**CASE 6**

# PUNJAB TRACTORS LIMITED (R)

## Company Background

Punjab Tractors Limited (PTL) was promoted by Punjab State Industrial Development Corporation Limited (PSIDCL) with the objective of promoting new industrial projects in the state of Punjab on 27 June 1970 at Chandigarh. The unit went into production in 1974. The tractor was based on completely indigenous design and was the result of six years of design, development and field proving effort at the Central Mechanical Engineering Research Institute (CMERI), a national laboratory under the Council of Scientific and Industrial Research (CSIR) of the Government of India. The group of design engineers, who had developed he first model at CMERI, were later transferred to PTL to commercialise the product.

During the period 1974 to 1980 PTL increased its production and sales from 58 to.7116 tractors, gross block from Rs. 31.53 million to Rs. 97. 25 million, net worth from Rs. 9.32 million to Rs. 51.10 million, gross income from Rs. 1.64 million to Rs. 345.54 million, earnings per share from nil to Rs. 16.08, number of employees from 518 to 2470, and market share from 1.0 per cent in 1974 to 11% in 1980. (See Exhibits l and 2 for some financial information.)

The character 'of the company has changed considerably during the last few years. In addition to manufacturing tractors, PTL now manufactures harvester combines and grey iron castings. Recently PTL entered into a technical and financial collaboration with Toyokogyo Co. Ltd. of Japan for manufacture of light commercial vehicles and a new company named Swaraj Vehicles Limited has been formed for this purpose.

This case describes the process of development of indigenous technology at CMERI and its subsequent commercialisation by PSIDCL and PTL.

## About CMERI

The CMERI was established in 1958 at Durgapur in West Bengal as one of the links in the chain of national laboratories under the Council of Scientific and Industrial Research (CSIR) of the Government of India. The objectives of laboratories set up under, CSIR were:

i). Development of substitutes for imported raw materials.

ii). Indigenous manufacture of essential components hitherto imported.

iii). Development of indigenous know-how at a significantly advanced level to be commercially utilisable in respect of those articles on which repeated foreign collaboration has been sought.

iv). Orientation of industrial research to the needs and requirements of industry.

CMERI.'s activities were to be exclusively devoted to design, development and improvement of machinery and equipment, development and improvement of process technology, and evaluation methods for engineering products and materials. In 1965, it was organised under seven divisions: i) Applied Mechanics, ii) Applied Science, iii) Automobile Engineering, iv) Heat Power and-Refrigeration, v)) Materials vi) Product Development and Industrial Design, and vii) Production Engineering.

Aurora and Morehouse (1974) mention that:

> …The preliminary work of developing the Institute, namely the buildings, ordering and erection of equipment, and recruitment of scientific and technical staff, took a long time. When Mr.G.S. Chowdhury became director-in-charge in 1962, the Institute's Professional staff was composed primarily of scientific and included only two mechanical engineers. During his tenure, Mr. Chowdhury was able to enlarge the staff of scientist-engineers and created several new research units related directly to industrial problems, such as industrial design, welding, automobile production and refrigeration. It was only in 1963 that significant activity in applied research began at the Institute. In

June 1964 Mr. Chowdhury was replaced as director-in-charge by M.M. Suri. He too was a person of outstanding energy and imagination... Within the first three years of his accession to the directorship, collaboration with industry increased remarkably (Table 1).

**Table 1: Collaborative Agreements 1964-67**

| Year | Number of industrial collaborators | Initial fees received for industrially, spon- sored research in Rs | Fees received for the evaluation of products& materials in Rs. |
|---|---|---|---|
| 1964-65 | 6 | 25,000.00 | 19,000.00 |
| 1965-66 | 24 | 175,000.00 | 17,000.00 |
| 1966-67 | 28 | 48,500.00 | 99,000.00 |

**Demand for Tractors**

Up to the end of the First Plan period, tractor requirements were met to a some extent by Indian firms assembling semi-knocked down packs in agreement with foreign principals. In 1955 a committee was appointed by the Ministry of Commerce to estimate the total demand for tractors. Exhibit 3 shows the estimates of tractor requirement by the year 1960-61. The Fourth Plan estimates made by the Ministry of Agriculture are shown in Exhibit 4. Exhibit 5 gives in concise form estimates made by a number of organisations.

The sudden increase in perceived demand for tractors could be, explained by the occurrence of Green Revolution in the mid sixties. The Indian Agricultural Research Institute made an interesting analysis of the power build-up required during the Fourth Plan period. This study highlights the fact that if the Fourth Plan food production targets were to be met, it was necessary to step up the power input into agriculture from 42.9 million H.P in 1965-66 to 111 million in 1970-71. The study, after looking into alternative sources of power, like human and bullock power, concluded that tractors and power tillers would be required to provide an additional 47.5 million H.P. in 1970-71. Their estimated tractor requirement is presented in Exhibit 6.

**Government Policy and Development of the Tractor Industry**

The Indian tractor industry is now more thari'25 years old. A beginning with indigenous manufacture was made in 1959 when the first tractor manufacturing unit was set up by Eicher Tractors Limited in Faridabad near New Delhi. Though indigenous manufacture was initiated as early as 1959 there was significant dependence on imports till the end of the sixties as could be seen from Exhibits 7 and 8. However, the industry has grown quite rapidly since the mid 70s and is now said to be the fifth largest in the world, In 1984 the tractor industry produced more than 80,000 tractors.

The various policies enunciated by the Government of India from time to time have played an important role in the development of the industry. In this section we shall try to explore the more important policies from the point of view of the tractor industry.

As seen in the section on demand for tractors, the real spurt in the perceived demand came with the onset of the Green Revolution. The introduction of high yielding seeds in the mid sixties in what growing areas of northern India and its adoption by farmers led to the need for mechanisation of forming activities and hence the demand for tractors spiralled'.

**Import of Tractors**

Tractors were allowed to be imported by established importers, who were required to provide evidence that 1) they were accredited agents of manufacturers of imported tractors, 2) they had adequate workshop facilities and trained engineers to service the imported tractors, and 3) the makes of tractors to be imported by them had obtained specific official test certificate. Imports were allowed relatively easily till 1956, though certain procedural modifications were made because of the deteriorating foreign exchange position of the country. From 1957, besides the normal trade channels, tractors were imported through the State Trading Corporation largely from Soviet Russia and Czechoslovakia. During the period 1961-70, Russia, Czechoslovakia and Rumania were the major sources for imported tractors.

During 1971 and 1972 massive quantities of tractors were imported under a world Bank Scheme for financing integrated agricultural projects in India. However, from 1974 onwards import of complete tractors

was stopped.

An interesting aspect is that prices of tractors imported from East European countries were substantially lower than those of locally manufactured ones. The Government was of the opinion that such a policy of .. import of low priced tractors would not hurt the domestic industry as imports were allowed to bridge the gap between production and demand.

**Industrial Licensing**

During the period 1960-61 four firms were granted industrial licences to set up tractor manufacturing units with a total capacity of 11,000 tractors per year. As a result of the increase in perceived demand for tractors, the Government allowed the existing manufacturers to increase their capacities and also licensed an additional private film and proposed to set up a public sector firm to manufacture tractors. The total licensed capacity in 1966 wad, .18, 500 tractors per annum. The sudden spurt in demand from 1966 onwards prompted the Government to delicense the tractor industry on February 7, 1968. Nine new projects were approved. However, again when the demand seemed to stabilise and the industry seemed to be becoming extremely ciewded by a large number of potential manufacturers, the Government brought the industry under the purview of industrial licensing in 1970. Ultimately, only a few projects finally materialised. During the period 1959-65, five firms set up plants for manufacturing tractors. In the second phase of the development of the industry six new units set up tractor manufacturing facilities. Two units were set up during the period 1981-83. Exhibit 9 gives the names of units, along with their collaborators and date of commencement of indigenous production.

**Other Policies**

1. To protect the interest of the farmers in a situation of shortage of tractors, the Government in 1967 imposed statutory control on selling prices of indigenously produced tractors. In 1971 the Government also imposed control on distribution of tractors. However, these controls were removed in 1974 and 1976 respectively.
2. To accelerate the pace of indigenisation the Government required new projects to give a plan of progressive indigenisation. Duties on imported components were raised considerably in 1969-70; however, in spite of heavy duties, imports from the East European countries were substantially cheaper than indigenously produced components. This hampered the pace of indigenisation.
3. To strengthen the demand for tractors the Government attempted to increase the credit facilities to farmers for purchase of tractors through directives to commercial banks to increase their proportion of rural lending and through expansion of rural branches. Agricultural development branches were created within commercial banks specifically for advancing rural credit. Re-finance facilities to commercial banks were analysed and special schemes for encouraging tractorisation were developed:

**Genesis of SWARAJ**

The story of SWARAJ ("Swaraj" means self-rule) tractor began in 1965 when the Fourth Five Year Plan was being formulated. One of the projects for which the Government of India was thinking of obtaining aid from Soviet Russia was the establishment of a plant for manufacturing a 20 H.P. tractor in India. Tractors in the lower horse power ranges were required in view of the pattern of landholding as shown in Exhibit 10. The aid envisaged to be obtained from Soviet Russia was both financial and technical. However, the Russians indicated their reluctance to assist the project.

