

World Bank Reprint Series: Number Ninety-six

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Reprinted with permission from *Economic and Political Weekly*, Bombay, vol. 13, no. 21
(May 27, 1978), pp. 30-45

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Case Study of Swaraj Tractor

V V Bhatt

The characteristic feature of the development process since World War II has been the deliberate assumption by the State of the function of regulating the pace and pattern of socio-economic development.¹ In a large number of LDCs, the State is also playing an active role in promoting and managing enterprises in the manufacturing sector. The functioning and growth of these enterprises depend on the decision-making process in the public sector. This process of decision making, which is complex enough in the private sector, is inevitably much more complex in the public sector.²

This case study of the Swaraj tractor has been undertaken with a view to understanding the problem of decision-making in public manufacturing enterprises in India.

The paper is divided into five sections. Section I provides some information about the tractor industry in general. Section II narrates the story of the Swaraj tractor. In Sections III and IV some problems about the decision-making process are raised and some conjectures made about public sector behaviour. In the final section, an attempt is made to formulate some explanatory hypotheses about the public sector decision-making process—hypotheses that many have general relevance for the LDCs with mixed economies.

I

Introduction

BEFORE we present the Swaraj tractor case, it is essential to give some background with regard to the tractor industry. In North America, tractors began to replace draught animals (usually horses) around 1900 and this substitution process was completed before World War II. In Europe, this substitution occurred during the first decade after the war as small versatile tractors and government support for tractor purchase became widely available.³

Most of the technical development of the tractor had taken place by World War II and much of it occurred in the US. However, the truly revolutionary development of the pre-war period, the "Ferguson System", came not from the US but from the UK and was introduced in the US in 1939. By this time tractor-technology had more or less stabilised and there has not been any significant change in this technology. There have been minor additions to the tractor design, like power-steering and automatic transmission; but there have been few important patents in the tractor industry since 1939.⁴ By comparison with an automobile, a tractor is a simple machine. While a car typically has 15,000 parts, a farm tractor has a mere 2,000; of these 1,365 are seldom or never actually manufactured by tractor manufacturers.⁵ These characteristics of tractor technology and manufacture indicate that it should not be difficult for newcomers like LDCs to absorb and master this technology. This point is relevant for the Swaraj

tractor case.

There is another characteristic of the tractor industry that is also relevant to note. In the tractor industry there are economies of scale both in production as well as distribution. It has been estimated for the US that approximately the same economies of scale, around 20 per cent, would attach to distribution expansion from 20,000 to 90,000 units as would accrue to a production expansion.⁶ This is part of the reason why the industry in the West is dominated by a few firms, resulting in oligopolistic competition as well as collusion.⁷

In a durable good like a tractor, the farmer essentially buys tractor services and hence is concerned in his purchase decision about after sales service and parts availability. Farmers' loyalties or preference are dealer oriented and sales of tractors thus crucially depend on the quality of distribution and service. As seems to have happened in the US, this dealership network can reduce competition and work against the interests of the farmers; for farmers generally all over the world have no adequate information to judge the quality of a tractor excepting through the marketing structure. This characteristic of the tractor market suggests the need for public policy in the interests of the farmers—the group in a weak bargaining position *vis-a-vis* the production-distribution system.⁸

Farm mechanisation in India started only after the War. In 1944-47 there were about 5,000 tractors; the number sharply rose to 20,000 in 1956-57 and by 1964-65, when our story begins, there were about 40,000. This was

the year when the new agricultural strategy—the so-called green revolution—was formulated. The domestic production of tractors started in 1963-64 with a licensed installed capacity on a two shift basis of 8,500 units by two firms—Tractor and Farm Equipment (TAFE) and Eicher Tractors India Ltd (Eicher)—the former with a capacity of 7,000 units and the latter with a capacity of 1,500 units. Both were permitted foreign collaboration in 1961: TAFE with Massey-Ferguson, UK and Eicher with Eicher of the Federal Republic of Germany.

