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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

Distr.
LIMITED
ID/WG.282/7
22 Sept. 1978
ENGLISH

08303

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

# INTERNATIONAL FORUM ON APPROPRIATE INDUSTRIAL TECHNOLOGY

New Delhi/Anand, India 20–30 November 1978

## WORKING GROUP No.1

## APPROPRIATE TECHNOLOGY FOR HEAVY INDUSTRIES

THE ROLE OF THE ENGINEERING INDUSTRY

Background Paper

id. 785771

# THE ROLE OF THE ENGINEERING INDUSTRY

by

The National Industrial Development Corporation Ltd.,
India

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# CHAPTER - I

## INTRODUCTION

1.1 Consumption of materials like Steel, Non-ferrous metals, Construction materials like Cement etc. is indicative of the affluence or otherwise of the Society. Such materials along with others go into the daily requirements of life.

1.2 The advanced world had the benefit of low population coupled with world-wide market when they started producing and converting raw materials into useable products. Today, a large portion of consumption of these resources is directly related to the advanced world whose population is significantly less when compared to the developing world.

1.3 With the growth of communications over the past few centuries, there is a tremendous amount of inter-action between the advanced and developing countries. In such an environment, the needs of the developing countries are more or less on the same scale as that of the developed world. However, the resources available are not adequate to meet the demands. This would mean either continuous perpetuation of the developing countries being a ready outlet for new products of the advanced world, or make efforts (by the developing countries) so as to see that a major requirement of theirs is met with from domestic resources.

1.4 It is, with this concept in view, that the Lima Declaration envisaged at least 25% of the industrial production to be coming from developing countries by the year 2000 A.D.

1.5 The developing countries suffer from large unskilled population, non-availability of scarce capital, non-availability of adequate technologies which would meet the basic requirements of economic survival. In addition, the environs prevent the developing countries from being complacent about their industrial activity.

1.6 Whereas the advanced countries had ample time and opportunities in perfecting the technologies, the same is not there for developing countries now. An important aspect is non-availability of a large market to the developing world today. On the other hand, it looks that the developing countries continue to depend on availability of industrial products from advanced countries.

1.7 One of the primary objectives of the developing countries is to give a better economic life to its population which would, inter-alia, mean having adequate employment opportunities. This would, in effect, mean more and more factories manufacturing various industrial products which have direct relevance to economic prosperity of the country also.

1.8 The situation being this, developing countries cannot copy the various steps taken by the advanced countries in coming to this position. They may not, also, at the same time, directly absorb the labour-saving technologies which are prevalent in the advanced countries as it is directly against the precepts of the national economy. It is, with this object in view, that the developing countries should look for appropriate technologies which would satisfy most of the requirements.

1.9 The engineering industry has predominantly been nourished in the advanced world for obvious reasons. The environments in the advanced world were and continue to be such that more and more sophistication in the product and its execution are being sought after. This strategy is having a great bias towards labour-saving devices. The technological gap between the developing and advanced countries is progressively widening.

1.11 India has gone in for an intensive development of engineering industries with greater emphasis on producing capital goods. This strategy is based on sound principles of making the country independent for its basic requirements of industrial machinery and machine tools.

1.12 Capital industries are concentrated and cannot spread industrial activity. This is borne out by the experience in Bihar and Bengal areas where investment in capital industries is very high and yet industrial culture is not prevalent there. Recognising this, the country launched schemes for establishing industrial estates of small size which are primarily aimed to cater for production of small value items to the large industrial houses. In addition, these have established capabilities for manufacturing products which are directly sold to the consumers. In fact, development of such small-scale industries and ancillary industries have spread the industrial activity in a much wider scale and today, nearly 30% of engineering activity in the country is coming from such sectors. The Punjab area producing a variety of goods and the Rajkot and Kolhapur areas producing diesel and pumpsets for agriculture are examples of this.

1.13 Development of industrial activity in the country was dependent to a large extent on availability of collaboration from advanced countries. This being the case, in majority of cases, the choice of technology was limited to the availability of the same on terms which were acceptable to collaborators and hence, a detailed examination of all aspects could not have been the primary consideration. Engineering activities pertaining to manufacture of capital goods like industrial machinery, Railways, Automobiles etc. is a case in point. Even here, appropriate technology could not always be emphasised; rather the ready availability of collaboration was of consideration. Subsequently, the innovative features, unique to Indian environments, have led to development of technology pertaining to the relevant circumstances. Thus, general purpose machining techniques were resorted to in a very number of cases where elsewhere in the world, mass production techniques were the order of the day.

1.14 Having thus started, a measure of competence in absorbing the technologies was developed in the Indian industry which led to upscaling of the same.

1.15 The continuous industrial activity generated in the country has proved the requirements of the higher

technologies which are prevalent elsewhere in the world. This situation was recognised by the Indian industry and with the built-in capabilities, advanced technologies were made available to the Indian engineering industry. Examples of these are, using of carbides, coated carbides, ceramic cutting tools etc. in Indian engineering industry.

1.16 The industrial activity has also caused the demand for mass production techniques as well as demand for most sophisticated machine tools like NC machines for some of the industrial activities. Recognising these potentials, the country has established facilities for manufacturing the same and disseminating such technological knowledge in the Indian engineering industry.

1.17 Industrialisation in general and engineering industry in particular, have led to general socio-economic upliftment of the population. As a matter of fact, engineering industries are direct consumers of products produced in other core industries like minerals, metallurgicals, chemicals and the like thus producing a chain reaction of industrial activity. With development of skills in the population, more and more industries became feasible which has led to further industrial activity. An example of the same

is establishment of a machine tool factory at Bangalore which has led to development of the whole region for producing precision engineering goods ranging from watches to sophisticated NC machines.

1.18 The industrial activity having been continuous, it can be said that no one technology can be termed as appropriate or otherwise. Notwithstanding such a conflicting situation, a rationale is evolved for choice of a suitable technological base for industrial activity keeping in mind the flexibility and adaptability of the same to meet the changing environs. Even the model that was obtained in India may not be available elsewhere in other developing countries. However, the developmental effort of India could be taken as a guide and appropriate technology evolved for each and every situation separately.

1.19 The following case studies would indicate the relevance of appropriate technology to its growth and sustenance.

- Structural
- Automobiles
- Railways
- Metal working machines
- Power industry
- Consumer Durables.

1.20 Structural industries having stagnated for years, though one of the earliest industries were not able to cope with the increased industrial activity generated in the country thus making them sick units. Subsequent efforts of technological upgrading of these industries have proved a great success in meeting the requirements of industry, both in India and abroad. In fact, today, consequent upon such technological changes, Indian structural industry is able to compete in the international market.

1.21 Automobile industry is a typical example. Starting with manufacture of passenger cars, the industry has started producing commercial vehicles, two and three-wheelers etc. Though the passenger car manufactured in India is very much behind what is available in the world, with the encouragement of public and commercial transport system, the manufacture of commercial vehicle has tremendously picked up and th s is fairly advanced. Same is the case with two and three-wheelers manufactured.

1.22 It can be said that there was virtually no manufacturing activity in so far as the Railways were concerned till Independence. All its requirements of rolling stock, coaches and locomotives were imported. The little activity of engineering in

railways was confined to repair and maintenance of the same. Establishment of manufacturing facilities for such rolling stock as described above, has led to a great amount of industrial activity not only in the railways but in other ancillary manufacturing thus spreading the industrialisation in a much wider scale. Simultaneously, it has also helped modernising the Indian Railway System to the extent that today, apart from it being the biggest engineering enterprise in the country, is also being looked upon for technological assistance in other developing countries.

1.23 In so far as the Metal working machine tool industry is concerned, there has been an integrated technological development of the same. Beginning with simple general purpose machines manufactured under collaboration, today, the industry is in a position to manufacture some of the most complicated and advanced types of machine tools like special purpose machines, transfer machines, NC machines etc. In almost all these cases, development has taken place through collaboration with advanced countries. Development of machine tool industry has led to direct improvement of skills of the local population.

1.24 It can be seen here that whereas large requirement of machine tools in the country is met with by Indian production, the country is still dependent on imported machine tools. Such imported machine tools are high precision and sometimes special purpose. The development of machine tool industry in the country is not adequate to absorb such sophisticated technology. This would only mean that the industrial culture developed in the country will have to go a long way if the machine tool industry in the country is to be self-reliant. Even among the advanced countries, there is bilateral trade in so [illegible] machine tools are concerned and signifying [illegible]logical superiority of one country over the other in certain types of machinery, the Indian machine tools industry has started exporting machine tools all over the world including advanced countries. Technologically, the simple types of machine tools manufactured in the country are identical in several situations in developing countries and in some cases, the advanced world also.

1.25 The Consumer Durable industry is really a classic example of industrial activity. In fact, this industry has helped generate the industrial culture in a wider population. In some cases, these industries have started with technical collaboration;

in some other cases, these started on their own. Being consumer durables, where the price of the end-product has to be kept low, suitable technologies were evolved aiming at large volume and low cost of production. This has called for development of special purpose machine tools designed around components. Such technological developments were part of industrial activity in manufacture of products like Bicycles, Sewing machines, Refrigerators, Ceiling Fans etc. In addition, this industry has helped the establishment of large number of small-scale industries from where components are purchased by larger industrial houses. The progress of this industry, by far, was very rapid consequent upon large market being readily available by way of incentives for purchase of bicycles, sewing machines etc. It can be truly said that a greater self-reliance is shown by this industry as against the Capital industries.

1.26 The primary effort of the country has been development of capital goods industry. It was felt that this alone would generate industrial activity in various fields thus accelerating industrialisation of the country. Establishment of machine tool industry, manufacture of locomotives, coaches etc., manufacture of automobiles, etc. which need large

investments have led to development of various industrial disciplines causing further industrial activity. However, this is attendant upon longer gestation periods which would cause inflation of the trends and Indian experience has proved that certain amount of inflation was inevitable.

1.27 An examination of Indian experience in ushering in technological revolution for increasing the standard of life of its population has many aspects. Several factors have influenced its development of engineering industry. As such, the success and failures of the industrial activity of the country cannot be isolated and discussed separately. However, some conclusions can be drawn from out of this experience.

1.28 Unlike other industries, development of engineering industries is by far the simplest and easiest. This is particularly true where small scale industries are concerned. As explained in the report, investment per employee in engineering industries range from as low a figure as 8,000 to as high a figure as 588,000 depending upon the choice of the industry.

1.29 Development of capital industries generate wealth which in turn can be reinvested for increasing the economic activity of the nation. Unlike consumer industries, in addition to this, they raise levels of skills of the population which itself is an asset to a developing country.

1.30 Even with regard to development of capital industries certain restraints and cautions are essentials. In any developing country, market being limited, volumes of production and economies thereof are important factors so as not to flitter away the scarce resources. This is equally applicable for all industrial machinery, feeding industries like cement, sugar, textiles, jute, paper, engineering industries etc. This being the case, a close collaboration among the developing countries would make the market much wider which would offer scopes of economy for manufacture.

## CHAPTER - II

## ROLE OF ENGINEERING INDUSTRY AS A VEHICLE OF SOCIO-ECONOMIC UPLIFTMENT

2.1 Examples of advanced world show that lower dependence of population on agriculture would mean higher GNP and greater prosperity. For situations like this to be obtained, the industrial sector would have to be highly advanced absorbing a large amount of labour force. Unfortunately, the situation in the country is not so. The following Table amplifies the relation of GNP and consumption of steel (showing the position of metal working industry in the national economy) :-

TABLE

| S.No. | Country | Steel Consumption per inhabitant in Kg. | GNP per inhabitant in U.S. Dollars |
|---|---|---|---|
| 1. | U.S.A. | 577 | 3,840 |
| 2. | West Germany | 541 | 2,010 |
| 3. | U.K. | 435 | 1,920 |
| 4. | Japan | 620 | 970 |
| 5. | India | 14 | 125 |

Whereas the addition to GNP by engineering industry is nearly 30% in the advanced world, the same is about only 13-15% in India.