Mr. M.M. Suri, who was then the Director of the Central Mechanical Engineering Research Institute (CMERI), was also a member of the delegation which visited Soviet Russia. He felt that the project as formulated had excessive foreign exchange content and required a large number of Russian experts, and that it was not warranted with large idle capacities with Mining and Allied Machinery Corporation (MAMC), Durgapur, and Heavy Engineering Corporation (HEC), Ranchi, two public sector firms. Mr. Sufi suggested to the then Deputy Chairman of the Planning Commission that CMERI could develop an indigenous tractor design that could be produced without external assistance or even imported parts.

The thinking of Mr. Sufi and his associates who were to take up the project later was that the Indian industry was essentially foreign collaboration based. The diversity of the sources of technology posed a great problem to Indian planners, steel manufacturers and the users of various engineering products. Each new imported technology imposed fresh ancillary burdens for diverse components. They (PTL document) gave the example of the diesel engines:

> ... India manufactures a larger variety of diesel engines than any other country in the world, even though the total production is comparatively small. Each ancillary manufacturer has thus to cater to a very wide range of designs, sizes, and specifications of components which increases the cost of indigenous manufacture. Such a growth of national production has imposed on the country the choice between dependence on component imports, or in the alternate uneconomic production...

Mr. Suri began a crusade advocating the development of indigenous technology and was successful in getting the Government's approval for designing an indigenous tractor at CMERI.

A Committee of Technical Experts (CTE), comprising representatives of the industry, agricultural universities, fanners and the Tractor Training and Testing Station ('1'11'S) at Budni was constituted in 1965 at CMERI for directing the design team.

Regarding the role of the Planning Commission in this, Mr. Chandra Mohan as quoted by Bhatt 1978 said:

> If I look back, it was not the Planning Commission which assigned the task to CMERI, It was virtually Mr. Sufi, who forced the Indian approach on the Planning Commission ...

The design team created at CMERI to work on the tractor project consisted of two production engineers, two design engineers, an industrial engineer, a foundry expert, a metrologist and two automotive engineers.

**Development of Prototypes**

The design team undertook intensive studies in the comparative merits of designs of various tractors available in the country. The tractor was to be engineered specifically for the Indian environment and to withstand Indian use and abuse.

The philosophy underlying the design may be gauged by the following statement (ibid):

> At the time when Swaraj designs were initiated at CMERI I had analysed that considering the immense popularity of the Massey-Ferguson, Swaraj must be fully competitive with it, if not better.

Swaraj tractor was built to suit local conditions - farmers required a tractor in I I.P. range of 2() to 30; such a tractor would mean lower capital and operating costs to the farmer. While explaining the basis of the design of Swaraj, Mr. Chandra Mohan (ibid) said:

> ... Economics of scale can only be related to the scale of production for any particular design and not when different designs are under consideration. Specific examples, which I may mention are:

1. Sheet metal (fenders, bonnets etc.) of tractors all over the world and more particularly from the developed countries, is so designed that it requires minimum tooling investments of Rs. 5 million and plant investments of Rs.10 million. Designs have been developed basically to save labour. On the other hand Swaraj sheet metal requires a tooling investment of not more that Rs. 10,(00 and it is being made in three small-scale units with investments of around Rs.1,00,000each.
2. The casting wall thickness for tractors in the developed countries has been so reduced over the years to save material costs that they can be produced in foundries with investments larger than Rs.1(X) million. On the other hand Swaraj castings developed specifically for technology levels readily available in India are being made in foundries with capital investments as low as Rs. 5,00,000... Our production costs with these designs are decidedly lower even at low production levels...

According to the top management of the organisation:

> ... Indian standard materials are used to ensure 100% indigenous content. Secondly, a suitable diesel engine already manufactured in bulk is engineered into the tractor to reduce project capital cost and administrative effort to nearly half. Thirdly, ancillary components, switches, clips, clamps, fasteners, bushes, bearings, electrical steering wheel, guages, etc., which are already being manufactured in India for some user or the other, are used in the Swaraj to avoid developing new ancillary components to the extent possible, so that the benefits of rationalisation can accrue to the manufacturers of SWARAJ.

**Design Features**

Swaraj tractor was initially built around a four-stroke, two cylinder, air-cooled engine that was being manufactured by the Kirloskar Group within the country. Later on, the management decided in favour of a water-cooled engine. The managing director of the company explained;

We did eventually decide to switch to a water-cooled engine, despite proven technological advantages of air-cooled engines. A casual remark of a very senior Punjab Government official made

us take this decision: "As it is you are trying to market an unknown tractor based on Indian know-how: why open a second front by introducing an air-cooled engine with which our farmers have had bitter experience on some tractors earlier. One front at a time is better strategy..."

Some of the salient features of the original design (CMERI) were the following:

The tractor had a 20 HP diesel engine of French design with a rated speed of 2000 R.P.M. and a compression ratio of 16:1 with dual range four speed transmission so as to cover a wide variety of jobs ranging from heavy duty to fast transport, and a provision for an independent power take off unit which could be engaged or disengaged when the tractor was in motion and could be used as a prime mover for pumps and other similar equipment. Engine cooling was achieved by an axial blower. Implement movement was controlled by a hydraulic system with fingertip control. For improved traction in slippery and muddy spots a foot operated differential lock was provided. There was also provision for adjustment of front and rear axles, and manual steering,

**Design Innovation**

Availability of hydraulics was considered as a major requirement for a good tractor. Providing a sophisticated system with automatic draft and position control of implements without infringement of the existing patents posed a problem. The CMERI team successfully developed an original single lever automatic depth-cum-control hydraulic system, which is covered extensively by CMERI patents in India, U.K., Japan, West Germany, U.S.A., France, Poland and Yugoslavia. All known tractor hydraulic systems in the world employ two or more remote control levers for controlling the working of the hydraulic system. The Swaraj system is an improvement upon the existing design concept. The entire control is effected by single lever which leads to:

i). Easier training of the farmer for handling implement operation efficiently.

ii). Lesser chances of confusion during operation. Field 'resting of the Prototypes

**Field Testing of the Prototypes**

Test rigs were developed to carry out endurance tests on the front axles, engine, main castings, etc. to fully prove each one of these sub-assemblies prior to their assembly on the prototypes. The first prototype tractor was assembled in 1967 and was put to extensive endurance tests in CMERI lasting 1197 hours non-stop running with 10-30% overload during the hot summer months when the ambient temperature was as high as 49°C.

Three more prototypes were produced in March 1969 incorporating all the improvements that were found necessary during trials on the first prototype. These were sent for extensive field trials and performance evaluation at the Tractor Testing and Training Station at Budni, Punjab Agricultural University, Ludhiana (PAUL), and U.P. Agricultural University, Pant Nagar. Testing at Ludhiana and Pant Nagar not only covered the universities but also farmers. Tests extended over a period exceeding.1600 hours. The performance was very satisfactory and the farmers who had used this tractor were extremely happy.

At a meeting convened by the Additional Secretary, Ministry of Industrial Development and Internal Trade, on 22 February, 1971 where representatives of the Directorate General of Technical Development (DGTD), Ministry of Agriculture and the Director, Tractor Testing and Training Station, Budni, were present, the following points emerged:

1. The Director, TITS, Budni, noted that Swaraj tractor was better than most of the imported tractors with regard to drawbar pall and the ratio of drawbar H.P. to the power available at the power takeoff (PTO). These parameters were of primary concern to farmers.
2. Three main items which needed improvement were the steering, front axle and the hydraulic pump.
3. Steps had to be taken to submit RV2 engines made by Kirloskar Oil Engines Ltd. for testing them with regard to fuel consumption after certain modifications:

The improved versions of the three items mentioned in (2) above were evaluated by Director, 'I 11S during the period 17 to 22 May, 1971. Indications were that all the three items were satisfactory and were cleared for production.

**SWARAJ Runs into Heavy Weather**

While Mr. M.M. Sufi was advocating reliance on indigenous technology, the then Minister of Industries of

the Government of India, Mr. T. Singh, went to Czechoslovakia, where he concluded an agreement with M/s. Motokov to prepare a detailed project. report on the manufacture and assembly of 12,000 Zetor 2011 tractors and some agricultural implements for a plant to be established at Ramnagar (Aurora & Morehouse op. cit). The report was submitted in March 1967 involving a capital investment of about Rs. 32.5 crore.