As against this domestic capacity, it was estimated that the demand for tractors would increase substantially as a result of the adoption of new agricultural strategy in Punjab, Haryana and Western UP. With large increases in land productivity, farmers were facing a farm power shortage during the peak season; further, and even more important, cost of animal power was rising sharply. The adoption of high-yielding varieties of wheat improved the productivity of land, especially irrigated land. This in turn raised the opportunity cost of using draught animals, as fodder competed for the highly productive irrigated land. Mechanisation—task-wise—thus was expected to be an inevitable complement of the green revolution.⁹

However, in view of relatively small holdings—68 per cent of holdings in Punjab were below 9 hectares, accounting for about 20 per cent of the stock of tractors in 1971—the problem which the Planning Commission faced was: what type of tractors would suit the budget and the needs of small-

TABLE 1 : SWARAJ TRACTOR -- PERFORMANCE INDICATORS

	Expected	Actual
Capital Cost (Rs Million)*	37,002	35,916
Gestation Lag	105 weeks (March 1972 to March 1974)	105 weeks (March 1972 to March 1974)
Output Sales of Tractors (Number)	1974-75 1975-76 1976-77 1977-78	1,600 3,500 4,500 5,000
Operating Profit (Rs Million)	1974-75 1975-76 1976-77 1977-78	991 2,242 3,800 5,000
		-3,656 -0,320 1,761 2,702
		-8,824 +0,635 +2,300** +3,500**

*For cost-composition, see Table II.

**Estimated

Source: Industrial Development Bank of India.

TABLE 2 : SWARAJ TRACTOR : PROJECT COST.

	(Rs Million)	
	Expected (March 1972)	Actual (April 1974)
Land	1,162	0,985
Buildings	2,252	3,435
Plant and Machinery		
(a) Imported	3,191	3,135
(b) Indigenous	15,426	15,457
Technical Know-how	2,073	1,640
Miscellaneous Assets	0,781	2,337
Preliminary Expenses	0,480	0,583
Pre-operative Expenses	5,050	5,187
Provision for Contingencies	2,300	--
Margin for Working Capital	4,287	5,157
Total	37,002	35,916

Source: Industrial Development Bank of India.

medium farmers.¹⁰

II

Swaraj Tractor: Decision-Making Process

The story begins in 1965. A new team of members was appointed at the Planning Commission and it was busy formulating the Fourth Five-Year Plan. As a part of the Plan, several new projects required assistance, both financial and technical, from the Soviet Union. One of them was a 20 HP tractor project. The Planning Commission had estimated that the demand for tractors would be 40,000 units per year by 1968-69 and of this, half the demand was expected to be for tractors in the HP range of 20 and below. The Government of India's delegation, headed by the Deputy Chairman of the Planning Commission, visited the Soviet Union

in May 1965 to discuss with the Soviet Government the nature and magnitude of assistance for this and the other projects. M M Suri, Director of the Central Mechanical Engineering Research Institute (CMERI) was one of the members of this delegation.

The Soviet Union was reluctant to commit itself to the tractor project. Further, Suri felt that the project as formulated had excessive foreign exchange content and required a large number of Soviet experts. Since the Soviet Union was reluctant to assist this project, Suri suggested to the Deputy Chairman that CMERI could develop an indigenous tractor design that could be produced without external assistance or even imported parts. The CMERI thus started the work on the new tractor design under the direction of a Committee of Technical Experts (CTE) comprising representatives of the industry, agricultural universities, farmers and the Tractor Training and Testing Station (TTTS) of Budni.

