approximately 50,000 internal combustion-driven water pumps alone, with annual sales in the 7,000-9,000 unit range. With an estimated life span of the engine-pump system of four to six years, there is an attractive market for replacements as well as new equipment. Such engines are now imported mainly from India and Japan. While no new product research would be required, manufacturing techniques on the island would have to be upgraded. Thus, this product could be a vehicle for improving the country's overall manufacturing capabilities. Development costs could range from Rs 5-10 million.
- Small 4-wheel tractor (20 hp). Present two-wheel tractors are frequently overloaded, which shortens the tractor's limited life span. Unfortunately, available four-wheel tractors are too large and expensive for general use. Thus there appears to be a medium to high market for a small four-wheel tractor. These could be manufactured completely in Sri Lanka, or with the engine imported, and could be sold for Rs 50,000-80,000. Development costs of Rs 5-10 million should be expected.

Medium Potential

- Four wheel tractor (above 40 hp). Minor assembly and parts manufacture would be possible in Sri Lanka, but a high level

of technology would be required. Rs 1-2 million could be required for development.

- Large tillage implements. A small number are currently imported, primarily for large-scale cultivation. At the present time, a low total market is anticipated.

CHAPTER 5

MINERALS PROCESSING SECTOR

I. SUMMARY

A. INTRODUCTION

Private sector opportunities in Sri Lanka are more limited in minerals than in other industries because of state ownership of mineral resources. Not only does the government own all mining operations, but state corporations are chartered to market, process, and manufacture all derived products. Although the industry would appear to be closed to private investments, the sector is gradually being opened to joint ventures, particularly those with foreign firms.

The government's role in minerals must be understood if private sector opportunities are to be exploited. Therefore, a review of the industry and then a financial analysis of specific opportunities was undertaken in this sector survey.

B. INDUSTRY DEFINITION

The Sri Lankan minerals industry accounts for approximately Rs 1.5 billion in annual sales. Domestic sales in 1981 were approximately Rs 1.3 billion with exports of Rs 209 million. The major products are: graphite, heavy metal mineral sands, silica sands, cement, clays, dolomite, and to a lesser extent apatite. Plans to exploit the Eppawala phosphate deposit through building a fertilizer plant have been announced. This project would more than double the size of the minerals industry.

The minerals industry is dominated by the government through its ownership of the major mining companies. Table 1 shows that these government companies account for approximately 50% of sales. The government share of revenues from actual mining operation is over 90%.

TABLE 1

1981 SALES/EXPORT VALUE OF MINERALS PRODUCTION

Mineral Category	1981 Sales (million Rs)	1981 Export Value (million Rs)
* Brick & Tile	7.1	--
* Ceramics	219.1	2.8
* Cement	876.9	--
Dolomite	0.4	--
* Graphite	114.8[1]	101.0
* Mineral Sands	51.1[1]	32.1
* Porcelain	79.7	64.0
Silica Sands	0.02	--
Stone	60.0	--
Total	1409.12	199.90

*Government participation in a corporation involved with mining and processing.

[1]Figures represent value of production for sales.

Source: Bank of Ceylon and Arthur D. Little estimates.

C. SECTORS STUDIED

In the selection process, the Arthur D. Little team screened for minerals that would have the greatest potential for generating high value-added products, increasing exports and creating employment.

The screening process identified graphite, mineral sands, and phosphates as the minerals with the greatest potential. Dolomite, granite, and clays were dropped because of their lower value-added potential and because they have no significant advantage in world markets. The quality of Sri Lanka's graphite and ilmenite, however, provides distinct comparative advantages.

The Eppawala reserve has a phosphate rock nutrient content P_2O_5 of 35-37; some chloride and alumina in the lattice make special processing necessary. The phosphate profile was limited to publicly available information because of Sri Lanka's current negotiations with Agrico. Considerable work has been completed on the design of a fertilizer plant that would be operated as a joint venture.

D. OPPORTUNITIES

There are significant opportunities for Sri Lanka's mineral resources as world markets for these products grow. World graphite consumption is expected to grow at or slightly better than GNP levels. The demand for Titanium Dioxide (TiO_2) pigments will increase at an average rate of 2.5-3.0% annually. Although a world oversupply of phosphoric fertilizers is projected for well into the 1980s, a regional analysis shows a supply deficit in the South Asian market. Thus, a fertilizer plant in Sri Lanka may be well timed to satisfy this regional imbalance.

One of the most pressing needs or opportunities for Sri Lankan graphite and mineral sands is to achieve market penetration with existing products. Aggressive marketing to maintain and increase production levels would help to achieve cost control and stable margins. Market shares have been eroded over the past few years; reestablishment of a market position should be a high priority.

A second opportunity would be forward integration into processing or manufacturing. The products would represent higher value-added inputs, thus achieving improved margins and more foreign exchange. Manufacturing of equipment represents too small a market to support backward integration to a supply industry. Almost all tools and equipment are imported and backward integration would require entering competitive, mature world markets.