In the initial stages of development, Mining and Allied Machinery Corporation (MAMC), a public sector corporation at Durgapur, was expected to undertake the tractor project with the addition of some balancing equipment. But in the period of industrial recession in the country -1967 to 1971-MAMC incurred financial losses and was therefore not willing to take the additional risk involved in the manufacture of tractors (Chaudhuri, 1980).

At this time HMT, another public sector undertaking, was exploring for diversification opportunities. HMT perceived the tractor industry to be a promising field and hence suggested to the Government that it would like to take up the manufacture of tractors in the 2025 HP range. CMERI saw some hope of reviving Swaraj when HMT put forward its proposal to the Government.

The Government of India appointed the National Industrial Development Corporation Ltd. (NIDC), to prepare a project report with the following terms of reference :

i) To select the most suitable design for the tractor to be produced.

ii) The extent to which the existing facilities in HMT, Pinjore and MAMC, Durgapur could be utilised for manufacturing tractors.

iii) Additional investment involved and economic analysis of such a venture.

The NIDC submitted its report to the Government in April 1969, recommending the manufacture and assembly of 12,000 Zetor tractors of 25 HP at HMT, Pinjore.

The Swaraj tractor project seemed to fizzle out without any governmental support. The Planning Commission members who had shown interest when Mr. Suri had made the proposal to manufacture the 20 HP tractor indigenously had been changed by 1969. Mr. Sufi, who had spearheaded the initial phase of the project, left CMERI in 1969.

**Revival of Swaraj**

When all seemed.lost, help came from unexpected quarters. The Punjab State Industrial Development Corporation Limited (PSIDCL) had been familiar with the development of Swaraj; it had observed the field trials in Punjab and was aware of the farmers favourable response to it.

The PSIDCL is a wholly owned undertaking of the Punjab Government. It was specially set up in 1966 to promote large and medium sized industries in the State. It had already implemented successfully six industrial projects by 1970.

According to the Managing Director of Punjab Tractors Ltd., though PSIDCL was aware of these developments, they were not very enthusiastic about the project's success. Possibly, they were sceptical about indigenous technology. The Central Government which should have encouraged the development of indigenous technology, had cold shouldered Swaraj. The PSIDCL's risk-taking ability was also not very high. The design team of CMERI impressed upon the PSIDCL the inherent strength of the project, and the benefits that would accrue to Punjab, some of which seemed to be:

1. Indigenous design, specifically engineered for the Indian environment.

2. Favourable customer reaction during the tests in Ludhiana and Pant Nagar.

3. Employment potential in the factory itself and development of a multitude of ancillary units.

4. Injection of high technology and the development of quality conseiopsness in the small industries around.

The PSIDCL authorities, having been influenced by the thinking of the leader of the CMERI design team, promoted the Punjab Tractors Limited. The company was incorporated on 27 June, 1970 at Chandigarh and obtained the Certificate of Commencement of Business on 29 July 1970.

The know-how and technology development by CMERI, Durgapur, was licensed to PSIDCL through the National Research Development Corporation (NRDC) of India, New Delhi, a Government of India organisation. The conditions were:

1. Right to CSIR's Indian Patent Nos. 113114, 113115, 116257 and their corresponding patents in USA, UK, West Germany, France, etc.
2. Right to any further developmental work done by CMERI on Swaraj tractor and first options on work in a field allied to tractors.
3. A royalty of 2% on the net ex-factory sales price of the tractor excluding major bought-outs like the engine, tyres, tubes, rims, and electricals.(including dashboard instrumentation) would be payable to NRDC for a period of 10 years.
4. A royalty advance of Rs. 1 lath to NRDC to be adjusted subsequently.

**Implementation Team**

For the implementation of the tractor project, PSIDCL obtained the services of the team of engineers of CMERI, which had been working on the development of the tractor since 1965. The promoters felt that it was essential to have the services of the original design team for successful implementation of the project. The CMERI team had become wellknown for its dedication and commitment to the cause of indigenous technology.

**Consultancy Services for the Implementation of the Swaraj Tractor**

In the initial negotiation with the CMERI it was indicated that the major responsibility for translating the developmental know-thow into mass production technology would have to be taken by PSIDCL. This aspect was further emphasised during discussions between PSIDCL, NRDC and CSIR.

It was recognised that the development of production technology for Swaraj would require expertise of the highest calibre in every field: styling, jig and tool design and manufacture, stores and procedures, production planning and controls, material management, plant layout, etc. Two alternatives were available to PSIDCL:

i) Appointment of reputed consultants who would provide the composite engineering services for the project; and

ii) Building up PSIDCL's own cadre of experts.

The second alternative was dropped after detailed consideration, when it was recognised that full-time services of experts of the calibre required would be extremely expensive. Furthermore, it would not be possible to give these experts full tithe occupation, particularly after the project went into production.

It was then decided that the services of some reputed consultants would be retained for helping PSIDCL in executing the Swaraj tractor project and at the same time training its young team of engineers in all the facets of implementation.

The services of M.M. Suri & Associates (P) Ltd., New Delhi, a reputed consultancy firm headed by Mr. M.M. Suri, formerly with CMERI, were retained with effect from 3 September 1971 to provide comprehensive engineering services during the period of construction and six months of production thereafter at an approximate cost of Rs. 19.3 lakh. They were to be given the responsibility of training an adequate number of engineers and staff in all aspects of project execution, production, and management.

**Competition**

Some information on the industry has already been provided in the section on government policy. This section provides brief description of the major competitors of Punjab Tractors Ltd.

**Eicher Tractors Limited (ETL)**

This was the first company to commence manufacture of tractors in India. ETL was floated in 1959 in collaboration with Geier. Eicher of West Germany. The manufacturing operations started in a very small way. Starting with a single cylinder air-cooled tractor of 24 HP Eicher India now has developed improved models of the original tractor, It has also developed 35 and 12 HP tractors through its own efforts and the tractors are likely to be in the market soon. Beginning in 1960-61 with a production of 132, the company manufactured 13,650 tractors during 1983-84. The company's plant is located at Faridabad about 60 Km from New Delhi. The company set up a relatively large research and development centre at Faridabad during 1975-76, with departments specialising in engine design; tractor design, system design, transmission

design, metrology, prototype development, materials science, and testing. The annual recurring expenditure is approximately Rs. 10 million.

**Gujarat Tractors Limited (GTL)[1]**

GTL was set up in 1961 in Vadodara by an erstwhile trading company, which was perhaps the first to introduce tractors into India in the twenties. Owing to poor financial performance GTL was closed down in 1971 and was then taken over by the Government. This company is presently manufacturing 50 HP tractors mainly and a 6171P tractor to a limited extent. The company had introduced a 35 HP Model in 1964 with imported powerpacks but the model was discontinued after 1975. The original 50 HP model is based on the know-how provided by M/s. Motokov of Czechoslovakia. GTL recently entered into a collaboration agreement with M/s. Polytechna of Prague for manufacturing Zetor 45 HP tractors. The 61 HP model which GTL, is presently manufacturing was developed through in house developmental efforts. After the takeover by the Government production has improved but been erratic. Production in 1971 was 211 tractors which increased to 2654 in 1978-79 but declined to 1150 during 1980-81. ,

GTL's R & D department was set up in 1972 after the takeover by the Government. It is still in its infancy. GTL has developed a 61 HP model which it has started marketing. The R & D section forms a part of the larger engineering department.

**Tractors & Farm Equipment Ltd. (TAFE) (Based on Suri Report)**

TAFE was engaged in distributing and servicing Massey Ferguson tractors before manufacturing it in 1.961 in collaboration with Massey Ferguson. The factory is located in Madras. The company forms part of the Amalgamations Group, which manufactures automotive and industrial diesel engines, tractors and farm equipment, forgings, stampings, cutting tools, batteries, and automotive ancillary equipment such as pistons, liners, rings, and bimetal bearings. Commencing with a 35 HP model the firm introduced a number of other models which were assembled from imported kits. However, those were soon withdrawn from the market. In 1974 a 55 HP model was introduced but was given up in favour of a 45 HP model which along with the original 35 HP model are in production presently. By 1971 this company was producing close to 5000 tractors; however the production declined to about 2000 in 1973 but has again almost steadily increased to about 8000.

**Escorts Limited and Escorts Tractors Limited**

Prior to commencing manufacture of tractors Escorts was engaged in distributing Ferguson tractors. However, when the agency was terminated, Escorts Limited started selling a Polish made tractor known as Ursus. In 1966 their manufacturing operations began with a 27 HP model. Over the next few years a number of models were added by attaching prime movers of different horse power to the original transmission, which was considerably overdesigned. The engine was procured locally from an indigenous manufacturer, Kirloskar Oil Engines Limited. Later, Escorts started manufacturing the engine in collaboration with the Polish manufacturer. They now have 35 HP and 47 HP model, in production at their plant located at Faridabad near New Delhi. In 1970 Escorts, production reached a peak of more than 10,000 tractors, but declined due to certain field problems. It remained below 6000 tractors still 1976 and since then it has picked up to about 12,500.