A team of engineers under the direction of Suri studied in depth the relative merits of the available designs of agricultural tractors, keeping in view the local manufacturing facilities, skills, raw materials and agro-climatic conditions and developed a tractor, component by component. Since the availability of standard hydraulics was considered as the key requirement for a good tractor, the CMERI engineers successfully developed an original single lever automatic depth-control hydraulic system, patents for which were accepted in India, the UK, Japan, West Germany, the USA, France, Poland and Yugoslavia. The first prototype tractor was assembled in November 1967 and was put to extensive endurance tests in CMERI on specially designed test rigs simulat-

ing field conditions, lasting over 1,200 hours non-stop running with 10 per cent to 30 per cent over-load during the hottest summer months. With the experience gained on this prototype, three more units were assembled in March 1969 for extensive field trials and performance evaluation at the TTTS, Punjab Agricultural University (Ludhiana) and the UP Agricultural University (Pant Nagar). As a result of these tests, a number of modifications were incorporated in the hydraulics, steering gear, front axle, engine and its cooling system and the modified tractor was again tested at TTTS in May-June 1971. These tests indicated that its performance was better than most of the imported tractors in 20-25 HP range in regard to drawbar pull and ratio of the drawbar HP to the power available at the PTO which are of primary concern for cultivation. The tractor passed the TTTS test. Thus was born the Swaraj tractor, the product of local technological competence.

The design for Swaraj 20 HP was built around the four-stroke, twin cylinder, air-cooled Kirlosker engine that was being produced in the country. Some of the other salient features of the Swaraj: It has a 20 HP diesel engine of French design with a rated speed of 2,000 rpm and a compression ratio of 16:1. It has a 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 PTO which can be engaged or disengaged when the tractor is in motion and can be used as a prime mover for pumps and other similar equipment. Engine cooling is effected by an axial blower and fins provided on the engine cylinder block. Hydraulic with finger tip control for both positions and draft control of three point linkage is provided for operating the implement. A foot operated differential lock is provided to improve traction in slippery and muddy spots. It is also provided with adjustable front and rear axles, manual steering and vertical exhaust.

Thus by 1971, the Swaraj tractor was ripe for commercial production. But the question was: who would adopt this innovation? Earlier, the prototype was constructed with the assistance of a public sector concern -- the Mining and Allied Machinery Corporation (MAMC) and it was expected that MAMC would be able to undertake the tractor project with the addition of only some balancing

equipment. But in the period of industrial recession in the country (1967-71) the MAMC had incurred financial losses and was not willing to take any additional risk involved in the production of the tractor.

Because of industrial recession and decline in its sales of machine tools, the Hindustan Machine Tools (HMT), another Central Government concern, wanted to diversify its output by going into tractor production.¹² However, it wanted to use its unutilised capacity immediately by first going into assembly of Zeteor tractor parts imported from Czechoslovakia. Further, it thought that Zeteor was a proved production model, while Swaraj was only a prototype. In this decision, it was supported by the National Industrial Development Corporation (NIDC), in whose name the Swaraj tractor was patented.

Thus, at the Central Government level, there was no strong support for the Swaraj. The Planning Commission members were changed by 1969 and the new ones had no particular interest in domestic technological competence. Suri had left CMERI by 1969. The NIDC and the Council of Scientific and Industrial Research (CSIR) considered Swaraj a risky venture.

It was at this stage that a state government unit decided to produce the Swaraj tractor. The Punjab State Industrial Development Corporation (PSIDC) had been set up in 1966 with the object of promoting medium and large scale industries in the state. It had already implemented successfully six industrial projects by 1970: Punjab Prestressed Concrete Works, Punjab Chemi-plants, Punjab Footwear, Punjab Nylo-transmission, Punjab Saltpetre Refinery and Punjab Tanneries.

The PSIDC had been familiar with the development of the Swaraj tractor; it had observed its field trials in the Punjab and the farmers' favourable response to the Swaraj. Three characteristics of the Swaraj attracted the PSIDC: its indigenous design, its employment potential in the Punjab and its acceptance by the Punjab farmers as a sound dependable tractor. The PSIDC hence obtained an industrial licence to manufacture the Swaraj tractors in 1970.