2.2 Realising the potential of industrialisation as a means of achieving economic prosperity, the country embarked upon a massive industrialisation producing capital goods. Industries having larger investments and having higher gestations are some of the essential features for producing such capital goods as are needed by the Indian industry.

2.3 Location of such large industries was made after carefully considering the backwardness of the area and other factors like availability of transport and communications, water, power, coal, skilled manpower etc.

2.4 Engineering industries are the direct consumers of other products produced in industries like minerals, chemicals, and the like. Unless there is an outlet for industrial produce, the industry itself would die. This being the case, engineering industries play an important role as a basic consumer of industrial products.

2.5 Almost all the metals like pig iron, mild and alloy steels, aluminium etc. produced in the metallurgical industries directly go into other engineering industries (capital goods for consumer industries). When it pertains to consumption of such materials in capital goods industries, it generates further

employment potential. When the consumption goes into consumer industries, it not only generates employment but also raises the living standards of the area.

2.6 Whereas industries like minerals, metallurgical and chemical would generally be demanding heavy investments, engineering industries may be in the small scale or large scale sectors. If it is large-scale sector, manufacture of items such as capital goods and high-cost consumer durables like automobiles etc. are the products. In the small/medium-scale sector, manufacture of air-conditioners, consumer durables etc. would be the products.

2.7 Engineering industries directly improve the skills of performance of the population. In fact, even the industry itself has undergone such tremendous changes that the quality of equipment produced today is of much better standards than it used to be a generation ago, signifying the efforts of industry for producing better products.

2.8 Example of Switzerland shows that miniaturisation industry has improved the skills of population to such an extent that it has earned the name of "time keepers to the world". Such a culture of precision manufacture built in the population was not confined to manufacturing time pieces and watches alone. In the fields of

instrumentation and precision tools today Switzerland is the leader.

2.9 Almost the same situation has repeated itself in the country. Establishment of machine tool industry in Bangalore has helped generate an awareness for precision manufacture. This has led to acquisition of such greater skills to the extent that today it is understood that quality of products manufactured in that region is substantially higher. These skills have helped establishment of other industries thus spreading industrial activity.

2.10 Similar examples can be given with regard to other engineering industries. Establishment of Foundry Forges in traditional areas like the Hubli-Dharwar, Bihar areas etc. has built a culture for good foundry and forge practices.

2.11 Engineering industries have themselves become centres of attraction for other industrial activity. Many industries have been dispersed all over the country with the result that a good technological base is available in almost every part of the country though certain areas have developed in specific fields of engineering manufactures.

2.12 As is explained elsewhere in this report, engineering industry must be in a position to absorb the labour rendered surplus in other sectors (like agriculture). This would call for greater role for this industry to play in the total economic activity of the country. Being direct consumers of other industries, the engineering industries have an important role to play in the National Economy.

## CHAPTER - III

## PRESENT STATE OF ART

3.1 The past trend of manufacture was basically dependent upon availability of suitable technical collaboration. Such a situation precluded any detailed critical examination of either the product or its relevance to Indian environs. This is understandable as there was hardly any industry in the pre-independent India.

3.2 However, in many cases, particularly in the sector catering to consumer and consumer durables, lot of innovations have been made by industry and in fact, in several cases, they are more or less independent of foreign technological dominance.

3.3 The unique feature of industrial development in the country has been manufacture of consumer durables like sewing machines etc. Such products are in large, small scale, and unorganised sectors almost from the beginning. Today, a large number of people are directly employed in such industries. In-variably, in all such cases, technological development was more need-based which, in effect, caused development of the same by the manufacturing units themselves. This has caused development and manufacture of a variety of low priced special purpose machines which cater solely to such industries.

3.5 Some of the larger industries like Railways, Automobiles etc., were necessarily set up with foreign technical collaboration. Invariably, when such manufacturing ventures were conceived, enough emphasis was not laid on future trends in the relevant industries. Consequently, almost all manufacturing units of trucks, cars, two-wheelers etc. are employing techniques of manufacture which sometimes are definitely difficult-placed. They are obsolete already by the Indian Standards either in the quality of the product or in the method of manufacture or both. However, some progressive firms have seen through this situation and have embarked upon a massive technological improvement programmes which, inter alia, mean design, manufacture and installation of newer type of equipment within the plant. Based upon the experience and consumers' reaction for their products, they have also undertaken certain modifications in the basic configuration of the products. Wherever such measures are undertaken, it has led to technological competence and progress in the particular unit. This is particularly so in so far as markets of commercial vehicles and production of two-wheelers are concerned. However, this situation is not universal in respect of many manufacturing organisations. This has caused

manufacture of technologically obsolete products. It has also caused stagnation in technological improvement within the factory. This is particularly so in passenger cars.

3.6 Government, in the very early stages of industrial development of the country, have taken correct desi decision in so far as technological improvements are concerned. Establishment of technological centres like the National Institute of Foundry Forge, Central Machine Tool Institute etc., are examples of the same. In addition, research laboratories like the Central Mechanical, Engineering and Research Institute (CMERI), product-based institutions like the Leather Research Institute etc. have brought people on to one platform. Such institutions have functioned as focal agencies of various technologies. It has also contributed as a forum for exchanging ideas and improvement in the relevant technological fields. They have also undertaken sponsored as well as original research programmes with the objective of helping the industry develops appropriate technologies.

3.7 In the late fifties and early sixties, the country has embarked on a massive industrialisation programme. Several new industries have come up, of course, obviously with foreign collaboration. In almost all such cases, the industry was backed only by the

estimates of short-falls made by the relevant authorities for specific devices/products. The industry has not had time to make in-depth studies and choose relevant or appropriate technologies that are most suitable or long-lasting for the country. This is particularly relevant in so far as capital goods manufacturing is concerned.

3.8 Though the country is producing a large amount of industrial goods today when compared to the situation soon after Independence, it can be said that complete technological reliance is still not achieved. Even in advanced countries, there is a two-way traffic of industrial machinery and machine tools thus signifying inter-dependence of industry.

3.9 Even in the classic technologies of Foundry, Forge, Machining etc., tremendous amount of technological advances have been made elsewhere in the world. Examples of such advance are coated carbide tools, ceramic carbides etc. that are very effective in machining exotic metals at optimum speeds and feeds. Technologies of welding, brazing etc. have advanced tremendously abroad. Newer types of metal working and machining are constantly being developed with a view to satisfying the demands of the industry. Some of these have already become relevant to Indian industry.

3.10 The country cannot either totally accept all these technologies as of immediate consequence or shut itself off from technological advances made w elsewhere in the country. As such, there is bound to be continuous communication with advanced world so as to know and apprise the current technologies there. Such technologies should have to be carefully apprised to the specific situation arising in the country before they are contemplated for importation.

3.11 However, the country has shown marked self-reliance in the manufacture of a variety of products. Manufacture of general purpose and special purpose machine tools, a large amount of cutting tools, metal forming machines etc. is undertaken in the country to acceptable standards. Even though the advanced world has vacated certain manufacturing activities, they are in need of such industrial machinery and machine tools for some of their requirements and these are being successfully met with by Indian exports.

3.12 An example of self-reliance is development of Swaraj Tractors indigenously. When the country took to intensive agriculture, it liberally allowed imports of tractors. Several firms have come up for manufacture of the same under collaborations. Simultaneously, the Central Mechanical Engineering Research

Institute developed an indigenous tractor and the same has gone into production after intensive field trials. Similarly, for smaller agricultural operations, power tillers have been indigenously developed. However, such development has taken place at a time when the industry had already started under various collaboration terms and hence the same has not found an outlet, but it enabled the country to have a base for further development.

3.13 Another example of self-reliance is shown by the small and medium industries manufacturing diesel engines for stationary operations ( for example, pump-sets for irrigation and stand-by power generation). In fact, the manufacture of diesel pump-sets is an example of appropriate technology in Indian circumstances.

Due to various reasons, the plan of power generation did not fructify thereby unsetting the programme of power supply for irrigation operations. Diesel-powered pumpsets proved an ideal solution in such cases and today a large number of the same are operating in very large areas all over the country. Similarly, the power requirements of the industry were also upset due to failures in power plants and this gave a very good opportunity for producing a large number of stand-by diesel sets ranging upto

2000 K.W. capacity.

In fact, this industry has displayed a marked sense of awareness of the market problems and had worked itself to meet the same.

3.14 The small and medium-scale industries have shown remarkable amount of self-reliance on indigenous technologies. They are capable of and are manufacturing a variety of consumer goods and are acceptable by the Indian community as of proven quality. Examples of such products are : radios, television sets, domestic appliances etc. This trend is observable even in industrial products. The ancillary industries set up by large industries to feed them have shown rapid progress and in some cases they have taken to manufacture of the original equipment also.

3.15 The classic example of development of appropriate technology is development of machinery for plastic and rubber moulding. A variety of equipment, mostly semi-automatic and manual, are developed in the country for plastic and rubber goods manufacture. Such equipment are simple, rugged and easy to operate. Several of the operations are manual as opposed to

automatic controls available from the advanced countries(closing and opening of rams, dwells etc. in most of such equipment are automatically controlled in sophisticated equipment), thus making the equipment easy on maintenance and initial costs. Such type of equipment is widely used in India today for manufacturing a variety of goods.

3.16 In fact, the Government efforts have contributed to the development of small-scale industries to a large extent. The infrastructure for development of this sector was laid out by Government which has helped the situation immensely. Establishment of such institutes as the Small Industries Service Institutes with their extension centres, establishment of raw material banks at the consumer points, extending fiscal assistance by way of reduced rates of interest etc., establishment of tool room etc., did help this sector. In fact, such professional institutes as described above have acted as agents for transfer of appropriate technology.

3.17 Today, the country is in a position to offer technologies pertaining to metal working (both metal cutting and metal forming) to meet a variety of requirements of particularly other developing countries. Shorn of super sophistication, the equipment manufactured

and technologies thereof are simple, and rugged capable of taking rough handling. Being primarily meant for labour-aiding, the situation like the type obtained in other developing countries, they are most adaptable to varied work environs. The measure of success achieved in promoting medium and small-scale industries shows the ability of Indian industry in meeting the current situation. Very many entrepreneurs engaged in manufacturing a variety of products like fasteners, builders' hardware, electrical appliances, electrical switches etc. have established regular export outlets signifying the quality of their manufacture. Some of them have even given technical collaboration for establishing similar ventures abroad in other developing countries. In fact, India offers a very good example of development and its experiences can easily be drawn by other developing countries so that the gestation periods may be brought down considerably from what they normally are.

3.18 In addition, such institutes have started regular training courses in various disciplines so as to impart the technical skills required. Such institutes have played a vital role in dissemination of knowledge which has helped the industry immensely.

Some of these institutes have established sound professional relations with similar institutes elsewhere in the world also so as to keep them abreast with the latest trends in the industry. In addition, several of the universities conduct research in the field and there is a close interaction between the universities and industries in this regard. Some of these institutes are established with the help received particularly from U.N. organisations. Some of these institutes are :-

i) Central Machine Tool Institute, Bangalore

ii) Central Mechanical Engineering Research Institute, Durgapur

iii) Central Institute of Tool Design, Hyderbad

iv) Central Institute of Plastic Engineering & Tool Design, Madras

v) National Productivity Council having offices all over the country

vi) National Institute of Foundry & Forge, Ranchi

vii) National Institute for Training Industrial Engineers, Bombay.