E. CONSTRAINTS

- Marketing

Sri Lanka's minerals face competition in world markets from sources with different characteristics, and an aggressive marketing effort will be needed. Marketing efforts have heretofore been passive; the mining companies have done little promotion and relied on customers coming to them. Future marketing efforts will have to bring the mining companies closer to the market.

- Cost Control

Overall inflation in Sri Lanka has hurt the industry's cost position. Devaluation of the rupee can partially correct for the rising cost of production in international markets, but the mineral industry is faced with an internal cost control situation that must be corrected. Some sectors are faced with problems of productivity while others are burdened with inventory and carrying cost problems. Cost control is essential if Sri Lanka is to achieve a competitive market position for existing and future products.

- Technology

To be successful in forward integration, Sri Lanka will need processing technology, which does not exist in any of the local companies. Higher value-added products command price premiums because technological know-how is somewhat limited worldwide.

- Finance

Most opportunities in the mineralS industry are capital-intensive. The smallest projects reviewed required large sums of capital, the larger processing projects need capital of Rs 3 to Rs 5.8 billion for plants alone. Infrastructure development could easily add another Rs 2.3 billion to an overall project. Such large projects are beyond the capabilities of local financial markets.

- Management

Sri Lanka is faced with a management development and retention problem. Educational programs in mining engineering within the country are limited and most training occurs overseas. Low and uncompetitive wages lead to high rates of management turnover, which will present a problem if Sri Lanka integrates forward into the processing of minerals. Many chemical and processing engineers will also be needed.

- Government Ownership

Although government ownership of mining companies does not have to be a constraint, state control of the graphite and minerals sands industries could impede private sector development in Sri Lanka.

The first problem is government salary levels, which are neither competitive with salaries in the private sector nor with those in world markets. Thus, there is little incentive to invest in an engineering education if the rewards are not commensurate.

Also, government policies have resulted in a burdensome layer of "red tape". While there is clear need for controls, cost/benefit and efficiency are also important.

Furthermore, an implicit policy of full employment, irrespective of market conditions, is costly. Unit costs rise during slack times, productivity is hurt, and inventories require heavy carrying costs.

- Exploration

Sri Lanka has a Geological Survey, but its activity is limited by budget constraints. The minerals industry needs an organized exploration program, however, if it is to realize its potential. Before serious development can occur, the industry must have a better understanding of the quality and quantity of its reserves. Sri Lanka could possess some exploitable minerals that have not been discovered.

F. STRATEGY AND RECOMMENDATIONS

The minerals industry needs to follow two separate strategies that will have beneficial and complementary effects on each other.

The first strategy is to achieve greater market share through aggressive market penetration. The minerals industry is highly capital-intensive and companies have to achieve breakeven levels sufficient to cover fixed costs. Thus, volume is essential to economies of scale and cost control. Sri Lanka needs to protect and increase its market position.

The second strategy is to begin forward integration into the processing and manufacturing of exportable products. Integration into markets that Sri Lanka currently serves will bring greater returns on investment and effort.

II. INDUSTRY DEFINITION AND CHARACTERIZATION

A. GOVERNMENT OWNERSHIP AND CONTROL

The sectors reviewed for this report are all dominated by the government through its ownership of the key extraction companies. The assignment thus had to be approached differently than for the other industrial sectors. While the intent was to identify private sector opportunities, it became clear that further development would depend upon government's decision and involvement.

The government's role in minerals began in 1957 with the State Industrial Corporations Act No. 49. The Act laid the groundwork for the state corporations responsible for mining, processing and selling the island's minerals. The charters of these state corporations also provided for manufacture of products based on the island's minerals.

The Mines and Minerals Law No. 4 of 1973 was enacted to provide for the vesting of ownership of all minerals (except gems, radioactive minerals, and petroleum, which are covered by other Acts) in the State. The State would regulate mining, prospecting, collecting, processing, selling and exporting minerals. It would also provide for the health, safety, and welfare of workers in the mines and facilitate the compulsory acquisition or requisition of both immovable or movable property for any state corporation established to develop the minerals industry.

- Exploration

The government's Geological Survey Department is responsible for developing information and data on minerals reserves. A sizable amount of data on reserve quality and quantity has been collected for the minerals currently being exploited. Nevertheless, the Geological Survey needs further funding to expand its activity.

More exploration and coring is essential for the following reasons:

1. Accurate data on location, depth, thickness, etc., of the reserve is needed to calculate mining costs.

2. Reserve quality must be assessed to understand the reserve value in terms of processing costs and potential product yields.

3. The size of the reserve base is of concern to investors to ensure that it is adequate to cover the 20-40 years for operating and writing off a processing plant investment.

The Geological Survey does not need complete data on all reserves or deposits, but a basic exploration program would at least ensure a steady flow of information. If new deposits of key minerals were discovered, a concentrated effort could then begin to focus on the economic questions. The Asian Development Bank recently approved funds for a US $20 million loan to address the issue of upgrading the Geological Survey's effort.

- Mining/Production/Preparation

The key function of mining is currently carried out by the state corporations. Nevertheless, there is some private sector involvement. About 70% of the collection process of mineral sands is currently done by contractors. The cost data were not available to the study team, but it appears that the private contractors are efficient and that 100% of the collection process could be done by private contractors if the State did not fear losing control of the process and becoming vulnerable to work stoppages and strikes.