Escorts Tractors Limited was promoted by Escorts Ltd. in 1969 in collaboration with Ford Motor Co. of U.K. to manufacture a 47 HP tractor. The factory is located beside the older plant in Faridabad. Starting with a production volume of less than 1100 tractors in 1971 ETL produces over 8000 tractors per year. Its market share is around 11%.

**Mahindra and Mahindra Ltd.**

The International Tractor Division of Mahindra and Mahindra (M&M) was initially floated as a separate company in collaboration with International Harvester of Great Britain and Voltas Limited Bombay. From the beginning till 1976 the company did very well when it suffered a major set back. It was then merged with M&M as one of its divisions. Besides tractors, M&M manufactures jeeps, light commercial vehicles, agricultural implements, and process control instruments.

The company started manufacture with a 35 HP model which even today is the dominant one in the product line. A 43 HP model was added during 1971-72 in collaboration with IH and a 50 HP model designed by ITC's own R&D department was introduced in the market during 1981-82. The production has picked up from about 2000 during 1976-77 to almost 16,000 tractors during 1983-84.

[1] This section is based on a report prepared by M/s. MM Suri & Associates Pvt. Ltd. 98

**Hindustan Machine Tools Ltd.**

Hindustan Machine Tools Ltd., a central government enterprise is one of the most well known state owned enterprises. It is engaged in the manufacture of a variety of machine tools, tractors, wrist watches, watch manufacturing machinery, printing machinery, lamps and lamp making machinery, etc., in 13 plants all over the country.

Tractor manufacture commenced in 1971. at Pinjore near Chandigarh in collaboration with M/s. Motokov of Czechoslovakia. Starting with a 25 HP model, HMT has added two more models to its product line. A 35 HP model, developed through in-house R&D efforts, and a 58 HP model in collaboration with Ws. Motokov were introduced during 1977-80. Till around 1980 the 25 HP model was the dominant one; however by 1983-84 the 35 HP model accounted for about 60 per cent of the total production of a little less than 12,0[1])0 tractors. The 25 HP model accounted for almost 40 per cent with the 58 HP one accounting for less than 1 per cent.

**Kirloskar Tractors Limited**

Kirloskar Tractors Limited (KTL) was promoted by Kirloskar Brothers Limited and Kirloskar Oil Engines Limited in 1970. It entered into a technical collaboration agreement with Ws. Klockner Huboldt Deutz of West Germany in 1970 for technical know-how for the manufacture of tractors. KTL belongs to the well known Kirloskar Group of companies, which is engaged in the manufacture and selling of diesel engines, machine tools, electric motors, and pumps. In spite of the fact that the product technology acquired by KTL is acknowledged as superior to many of the competing brands, KTL has been having financial problems because of poor sales performance from the very beginning. As a result it was merged with Kirloskar Pneumatic in 1982.

Production commenced with a 43 HP model during 1972-73. Since then, three other models of 75 HP, 35 HP, and 100 HP have been added to the product line. But the first one continues to be the dominant one. Beginning with a volume of 500 tractors per annum during 1972-73, KTL reached a volume of a little more than 2000 during 1980-81. However, the production declined to about 800 during 1982-83. The plant is located at Nasik near Bombay.

**Financing of the Project**

The detailed project report was completed by March 1971. The next problem was that of financing the project. PSIDCL and PTL approached the Industrial Development Bank of India (IDBI) and other financial institutions.

PTL submitted a project (capacity output of 5,000 tractors in 20-30 HP range) with a capital cost of about Rs. 3.7 crore (Table 2). They had planned a very high percentage of (80 per cent) boughtouts with only 15-20 per cent own manufactured components in order to reduce the capital cost of the project.

**Table 2 : Swaraj Tractors : Project Cost**

(Rs. Millions)

| | Expected (March 1972) | Actual (April'74) |
|---|---|---|
| Land | 1.162 | 0.985 |
| Buildings | 2.252 | 3.435 |
| Plant and Machinery | | |
| a) Imported | 3.191 | 3.135 |
| b) Indigenous | 15.426 | 13.457 |
| Technical Know-how | 2.073 | 1.640 |
| Miscellaneous Assets | 0.781 | 2.337 |
| Preliminary Expenses | 4.480 | 0.583 |
| Pre-operative Expenses | 5.050 | 5.187 |

| | | |
|---|---|---|
| Provision for Contingencies | 2.300 | |
| Margin for Working Capital | 4.287 | 5.187 |
| Total | 37.002 | 35.916 |

Source: V.V Bhatt, "Decision Making in the Public Sector Case Study of Swaraj Tractor", Economic and Political Weekly, XDI (21), (May, 1978).

The expected project costs were exceptionally low compared to most tractor manufacturing programmes. Plant and machinery costs could be kept low by ensuring high utilisation rate of expensive machinery. In the words of the Managing Director of PTL (Bhatt, 1978):

> A very critical contribution of indigenous technology is the in-depth flexibility which it provides to the design group to adopt/ innovate to bring down the costs keeping local conditions in view. This flexibility is further increased by their indepth knowledge of the production processes. We have in our own case changed designs of components to cut down capital investments any number of times. Cornplementarity of the production group has also shown immense flexibility in selection of machines and stretching them to the limits of their capabilities to conserve capital, a scarce commodity in a developing country. We are perhaps the only unit in the world where in special purpose machines which are normally tooled up for the production of one or two components, have been stretched out to handle 4 to 5 components. Our utilization of these expensive SPMs had 100% utilisation at production levels of 400 and as we proceed further to higher production levels, we will keep on adding SPMs. Capital investments for us will always be made as the market demands higher production levels[1]

The PSIDCL was agreeable to contribute at the most 10 per cent of the project cost, while the IDBI's rule of thumb was that the promoters should finance the project at least to the tune of 15 per cent of the total cost through their own resources. The PTL team suggested that the Punjab Government and G,S. Atwal's combined shareholding would'satisfy IDBI's conditions. However, complications arose when IDBI took the decision that G.S. Atwal & Co. had to be dropped and PSIDCL's equity had to be increased to satisfy its conditions. Almost one year went by before PSIDCL could be convinced into taking this decision.

Some of the striking arguments made by the PTL team which won the case in their favour were (Company Document, PTL)

> ...This project has been worked out taking full advantage of the traditional dynamism of the ancillary industry of the Punjab, their initiative and their extreme competitiveness.4-lowever, their presently poor reputation as regards quality with resultant high rejection (which only increase the component costs) has to be overcome by providing technical assistance... to develop their manufacturing skills for precision working, heat treatment, etc. Having taught one supplier the right manufacturing process all concerned can rest assured that in the Punjab the technique will spread around the area through worker enticement defection etc., generating keen competition from the area as a whole. This strategy perhaps could not be deployed in any other region of the country with the same confidence as in the Punjab. The planned spillover of high technology for achieving quality production of the Swaraj would raise the quality standards throughout Punjab where production costs are lowest in the country. If quality is also assured, the Punjab ancillary would be like Japan, hard to compete in any international market. Swaraj is treated as a catalyst for the spread of precision technology which offers to the Punjab ancillary outlets around the world for component suppliers. Already western countries, especially West Germany, are poised as large buyers if quality could be ensured. Thus the project approach has wider horizons than the mere successful setting up of Swaraj tractor manufacturers by the Punjab Tractors Ltd. Permeation of high technology throughout the Punjab industry... is aimed at.

At one stage PTL was confronted with questions regarding the passibility of the project's attaining 100 per cent rated capacity in the second year of the project. The design team gave the following reasons for their optimism in achieving a rapid rate of production build-up.

[1] Source: V.V. Bhatt, "Decision Making in the Public Sector: A Case of Swaraj Tractor," (Domestic Finance Studies No. 48, Feb. 1978), World Bank.