Besides the above, some more institutes are being set up by the Government for developing suitable metal team forming technologies. Some of these

are : Metal Forging Institute, Hyderabad; Abrasives Research Institute, Madras; Institute of Welding, Trichirapalli etc. These institutes are besides professional bodies set up by industry itself which are solely concerned with the design and development of the product concerned. Some of these are : Automobile Research Institute at Bombay, Tractor Training Institutes at Hissar etc., and Badui ( set up by Government for production of agricultural implements).

## CHAPTER - IV

## TYPICAL CASE STUDIES OF INDUSTRIES

4.1 Choice of technology for any industrial activity is dependent upon various factors such as infra-structure, availability of skills, financial resources, market potential, collaboration, social needs, aspirations etc. It is not always possible to get the best possible solution for all these individual problems. As a matter of fact, any industrial activity would be optimising various factors enumerated above. This optimisation usually takes into account the situation obtained at the time of decision making.

4.2 In a continuous and changing situation as was obtained in India for the past three decades, no decision can be conclusively proved as the perfect solution. Similarly, no solution can be termed as totally misplaced. Notwithstanding such conflicting situation, a rationale has to be evolved for choice of a suitable technological base for industrial activity.

4.3 An important requirement of any industrial activity would, therefore, be the flexibility and adaptability of the industry to the changing environs with minimum dislocation. Often it is not easily attainable.

4.4 Technological appropriateness in so far as industrial activity is concerned has got a wide connotation thus defying a precise definition of the same. In fact, even among developing countries, whereas experience can be shared exact situations cannot be repeated. For example, in a country like India, massive investment in capital equipment and primary industries like mining, metallurgical etc. is feasible and desirable. The same may not be relevant in other developing countries for reasons such as smallness of market, need for raising large resources for establishing future ventures, socio-economic background like availability of skilled power, industrial culture etc. It can also be a fact that whereas a country like India may tend towards larger manpower employment bias other developing countries having less population would perforce go in for labour-saving technologies. However, the pathos of experience could be taken as a guide and appropriate technology for industry evolved which would suit the local environs.

4.5 The case studies enclosed would reveal the development of various typical engineering industries in the country (capital and consumer) and the compelling reasons for the development or otherwise of these industries. It is quite likely that these models

may not repeat themselves in other situations in sister developing countries. However, the logic of development could be taken as a starting factor. For this purpose, case studies of a wide sector of engineering industries are made out. These sectors are :

i) Structural

ii) Automobiles

iii) Railways

iv) Metal Working machines

v) Consumer Durables

vi) Power industry.

## 4.5.1 A CASE STUDY OF STRUCTURAL ENGINEERING INDUSTRY IN INDIA

The earliest industries in the country have been Railways, Small P.W.D.[1] Workshops, some Textile mills, Port workshops etc. Whereas Railway Rolling Stock continued to be imported mostly from U.K. and Europe, the track-laying became predominantly labour-intensive projects. In the process, construction of culverts, bridges, tunnels etc. were some of the essential requirements for this purpose.

2. Realising the potential for civil structures of this type, several factories were established in the country as subsidiaries of predominantly U.K. organisations. These factories have undertaken manufacture of girders, for bridges and similar other structures.

3. Having acquired expertise of manufacture of bridge girders, predominantly for Railways, the same has been used in Road network also wherever bridge construction is called for. In fact, construction of the famous Howrah Bridge in Calcutta has caused incorporation of a few companies in the country to undertake similar and other bridge construction works.

4. Even with regard to Railways, the foreign-owned Indian companies started manufacturing ( this is

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1/ Public Works Department

predominantly structural in execution) various types of wagons, coaches and other materials required.

5. Many of these factories have flourished in the Eastern region of the country by virtue of the fact that this was the only area having some engineering base in the country before Independence.

6. However, most of the raw materials required for such construction like steel plates, angles, sections of various other items continued to be imported from U.K. as the basic steel industry was in a very infant stage at that time. Part of this requirement was being started even before Independence but the necessity of importing could not be curtailed.

7. These factories manufacturing structures have established necessary infrastructure required for manufacture of such items. Necessary skills were also acquired for design and manufacture of the same with the result that they are in a position to independently design and manufacture similar or other structures for different situations.

8. Soon after Independence, management of these companies has changed hands and became totally Indian. Even at the time of take-over, the book value of the equipment installed was negligible.

9. All through the existence of these industries, there had been virtually no upgrading of equipment with the result that after certain amount of time, these factories became technologically obsolescent. It is at this point of time that the management of these companies changed into Indian hands. Even after the change-over, there has been virtually no new investment in these companies with the result that these companies continued to carry on obsolete practices.

10. It was very clear that many of these factories were not in a technologically competent position to undertake sophisticated work pertaining to various industrial activities started soon after Independence. While these companies could manufacture some of the traditional items, they were woefully incompetent to handle more difficult jobs.

11. The result of this technological obsolescence and poor management has been that these firms progressively decayed and became sick. Government, for reasons other than business principles, took over management of these firms and some of them also were nationalised. From then on, technological innovations were incorporated into the factories so as to make them competitive in the present industrial atmosphere. Notwithstanding such a poor situation, realising

the importance of structural industry in the industrial development of the country, Government started under public sector, factories for manufacturing technological structures. Such factories have started contributing to the requirements of industries in quite a sizeable way. In a very short period of time, they had acquired the expertise and skills and design, manufacturing and erecting at site some of the many complicated structures.

12. Today, these Government companies are effectively contributing in large industries like Cement, Fertilizer, Petro-chemicals, Iron & Steel, and Sugar plants, Chemical plants etc.

13. An important industrial structure which is slightly out of the normal described above, has been the manufacture of transmission towers. The country's power programmes gave a large market for such towers and this market was readily cashed and several firms have specialised in manufacturing such towers in the country. In fact, Indian manufacturers are some of the leading manufacturers of towers in the world and they had exported such towers to several countries in the world.

14. The industrial boom that was generated during the first three Plans has caused creation of large amount of capacity for structural production.

In terms of tonnage, the total capacity is 452,000 tonnes per annum. As against this, the production of structures is 124,000 tonnes per annum. This is due to the fact that there has been a retardation of the total industrial activity from the Fourth Plan onwards which also affected the industry manufacturing structurals.

15. Manufacture of structurals involve both in-plant manufacture and site-manufacture/installation. There is a close relation between these two activities without which installation of the structures would become difficult. The Indian structural industry has come of age to the extent that they are capable of taking turn-key assignments for design, manufacture and installation. Some of the Indian structural manufacturers have become prime contractors to overseas consultants in Third countries. This has come about as a boon at a time when the industry is starving for work.

16. One of the important items of structures is manufacture of EOT[1/] cranes. Such cranes were a major imported item till Independence. Subsequently, the position has changed drastically to such an

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1/ Electric Overhead Travelling

extent that today, the country is in a position to manufacture cranes upto 100 tonnes capacity for various duty requirements.

17. Technologically, manufacture of structures involve large covered areas as well as working in the open at site. Covered area becoming more expensive and the labour unwilling to spend in difficult working situations, the technology of manufacture of structures is being slowly vacated from the advanced world. This situation has become ideal for Indian structural manufacturers to cash in.

## 4.5.11. AUTOMOBILE INDUSTRY - A CASE STUDY

Shortly after the Second World War, a private firm was permitted to start automobile assembly for passenger cars. Soon after, the same firm was allowed to expand into manufacturing activity for passenger cars. Subsequently, in early fifties, two more companies started passenger car assembly and manufacturing activities. In mid-fifties, the country took to manufacture of trucks and a few firms were licensed for the same.

2. A large amount of motor cycles were disposed of as junk by the Army soon after the War and these came into the possession of private parties. This helped generate demand for motor-cycles and some firms started manufacturing of motor-cycles under collaboration. Subsequently, a Scooter made its appearance in late-fifties and it became instantly popular. Its popularity led to another firm also being licensed for manufacture of scooters. Both these ventures were with Italian collaboration.

3. There was demand for automobiles having strenuous duty like Jeeps and Army vehicles. This demand was also recognised well in time and manufacturing activities were initiated in the country at a fairly early stage for these vehicles.

4. It was recognised that the automobile industry has a significant role to play in the industrial development

of the country. Apart from the fact that it generates the maximum employment potential, it also helps in the industrial growth in other sectors also. It also has been the fore-runner of development of industrial skills in the country which are of immense value in a developing country like India.

5. Table I shows the production of various vehicles in the country beginning from early fifties. It will be seen from this table that the volume of production is in no way near the then volumes of production in the advanced countries. Even today, the volumes of production are nowhere near the regimes of production in the advanced countries.

6. With volumes being low, the production techniques were suitably scaled down. Thus, a technology of general purpose machining involving a large number of operations, long cycle times, large inventory of jigs and fixtures etc. was the order of the day. This has resulted in the quality of the products being necessarily low. The passenger cars produced in India are way behind and cannot be compared to the products of advanced world.

7. For production during the period of growth of automobile industry, the basic input, viz., steel (structural steel, carbon and alloy steels, sheet steel etc.) were woefully inadequate and these were

being imported. Apart from these, other accessories like spark plugs, pistons, piston rings, bearings, panel meters etc. were also being imported.

8. During this period, the country took a decision to large-scale industrialisation which necessitated import of large amount of Capital equipment. With resources being inadequate during that time, enough attention was not paid to importation of raw materials. This has led to restricted quota system which prevented sizing the factories for large volume production. Thus, the technology of production was slated down.

9. The spin-offs from automobile industry were felt in various fields. Development of this industry led to the establishment of industries for producing rubber products, non-ferrous quality grade foundry and forge industries, etc.

10. At the time of start of Industrial Revolution in the country, viz., in early fifties, no industrial base of any significance was existing in the country. Because of this, the factories which were being established, automobile industry being no exception started with the concept of complete manufacture, barring accessories (inclusive of such small items like fasteners etc.) which was thought of as the only solution.

11. This has led to more and more capital being employed towards manufacture of components having features similar to other industries also. Thus, under one roof, manufacture of complete engine inclusive of engine castings, forgings, crank-shaft, valve and tappet rods, fasteners, rocker arms etc., were undertaken. This was another cause for the bias towards more and more general purpose machines being employed in this industry.

12. Notwithstanding such tendencies, the truck industry took the leap forward by initiating technology for mass manufacture. This has led to utilisation of more and more automotic machine tools, transfer lines, multi-spindle lathes etc., without which the volumes of manufacture were unthinkable. This development led to manufacture of special purpose machines in the country.

13. Around this period, industrial climate has picked up significantly and several ancillaries have come about which manufactured same or similar items catering to different industries. Automobile industry encouraged this tendency and even profited by the same.

14. An accelerated industrial development producing capital goods has greatly helped the automobile-industry to the extent that their dependence on imported raw materials, castings and forgings etc. has become less and less. Today, barring a few items, there is hardly any dependence on imported raw materials.

15. Industrial development generated demand for personal transport far in excess of production with total stoppage of importation of automobiles. Waiting time for passenger cars was verylong. The personal transport requirements were both for passenger cars and two-wheeler scooters. It was at this time that the Government thought of entering into manufacture in the Public sector. Consequently, Government entered into an agreement with an Italian firm for complete transfer of scooter plant from Italy to India. This happened sometime in late-sixties. However, the Government did not encourage the passenger car industry as much as it has encouraged the other industries and this industry has not given a good account of itself.