The State also does all "preparation," or basic beneficiation of a mined mineral that removes basic impurities and sizes, sorts, and

upgrades the product to a packaged or transportable "raw material." This step can be both labor- and capital-intensive, depending upon the mineral and the specific beneficiation process.

- Marketing/Finance/Promotion

The administrative functions of the mineral industry are also part of the State's responsibility. Consideration has been given to all permitting private companies to do the marketing and sales of minerals, but to date, all minerals are sold directly to customers by the state corporations. Some sales are to "brokers," but these brokers represent the buyer, not the selling interest.

The government has engaged in limited promotional activity, soliciting interest through the Export Development Board and making contacts through the embassies abroad. A great many sales are made, however, in response to customer inquiries by telex to the various state corporations. Thus, marketing is reactive and restricted to the state corporations.

Financing of the minerals industry is also under government control. With the growing interest in capital-intensive projects, however, financing will have to be sought increasingly from the international capital markets.

B. OTHER INDUSTRY PARTICIPANTS

Despite the dominance of the state corporations, there are other participants in the minerals industry. Some private contractors participate in the collection process for mineral sands. Most of the other participants fall into the category of foreign suppliers, potential foreign investors, and local private sector participants in recovery of minerals not reviewed in depth in this report.

- Foreign Suppliers

The equipment and tools used in the Sri Lankan minerals industry are supplied by foreign firms. The equipment for extraction, such as drag lines, trucks, tractors, etc., are produced by, and imported from, companies that supply the world mining industry. These firms are larger than the state corporations and are able to command considerable market power. The equipment used for preparation or beneficiation is also supplied by large foreign engineering and equipment firms. Opportunities for Sri Lanka's private sector as a supplier of equipment are limited.

- Potential Foreign Investors

Foreign investors are increasingly interested in joint ventures with the state corporations or possibly with some of the mineral-based manufacturing companies. Companies from Japan, Western Europe, India, Canada, the United Kingdom, and the United States have explored possible arrangements. Japanese firms have already entered into equity agreements with the Ceramics Corporation, and if the Agrico phosphate deal is approved, foreign investors will be key participants in that industry.

- Local Private Sector

The local private sector is small, but does exist with potential for expansion. A pencil manufacturer consumes approximately 200 tons of graphite annually and attempts have been made to manufacture carbon brushes and crucibles. A large private sector exists in the quarrying and building stone industry.

III. SELECTION OF SECTORS FOR ANALYSIS

In the screening process, emphasis was placed on identifying the natural resources with the greatest potential for high value-added products leading to favorable foreign exchange impacts and creation of employment. The study team also screened for (a) market size to determine the potential for developing economies of scale, (b) for comparative advantage in reserve quality that would help ensure a successful market niche strategy or a lower cost of processing, and (c) for reserve size to determine long-term viability.

The minerals selected for concentrated study were graphite, mineral sands, and, to a limited extent, phosphate. Graphite ranked well for several reasons. First, Sri Lankan lump and vein graphite enjoy a comparative advantage at the high quality end of the graphite market. The market for graphite is growing and the potential exists for developing a graphite-based industry to produce high value-added products with favorable foreign exchange impacts. There is also a large reserve of graphite. While additional work should be done to prove the extent of the reserve base, the known reserve should support at least 20 years' production at current levels.

Mineral sands was a sector selected for concentrated study because the deposit in Sri Lanka is a fairly high-quality reserve. Ilmenite concentration is close to 75% and the sand is easily mined on the beaches of Pulmoddai, thus ensuring the opportunity for low cost production and beneficiation. The markets for titanium dioxide (TiO_2) are also large and while they will vary with overall economic activity, the long-term growth trend is forecast between 2.5-3.0% per year. The returns for processing are also favorable in that forward integration will result in much higher value-added products and an improved foreign exchange earnings.

Phosphate ranked well for a concentrated review effort, but only a limited review was done because of current negotiations between the State Mining and Minerals Development Corporation and the U.S. firm,

Agrico. The review was restricted to publicly available information. The negotiations center around a joint venture entitled "Eppawala Phosphates (Private) Ltd." In this venture, the SMMDC owns 51% of the equity and Agrico 49%. The company will mine phosphate in the Eppawala reserve and transport the material to a new plant in Trincomalee, which will produce phosphoric acid, diammonium phosphate, and triple superphosphate. Like the other minerals reviewed, the Eppawala reserve is fairly high quality in that the P_2O_5 content is 35-37%, the reserve has little overburden, and is mineable. This suggests the potential for low cost mining and processing. The reserve does have a chloride and alumina problem, however, which will require special consideration in processing.

A. GRAPHITE

1. Company Profile--State Mining and Minerals Development Corporation (SMMDC)

- Historical Background

The Sri Lankan graphite industry is approximately 200 years old. At the turn of the century, Sri Lanka was a dominant force in the world market. Production peaked in 1916 at approximately 33,000 tons and while new competition from Malagasy changed the market, the Sri Lankan industry did well through World War II when production peaked again at 27,000 tons.