The PSIDC approached the CMERI and requested the latter to release the five engineers who had worked on the Swaraj design for its new firm — The Punjab Tractors Ltd (PTL). Simultaneously, it appointed the consulting firm Suri and Associates,

organised by Suri after he left the CMERI, to prepare a detailed project report and undertake the entire installation and commissioning of the plant along with the company's engineers (the CMERI group). The detailed project report was completed by the middle of 1971. The next problem was: how to finance this project?

The PSIDC and PTL approached the Industrial Development Bank of India (IDBI), owned by the central bank of the country, the Reserve Bank of India. The IDBI was set up in 1964 as an apex development bank to promote industrial development, particularly viable projects that could not obtain financing from the other institutions. Its charter is broad and flexible; it can finance any sound project, irrespective of its ownership, organisation and size.

At the time the IDBI was approached by the PSIDC for financial assistance, its top management had changed. This new management had given an assurance to industry that the IDBI would be prepared to finance any sound project that met its selection criteria, irrespective of the assistance required. Its selection criteria related to the project's internal rate of return and exchange rate, the cut-off rates being 15 per cent and Rupees 9.5 to one US dollar. Further, it had taken up active promotional work with regard to the identification of project ideas in backward states, had a firm policy of supporting domestic technical consultancy services and research and had set up its own technical consultancy service — Kerala Industrial and Technical Consultancy Organisation (KITCO) in Kerala to prepare feasibility and detailed project reports and provide technical assistance to small and medium enterprises.¹³

Even with this new IDBI management, the PTL were not completely confident of obtaining financing to the tune of 85-90 per cent of the project cost. The lack of sponsorship by the Central government, and the scepticism about its success expressed by both the CSIR and the NRDC made the PTL somewhat diffident about getting the IDBI support. They, therefore, had suggested only a modest project (capacity output of 5,000 tractors in 20-30 HP range) with a capital cost of less than Rs 40 million. They were to buy the Ra-2 engine from another well-established Indian firm, purchase about 80 per cent of total component requirements from

established and new firms — largely small-scale engineering firms from Punjab — and concentrate on manufacture of only 15-20 per cent of key components; it was thus that they were able to reduce the project cost (see Table 2).

But the PSIDC was able to contribute only less than 10 per cent of the 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 project cost through their own resources. The PSIDC, hence, was willing to take a private firm of civil engineering contractors as a co-promoter on condition that it would provide more than 5 per cent of the required resources. The firm was willing to do so if its representative was made the managing director.

The IDBI was much impressed by the quality of the detailed project report; the IDBI had not received such a high quality project report from any one of the more than 150 projects that it had financed up to that time. Following discussions with PSIDC, PTL and the technical consultants, the IDBI was convinced about the management capacity, technical competence and motivation of the three critical groups.

The following characteristics of the project were particularly impressive:

(i) Based on domestic technology, knowhow and consultancy services, the Swaraj tractor was specially designed to meet local conditions, had passed the TTTS test and was approved by the farmers; of the existing six producers, the tractor design of only two firms had passed the TTTS test and all of them had obsolete models which were of pre-1965 design of their foreign collaborators and were not specially adapted to local conditions.

(ii) The three groups associated with the project were strongly motivated to make it a success.

(iii) It would support a large number of engineering ancillary industries in the Punjab — known for its entrepreneurial and mechanical talents — and thus have a large employment impact. In addition, the engine manufacturer was suffering from lack of demand as a result of industrial recession and would now be able to increase his output.

(iv) The project envisaged an efficient distribution and service system; no other existing firm had paid adequate attention to distribution and after-sales service.