16. Government also toyed with the idea of manufacturing people's car from mid-sixties onwards. Several proposals were invited from the then existing manufacturers and evaluation efforts were also made. However, due to paucity of funds and priorities of industrialisation,

Government did not come to a conclusion regarding manufacture of People's car in the Public sector. However, it was decided by the Government to develop indigenously a People's car. This was more a decision based on the spirit of nationalism than pragmatism.

17. With large production of trucks and availability of personal transport in the form of cars, scooters, mopeds etc. in the market, both the industrial scene and the rural economy underwent tremendous changes. The agricultural produce found quicker outlet to the markets. Apart from this, the rural areas also benefitted by the mobility offered by automobiles for passenger transport and goods transport. Seen as an input for rural development, automobile has an important role to play in uplifting the masses from the abysmal poverty levels to something better and higher.

18. Manufacture of automobiles started with a pay-load of 3-ton trucks. Today, it is slated to produce 10-ton trucks and even higher. Production of much heavier-duty trucks is also well within the competence and expertise available with the automobile industry and it is seriously considering manufacturing of such trucks subject to Government approvals etc.

In so far as manufacture of two-wheelers is concerned, already the snob value has become an important factor thus unseating the motor-cycle as the means of transport. People have started looking for scooters more and they are willing to wait for the same than going for motor-cycles.

20. Realising such tendencies, the Public Sector established for manufacture of scooters, has sub-licenced several units in the country for manufacturing scooters in various brand names. This, to some extent, has eased the market conditions.

21. Even in the matter of Scooters, the consumers have become more choosy and they are looking for better service conditions, reliability, performance etc., with the result that some brands of scooters are finding it increasingly difficult to compete in the market due to one reason or the other.

22. As stated earlier, availability of finance and availability of import licences for manufacture, decided more in sizing the factories than the demand for the same. This has resulted in a large un-fulfilled demand. This situation was well exploited by the automobile industry in maximising the production to the extent possible and profited by the same. However, the situation has substantially undergone a

sea-change from early 1974 onwards consequent to a steep rise in the fuel cost. The increased running cost had a telling effect on the automobile industry, particularly, the passenger cars, with the result that the demand for the same has fallen considerably. A part of this demand is diverted towards scooters.

23. Today, the automobile industry (the Truck and the two Wheeler/Three wheeler industry) in the country can be ranked as one of thevery mature industries. The low volumes of production are more consequent upon less demand and lack of availability of capital than due to anything else. The automobile industry has embarked upon exporting of the products, particularly, public transport vehicles, to other developing countries in the world. Being competitive by all standards, the Indian trucks and buses have found greater acceptability elsewhere in the world.

24. The country has also started exporting two-wheelers, particularly, scooters, and the Indian manufactured scooters have become increasingly popular in South-East Asia. In fact, one Indian firm has given technical collaboration for manufacture of its brand of two-wheelers in Taiwan.

25. In so far as the manufacture of automobile components like tyres, tubes, radiators, wheel-rims, dash-board instruments, fuel injection equipment, electricals etc. are concerned, India is in a commanding position today. Almost all these things are manufactured in the country to international standards. Several of these are finding export markets, both in developing and advanced countries. The Indian automobile industry is capable of manufacturing, apart from the proprietory items described above, such items as Crankshafts, Cam shafts, connecting rods etc. Such of these items can be manufactured either as completely machined to customer requirement or supplied as raw castings and forgings ready for machining. The industry is well poised for undertaking supply of components as well as sub-assemblies also to specific requirement of the customers. Infact some of the companies started negotiation for supply of such components (forged items in particular ) to EEC countries.

Table-I

## PRODUCTION OF AUTOMOBILES YEARWISE FROM 1950 to 1978

| Year | Cars | Jeeps | Motor Bikes | Scooters | Mopeds | Three Wheelers | Petrol Trucks | Diesel Trucks |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1950 | 2,221 | - | - | - | - | - | 1,720 | 171 |
| 1951 | 3,478 | - | - | - | - | - | 2,134 | 47 |
| 1952 | 2,093 | - | - | - | - | - | 2,613 | 68 |
| 1953 | 2,492 | 1,175 | - | - | - | - | 2,462 | 292 |
| 1954 | 4,995 | 2,460 | - | - | - | - | 4,234 | 1,066 |
| 1955 | 3,579 | 2,864 | 420 | 529 | 4 | 3 | 4,758 | 4,579 |
| 1956 | 13,339 | 3,988 | 1,022 | 3,068 | 1,667 | 529 | 4,411 | 10,083 |
| 1957 | 12,203 | 4,029 | 1,827 | 4,098 | 2,430 | 852 | 3,578 | 12,455 |
| 1958 | 8,114 | 3,550 | 2,653 | 2,923 | 1,468 | 483 | 3,288 | 12,002 |
| 1959 | 11,993 | 4,555 | 3,239 | 2,764 | 1,176 | 947 | 4,452 | 15,811 |
| 1960 | 19,097 | 5,501 | 3,998 | 11,494 | 836 | 496 | 4,314 | 23,204 |
| 1961 | 21,662 | 7,502 | 8,636 | 12,817 | 2,634 | 1,267 | 3,558 | 22,182 |
| 1962 | 23,326 | 7,597 | 8,828 | 14,318 | 513 | 1,426 | 3,391 | 23,503 |
| 1963 | 15711 | 8,104 | 9,456 | 15,419 | 5 | 1,701 | 4,236 | 24,246 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 1964 | 23,227 | 10,391 | 13,858 | 20,043 | 1,445 | 2,493 | 7,550 | 25,957 |
| 1965 | 24,790 | 10,483 | 21,364 | 20,316 | 7,444 | 1,884 | 6,985 | 30,423 |
| 1966 | 27,597 | 9,777 | 25,040 | 20,971 | 5,591 | 1,255 | 5,700 | 29,366 |
| 1967 | 33,395 | 5,561 | 23,338 | 30,302 | 9,108 | 3,995 | 4,595 | 26,859 |
| 1968 | 37,308 | 7,293 | 29,411 | 35,942 | 9,553 | 4,317 | 5,264 | 29,676 |
| 1969 | 35,183 | 7,838 | 34,477 | 49,740 | 11,043 | 5,072 | 5,942 | 29,300 |
| 1970 | 35,205 | 9,334 | 43,038 | 58.442 | 11,691 | 4,229 | 7,083 | 34,054 |
| 1971 | 38,316 | 11,053 | 39,670 | 67,211 | 14,104 | 6,156 | 7,230 | 34,624 |
| 1972 | 38,828 | 12,518 | 47,573 | 64,731 | 24,671 | 9,790 | 7,221 | 31,513 |
| 1973 | 39,937 | 13,071 | 48,812 | 78,007 | 23,360 | 11,336 | 9,849 | 35,060 |
| 1974 | 36,009 | 10,015 | 54,002 | 85,670 | 29,222 | 12,646 | 3,597 | 38,268 |
| 1975 | 23,070 | 8,152 | 69.732 | 101,630 | 33,859 | 12,223 | 1,506 | 41,518 |
| 1976 | 31,767 | 6,347 | 73,251 | 1,52,596 | 36,484 | 18,886 | | |

4.5.iii CASE STUDY OF RAILWAYS

1. The country has inherited a vast network of Railway system left by the British companies. The Railways were nationalised in early fifties and hence they become the property of the country. Strictly speaking, the Railways were one of the earliest and also the largest industrial enterprises in the country. The demand for civil engineering, mechanical engineering and electrical engineering was generated to a large extent by the Railways only.

2. The activities of the Railways can be divided into two features, viz., commercial and engineering. The commercial activity pertains to movement of passengers and goods traffic across the country and realising the revenue. The engineering portion can be taken as comprising of manufacture and maintenance of locomotives, rolling stock, railway tracks, construction, repairs etc. of bridges and other structurals.

3. In so far as the engineering portion was concerned, there was a network of Railway Workshops spread all over the country for maintaining the rolling stock. This maintenance also included manufacture of some of the spare parts which are frequently in use. Sometimes, these spare parts were heavier items also.

4. The first effort the country made towards self-reliance is the establishment of manufacturing facilities

for passenger coaches and Steam locomotives.

5. Even before Independence, the passenger coaches used to be manufactured in the country by some private firms the technology forwhich was fairly obsolete. Government took the step of manufacturing shell coaches which reduced the weight of the coach thereby increasing the haulage capacity of the engines. A collaboration was entered into for the manufacture of such coaches and soon, coaches of various designs and configurations were rolled out from this factory. Today, this factory manufactures a major amount of the coach-stock of the country and also is exporting a good proportion of its manufacture to other countries. Technologically, it has been proved that these coaches are as good, if not, better, as any other coach manufactured in the world.

6. With the establishment of a factory for manufacturing Steam locomotives in the Public sector, there were two organisations for producing the steam locomotives one for broad guage (in the public sector) and one for metre gauge (in the private sector). The very establishment of factories of this nature called for development of manufacturing skills in various fields like development of steel castings, manufacture of heavy forgings etc.

Such activities were taken on hand in a comprehensive manner and by late fifties, the country was fairly advanced in the locomotives manufacture though it was still importing some of these from Germany and Canada.

7. In the early sixties, the country rightly felt that it should go in for Diesel and Electric locomotives as compelling technological factors like haulage of heavier goods over long distances, necessity of higher speed to keep the tracks clear as quickly as possible and increase in the volume of both the Goods and Passenger traffic were already felt. With these ideas in view, a factory for manufacturing Diesel locomotives was set up with American collaboration. The diesel locomotives so manufactured were primarily intended for movement of goods and some of the fast passenger trains. Slowly, the network was increased to include more and more of passenger trains and the goods traffic.

8. Simultaneously, the country felt the need to use Electric traction as diesel oil is an imported item. Slowly, the steam engine manufacture is vacated and manufacture of electric locomotives, again with American collaboration, was taken up. Such manufacturing activities progressed simultaneously with making suitable modifications etc. in the tracks.

laying power cables on trunk routes so as to facilitate electric traction.

9. Today, the country is in a position to manufacture both electric locomotives and diesel locomotives and the import content of these products is confined to importation of raw materials and certain proprietory items.

10. Manufacture of such products has helped the establishment of a technological base in the country for undertaking manufacture of heavy industrial products. These include manufacture of steel and alloy castings, heavy forgings and welding technologies etc.

11. In so far as the exports are concerned, it is more a matter of availability of surplus production towards export rather than non-competitiveness of these products in the world market. However, the country has started exporting on a modest scale diesel locomotives to other developed countries.

12. Technologically, though it has progressed considerably over the last three decades, it does not compare with the advanced world. This is understandable.

13. Realising the potential for bilateral collaborations with Indian Railways, many countries are already approaching India for technical appraisal, assistance etc. India is already assisting a number of countries in this field.

## 4.5.iv A CASE STUDY ON METAL WORKING MACHINES

1. The Industrial Revolution launched in the country from early fifties onwards created a huge demand for Metal Working machine tools. This, coupled with the demand generated by Defence and other organisations, has justified in starting the Machine Tool industry on a comprehensive scale. Realising such huge demand the country started production of machine tools in the public sector. The machine tools contemplated in the public sector were again, general purpose lathes of various types and sizes under technical collaboration with foreign firms. The machines manufactured by the public sector were of a superior type by virtue of their technical collaboration with an European firm as against similar equipment manufactured by local enterprises which were more or less independent ventures. This has led to more and more demand for the machine tools manufactured in the public sector.

2. Realising the potential of having no other manufacturer in the country, the public sector started manufacturing Milling machines and Grinding machines also, again under technical collaboration. These machines became instant success as the demand for such machine tools was very large. Realising the market potential, the private firms in the country have also cashed on by improving their products and diversifying the same to suit to varied industrial situations. Though there was mutual competi-

tion in the beginning between the public and Private sectors, it became at a later stage mutually supplementary.