During this early period, the industry consisted of hundreds of small "pit" type operations. As markets eroded and the cost of the small operations rose, the industry consolidated into three mines.

In 1971 the State Graphite Corporation was established under the State Industrial Corporations Act No. 49 of 1957. The State Graphite Corporation, renamed the State Mining and Mineral Development Corporation in 1979, took over the three large mines--Bogala,

Kahatagaha, and Kolongaha (K-K). Since 1971 production and export sales have varied from a high of approximately 11,000 tons in 1978 to a low of 3,000 tons in 1982. Table 2 summarizes the volume of production and exports.

As seen in Table 2, the export tonnage has fluctuated with the overall world economy. The decline in 1975 exports coincides with the world recession of that period, although the drop since 1979 preceded the most recent recession. Apparently market factors beyond the recession have affected the Sri Lankan industry.

- Cost Profile

An overall review of cost trends helps explain some of the problems faced by SMMDC. The first cost analysis, shown in Table 3, reveals that the cost of production at the three mines has been rising rapidly. The range of cost increases (11% to 73% per year) is wide. The table does not show the effect of inflation, but it should be noted that Sri Lanka experienced serious inflation in 1980-1981. This cost analysis (coupled with an analysis of market prices) helps to explain why Sri Lanka's graphite exports fell continuously after 1979. Bogala's production varied considerably during this period, while K-K's production declined slowly. K-K had significant cost increases, but they were possibly controlled by trying to maintain level production. Bogala, on the other hand, had substantial volume cuts and serious cost increases. During this four year period, Bogala also experienced a 47% productivity decline. While further analysis of this issue is required, it appears that maintaining level production, or possibly increasing it, will help to control mine costs.

- Markets and Pricing

Natural graphite is used in many applications with different product specifications. The key specifications for graphite are carbon content, particle size and shape, ash analysis, and electric conductivity. Because the graphite market is fragmented, predicting demand becomes a difficult task.

TABLE 2

PRODUCTION AND EXPORTS OF GRAPHITE

(Metric tons)

Year[1]	Production	Exports	Percent Increase (decrease) of Export Over Previous Year
1972	7,041	6,253	
1973	7,806	7,579	21
1974	10,425	10,780	42
1975	7,908	5,979	(45)
1976	8,125	8,014	34
1977	8,850	8,765	9
1978	10,675	11,163	27
1979	9,491	10,933	(2)
1980	7,656	6,566	(40)
1981	7,453	4,491	(32)
1982 (to Sept.)	6,439	2,062	NA

Source: Years 1972-1976 figures used in Nathan Report, USAID, 1982,
Years 1977-1982 figures provided by SMMDC.

TABLE 3

COST ANALYSIS OF SMMDC[1]

	Bogala			Kahatagaha and Kolongaha		
Year	Production (MT)	Cost (RS/MT)	Increase (%)	Production (MT)	Cost (RS/MT)	Increase (%)
1977	5,163	1,512	NA	3,549	2,620	NA
1978	7,032	1,442	(5)	3,495	3,317	27
1979	6,021	2,166	50	3,374	4,080	23
1980	3,934	3,749	73	3,155	4,519	11

1. Costs are a weighted average of variable and semivariable cost at the respective mines. Costs do not include transportation or overheads of the corporation.

Source: Asian Development Bank.

Some major end-use categories help in identifying trends and possible segment opportunities. The largest segment is the refractory industry, followed by foundries and steelmaking. Graphite is also used in lubricants, carbon brushes for electric motors, and carbon arc tips. Each segment uses graphite for different reasons, depending upon the characteristics most needed from the material.

Industry statistics on graphite consumption are not readily available, but it is generally known that the United States, Japan, Australia, and Western Europe have been the major consumers of graphite. Sri Lanka has sold to all these markets and offers a lump and chip product with a carbon content ranging from below 80% to 95-97%. Sri Lanka's major competitors are Norway, Malagasy, Brazil, and West Germany. Recently, China and Mexico have been capturing a greater share of the lower end of the market. Technology exists to upgrade the lower quality graphite, and customers have been seeking the low cost, lower quality product. This has had a dual affect on Sri Lanka; their share of both low quality and high quality graphite has been eroded. It might be easy to conclude that new "low cost" producers like China and Mexico are "buying" share of the market, but Tables 4 and 5 reveal an interesting price comparison and market share affect.

Before reviewing the following tables, it should be noted that the prices are a weighted average for the years shown and there are quality differences between the various countries. The data are useful, however, for illustrating overall price trends and resulting changes of market share.

As seen in Table 4, Sri Lanka went from a "competitive" low cost position to the highest priced in the U.K. and one of the highest priced in Japan. While the data are not available for the U.K., Table 5 shows that Sri Lanka has lost considerable market share in Japan. Japan's consumption of graphite was virtually identical in both 1976 and 1980 indicating that Sri Lanka lost sales in absolute as well as relative terms.