1. The design itself is evolved around major assemblies which were already in production in India and where no new capacity/technology/tooling is to be established either by the ancillary manufacturers or by PTL.
2. Ancillary manufacturers, particularly for the hydraulic system and 3-point linkage, were associated with the development of these, assemblies ever since 1967. This four-year- association has given them a major understanding of the technological problems involved in the development of these components.
3. The technological skills which have been generated within PTL by the availability of the CMERI team which has worked on the development of each and every component of the tractor over the last six years. This experience is further heightened by the fact that the development was done with established industry and not within a research laboratory.
4. The design know-how and experience available with PTL which will enable PTL not only to educate the ancillary industry in the supply of components and the requisite quality standards but also enable them to modify the designs for adaptation of scientific components which may already be under manufacture in India.
5. The two years of construction schedule of the project is a period dictated primarily by machine deliveries. This construction schedule is typical only to our project because of its 100 per cent indigenous content and is not applicable to any of the other tractor manufacturers, who because of the availability of CKD components start assembly operations within the first year itself. This early commencement of production with CKD supplies and the phased deletion programme thereafter delay the attainment of rated production levels.
6. The extensive pre-planning that has gone into the project since 1968 from the manufacturing point of view, the location of the sub-contract facilities for components, tooling, spare machine capacity, etc.
7. The component that is there behind the project of the CMERI team which is determined to make the Swaraj project a true and effective symbol of the emergence of national technology. It will be appreciated that a committed management/technological team will go a long way towards overcoming any hurdles that are likely to be experienced in the implementation of such a major project:

The company was successful in making arrangements for underwriting and long-term loans with the IDBI, Industrial Finance Corporation of India (IFCI), Industrial Credit and Investment Corporation of India (ICICI), Life Insurance Corporation of India (LIC), and the Unit Trust of India (UTI) under which the financial institutions agreed to provide underwriting assistance to the extent of Rs. 85 lakh (equity and preference) and long-term loans totalling Rs. 230 lakh. The Government of India also took the decision to participate in the equity capital of the company to the extent of Rs. 8.5 lakhs, which was ultimately routed through HMT, Bangalore.

**Project Implementation**

IDBI, a major partner, was very impressed with the performance of the project on various dimensions: meeting target date of completion; keeping within expected project cost at a time of rising material prices, raw material shortage, financial stringency; and reaching full capacity in the expected time (See Table 3).

Table 3: Some Performance Indicators

| | **Expected** | **Actual** |
|---|---|---|
| Capital Cost (Rs. million) | 37.002 | 35.916 |
| Costation Lag | 105 weeks (March 1972 to March 1974) | 105 weeks (March 1972 March 1974) |
| Output/Sales of Tractors | | |
| 1974-75 | 1600 | 933 |
| 1975-76 | 3500 | 2242 |
| 1976-77 | 4500 | 3196 |
| 1977-78 | 5000 | 4003 |
| Operating Profit (Rs. Million) | | |
| 1974 75 | -.3.656 | -8.82 |

| | | |
|---|---|---|
| 1975-76 | -0.320 | +0.57 |
| 1976-77 | 1.761 | +11.89 |
| 1977-78 | 2.702 | +13.34 |

This was achieved through management action in various areas as explained by the Managing Director:

> In Punjab Tractors Ltd. (PTL), completion within project estimates was a total commitment, This commitment in a situation where prices started rising abruptly at an alarming rate inspired us to explore every conceivable avenue towards cost saving in all aspects of the project...

To save on construction costs, PTL adopted a large number of innovations in building technology, some for the first time in industrial construction, even though all these technologies had been proven extensively in other fields of civil engineering.

Once the project was commissioned, the one goal uppermost in the mind of management was to reach full capacity utilization. Some problems arose in reaching this target :

1. Development of reliable vendors to cater to the very steep production growth curve.
2. Technical problems of the product.
3. Manufacturing problems.

**Development of Reliable Vendors**

PTL has developed about 125 ancillary units out of which 60 per cent have been promoted by PTL,' the remaining 40 per cent being those existing in small units which were located and given support to manufacture Swaraj components.

Out of the 750 components, approximately 60 are made by PTL. The largest single item is the engine (about Rs. 12,000 or 25-30 per cent of the retail price) which comes from Kirloskar of Pone,

Approximately 50 per cent of the components come from large scale enterprises. Components like tyres, tubes, batteries, wheels, radiators and clutches come from suppliers all over India, Out of 125 small and medium scale enterprises supplying components to PTL, 40 are within a distance of 1 km from the plant and another 40 are in Chandigarh. Proximity has several advantages : ease of communication, better quality control, and greater continuity in supplies, Some 50% of PTL's components come from such enterprises, although in rupee value the share is much less.

Initially PTL found it difficult to convince potential vendors to take up manufacture of Swaraj components. During this period PTL started manufacturing a large number of components within its premises to somehow increase production. Production facilities had been planned to manufacture only 70 to 80 components. When it was utilised for manufacturing several times this number the production of complete tractors was naturally small. A separate vendor development cell was created, which reported directly to the Managing Director. Its role was to develop entrepreneurs from fresh engineering graduates in order to meet component requirements of an increasing production volume. In 1978 PTL received the ASSOCHAM award for ancillary promotion.

**Technical Problems**

To cope with teething problems on the product a Product Servicing Group was created. It reported to the Marketing Manager, and worked in close coordination with R &D. Later it was brought under R & D .

**Manufacturing Problems**

The assumptions of 90 per cent machine utilisation and 90 per cent operator efficiency which had been made while planning for facilities did not come out to be correct and balancing machinery had to be purchased. Also third shift working had to be introduced. Third shift working has its attendant problems of poor discipline and low efficiency. Experienced workmen could not be recruited as salary bills had to be kept low. Machinery selected was more of the general purpose type which required high operator skill, which could only be developed over a period of time. Special jigs and fixtures had to be designed to do-skill the operations.

**Marketing Swaraj**

By 1974 the tractor industry was facing a major depression. In addition there. were 11 manufacturers in the fray, which had resulted in the market's transition from a sellers' to a buyer's one. In the initial stages Swaraj faced some resistance as explained by the Managing Director (1979):

> This project is the first large scale tractor project in India based on .100% Indian . knowhow and technology. There was some initial resistance in accepting the Indian knowhow by both the central and state governments since it had never been tried before. When we proposed to manufacture the tractors, a foreign collaboration agreement was acceptable to everyone but our project which was 100% indigenous was not.'

PTL faced a challenging task in marketing Swaraj. When PTL began its effort in the selection of dealers, the factory was still under construction and prospective dealers were doubtful about the company's ultimate success. PTL's management realised that product performance, product quality and reliability, and easily-accessible servicing facilities were critical dimensions in a competitive market which would dictate customers' decision-making.

PTL did not begin lining up dealers until the end of 1973 and the beginning of 1974. By mid 1975 it had 19 dealers in a 200 mile radius of Chandigarh. By the end of 1976, it had 80 dealers spread all over the country. Out of the roughly 10,000 tractors sold by mid 1978 over 80 per cent had been sold in Punjab, Haryana, Delhi and U.P.

When the tractor market was very tight in 1975-76 and 1976-77, PTL began experimenting with incentives to dealers. If a dealer sold over 100 tractors in a year, he would get a seven-day paid vacation in Kashmir. If he sold over 150 tractors he would get a ten-day vacation in Goa. During tight condition PTL began exploring diversified uses and outlets for its tractors-as road-masters for transport and haulage, without the hydraulic lift for Rs. 2,500 less. PTL was also exploring the use of the tractor as a hydraulic lift platform for fixing street lamps and electric transmission lines.

PTL provides a one-year guarantee on its tractors. Most other tractors carry only a six-month guarantee.

Servicing is of course critical to building up a satisfactory group of customers who in turn are the product's best salesmen. PTL has three service centers with personnel and dealer coverages as indicated in Table 4 below.

**Table 4: Swaraj Service Centres**

| Centre | Dealer Coverage | Staff |
|---|---|---|
| Chandigarh | 52 | 24 |
| Lucknow | 29 | 6 |
| Bhopal | 19 | [1] |

PTL is also trying to establish auxiliary service centres in small towns. PTL's input is to provide training for the mechanics.

The Director's report for 1976 stated:

To cater to a larger market spectrum the product range was enlarged in November 1975 with the introduction of a new 35- HP tractor, the Swaraj-735. Swaraj-735 has been developed by the company's own R&D and is again 100 per cent indigenous. Exhibits 11 and 12 give comparative prices of tractors of different makes.

**Research and Development**

Research and development is of prime importance to this company. The whole project was started because of Mr. Surf's faith in indigenous technology. The manager of the R&D department said:

[1] "Professional Profile- The Man. Behind Swaraj," Business India, April 16-29, 1979, p. 38.

We strongly believe that for our country to develop at a fast rate India R&D is a must and products suitable for Indian conditions and at suitable prices can best be done by R&D in India. The founding of our company has been based on this bask principle itself. Our company started with the purpose of using indigenous design for manufacture and consequently R&D was .set up at the start of the company.

In fact it was the tool room which was the first block to be commissioned on 16 August 1972. From October, two-shift working began for manufacturing jigs and fixtures. Perhaps PTL is the only company in the tractor industry to have started with a R&D department from the very first day. Tool room facilities were to be used for the manufacture of jigs and fixtures and other toolings and prototypes of new products.