3. The country embarked upon development of small-scale industries for manufacturing various items. It was also made the declared policy of the Government that every large industrial house should promote ancillary industrial estates for manufacturing and supplying various items of their needs. This has led to demand for simple general purpose machine tools which are less costly and which a small entreprenour can afford.

4. Seeing the potential several small-scale industries have come up for manufacturing general purpose machine tools like drilling machines, lathes, bench grinders, and a host of other types. Invariably in all such cases, the manufacturing activity was confined to manufacture and assembly of machine tools leaving castings and forgings to be procured from other areas. This has led to development of a Forging and Foundry industry in the country even in the small-scale sector with the result that today, very many small foundries and forging industries exist in the country supplying to a variety of firms.

5. With the growth of industrial activity, more and more types of machine tools are added to the manufacturing range, sometimes by collaboration and sometimes by internal development. Such machine tools include

special purpose machines used in industries like Railways, Automobiles, Tractors, Electrical industries etc. and N.C. machines used in batch production industry.

6. In fact, there are a few large undertakings exclusively for manufacturing special purpose and transfer machine tools only in the country. Many of the special purpose machines like centering and facing machines, drilling machines etc. are being manufactured increasingly in the small-scale sector thus signifying the growth of this sector and its competence. In fact, the small-scale sector is manufacturing both general purpose and special purpose machine tools. Most of its products are sold to the small and medium-scale industries.

7. The country manufactures today lathes, milling machines, grinding machines, crank-shaft grinding machines, horizontal boring machines, vertical turning and boring mills, special purpose horizontal boring machines, single spindle and multispindle automats, gear cutting machines, tool and cutter grinders, pantograph engraving machines, special purpose machine tools suited to particular configuration for use in automobile, engineering and other industries etc. These machine tools are manufactured to international standards. These machines are supplied with the necessary accessories thus extending the range of the machine tools. The quality of such machine tools

manufactured in the country is of such a class that, in a short span of time, the country has exported machine tools worth over Rs. 100 million worth of tools all over the world in 1977-78 alone.

8. An important requirement of metal cutting machine tools is availability of correct and superior cutting tools. Having recognised this requirement in time, the country has established a strong industrial base for manufacture of cutting tools. The country today is in a position to manufacture high-speed cutting tools like drills, reamers, dies and taps, milling cutters, slitting saws etc. to international standards. The country is also manufacturing Tungsten Carbide tools (both brazed and throw-away tips with tool holders) for use in all machine tools of high productivity. Even here, the trends in the advanced world towards making tougher and tougher carbide tools like coated carbides etc. are already in the manufacturing programmes of many cutting tool manufacturers. Some of the cutting tool manufacturers also started offering customer services of manufacturing and supplying special purpose machine tools in larger volumes also.

9. In so far as metal forming machine tools are concerned, the position has not lagged far behind. Beginning from total imports at the time of Independence, today, the

country is almost self-sufficient in manufacturing shears, press brakes, power presses etc. In fact, power presses upto 1000 tonnes of capacity are successfully manufactured already.

10. The sheet metal machine tools manufactured in the country are supplied to various types of industries. The country is manufacturing roller-feed automatic machines used in mass production industries and also presses with rotary index tables used specially in electrical industries. Manufacture of double-stroke and triple-stroke machines has already been perfected with the result that today the country is almost self-reliant for most of its sheet metal requirements. In fact, there is a sizeable volume of these machine tools exported all over the world including advanced countries like U.S.A. and west European countries.

11. For certain types of operations, it is essential to have hydraulic presses as against mechanical presses. These presses are also manufactured in the country today to acceptable international standards.

12. The following table would show the total consumption of machine tools, internal production, imports and exports

T A B L E

| Year | Total Production | Import | Export | Total Consumption |
|---|---|---|---|---|
| | (Rupees in Million) | | | |
| 1961 | 85.2 | 178.9 | 1.5 | 262.6 |
| 1962 | 120.1 | 189.5 | 1.0 | 308.6 |
| 1963 | 167.8 | 315.1 | 1.7 | 481.2 |
| 1964 | 209.7 | 344.4 | 2.6 | 551.5 |
| 1965 | 254.6 | 352.1 | 5.6 | 601.1 |
| 1966 | 284.8 | 430.0 | 6.6 | 708.2 |
| 1967 | 254.7 | 394.0 | 6.8 | 641.9 |
| 1968 | 206.3 | 335.1 | 18.8 | 522.6 |
| 1969 | 236.7 | 189.9 | 29.5 | 427.1 |
| 1970 | 374.5 | 183.0 | 27.9 | 529.6 |
| 1971 | 503.0 | 247.0 | 30.5 | 689.5 |
| 1972 | 494.6 | 236.4 | 21.3 | 709.7 |
| 1973 | 680.0 | 330.0 | 35.9 | 875.1 |
| 1974 | 854.3 | 334.0 | 71.2 | 1117.1 |
| 1975 | 1038.5 | 421.0 | 83.9 | 1375.6 |
| 1976 | 1169.3 | - | 100.0 | - |

13. As would be seen, the technological demand on the domestic production of machine tools is for the whole system, from the simplest to the most complex in technological execution. Happily, this complete system is being catered for by local manufacture.

14. The demand for metal working machines is a derived demand. Almost all the products it manufactures go towards capital equipment for other industries, the technology of which is dependent on factors like demand, supply, type of product (whether it leads to simpler manufacture or needs a complex technological base), the type of collaboration etc. In such a situation, particularly when the country is on road to industrialisation, some of the very sophisticated machine tools, metrological items etc. are not taken up for manufacture.

15. Even though the performance of the industry appears to be impressive, it is nowhere near the technological standards obtained in the advanced countries. Notwithstanding this, these equipment are able to meet, by and large, the demand for this class of equipment.

16. Whereas the industry has built adequate manufacturing competence, its design competence is yet to be fully developed. This aspect is in its early stages of development now. The stage is now such that the country has to impart know-how for some of the advanced type of machine tools though it can launch improvements (by design modifications) on the existing products.

17. Many developing countries have taken advantage of the Indian machine tool industry and have profited by seeking collaborations from Indian parties.

## 4.5.vi A CASE STUDY OF CONSUMER DURABLES INDUSTRY

1. Consumer durables may be classified as such of the items which a person is in need of possessing but unable to do so for want of disposable income. Such items as Bicycles, Sewing machines, Electric Fans, Electric Irons, Refrigerators etc. may be classified as consumer durables. While there is no precise logic to define or exclude items, it is generally understood that such of the articles which help comfortable living of middle-class societies can be classified as consumer durables.

2. The development of consumer durables industry in the country is rather interesting. Till independence, almost none of these products were manufactured in the country. However, the country had been a ready market for products of these goods, particularly from U.K. Many of the trade names, e.g., in Bicycles were a by-word even with the rural folk.

3. Cashing on such immense popularity and demand for the same, to take Bicycles as a specific case, many firms in India have entered into collaboration agreements with foreign manufacturers whose brands by then become popular in the country. In some cases, foreign technicians were hired and no collaboration

was entered into. Both these types ventured in the market.

4. The Industrial Revolution brought about the need for cheaper transport at various strata of society. Thus Bicycles became an object of possession by a large number of population. In rural areas, apart from personal transportation, Bicycles are used for transportation of goods also in a modest way. Things like Kerosene, Milk, Vegetables, are some examples.

5. Government also encouraged this industry by giving liberal incentives by way of loans to various employees for acquiring bicycles. This has helped the industry substantially.

6. Production of bicycles was taken on a mass scale right from the beginning so as to keep the cost of manufacture at the lowest possible level. Hardly any frills are added to the bicycle so as to keep the cost down. With such cost-saving techniques coupled with mass production, the cost of bicycle became cheaper. This has caused to keep the price of bicycle at fairly low level. Coupled with incentive to acquire bicycles the demand was kept up and sometimes generated.

7. In several cases the technical collaboration ended

up with importation of second-hand and reconditioned machines from the principals with the sole objective of producing bicycles on a mass scale.

8. The demand being ever-increasing all the firms started expanding their plants. This expansion invariably was achieved by duplicating the plant within itself rather than buying original equipment from either the principals or other overseas manufacturers. This period coincided with bicycles having been vacated from the manufacturing activity in the advanced countries.

9. Bicycle became an item of possession for the physical and sports activities even in the advanced countries and India cashed on in this new situation by exporting bicycles to various countries in the world.

10. Very soon the bicycle industry established a strong base for itself and started working on mass production techniques. It started development of special purpose machines, on its own. Simultaneously a large base of small and ancilliary industries was activated with a view to reducing investment. In fact, the cult of engineering activity was actively spread by bicycle manufacture.

11. When export of bicycles was taken on a large scale, the country had to import high speed hubs in the initial stages. However, the situation is changed now and such and several other devices are being manufactured in the country both for domestic and export market.

12. The manufacturers have taken several steps to make the products more attractive. Several new models were brought out into the market to meet different demands (both from poor and affluent societies). Of late, some parties have come up in the country which have developed a small petrol engine to propel the bicycle. Such power packs are increasingly being used in cycle rikshaws which are predominant in several parts of the country. (The cycle rikshaw is a cheap alternate mode of transport). Of late, the cycle manufacturers have even diversified into manufacturing mopeds etc., signifying the technological advancements they had made.

13. Today, Indian bicycle industry has set up establishments in several other developing countries which include

export of know-how, equipment, engineering services etc. The bicycle industry in the country is one of the most self-reliant industries today.

14. Manufacture of sewing machines has been somewhat on a different scale. Tailoring became a very common thing for ameliorating unemployment problem. Some of the well-known brands like Singer and Pfaff were very popular names in the country.

15. For some reason, no foreign name was allowed to be used as trade name for domestic manufacture of sewing machines. Several firms have come up for manufacturing sewing machines in the country by way of copying and by way of importing technology. Giant organisations have sprung up in the country in a very short time for manufacture of domestic sewing machines. These have captured the whole market and availability of sewing machines itself generated a new market for the sale of the products. Seeing the potential of this item, several firms in the small-scale sector have come up for manufacturing and supplying of various components of sewing machines, both machined and un-machined. Such factories having low overheads were able to supply these components to a large number of

organised sewing machine manufacturers on a very competitive basis. Being a product of ready acceptance even in the rural areas, manufacture of sewing machines demanded mass production techniques. Many of the sewing machines and component manufacturers have developed their own special purpose machines solely built around the component configuration. Such technology proved an instant success in bringing down the cost of manufacture and increasing the productivity per unit capital employed. Such strategies were not in the way of higher labour employment as the market for sewing machines was unlimited.

16. Certain technological improvements - both in the design of the machine and in the manufacturing techniques - were attempted and such attempts by and large, have succeeded. Manufacture of a variety of designs to suit different strata of customers, e.g. making Hand-model, Tailor-model, motorisation were successfully attempted so as to cater to all sectors of consumers.

17. The manufacturing techniques of sewing machines are so perfected by the Indian industry that they are one of the most competitive in the world. Recognising this, many advanced countries like Germany and Japan have started importing a large numbe of sewing machine components manufactured in India thus signifying the technological progress that the the industry has made.

18. In spite of the fact that there was an ever-expanding market for various configuration of sewing machines, little attempt was made by the manufacturers to tread into other allied lines. For example, there is a great potential in the country even today for manufacture of industrial sewing machines for stitching of canvas, leather and even garment manufacturers. No manufacturer of sewing machines, particularly, the large houses have taken pains to manufacture such produc s. Today, the country imports a significant amount of these machines.