TABLE 4

IMPORT UNIT VALUES OF CRYSTALLINE GRAPHITE IN JAPAN

($/MT)

Year	Sri Lanka	China	USSR	Malagasy	Brazil	India
1980	705	524	346	795	796	510
1979	438	502	255	553	828	454
1978	319	424	232	473	--	--
1977	277	339	207	435	--	--
1976	217	313	212	433	--	--

Code: 24.04.210

IMPORT UNIT VALUES OF CRYSTALLINE GRAPHITE IN U.K.

($/MT)

Year	Sri Lanka	Malagasy	Norway
1980	1247	662	462
1979	540	512	375
1978	423	439	306
1977	NA	359	285
1976	NA	342	265

Code: 278.22

Source: Asian Development Bank.

TABLE 5

PERCENTAGE OF JAPAN'S CRYSTALLINE AND POWDER GRAPHITE

SUPPLIED BY COUNTRY

Year	Sri Lanka	China	Brazil	India	USSR
1980	7.7	60.4	6.2	4.8	14.5
1979	19.5	47.5	0.4	1.5	20.1
1978	31.0	18.8	--	--	38.8
1977	23.4	15.1	--	--	47.8
1976	25.3	9.0	--	--	51.9

Source: Asian Development Bank.

Comparing these tables with Table 3, it appears that Sri Lanka elected to raise prices to meet rising costs. As long as costs and prices stayed below competition, Sri Lanka's sales were not hurt. When costs and prices got above competition during 1979 and 1980, sales were hurt and the resulting decline in volume further exacerbated the situation by driving unit costs higher.

Another interesting comparison is to see how the product mix for Sri Lanka's graphite changed between 1978 and 1980. Table 6 shows that the higher quality products (90+ carbon) have captured a greater percentage of the sales, although the absolute tonnage in all classifications was less in 1980. As Table 7 reveals, sales in terms of constant 1974 rupees have declined in recent years.

In current rupees, sales of graphite have increased since 1976. The constant 1974 rupees figure shows that there were actually significant decreases in 1980 and 1981. Thus, the loss of volume has not been "offset" by the higher prices. In a "volume and price sensitive" industry, it may have been better to sacrifice some profit margin to keep prices down and sales up. This question has been addressed by the SMMDC board and price reductions have been made. With overall demand down as a result of the world recession, it may be a year or two before the results of this policy change are evident.

2. Opportunities in the Graphite Industry

Several plans for the graphite industry have been reviewed by both the public and private sectors. There are opportunities for the SMMDC as well as for three private sector projects, one of which is already being implemented by Cuska Graphite Ltd.

- Rehabilitation Program

The Asian Development Bank has recently authorized a loan to SMMDC for a multimillion-dollar project to rehabilitate the graphite

TABLE 6

PRODUCT MIX OF SRI LANKA GRAPHITE EXPORT,

1978 and 1980

Grade	1980 tonnage	1980% of total	1978 tonnage	1978% of total
+97	1859.5	28.3	2778	24.9
90-97	2695.5	41.1	3251	29.1
80-90	1810.9	27.6	3635	32.5
-80	200	3.0	1499	13.5
	6795.9	100.0	11,163	100.0

Source: Annual Reports, SMMDC.

TABLE 7

REVENUE OF GRAPHITE SALES IN CURRENT RUPEES AND CONSTANT 1974 RUPEES

Year	Inflation Index[1]	Graphite Revenues (Current millions of Rs)	% Increase over previous year	Graphite Revenues (Constant million 1974 Rs)	% Increase over previou year
1974	100	16.7		16.7	
1975	105	10.6	(37)	10.1	(39)
1976	107	17.2	62	16.1	59
1977	145	22.6	81	15.6	(3)
1978	145	57.8	155	39.9	156
1979	150	77.2	34	51.5	29
1980	210	83.8	8	39.9	(23)
1981	260	96.8	16	37.2	(7)

[1] Arthur D. Little estimates.

Source: Bank of Ceylon and Arthur D. Little estimates.

mines. The program is designed to increase productive capacity at Bogala and K-K to 20,000 tons/year, and at the same time achieve a 20% cost reduction. With possible higher volumes and improved productivity, cost improvements could be even better.

The program will also address beneficiation improvements needed to develop a wider product offering. While price increases account for most of the market share loss, the SMMDC has also lost some sales because some products were not available. The program will address the issue of delivering a wide variety of products on a timely basis.

- Upgrading of Graphite to Flake

Technology is being developed in consuming countries to upgrade low grade graphite to a flake product. Customers are now able to get low grade graphite from low cost producers and upgrade it economically; the process is a high-value-added operation. Sri Lanka has lost some of its markets to low cost producers.

In Sri Lanka, the upgrading process could be done either by a private sector company, the SMMDC, or a joint venture with foreign interest. One private company is trying to get a subsidiary "off the ground" and upgrade graphite to flake for export.

Investment requirements for such a project are estimated at Rs 70-90 million. Revenues would be approximately Rs 3.5 million/year with after-tax margins of 15-20%, providing a 4-5 year payback.

- Joint Venture to Product Carbon Brushes and Electrodes

Another opportunity reviewed was for manufacture of carbon brushes and electrodes in Sri Lanka. The local pencil company, Ceylon Pencil Co., Ltd., is looking for a foreign partner to form a new company. Ceylon Pencil would offer some capital, a working knowledge of local markets and labor, and supervision. A foreign partner would

supply equity capital, technology, and knowledge of foreign markets. The financial details of the project are shown in Table 8.