The usual practice with regard to manufacture of jigs, fixtures, and tools in the tractor industry is that special purpose machine tools are purchased from the manufactures in completely tooled up condition but the jigs and fixtures for the general purpose or universal machinery are partly manufactured within the plant and partly sub contracted. The function of the tool room in the tractor industry is that of maintenance of these special tools as and when required. But in the case of PTL, a deliberate policy decision was made to manufacture all jigs and fixtures for general and special purpose machinery within the plant itself in order to reduce costs. The designs of the jigs and fixtures were made by PTL engineers with the aid of their consultants. Tractor manufacturers having foreign collaboration could get ready-made designs which had to be modified to suit Indian standards. In many cases they could import complicated jigs and fixtures from their principals. Tool room facilities in India are scarce and therefore difficulties crop up in developing reliable sources of high quality jigs and fixtures. Also their cost is exhorbitant. According to a very senior officer of the company, the cost of manufacturing these jigs and fixtures for PTL was less than half of what they would have cost in other places.

Table 5 shows yearwise.capital and recurring expenditure on R&D activities.

**Table 5: R & D Expenditure (Rs. in Lakhs)**

| Year | Capital | Recurring |
|---|---|---|
| 1972-73 | | 0.41 |
| 1973-74 | 3.00 | 1.26 |
| 1974-75 | 0.30 | "3.65 |
| 1975-76 | 0.52 | 3.94 |
| 1976-77 | 0.80 | 4.70 |
| 1977-78 (est.) | 11.0& | 5.10 |

Capital expenditure has gone towards purchase of certain instruments and building of a small shed. Plant and machinery for R&D.has-not been set up in a separate shed.because of the company's policy of conserving scarce capital. Tool room facilities are used for R&D work and the coordination for the use of the common facilities is done at the managerial level, but when there are complex situations the priorities are given by the Managing Director. Research and developmental work does not follow a smooth pattern. At certain times there is a very heavy work load and at other times the utilisation rate of machinery may not be more than 15-20 percent. For this reason R&D work is generally scheduled whenever the load in the tool-room is less and by this arrangetnent extra capital investments have been avoided.

Even without its own production facilities R&D's achievements have been quite remarkable in terms of the new products it has developed, and design improvements made on existing products for cost reduction and quality enhancement. The department has to its credit several types of agricultural implements in addition to the new model of tractors, i.e., Swaraj-735 (39 HP) and Sartaj, the economy 'model, which uses a single cylinder engine of about 17-18 HP. About 80-90 per cent of all the new products developed by the R&D Department have been commercialised and all the company's products are products of its own R&D. Already work has begun on developing a 50-HP tractor, to be called "Samrat". PTL will have then the most complete range of tractors ranging from 18 HP to 50 HP

**Organisational Set-up and Training**

PTL has a functional structure with the Managing Director as the head. The CMERI team which developed Swaraj Tractor formed the core of the project management team with. four of them heading four of the functional areas which were found most suitable to them. A few experienced persons were taken over the production planning, maintenance, technology, tool room, marketing, finance, etc. A phased recruitment of

personnel was planned to reduce personnel expenses. Particular attention was given to the provision of engineers in every major activity. This was done with the idea that attachment of trainee engineers right from the inception of each activity would groom them into the very rationale of each plan and its subsequent execution. The idea was that in the two years during project implementation, this would build up a core of young, enthusiastic and competent engineers who would be able to shoulder responsibilities for further expansion with full confidence and technical capability.

The training of the engineers consisted of a certain period of on-the-job apprenticeship in tool room and design. Design was given special emphasis including jigs and fixture design because the management believed that injection of these disciplines activated processes of thinking and emergence of ingenuity. Quality control is the primary importance. The Manager (Quality Control) reports directly to the Managing Director to ensure strict and impartial observance of high standards of products. Even when the Manager, materials, develops the ancillary supplies, the Manager, quality control, is the independent authority to check on the quality of the supplies.

The Manager, R & D, also reports directly to the Managing Director in addition to the Director, Finance. Manager,' Materials, also reports to Director, Finance. The Works Manager and Manager, Special Assignments who looks after new investment planning and export marketing, report to the Managing Director. The partial organisational structure is shown in Figure 1.

**Questions**

1. What were the forces that led CMERI to take up the 20 HP project?
2. What factors were responsible for delay in the successful completion of the project?
3. What problems were faced in developing the technology and how were they overcome?
4. Evaluate the strategy of P'I'T., including its technology strategy.
5. What lessons can we draw from this case?

**Appendix**

TRACTORS

A tractor is a self-propelled vehicle capable of pulling a load. It is usually powered by an internal combustion engine, and is used on highways and in factories; but its greatest use is on agricultural land.

Basically, a modem farm tractor consists of an internal combustion engine, a transmission or gear reduction and selection unit to change engine power to torque at various speeds, main drive gears for further speed reduction, a differential unit to apply equal torque to each rear drive wheels at all times, and the drive or traction wheels. These units may be self-supporting by bolted to each other, suspended in a framework or by a combination of these methods of assembly. An engine clutch is necessary in order that the transmission gears maybe stopped to "shift" gears and to absorb the load without breakage or engine stalling.

-There are 4 to 8 gear ratios-incorporated in tractor transmissions with travelling speeds ranging from approximately 24 to 15 or 20 miles an hour.

Tractors are equipped with high capacity air cleaners because of the extremely dusty conditions in which they operate. AU are equipped with belt pulleys and power take-off shafts and many have some type of hydraulic lift system. The power take-off shaft is a powered shaft extending at the rear of the tractor from which an extension transmission shaft can be used to operate trailed machines such as a combine.

Tractors can be classified according to their main functions such as farm tractors, industrial tractors and highway tractors..

The farm tractor has revolutionised the mode of farming wherever it has been used. It has relieved fanners of arduous work and made great increases in production possible. Through the use of the tractor, farmers can control power that is equivalent to many horses and men. The average man is rated at 1/10 H P, but when he drives a 20 HP tractor across his fields he is doing the work of 200 men. Tractors are used for a variety of purposes such as ploughing; harrowing, sowing, harvesting, pumping, and transporting.

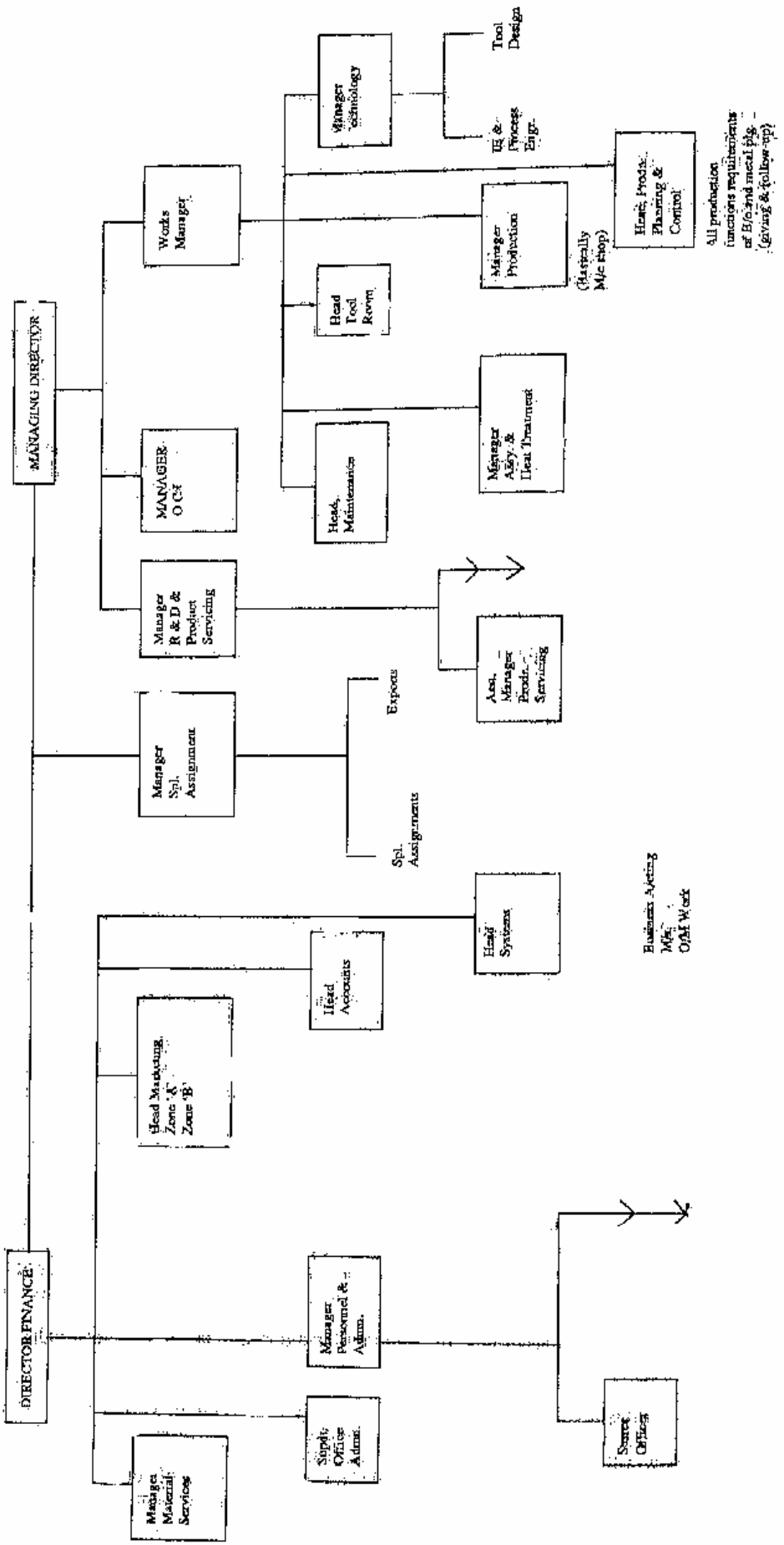


Figure 1
Partial Organization Chart (1978)