19. India, being a tropical country, the demand for table/Ceiling fans was already existing. With electrification increasing progressively much of this demand was converted into ready market. Being a sophisticated product comparatively, these

items are manufactured in large sectors. However, for keeping the prices down and becoming competitive, many of the large manufacturers of such items have resorted to sub-contracting the various items. This has resulted in a large gainful employment for many un-skilled people.

20. Both in design and execution, the Fan manufacturers have achieved a measure of perfection with the result that these articles are regularly exported under various trade names all over the world including advanced countries.

21. In this case also, the manufacturers have successfully perfected various models to suit different types of end-users thus widening the market.

22. In the late fifties and early sixties, the country embarked upon manufacture of Refrigerators under technical collaboration from advanced countries. Till then, these articles were considered luxury goods and few could afford the same.

23. Knowing the conservative society to which they have to cater, it may be stated that manufacturers took a really bold step in venturing into production of Refrigerators.

24. Such technical collaboration involved supply of part drawings, manufacturing know-how, testing instructions etc. It also included supply of precision tooling required and in cases, machinery as well.

25. Being an industrially backward country, India had no option but to acquire all these things, sometimes new and sometimes reconditioned for a second-time and start manufacturing the products for domestic consumption. Soon, it was recognised that there is a ready demand for Refrigerators if only they are available in the market. The discovery of the market became one of the biggest incentives for the manufacturers. The manufacturers started producing various models and sizes to cater to the varied strata of the society thus showing their capability of independent designs. They had also made further changes in the basic design of the refrigerators by various changes in the sealed unit, evaporation unit, heat exchanger etc. Even the exterior was changed keeping in view the customers' demand.

## CASE STUDY OF POWER INDUSTRY

The classical example of technological revolution brought about in the country, particularly with emphasis on capital goods, is production of power generation equipment. At the time of independence there was virtually no industrial activity whatsoever in this field. Even small items like electric motors etc. used in industrial machinery were imported.

2. The successive Five Year Plans laid due emphasis for power generation as an instrument of technological revolution. With emphasis having been towards manufacture of capital equipment the country went in for manufacture of power generation equipment obviously with foreign collaboration. These were limited to manufacture of steam and water turbines, alternators, transformers etc. upto about 110 MW. The absorption of technologies for manufacture of these goods was rather difficult with the result that the country continued to import several aggregates and raw materials that go into manufacture of such items as described above. Turbine blades, rotors, heavy castings, lamination sheets, some special types of contactors and several other consumable items for manufacturing these machinery had to be imported for long years. As in case of other industries, the meagre

availability of foreign exchange for import of raw material and other hard-ware items has had a telling effect on the growth of the industry.

3. However, the power plants of the country could not be put back and the industry was encouraged to grow though simultaneously power equipment continued to be imported. Broadly, power industry could be discussed in four separate headings :

i. Manufacture of power generation equipment, both hydraulic and steam.

ii. Manufacture of control gears

iii. Manufacture of distribution systems like transformers, transmission etc.

iv. Manufacture of industrial equipment like motors and their control gear used in driving the industrial machinery etc.

4. From virtually zero level of production in the early Fifties, the country has come a long way off today. Manufacture of captive power units for industrial establishments upto 50 MW, manufacture of 110 MW and 150 MW power generation equipment is already perfected. Necessary technological content of the same has adequately been mastered with the result that today the Indian power generation industry is in a position to compete with similar organisations elsewhere in the world. The plans are ahead for absorbing and upgrading the technology

for manufacture of 500 MW power generation equipment. The power generation equipment would include boilers with attendants ancillaries like pumps, valves etc., turbines, generation equipment and transmission equipment and control gear like switching, circuit breakers etc.

5. Whereas the country is in a position to manufacture equipment for thermal and hydro stations as described above, no technology exists as of now for manufacture of power generating gas turbines which are becoming increasingly popular elsewhere in the world or preferred to conventional power generation with diesel engines in view of shorter gestation period and higher performance characteristics.

6. The power equipment manufacture in the country started with production of switchgears of the simplest type in the country. Subsequently, switchgears for higher KV ranges of the order of 130, 220 KV and above are today manufactured in the country, thus showing the technological competency of the industry. Further, air and oil circuit breakers, vacuum circuit breakers are manufactured both in public and private sectors. The control gear is slowly yielding place from conventional to solid state.

7. Along with other power generation the aspect of sub-station equipment, distribution and transmission was

attended to in an integrated manner. Today, several factories, both in public and private sector are manufacturing transformers and other distribution equipment with collaboration from advanced countries. They are in a position to offer systems design and installation to suit specific situation.

8. The widest requirement of electrical equipment is in the manufacture of motors for driving the industrial machinery. Beginning with Fractional Horse Power (FHP) motors required to drive small hand tools, manufacturing activity in the country extend upto the largest industrial motors of 1500 BHP. Several executions of such motors are manufactured to meet different mounting situations and other circumstances. In almost all these cases manufacture has taken place with collaboration. In spite of a sound technological base for manufacturing various AC motors, the industry is not in a position to undertake DC motors, particularly for driving of some special equipment like pneumatic control machine tools etc.

## CHAPTER - V

## TRENDS IN ENGINEERING INDUSTRY - A COMPARATIVE STUDY

5.1 Transformation of Metal from primary stage to the usable shape is an important requirement in Industry. Conversion of pig iron to castings, conversion of ingots and blocks to usable forgings, machining of such of the items as the above in addition to machining of extruded parts etc. are the important requirements in metal transformation. In addition to the classic methods of metal conversion as described above, several new technologies sometimes aimed at maintaining close tolerances and sometimes avoiding drudgery of long manufacturing process are discernable today. Examples of such processes are : precision castings (like lost-wax process or investment castings), explosion forming, precision extrusion, cold forging, powder metallurgy etc.

5.2 Notwithstanding the modern development as described above, the demand for classic technologies shall continue for sufficiently long period if anything because of their easy acceptability and adaptability to local environments. However, a judicious exercise will have to be done even here to adopt the correct technologies and techniques of casting, forging and machining works.

5.3 In so far as Foundry Technology is concerned, we have the conventional cupola and moulding processes. While these were relevant, perhaps, a generation ago, the same is not true today even for developing countries. Preparation of sand, moulds etc., are no more as unskilled as they used to be. Application of correct techniques in such cases would lend to better manufacture.

5.4 Similarly, in forging industry, rapid inroads have been made by modern machinery. Sophisticated machine tools have come up in this field for manufacture of a variety of forged items.

5.5 Perhaps, greatest technological changes have come about in machining technologies. Elsewhere in the world, people talk of special purpose machines, transfer machine etc. In addition, manufacture of some of the very difficult to machine products have led to development of a variety of cutting tools, machines etc. The Space Industry has led to development of Numerical Machine tools which have become a vital part of any sophisticated manufacturing industry today. Similarly, large volume production has compelled development of transfer machine tools with adaptive controls, feed-back mechanisms and a host of other devices to ensure fault-free production.

Such developments have led to development of various ancillary systems of measurements and control in the regions of Optics, Electronics, Hydraulics etc.

5.6 There is a two-way traffic in metal working machine tools among the advanced countries. Of late, developing countries have also started exporting a variety of machine tools, some of which find their way into advanced countries.

5.7 Metal transformation technologies, as described above, are the basics for industrial development of any country. Further, skills of metal transformation have to be acquired in a host of circumstances. These circumstances lend to a variety of description. Such descriptions are :

i. Capital industry,

ii. Consumer industry,

iii. Manufacturing by Batch production,

iv. Manufacturing by mass production etc.

5.8 In India, rightly emphasis was laid on manufacture of Capital Goods from the time of Independence which is the period of start of the Industrial Revolution in the country. It started with manufacture of simple machine tools by conventional methods. Obviously, such machine tools were not aimed to cater for

large-volume production facilities. These machine tools found ready acceptance within the country for growing industrial demand. A stage has come during this period when such simpler type of machine tools could no more feed the ever increasing demand which compelled the industry to go in for next generation of technologies like transfer machines, special purpose machines etc.

5.9 The present technologies adopted in advanced countries are capital-oriented for obvious reasons. They call for a high level of technological competence of the society as such technologies cannot exist in isolation. Right from the beginning of the Industrial Revolution in the West, effort has been directed at perfecting the product and production techniques with a view to cater to a large market. Coupled with the problems of lower population, this naturally has led to labour-saving devices constantly. Such efforts have culminated in the super technologies available in the advanced world today.

5.10 Most of the developing countries have become free from foreign rule during the past 3-4 decades. At the time of Independence, in so far as India is concerned, there was no industrial base worth the while barring certain essential services like the

Railways, Posts & Telegraphs etc. The country has inherited a large population and a poor economic position. The basic requirement of the Government was, therefore, aimed at economic survival of the Indian society. This called for rapidly increasing agricultural, industrial, mining and other activities. Massive inputs in terms of labour, material and capital is thought to be an answer to combating the problem of economic survival. This itself would mean again the availability of adequate facilities so as to aim at larger volumes of production of essential goods required by the community.

5.11 The pitfall of importing current technologies from abroad which have proved highly successful is very obvious when seen through this background. Conceding the fact that rapid economic prosperity is required, there is no denial that a careful appraisal of various alternate routes will have to be made before the choice is made. For example, if mass production techniques of essential items are started without the total technological level of the society being up-scaled, the situation will come about where there are goods to be sold and no buyers for want of money. At the same time, if the gestation period of industries is made very long in the name of appropriate

technology, by the time the fruits of the industry are available, the technological obsolescence would have become much bigger and the problems will be perennial.

5.12 Cost is an important aspect of selecting the right technology in a given situation. Use of special purpose and transfer machines has become relevant in manufacture of such products as sewing machines, bicycles etc. (in consumer durable industry), trucks, scooters etc. in heavy engineering industry. Similarly, use of NC machines (Numerically Controlled machines) has become appropriate in several industries in the country, particularly in manufacture of machine tools, industrial machinery, railway and other allied industries for which a firm base is laid in India. The following examples will show the relative factors emphasising the use of N.C. machines (as appropriate to the particular industry) :

| S. No. | Industry | Part with brief specifications | Time per piece | |
|---|---|---|---|---|
| | | | Conventional Machinery | N.C. Machinery |
| 1. | Machine Tool Industry | Shaft Ni.Cr. Steel | 225 Minutes | 92 Minutes |
| 2. | -do- | Journal Cast Iron | 136 minutes | 18 minutes |
| 3. | Boiler Plant | Forged Shaft AISI-C-1035 | 390 minutes | 45 minutes |
| 4. | -do- | Forged Shaft ASTM-A-105 | 120 minutes | 38 minutes |

| | | | | |
|---|---|---|---|---|
| 5. | Railways | Axles, Forging Steel C1-IV | 340 minutes | 50 minutes |
| 6. | -do- | Flange Mounting Forging 13.2062/42W | 120 minutes | 25 minutes |

Even considering the cost of equipment, use of N.C. equipment has been known to have effected substantial savings in operation costs.

5.13 During the last 3 decades of industrial activity, the country has come a long way.

In spite of this, the industrial activity generated today is not in a position to satisfy the economic needs of a larger section of the population. This only emphasises the gigantic proportion of the problems involved in a developing country like India.

5.14 In such a situation as described above, today in the country we have the widest spectrum of industry, at one end of which are capital saving devices having a large bias towards larger labour inputs and at the other end most sophisticated equipment aimed at industrial production of a very high class. Such a mix of industrial culture has led to more and more innovations and greater self-reliance of the industry. This has led to increase in general level of skills

of the population which, as a whole, is a welcome feature.