- Refractories

Another promising opportunity is the use of carbon in refractories. The project was proposed in a recent report, Sri Lanka Manufacture of Natural Graphite Based Products.[1] While the report suggested several other products, the carbon refractories appear to have the best chance for successful implementation. This project would be of interest to a foreign investor; the Japanese have a joint venture with Ceylon Ceramics, where refractories are currently being made. A carbon brick could be a future project for joint venture with Ceylon Ceramics, SMMDC, or a private Sri Lankan investment group.

The market for refractories is in the steel and foundry industries, and most market projections show that the steel industries in Southeast Asia have the greatest potential for growth. This would give Sri Lanka a favorable and close position to these markets. The project financial details are shown in Table 9.

3 Constraints

In the review of SMMDC and the opportunities for graphite projects, the constraints to development included:

- Cost Control

The basic costs of the graphite industry must be controlled because investors and customers need reliable supplies of graphite at

[1] Industrial Development Unit, Commonwealth Fund for Technical Cooperation, Commonwealth Secretariat, Marlborough House, London, September 1982.

TABLE 8

PROJECT REVIEW: ELECTRODES AND CARBON BRUSHES

(US $)

Investment:[1]

Land	100,000
Building	400,000
Plant & Mach.	2,000,000
Working Capital	270,000
Other	582,000
	3,352,000

Financing: (Capital Structure)

Equity	2,048,000
Long Term Loan	1,250,000
Other	54,000
	3,352,000
Local Capital	1,202,000
Foreign Capital	2,150,000

Equity: 51% local
49% foreign

Yearly Revenue Estimate[2]	1.95 million
Operating Cost	.50
Overhead	.20
Profit Before Tax	1.25 million

Products: Midget Electrodes for Batteries
Cinema Arc-Carbon
Industrial Graphite Electrodes
Carbon Brushes

Manufacturing Capability: Mixing, extrusion, molding, pressing firing, impregnation

Raw Materials: Coal tar, petroleum coke, graphite, copper sulfate

Employment:

7	managers
16	clerical
14	technical supervision
42	skilled labor
24	semi-skilled
62	seasonal unskilled
165	total

[1]Investment, financing, employment requirements were taken from the FIAC application and Ceylon Pencil records.

[2]Yearly revenue was scaled down by Arthur D. Little because a review showed the original market estimates and prices for the products were too optimistic. Arthur D. Little also scaled up operating costs to present a conservative estimate of yearly profit.

Source: Ceylon Pencil, Ltd., records and Arthur D. Little estimates.

TABLE 9

GRAPHITE AND CARBON REFRACTORIES INCLUDING

MAGNESITE CARBON BRICKS

Investment:	(US $)
Land	200,000
Building	1,000,000
Equipment	5,500,000
Utilities	100,000
Misc. fixed assets	150,000
Expense	750,000
Know-how fee	500,000
Contingency	800,000
Working Capital	1,000,000
	10,000,000

Sales Proforma:	(per year)
Sales	$15,000,000
Cost:	
Raw Material	5,290,000
Power	1,170,000
Salary	520,000
Administration	80,000
Insurance	120,000
Sales Exp.	450,000
Maint.	400,000
Royalty	750,000
Contingency	880,000
	9,660,000
Gross Margin	5,340,000
Interest	1,200,000
Depreciation	750,000
Operating Profit	3,390.000

Source: Sri Lanka Manufacture of Natural Graphite Based Products, September 1982.

stable prices. The price increases of 1980 (prior to the current recession) hurt graphite sales. This exacerbated the cost situation because as volume dropped, unit costs rose further and productivity suffered because management chose not to lay off employees.

- Management Development and Retention

As pointed out previously, the state salary system provides little incentive for personal investment in engineering education. It provides little incentive for managers to stay once they are trained. Salaries in foreign mining industries are anywhere from 10 to 20 times those in Sri Lanka. The development and retention of good management are necessary for continued long term growth of the graphite industry.

- Marketing Effort

Currently Sri Lanka's marketing effort is more "passive" than "active." A competitive pricing strategy is needed, coupled with an aggressive promotional effort. Effective marketing, with increased sales volume, would help solve some of the cost control problems. Increasing volume would help reduce unit costs, thus providing a stronger competitive base.

Market intelligence concerning foreign markets for new graphite products is limited. Foreign joint venture partners could help to solve this constraint since they would bring marketing knowledge and market access.

- Technology/R&D

There is limited technical "know-how" in the existing industry. Projects such as refractories, carbon brush manufacturing, etc., require new technology and a continuing R&D effort. To obtain the necessary technological support, Sri Lanka will be dependent upon

foreign joint ventures, foreign licensing of technology, and a greater educational base in engineering and science.

- Financing

Local capital is available for graphite projects, but some outside financing would be needed for projects in excess of Rs 100 million.