## EXHIBIT 1

### PUNJAB TRACTORS LIMITED
**Summarized Income Statement**

(Rs. in thousands)

| Sl. No. | | 1973-74 | 1974-75 | 1975-76 | 1976-77 | 1977-78 |
|---|---|---|---|---|---|---|
| 1 | Product. Sales | 1,625.65 | 30,548.73 | 83,814.87 | 1,29,675.99 | 1,71,286.42 |
| 2 | Other Sales | 6.38 | 772.42 | 60.37 | 90.18 | 71.73 |
| 3 | Other Income | 2.80 | 37.56 | 394.99 | 188.79 | 725.65 |
| 4 | Total Revenue (1+2+3) | 1,634.83 | 30,663.52 | 84,270,23 | 1,29,954.96 | 1,72,883.80 |
| 5 | Consumption of Materials | 1,247.31 | 24,724.82 | 64,781.36 | 97,019.86 | 1,21,882.47 |
| 6 | Excise Duty | 136.09 | 2,689.99 | 1,865.62 | 20.13 | 10,843.96 |
| 7 | Operating & Administrative Expenses | 983.88 | 5,880.31 | 9,727.18 | 13,723.91 | 19,853.58 |
| 8 | Finance Charges | 572.68 | 3,862.84 | 4,871.63 | 4,589.43 | 2,364.62 |
| 9 | Depreciation | — | 2,328.96 | 2,454.29 | 2,708.99 | 3,801.08 |
| 10 | Total Expenses | 2,939.96 | 39,486.92 | 83,700.08 | 1,18,061.52 | 1,58,745.71 |
| 11 | Profit for the year (before tax) (4-10) | —1,305.13 | —8,823.41 | 570.14 | 11,893.44 | 13,338.09 |

## EXHIBIT 2

### PUNJAB TRACTORS LIMITED
**Summarized Balance Sheet For a Decade**

| Particulars | 1970-71 | 1971-72 | 1972-73 | 1973-74 | 1974-75 | 1975-76 | 1976-77 | 1977-78 |
|---|---|---|---|---|---|---|---|---|
| **Assets** | | | | | | | | |
| Fixed Assets | 0.454 | 11.635 | *43.037<br>136.355 | | 321.760 | 307.835 | 302.833 | 300.155 |
| Current Assets, Loans & Advances | 2.188 | 16.849 | 87.788 | | 197.951 | 352.446 | 360.707 | 414.808 |
| Miscellaneous Expenditure | 4.807 | 15.434 | 5.836 | | 150.690 | 146.179 | 47.695 | 1.960 |
| Profit & Loss Account | 0.031 | — | — | | — | — | — | — |
| Total | 7.470 | 43.970 | 273.016 | | 670.407 | 806.460 | 711.236 | 716.882 |
| **Liabilities** | | | | | | | | |
| Share Capital | 7.000 | 37.500 | 138.910 | | 139.815 | 139.815 | 139.815 | 139.815 |
| Reserves & Surplus | — | 0.002 | 0.002 | | 46.271 | 48.503 | 53.176 | 114.984 |
| Secured Loans | — | — | 117.535 | | 363.817 | 383.624 | 302.096 | 191.090 |
| Unsecured Loans | — | 0.392 | — | | 26.050 | 44.410 | 17.175 | 17.000 |
| Current Liabilities & Provisions | 0.470 | 6.075 | 16.570 | | 94.454 | 190.109 | 198.973 | 253.992 |

Note : Errors in totals are due to rounding off *(1972-73) — Unallocated Capital Expenditure.

## EXHIBIT 3

### Estimated Demand for Tractors by 1960-61

| H.P. Range | Nos. |
|---|---|
| 12-18 | 1,500 |
| 20-30 | 3,000 |
| 35-45 | 500 |

Source : *Report on the Fixation of Prices of Agricultural Tractors.* (Bombay: Tariff Commission, 1967), p.6.

## EXHIBIT 4

### Estimates of Tractor Demand

| Sl. No. | Year | Nos. |
|---|---|---|
| 1 | 1966-67 | 20,000 |
| 2 | 1967-68 | 25,000 |
| 3 | 1968-69 | 30,000 |
| 4 | 1969-70 | 35,000 |
| 5 | 1970-71 | 40,000 |

Source : Adapted from Fourth Plan estimates quoted in *Tariff Commission Report*, 1967 (Estimates made in 1966-67),p.27.

## EXHIBIT 5

### Tractor Demand—Estimates for 1973-74

| | Upto 25 HP | 26/35 HP | 36 HP & above | Total |
|---|---|---|---|---|
| Planning Commission | 21,000 | 38,000 | 9,000 | 68,000 |
| Ministry of Agriculture: | | | | |
| a) 1968 Estimates | 25,000 | 45,000 | 20,000 | 90,000 |
| b) 1972 Estimates | — | — | — | 40,000 |
| Loading Tractor Manufacturers: | | | | |
| a) Estimate 1968 | 10,000 | 40,000 | 15,000 | 65,000 |
| b) Revised Estimate-1972 | — | — | — | 36,000 |
| Indian Society of Agricultural Engineers : Estimate 1968 | — | — | — | 52,000 |
| Actual Demand 1971-72 : | | | | |
| a) Production | 1,301 | 22,168 | — | 23,469 |
| b) Imports | 10,000 | 4,000 | — | 14,000 |
| c) Total | 11,301 | 26,168 | — | 37,469 |

## EXHIBIT 6

### Tractor Requirements Achieving Fourth Plan Targets as Estimated on I.A.R.I

| Sl. No. | Horse Power Range | Nos. |
|---|---|---|
| 1 | 6–10 | 500,000 |
| 2 | 12–16 | 500,000 |
| 3 | 22–24 | 500,000 |
| 4 | 28–36 | 200,000 |
| 5 | 44–50 | 50,000 |

Source: *Tariff Commission Report*, 1967, P. 31

EXHIBIT 7

**Import of Tractors (1961-1974)**

| Year | Imports (Nos.) | Total Availability |
|---|---|---|
| 1961-62 | 2,997 | 13,877 |
| 1962-63 | 2,616 | 4,030 |
| 1963-64 | 2,349 | 4,332 |
| 1964-65 | 2,323 | 6,646 |
| 1965-66 | 1,989 | 7,703 |
| 1966-67 | 2,591 | 11,407 |
| 1967-68 | 4,038 | 15,432 |
| 1968-69 | 4,276 | 19,742 |
| 1969-70 | 10,478 | 28,598 |
| 1970-71 | 13,300 | 33,399 |
| 1971-72 | 19,739 | 37,839 |
| 1972-73 | 1,000 | 27,802 |
| 1973-74 | 1,000 | 21,425 |

Source : Adapted from B.K.S. Jain "Production of Agricultural Machinery in India," (Paper presented at the International Rice Research Conference, Manila, April 19 to 23, 1971) p. 8 (Estimate made in 1968) and S. Kumar Deb, "Indian Now an Exporter," *Commerce*, (February 28, 1976), pp. 271-72.