5.15 Recognising such a situation the Government has launched various schemes to spread industrial activity in as wide an area as possible. Establishment of state aided industrial estates throughout the country, establishment of ancillary industrial estates, several agencies aimed at assisting such entrepreneurs etc. (like Small Industrial Service Institute etc.) are some of the examples in this regard.

5.16 Such industrial activity has raised the level of skills of the region in which such industries are established. In addition, they had contributed substantially towards employment of the local people who are not technically very highly qualified.

5.17 Such small and medium scale industries as have come up in the country have given a good account of themselves. In addition to acting as suppliers of industrial products to other industries, they had started making of items which are of direct use to the country. Such low value items as buttons, electrical switches, utensils and other consumer products are today increasingly manufactured in small sector which has really spread the industrial revolution to the countryside.

5.18 They had undertaken manufacture of industrial products also, particularly agricultural implements. Manufacture of several farm implements, diesel and electric pumpsets etc. are undertaken by small scale industries in certain regions of the country.

## CHAPTER VI

## RATIONALE FOR DECENTRALISATION OF INDUSTRIES - AN APPROACH

6.1 Unlike in the sparcely populated countries of the world, the population of India is fairly widespread throughout its length and breadth and the problems of illiteracy, economic prosperity etc. are uniform throughout the country.

6.2 However, in so far as input services are concerned, these are not as widespread as one would wish them to be. This situation has been inherited by the country from the colonial past. Such lopsided growth has led to comparative development of certain pockets in the country. Naturally, these areas have all the infrastructural facilities of transport, communication and other services like financial institutions etc. These pockets also happen to be the centre of political power which had made them as strong attractions for locating the industries also around the same area thus causing further concentration and more imbalance in the development of the country.

6.3 This situation, even though it had to be remedied, would cost a colossal effort in reversing the already established centres of power and position. Such an effort would call for a massive investment in other areas which are potential but lacking in basic amenities.

This, by itself, though does seem to be the answer, is fraught with grave consequences and increased gestation periods and long delays in execution of projects.

6.4 Taking such aspects into consideration, while the Government did not prevent the growth of industries around the known centres of industrial activity, a large number of schemes were drawn up for industrialisation of backward areas. Such schemes included extension of road and rail network giving incentives for new entrepreneurs for locating factories in backward areas etc. In addition, incentives included participation in capital structure, reduced interest rates, tax holidays, priority release of foreign exchange and allotment of scarce raw materials and resources etc.

6.5 Wherever possible, even the Government also took steps in establishing large industrial ventures in such places. Such examples are - the Heavy Electrical factories set up at Bhopal and Tiruchirappalli, the Heavy Engineering factories set up at Ranchi as against setting them in already-known industrial centres like Bombay, Calcutta and Madras etc.

6.6 Even dispersal of industries state-wise, is not done in a haphazard manner keeping in view the nearness

to the market of the produce. Factories have come up around what may be called the sphere of influence of large factories. This is a welcome sign in so far as dispersal of industries is concerned. Examples of such dispersal are development of a large number of metal working factories, tool rooms etc. around Bangalore-Madras region. Since large metal working factories have been established in several parts of the country, they had themselves become centres of attraction for establishment of small and medium industries. Coupled with the objectives of the Government for establishment of more and more small industries, ancillary estates, industrial units etc., as measures of industrialisation such small-scale and ancillary industries have and are coming up around larger industrial areas. This has led to increased skills in the population which itself is a welcome feature for further industrialisation.

6.7 Larger dispersal of such metal working industries would call for simultaneous development of other infrastructural facilities like transport, roads, communication networks, power, water, etc. In addition, so as to benefit the population which is one of the prime objectives of industrialisation, educational institutions aimed at imparting technical

skills also are important infrastructural requirements. Training of local available manpower to the skills required would make them more conscious of the benefits of industrialisation.

6.8 Engineering industries can be classified both as large and small-scale. As explained elsewhere in this Report, the culture of industrial activity is spread more by small-scale industries. The investment, number of employees, output etc., depend upon the product chosen. The following table shows the above figure for typical industries :

T A B L E

| S. No. | Industry | Capital Invested (Rs. million) | No.of Employees (Nos. in'000) | Total Output (Rs.in Million) | Capital per Employee (Rs.) | Output per Employee (Rs) |
|---|---|---|---|---|---|---|
| 1. | Machining, Machine Tools etc. | 12,150 | 335 | 14,856 | 35,000 | 45,000 |
| 2. | Manufacture of Electrical machinery | 12,135 | 254 | 13,844 | 48,000 | 54,500 |
| 3. | Transport Equipment | 10,880 | 395 | 13,607 | 26,800 | 34,400 |
| 4. | Watches/ Clocks | 154 | 7 | 206 | 22,000 | 29,400 |
| 5. | Basic Metals and Alloy Industries | 24,558 | 422 | 26,360 | 588,000 | 625,000 |

It would be seen from the above that investment per employee is lowest for manufacture of watches and clocks followed by transport equipment. At the same time, investment per employee is highest for basic metal industries producing iron and steel etc.

As against the above, investment in small-scale industries per employee is very low. The following table shows the data typical to small-scale industries :

TABLE

| S. No. | Industry | Total Investment (Rs.Million) | Total No.of Employees (Nos. '000) | Total Output (Rs. Million) | Capital per Employee (Rs.) | Output per Employee (Rs.) |
|---|---|---|---|---|---|---|
| 1. | Castings & Forgings | 1025 | 82 | 2118 | 12,500 | 25,800 |
| 2. | Bolts & Nuts | 162 | 12.7 | 202 | 12,760 | 15,830 |
| 3. | Utensils | 472 | 56.5 | 949 | 8,430 | 16,900 |
| 4. | Auto Parts | 521 | 37.8 | 648 | 13,700 | 17,000 |
| 5. | Bicycle Parts | 189 | 17.0 | 271 | 11,200 | 16,000 |

It will be seen from the above that small-scale industries having low investment per person employed help the industrial development of the region as opposed to large-scale industries. The investment per unit in this sector varies from Rs.0.5 to Rs.41.5 million.

6.9 Such dispersal of industries would spread the industrial activity over a wider area thus reducing concentration of labour. This would also mean that some of the problems of housing, sanitation etc., could be avoided as mostly the labour would not be migratory and confined to their home-towns. This itself is a big social gain in so far as population is concerned.

## CHAPTER VII

## DEVELOPMENT OF CAPITAL GOODS INDUSTRY AS A MEANS OF SOCIAL UPLIFTMENT - INDIAN EXPERIENCE

7.1 As discussed in the earlier chapters of this Report, the country embarked upon massive industrialisation soon after Independence. The choices open for the country were many towards this end. Some of the choices are :

i. Development of Capital Industry;

ii. Development of Consumer industries;

iii. Development by way of financial collaboration with foreign firms;

iv. Development of industries by way of purely technical collaboration, etc.

7.2 Trade has been an important instrument of political influence in the World. Having realised this, the country felt that foreign participation in the financial structure of the factories coming up in the post-Independent India should be avoided. However, without financial stake no foreign firm would be willing to collaborate for developing the country. Knowing such contradictory situation obtained then, the country chose on merits to promote equity participation from foreign companies on selective basis. At a later date, the country's declared policy has been that in so far as the core sector

is concerned, such as mining, steel, power generation, defence, atomic energy etc., there will be no foreign financial participation. In other sectors, financial participation is permitted on selective basis.

7.3 The Indian planners felt that development of capital industry is of prime importance when compared to consumer industry. This is because the planners rightly felt that as long as capital goods continued to be imported, the skills of the country cannot be adequately developed. On the other hand, there will be continued dependence on importation of capital equipment from abroad having got used to brand names.

7.4 Development of capital goods industry would mean simultaneous development in various allied fields of industrial activity. For example, an industry manufacturing locomotives led to development of industries in grey iron foundries, steel foundries, precision castings, electrical industries, non-ferrous metal industries and the like. Development of such industries which are drawn up by one prime industry would cause further development in other fields such as mining, metallurgy and other engineering fields. It can thus be seen that development of capital goods industry would cause chain development in almost every branch of engineering. The experience shows that it had been so.

7.5 As can be seen, unless the development in all branches which are opened up by the capital goods industry is sustained and maintained, there can be serious consequences. Sustinence of development would mean constant inputs by way of capital, manpower etc. into identified fields as and when the need for the same arises. Capital industry generation would progressively call for higher and higher investment in industry.

7.6 Such accelerated development of industry coincided with development in other sectors of economy, particularly in agriculture, calling for allocation of resources. The development activity of capital goods industry as explained earlier, has got greater gestation periods during which time no returns on investments could be expected. Thus, massive investments were getting laid up with lesser returns which has caused an inflationary trend in the Indian economy. Once the inflation set in, the cost of every input including development activity increased beyond proportion with the result the development itself became diificult, if not impossible.

7.7 The country's exports for sustaining development were not commensurate with the country's demand for imports. The imports included capital goods, spare

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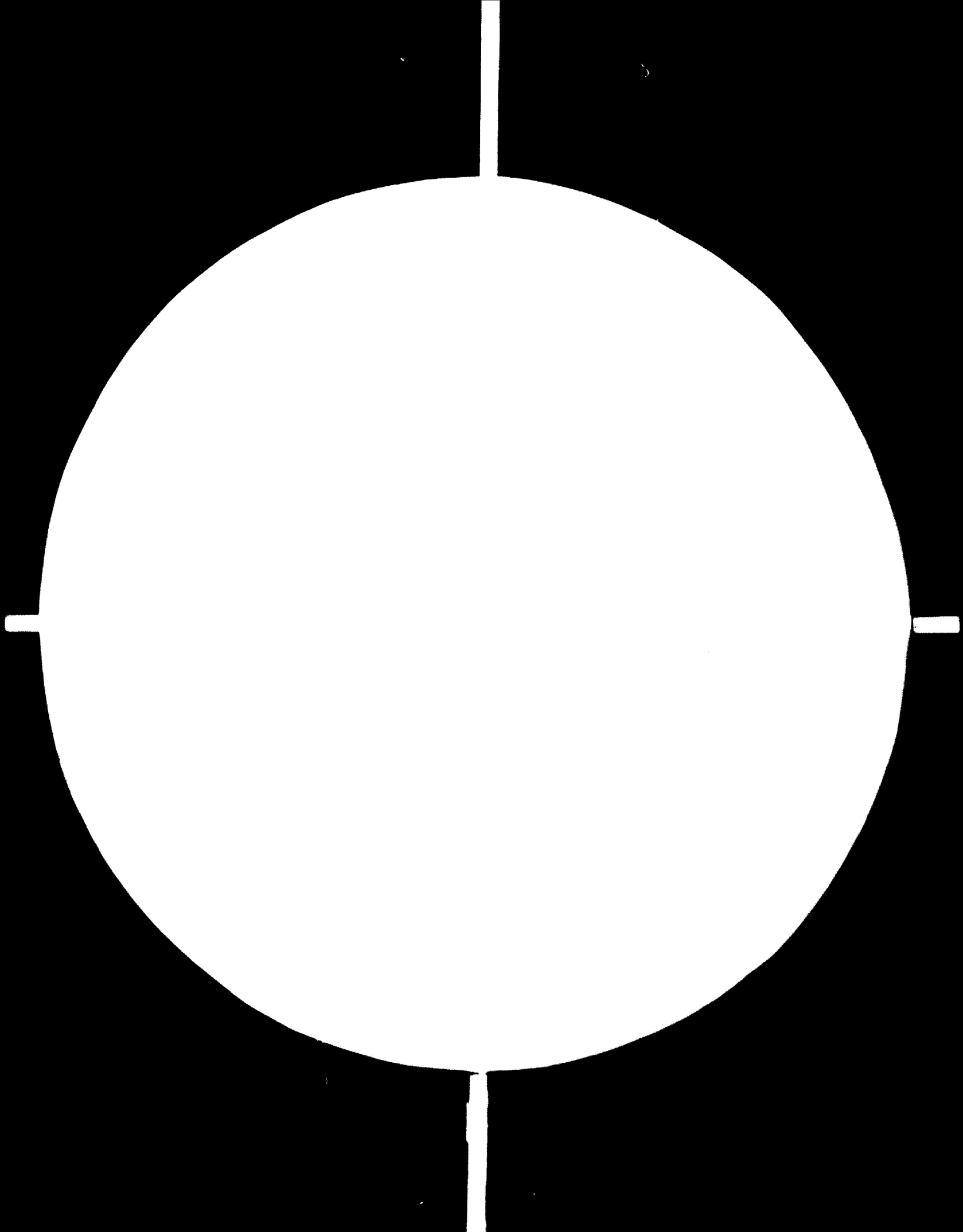