B. MINERAL SANDS

1. Company Profile--Ceylon Mineral Sands Corporation (CMSC)

CMSC was incorporated in 1957 under the State Industrial Corporations Act No. 49. The Corporation is responsible for the mining, processing, and refining of mineral sands. CMSC is also responsible for direct sales of the products, which are essentially all exported. A limited amount of rutile goes to Ceylon Oxygen for welding rods, but potential growth is in foreign titanium dioxide (TiO_2) pigment markets.

CMSC's products are ilmenite, rutile, and zircon. Mining and processing takes place in Pulmoddai, approximately 34 miles north of Trincomalee. The raised beach sands have a concentration of 75% ilmenite, 10% rutile, and 7% zircon. These concentrations and beach mining and collection keep production costs low. Table 10 shows a product mix of export sales.

The processing ratio of ilmenite to rutile is 4 to 1. Although ilmenite sales have fallen, rutile and zircon sales have increased. The drop in demand for Sri Lanka ilmenite is a result of increased world competition and the market move toward upgraded products leading to TiO_2 pigment. CMSC can usually sell all the rutile and zircon produced, but stockpiling the excess ilmenite creates a costly inventory problem.

TABLE 10

EXPORT OF PRODUCTS - METRIC TONS

Year	Ilmenite	Rutile	Zircon
1971	85,300	1,010	--
1972	83,862	3,225	--
1973	85,638	2,801	--
1974	85,627	2,200	--
1975	50,231	3,273	--
1976	52,259	2,177	--
1977	41,211	194	--
1978	37,145	9,246	2
1979	30,500	14,838	1,329
1980	36,680	12,153	2,025
1981	42,130	5,411	4,617

Source: Mineral Sands Corporation Records.

The CMSC currently has a stockpile of more than 50,000 tons of ilmenite. Average production costs are estimated at $12/ton; at a carrying cost of 25%, annual inventory costs would total approximately Rs 3.2 million. This inventory problem has not been addressed in CMSC's long-term planning. If, for every ton of rutile sold, the excess ilmenite is never sold, 3-4 tons of ilmenite cost should be "assigned" to the rutile cost. For this analysis, the cost of rutile production was reported as Rs 3,680/ton. If the cost of 3-4 tons of excess ilmenite were assigned to the rutile, costs would then range from Rs 4,500 (US $196) to Rs 4,800 (U.S. $208) per ton, close to world market price for the product.

The ilmenite carrying cost should be acknowledged, either through "carrying cost" charges or allocation to other products. CMSC is currently expanding capacity by building a wet gravity and wet magnetic separation plant, scheduled to come on line by the end of 1984. The expansion program will increase ilmenite production from 80,000 to 150,000 tons per year. The expansion program appears reasonable when considering the fact that sales of rutile and zircon are "constrained" by the present production yields. However, the advantages of increased rutile and zircon production will be offset to some degree by stockpiling of still more ilmenite. The study team believes that the cost of "over producing" ilmenite should be factored into the cost of rutile and/or zircon.

Marketing forecasts reviewed in trade journals suggest that long term growth of TiO_2 end markets for paints, paper, plastics, rubber, ink, textiles, and ceramics will grow on a worldwide average of 2.7%/year.[1] The forecasts also suggest that regions with the highest growth will probably be in areas close to Sri Lanka. Thus, expansion of CMSC seems reasonable, but excess ilmenite production needs to be addressed.

[1] Industrial Minerals, July 1982, pp. 22-27.

One way to address the ilmenite sales problem is a more aggressive marketing effort. CMSC's marketing is largely passive. Another possible solution is to upgrade ilmenite into products in greater demand. CMSC has looked into this issue and would like to find foreign joint venture partners to build a plant to produce titanium slag, synthetic rutile, or titanium dioxide pigment.

2. Opportunities for Mineral Sands

Opportunities for this industry need large capital investments. Ceylon Oxygen makes such end-products as welding rods, but has undertaken no study of possible expansion of the TiO_2 base industry. Local markets are too small and it is difficult to penetrate export markets. Thus, the study team concentrated on the upgrading of ilmenite and reviewed a projected plant to produce synthetic rutile and titanium dioxide pigment. CMSC had commissioned a consultant's study in 1980, and the USAID Nathan Report of 1982 also reviewed the technology needed for upgrading ilmenite.

The chloride process will be used. Table 11 summarizes the financial data for the synthetic rutile and titanium dioxide pigment plant. An investment of US $120-130 (Rs 2,760-2,990) million is required, returning 12% on an after-tax basis. Depending upon the structure of the company ownership, the project might qualify for tax holiday status. Any tax concession would improve the financial attractiveness of the project.

3. Constraints

Like the graphite industry, further development of the mineral sands industry is constrainted by several factors. Several of the constraints can be overcome by encouraging foreign participation.