## EXHIBIT 8

### Production of Tractors

Number of Tractors Produced

| | Tractors | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ETIL | EIL | ETL | GTCL | HIL | HMT | KTL | M & M | PTL | PTPL | TAFE | TOTAL |
| | EGL | Escorts | Ford | Hindustan | Harsha | Zetor | Kirloskar | International | Swaraj | Pittie | Massey Ferguson | |
| 1960 | 59 | — | — | — | — | — | — | — | — | — | — | 59 |
| 1961 | 202 | — | — | — | — | — | — | — | — | — | 395 | 597 |
| 1962 | 269 | — | — | — | — | — | — | — | — | — | 1,308 | 1,577 |
| 1963 | 36 | — | | 485 | — | — | — | — | — | — | 1,124 | 1,645 |
| 1964 | 235 | 445 | — | 1,355 | — | — | — | — | — | — | 1,716 | 3,751 |
| 1965 | 113 | 1,055 | — | 1,270 | — | — | — | 225 | — | — | 2,935 | 5,598 |
| 1966 | 135 | 2,115 | — | 1,870 | — | — | — | 550 | — | — | 3,400 | 8,070 |
| 1967 | 122 | 2,109 | — | 1,805 | — | — | — | 2,669 | — | — | 3,819 | 10,524 |
| 1968 | 346 | 4,269 | — | 2,032 | — | — | — | 3,818 | — | — | 3,336 | 13,801 |
| 1969 | 329 | 8,120 | — | 1,971 | — | — | — | 4,329 | — | — | 3,344 | 18,093 |
| 1970 | 768 | 9,665 | — | 1,402 | — | — | — | 5,835 | — | — | 2,267 | 19,937 |
| 1971 | 878 | 3,204 | 1,053 | 344 | — | 617 | — | 7,603 | — | — | 3,412 | 17,111 |
| 1972 | 780 | 2,481 | 1,823 | 703 | — | 2,578 | — | 10,161 | — | — | 1,420 | 19,946 |
| 1973 | 969 | 4,887 | 2,838 | 310 | — | 3,557 | — | 9,502 | — | — | 1,494 | 23,557 |
| 1974 | 1,196 | 5,133 | 3,403 | 750 | — | 5,704 | 506 | 9,230 | 380 | 93 | 2,351 | 28,746 |
| 1975 | 1,563 | 4,651 | 4,701 | 766 | 982 | 6,549 | 754 | 7,399 | 1,508 | 35 | 3,430 | 32,378 |
| 1976 | 2,854 | 5,259 | 5,010 | 1,565 | 588 | 6,553 | 325 | 6,348 | 3,001 | 105 | 4,842 | 36,450 |
| 1977 | 3,485 | 7,142 | 5,500 | 2,056 | 1,028 | 4,132 | 252 | 1,932 | 3,272 | 101 | 5,727 | 34,627 |
| 1978 | 5,159 | 10,377 | 6,671 | 2,552 | 731 | 9,190 | 600 | 7,077 | 4,541 | 300 | 6,201 | 53,399 |
| 1979 | 7,011 | 12,246 | 7,428 | 2,100 | 523 | 8,441 | 1,027 | 9,405 | 6,355 | 279 | 4,975 | 60,190 |
| 1980-81* | 11,164 | 11,266 | 7,304 | 1,150 | 795 | 8,105 | 2,087 | 13,401 | 8,929 | N.A. | 7,794 | 71,995 |
| 1981-82 | 12,710 | 13,478 | 7,286 | 2,146 | 897 | 11,034 | 1,235 | 11,751 | 9,420 | N.A. | 8,862 | 78,819 |
| 1982-83 | 10,573 | 9,211 | 7,375 | 729 | 245 | 9,890 | 784 | 11,901 | 5,310 | N.A. | 8,258 | 64,276 |
| 1983-84 | 13,650 | 12,208 | 8,611 | 1,335 | 185 | 11,780 | 1,563 | 15,901 | 10,285 | N.A. | 7,632 | 83,150 |

* From 1980 onwards the figures are for financial year April to March

Source: Association of Indian Automobile Manufacturers.

Note: From 1955-1959 the production of tractors was 'nil'.

## EXHIBIT 9

### Indian Tractor Manufacturers

| Period: 1959-65 | Date of Commencement of Commercial Production | Name of Collaborator |
|---|---|---|
| 1. Eicher Tractors Limited Faridabad | 1959 | Gebr. Eicher, West Germany |
| 2. Gujarat Tractors Limited (Erstwhile Hindustan Tractors Limited) Vadodara | 1963 | Motokov Czechoslovakia |
| 3. Tractors and Farm Equipment Limited, Madras | 1964 | Massey Ferguson, U.K. |
| 4. Mahindra and Mahindra Ltd. Bombay (Erstwhile International Tractor Co. of India Ltd.) | 1965 | International Harvester,U.K. |
| 5. Escorts Ltd., Faridabad | 1966 | Motoimport Warzawa, Poland |
| **Period 1971-75** | | |
| 6. Escorts Tractors Ltd. Faridabad | 1971 | Ford, U.K. |
| 7. Hindustan Machine Tools Ltd., (State owned Central Govt.) Pinjore | 1971 | Motokov, Czechoslovakia |
| 8. Kirloskar Tractors Ltd., Nasik | 1974 | Klockner—Humboldt Doutz, W. Germany |
| 9. Punjab Tractors Ltd., Chandigarh (state owned) | 1974 | Indigenous know-how |
| 10. Pittie Tractors, Poona | 1974 | Indigenous Know-how |
| 11. Harsha Tractors Ltd., Ghaziabad | | Motoimport, USSR |
| **Period: 1981-83** | | |
| 12. Auto Tractors Ltd., Pratapgarh (state owned) | 1981 | British Leyland,U.K. |
| 13. Pratap Steel Rolling Mills Ltd., Ballabhgarh. | 1983 | Indigenous know-how |

## EXHIBIT 10

### Distribution of Operational Landholdings by Size

| Size | 1961-62 | | | | 1970-71 | | | |
|---|---|---|---|---|---|---|---|---|
| | Holdings No. (Millions) | % | Areas Hectares* (Millions) | % | Holdings No. (Millions) | % | Area Hectares* (Millions) | % |
| Marginal (0 to 1 ha) | 19.8 | 39 | 5.1 | 7 | 35.7 | 51 | 14.5 | 9 |
| Small (1 to 2 ha) | 11.5 | 23 | 16.4 | 12 | 13.4 | 19 | 19.3 | 12 |
| Semi-medium (2 to 4 ha) | 10.0 | 20 | 27.6 | 21 | 10.7 | 15 | 30.0 | 18 |
| Medium (4 to 10 ha) | 7.1 | 14 | 41.6 | 31 | 7.9 | 11 | 48.2 | 30 |
| Large (10 + ha) | 2.3 | 4 | 38.6 | 29 | 2.8 | 4 | 50.1 | 31 |
| Total | 50.7 | 100 | 133.3 | 100 | 70.5 | 100 | 162.1 | 100 |

Source: For 1961–62: *National Sample Survey*, No. 144, 17th Round, Cabinet Secretariat, Government of India, New Delhi, 1968.

For 1970 –71: I.J. Naidu, *All India Report on Agricultural Census*, Government of India, Ministry of Agriculture & Irrigation, New Delhi, 1975

One hectare = 2.47 acres

## EXHIBIT 11

### Tractor Retail Prices (Rs.) (20-30 HP)

| Year | Eicher | Swaraj 724 | Zetor |
|---|---|---|---|
| 1970 | 17,480 | | |
| 1971 | 19,460 | | |
| 1972 | 25,200 | | |
| 1973 | 27,720 | 27,720 | 30,400 |
| June 1974 | 30,410 | 30,700 | 30,700 |
| Sept. 1974 | 30,700 | 33,330 | 31,200 |
| Nov. 1974 | 30,700 | 33,330 | 35,500 |
| April 1975 | 30,700 | 31,516 | 35,500 |
| Oct. 1975 | 30,700 | 35,516 | 35,500 |
| Jan. 1976 | 30,700 | 37,000 | 35,500 |
| May 1976 | 30,370 | 37,000 | 36,700 |
| Aug. 1976 | 30,370 | 37,000 | 38,570 |
| May 1977 | 30,370 | 37,000 | 38,570 |
| 1st Jan. 1978 | 30,370 | 41,313 | 40,947 |
| Sept. 1978 | 32,170 | | |

Source: Company Documents.

## EXHIBIT 12

### Tractor Retail Prices (Rs.) (30 – 40 HP)

| Year | Escorts E – 3036 | Escorts E – 335 | International IH – 275 | Massey Ferguson MF – 1035 | Swaraj 735 |
|---|---|---|---|---|---|
| 1970 | | 17,291 | 19,570 | 21,140 | |
| 1971 | | 18,896 | 22,890 | 24,250 | |
| 1972 | 25,200 | 25,200 | 25,200 | 26,300 | |
| 1973 | 27,720 | 27,720 | 28,930 | 28,930 | |
| June 1974 | 30,410 | 30,410 | 31,710 | 31,710 | |
| Sept. 1974 | 32,000 | 32,000 | 32,000 | 32,000 | |
| Nov. 1974 | 36,528 | 36,528 | 37,750 | 38,207 | |
| April 1975 | 36,528 | 36,528 | 43,250 | 43,497 | |
| Nov. 1975 | 36,528 | 36,528 | 43,250 | 43,497 | 41,423 |
| July 1976 | 36,528 | 36,528 | 43,250 | 43,550 | 40,830 |
| Jan. 1977 | 41,791 | 40,613 | 43,250 | 43,104 | 40,830 |
| April 1977 | 43,150 | 40,613 | 43,250 | 43,104 | 40,830 |
| Jan. 1978 | 44,015 | 41,425 | 43,250 | 43,104 | 40,830 |
| Sept. 1978 | 48,617 | 44,851 | 47,352 | 46,566 | 45,734 |

Source: Company documents