(v) It had already started with the establishment of its own tool room to manufacture jigs, fixtures and inspection gauges; this tool room was also to be used for training its personnel, developmental work and re-

TABLE 3 : TRACTOR CAPACITY AND OUTPUT — SOME CHARACTERISTICS, 1972

Firm	Collaboration	Model - Make	Capacity (Two Shift Basis)				Production 1971-72 (Number)	Retail Price (1972) (Rs)	Retail Price (1972) (Rs)	Indigenous Content (%)	TTTS Test	
			HP Range									
			Up to 25	26-35	36 & above	Total						
1	Tractor & Farm Equipment (TAFE, 1961)	Massey Ferguson (UK)	MF-1033 DT-555 558	—	7,000	—	7,000	3,412	26,300 (MF-1035)	45,075	88	Passed
2	International Tractors (ITI, 1967)	International Harvester (UK)	B-275 B-435	—	7,000	—	7,000	9,005	25,200 (B-275)	45,000	80	Not Passed
3	Escorts Ltd (1966)	Motoimport (Poland)	E-37/3036	—	7,000	—	7,000	6,633	—	38,602	60	Not Passed
4	Escorts Tractors Ltd (1971)	Ford Motor Co (USA)	Ford-3000	—	6,000	—	6,000	1,950	25,200	—	51	Not Passed
5	Hindustan Tractors Ltd (1960)	Motokov (Czech)	Zeteor-3011 Super-50	2,000	5,000	—	7,000	377	(Super 50) 32,900 (Zateor) 24,100	—	85	Not Passed
6	Eicher Tractors Ltd (1961)	Eicher (W Germany)	D-BHP	—	2,000	—	2,000	789	25,200	31,600	82	Not Passed
7	Kirlosker Tractors (Assembly started 1972)	Klockner Humboldt (W Ger- many)	D-3006 D-4006 D-50006 D-10006	2,500	4,000	3,500	10,000	—	—	—	—	Not Passed
8	Harsha Tractors (Assembly started 1972)	Prommeshe- port(USSR)	T-25	10,000	—	—	10,000	—	—	33,360	—	Not Passed
9	United Auto Tractors (Assembly started 1972)	Industrial Export (Romania)	U-5000 U-6500	—	—	5,000	5,000	—	—	—	—	Not Passed
10	Hindustan Machine Tools (Assembly started 1972)	Motokov (Czech)	Zeteor 2011/2511	12,000	—	—	12,000	1,301	—	32,221	45	Passed
11	Punjab Tractors (Production to start in 1974)	None	Swaraj-724	12,000	—	—	12,000	—	—	33,354	100	Passed
12	Four Units Licensed (Not in Production)	W. Germany Australia & UK	—	—	—	—	38,000	—	—	—	—	Not Passed
13	Six Units—Letter of Intent (Still not given full Licence)	France, UK & USA	—	—	—	—	43,000	—	—	—	—	Not Passed
14	Capacity Expansion of 2 & 3. (Licensed but yet to be un- dertaken).	—	—	—	—	—	22,000	—	—	—	—	Not Passed
15	Total for 21 Units	—	—	—	—	—	188,000	—	—	—	—	Not Passed
16	Total for First 11 Units (Production and Assembly)	—	—	—	—	—	85,000	23,469	—	—	—	Not Passed

Source: Industrial Development Bank of India (IDBI).

TABLE 4 : TRACTOR DEMAND -- ESTIMATES FOR 1973-74

	Up to 25 HP	26/35 HP	36 & above HP	Total
Planning Commission Ministry of Agriculture	21,000	38,000	9,000	68,000
(a) 1968 Estimate:	25,000	45,000	20,000	90,000
(b) 1972 Revised Estimate:	---	---	---	40,000
Leading Tractor Manufacturers Estimate : 1968	10,000	40,000	15,000	65,000
Revised Estimate: 1972	---	---	---	36,000
Indian Society of Industrial 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
Total	11,301	26,168	---	37,469

Source: Industrial Development Bank of India.

search; no existing firm had research and development facilities and none of them had made any conscious effort to improve the design of their models to suit the local conditions.

(vi) About 10,000 tractors in the HP range of 20-25 were currently imported, while there was no domestic production of tractors in this range. The demand was expected to grow.