TABLE 11

FINANCIAL REVIEW OF A SYNTHETIC RUTILE AND TiO_2 PIGMENT PLANT

Process: Chloride

Assumptions:

1) Annual Production--approximately 50,000 tons

   a) 25,000 tons of rutile
   b) 25,000 tons of pigment

2) Plant Investment 120 to 130 million dollars

3) Operating Costs 20 to 22 million dollars per year

4) Selling Price for rutile $200/ton FOB

5) Selling Price for pigment $2300/ton FOB

6) G.S.&A. 10-15% of operating costs

	(Millions of Dollars)
Revenue	62.5
Operating Cost	20.0
Depreciation	10.0
Gross Margin	32.5
S.G.&A.	3.0
Profit Before Tax	29.5
Tax	14.7
Profit After Tax	14.8
ROI	12%

Source: Mineral Sands Corporation and Arthur D. Little estimates.

- Technology/R&D

Sri Lankan companies do not have the technology to process mineral sands into slag, synthetic rutile, or TiO_2 pigment. As mentioned earlier, Sri Lanka has had consultant studies that have reviewed available technology, but the task of implementing and building a plant will have to come from a foreign firm.

Another constraint will be the need for a continuous R&D effort. Once a company starts processing TiO_2, it will have to make an effort to stay at the forefront of new processing technology. Such a commitment must be made to ensure an adequate R&D budget and an adequate supply of trained technical people.

- Management Development and Retention

Sri Lanka will need to develop managers for the plant. Few people are knowledgeable about TiO_2 processing and Sri Lanka will have to rely on foreign expertise, but commitment must be made to encourage management training within Sri Lanka. The salary structure should be competitive, reflecting the cost of an education and the responsibility of managing a large plant.

- Marketing Effort

As in the graphite industry, the mineral sands marketing effort is "passive." An aggressive marketing program is needed, even without a new processing plant. The current product line needs promotion to help work off large stockpiles of ilmenite.

A joint venture into processing would help the marketing program, provided the partner has access to markets and has demonstrated marketing skills. Sri Lanka may never have to concern itself with marketing the processed products if an excellent partner is obtained. Nevertheless, the need may eventually rise for the Sri Lankan staff to

carry on its own effort. Therefore, a recognition and commitment of management to marketing is needed early in the project to ensure adequate time for developing marketing skills.

- Cost Control

Mineral Sands Corporation appears to have reasonable cost control of production. Its problem lies in the inventory of ilmenite. If the product can be moved by means of an increased sales effort, there is less need for concern. The carrying cost of the ilmenite is significant, however, and overall profitability is questionable if production costs of ilmenite have to be assigned to other products.

- Financing

A project of the size of a synthetic rutile and TiO_2 pigment plant would require the infusion of capital from outside investors. The capital markets of Sri Lanka would have difficulty raising the money for mineral projects. Considering government priorities, it is likely that such capital will have to come from foreign interests.

C. Phosphates

The third mineral reviewed was the phosphate deposit of Eppawala. The State Mining & Mineral Development Corporation is currently planning a joint venture with Agrico Chemical Company of the United States. Since the Sri Lankans are currently completing plans for this project, the study team could only review publicly available information on the project. Therefore, this report gives only a general discussion of the project.

The joint venture will be named Eppawala Phosphates (Private) Ltd. Agrico will own 49% of the equity and the SMMDC, 51%. The plan

is to mine phosphate rock in Eppawala and transport the rock to the coast where a plant will be built near Trincomalee. The project will cost about $400 million, approximately $30 million for the mine, $130 million for infrastructure, and the rest for the plant.

The Eppawala reserve has a P_2O_5 quality of 35 to 37%. A concentration of chloride and alumina is embedded in the lattice of the crystal, but Agrico has the proven technology to process the rock.

The company will import sulfur and ammonia. The coastal location will facilitate the import of materials as well as disposal of waste gypsum through a pipe and into the sea.

The planned output will include diammonium phosphate (DAP), monoammonium phosphate (MAP), and triple superphosphate (TSP). The venture plans to exploit what is considered to be the fastest growing fertilizer market, namely Southern Asia. While fertilizers are currently in oversupply and prices are depressed, the company is anticipating a regional shortage which Sri Lanka is well located to satisfy. The project is several years from completion and is expected to come on line during a period of significant demand.

IV. SUMMARY AND OVERALL RECOMMENDATIONS

The Sri Lanka mineral industry has the potential of further development. Some opportunities will require outside help in technology, marketing, and finance. All new ventures are probably going to be part of a forward integration strategy. To implement further development, two courses of action are recommended:

1. Market Penetration with Existing Products

Sri Lanka's mineral companies need to market their products aggressively and capture a larger share of the market. Increased sales would help offset cost control problems and inventory carrying costs. By improving their cost position through increased sales, the companies would then be able to price more aggressively and hold their market positions. Establishing a stable cost structure and volume of production would help to position the companies for the move forward into processing.

2. Forward Integration

The opportunities discussed in this chapter are in the segment of the business where processing technology is critical. By integrating forward, the Sri Lankan companies would expand, achieve greater returns, and obtain higher values of foreign exchange.

Since the government is concerned that "turnkey" projects are risky investments for a country in need of technological know-how, joint ventures with foreign firms is a reasonable approach. Sri Lanka should be committed to developing its own management, marketing skills, R&D programs, etc., however. Joint ventures address many of the constraints reviewed in this chapter, but it is not in Sri Lanka's best interest to remain dependent upon foreign joint ventures for all phases of its mineral industry development.