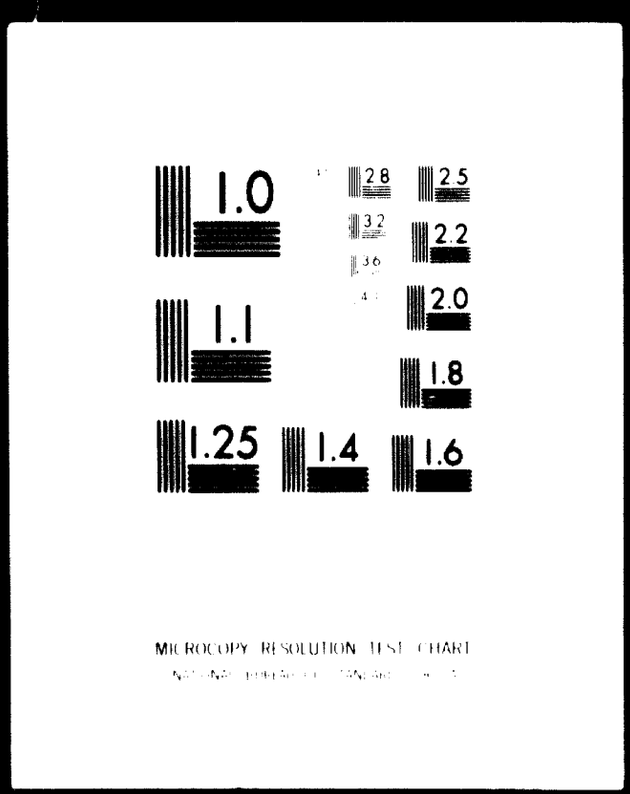

parts as well as raw materials for production. It may be noted that these raw materials are finished industrial products such as steel, plastics etc.

7.8 Such accelerated development would have to be supported by massive investments and unfortunately the resources available at the disposal of the country were woefully inadequate. Coupled with poor agricultural production during this period it has put tremendous strain on the country's economy. Unfortunately, this has coincided with external calamities like wars with neighbours. The economy of the country was not able to withstand the compounded effect of all these situations at one stroke, leading to severe recession in the Indian economy and the metal working industry was the first victim and the last to recover. In the mid-sixties, the country experienced the first ever post-Independent era recession. Orders for industrial machinery were at the lowest ebb from Private Sector. Development activities of the Government got retarded consequent upon non-availability of resources at its disposal. This has caused further depletion, reduction in orders for industrial machinery and machine tools. The overall gloom in the industrial scene persisted for 2-3 years. Slowly the economy picked up and

simultaneously the industrial activity as well. When the economy was poised for take-off, another war and the Oil crisis became serious problems for the country.

7.9 However, this time the situation was not as bad as the previous recession. The Indian industry had built in itself enough resilience and flexibility to withstand and overcome such situations. In fact, it goes to the credit of Industry that these situations were admirably met with and there was no let-up in the Industrial activity.

7.10 By this time, the industry has become quite mature and seasoned. The industrial activity stablised the level of operation which is profitable and hence poised for greater activities.

## CHAPTER VIII

## GUIDELINES FOR STRATEGY OF DEVELOPMENT

8.1 The country has lived through a phase of development programme spanning a period of three decades. This period is marked with intense developmental activity causing massive investment in Industry, Agriculture, Mining etc. This phase has also seen two consecutive recessions when there was a serious slump in industrial activity consequent upon severe draughts and reduced developmental effort primarily by Government and its agencies. It has also seen the catastrophe of high inflation to which the country has been a victim along with rest of the world - both advanced and developing.

8.2 This period is also marked with other developments that have taken place in the country like educational, health, scientific, cultural and other aspects.

8.3 The synthesis of the overall performance of the country towards industrialisation cannot easily be made in isolation. It is also not practicable to isolate each and every factor affecting failure of a particular event of the recession as the environ is very complex. Nevertheless, based upon the past experience some guidelines can be drawn towards the strategy to be adopted for development in the region.

Some of these experiences would be relevant to otner developing countries similarly placed.

8.4 By far, the simplest developmental activity for any developing country, India being no exception, is the development of engineering industries. This may encompass capital goods, industrial machinery and consumer goods. The exact choice will depend upon various factors like literacy levels, skill levels, availability of funds, national priorities etc., none of which can be ignored.

8.5 Given the onvirons, the development of suitable capital industry for manufacture of industrial machinery, the types of which are required for propelling further industrial growth can be taken as a national choice for developing countries in preference to manufacture of consumer goods. This, as a first step, would help generate employment and create wealth potential. Simultaneously, this would help the country becoming an importer of processed raw materials from the position of being importer of finished capital goods. This itself is a welcome feature. In addition, the value added in the country would become much higher which, in effect, would mean generation of wealth and employment potential. Employment potential would automatically mean

improvement of local skills and talents which is an attraction for further industries coming up. More or less, this would set off a chain reaction.

8.6 Generation of wealth would mean that there is greater money available than before. Such money could be employed in further industrialisation either towards more capital goods or consumer goods or towards more primary industries like iron and steel.

8.7 Development of primary industries and other metallurgical industries should be undertaken with great caution and restraint. In addition to adverse factors like non-availability of the specific ores, coking coal etc., these industries perforce are massive and consume almost all the resources of countries, particularly, small countries thus leaving little capital for overall development.

8.8 Immediate urge for development of consumer goods should be tempered with other factors. Whereas development of consumer goods on a larger scale would create greater employment, it comes in the way of prosperity of the country as a whole as the fundamental base of improved skills of the nation and production of wealth by manufacturing capital goods is not strong enough. It is a factor which is universal with almost all the developing countries.

8.9 However, development of capital goods should be taken in the correct perspective taking into account various other factors. For example, the country like India, has gone in for manufacture of jute and textile machinery in such a way as to keep the equipment fairly modern and yet is not so sophisticated as to cause unemployment.

8.10 Similarly, even with regard to manufacture of metal working machine tools and industrial machinery in the country, emphasis has been laid on the manufacture of a host of general purpose machine tools as well as manufacture of special purpose machine tools. In both these cases, emphasis has been on greater reliability on human factors than on sophisticated technology which invariably has got high import content.

8.11 Such factors as described above should be weighed carefully by choosing the correct and appropriate investment either towards capital or consumer goods in any other developing country. Cooperation in such fields would invariably lead to mutual interdependence which is what the developing countries should aspire to. In a situation where active cooperation exists among various developing countries, it can be seen that the market for any sophisticated

products is at once very large and this advantage is available to almost all developing countries uniformly. With markets becoming large, manufacturing technologies can be improved and a better equipment to suit the specific requirements of the developing countries could be manufactured and marketed. In effect, the situation would be what the advanced countries enjoyed for the past 200 years. This is a welcome feature.

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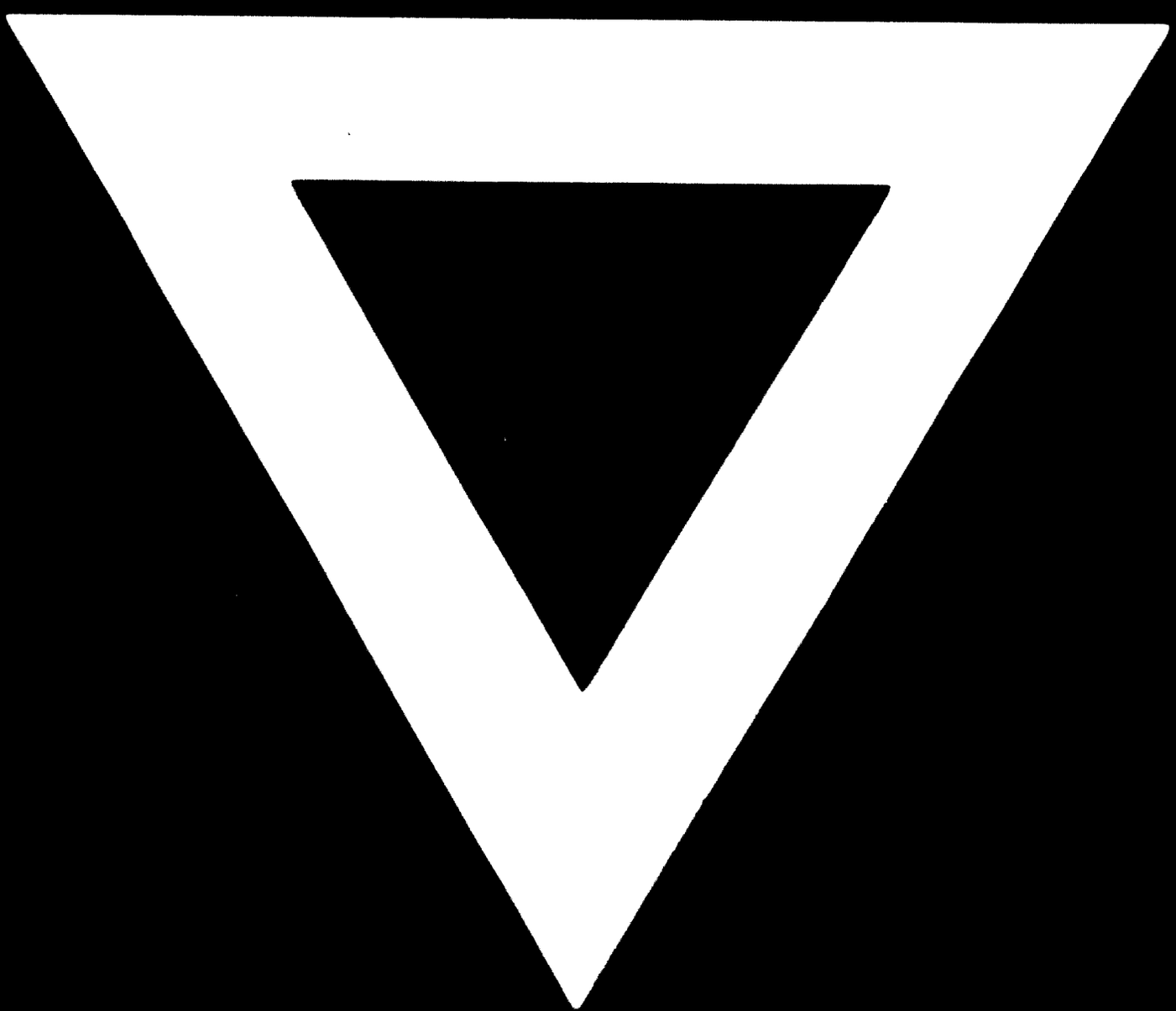

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