(vii) It was expected to produce and sell Swaraj at a competitive price and, as its capacity expanded — to 12,000 tractors after the initial pilot phase — it would be in a position even to export its tractors abroad.

However, the general Manager of the IDBI did not like the idea of a co-promoter; first because the co-promoter did not have particular experience with regard to tractor industry and secondly and crucially because he did not like the idea of the co-promoter's representative becoming a managing director. The success of the project depended on the CMERI Assistant Director becoming the Managing Director. He, therefore, assured the PTL that the IDBI would not insist on 15 per cent contribution by the promoters and arrange to finance 85-90 per cent of the project cost in collaboration with the other financial agencies if the project met the IDBI selection criteria.

The IDBI project appraisal team then prepared its report within two months. This report was submitted to an Ad Hoc Committee of Advisers (ACA) for critical examination and, as was the IDBI's practice, invited the ACA to discuss their comments with the project promoters. Such confrontation and dialogue gave the IDBI an additional opportunity to test the managerial and technical competence of the project promoters.

The ACA raised several critical questions. These questions and the

promoters' responses are given below as Q and A respectively:

Q: Farmers preferred a 30 HP engine, while the project had provided for a 20 HP engine.

A: 20 HP engine is cheaper and more suited to the conditions of small to medium holdings. Further, the Swaraj-20, in actual field trials, had performed better than the other indigenous 30 HP tractors and even better than most of the imported tractors in 20-25 HP range in regard to draw-bar pull and ratio of the draw-bar HP to the power available at the PTO — which are of primary concern to the cultivators.

Q: Farmers did not like air-cooled engines and hence one of the domestic manufacturers is to change over to water-cooled ones. A: We conducted a field survey in Punjab on this issue. The farmers do indeed prefer the air-cooled system. Thermodynamically, the air-cooled system is superior and the CMERI had completely redesigned the cooling system of the air-cooled engine for the Swaraj; in actual field tests at the TTTS, it was found that this engine was over-cooled to some extent.

Q: In view of the low capital investment per tractor of the PTL — lower by about Rs 2,000 than that of the other producer — the PTL can reduce production costs further by manufacturing its own engine. A: Since there is under-utilisation of capacity in the diesel engine industry, it does not seem advisable to add to capacity in this branch. Further, this would require additional investment and cause delay in project implementation. If our experiment succeeds, we propose to manufacture the engine at a later stage and the Kirloskers have already given an undertaking to the Central Government to transfer the complete knowhow for the manufacture of the Ra-2 engine to the PTL if the latter decided to manufacture it.

Q: It is not normal for a tractor manufacturer to produce its own requirements of jigs, fixtures and tools (JFTs). A: Unlike other do-

mestic producers with foreign collaborations, the JFTs required by PTL are not readily available. To develop a reliable source of quality JFTs in India far in advance of the commencement of trial production is difficult. Further, the cost of such JFTs would be nearly three times what would cost the PTL to manufacture them. The tool room is in fact a nucleus for R and D work; no other domestic producer has such R and D facilities.

Q: The Swaraj manufacturing programme envisages procurement of more than 80 per cent of components and materials from domestic sources; there is no import content. This would require a sound machinery for materials, planning and procurement, together with quality control of bought out components from ancillaries. This purchase from outside sources may lead to higher than expected costs and adversely affect delivery schedules as has happened in the case of the other manufacturers. The PTL should have more than one source of supply of components. A: This is a valid point. We are trying to develop alternative sources of supply and even provide technical assistance to new entrepreneurs seeking to start such ancillaries. Besides, we would have adequate machinery to ensure strict standards of quality control at each procurement, manufacturing and assembly stage.

Q: By 1973-74 the domestic production of tractors is likely to be about 40,000 tractors, while the demand may be of the order of 50,000. Thus there would be adequate demand for Swaraj. Further, Swaraj with its automatic hydraulic depth-cum-draft control (only Massey-Ferguson has similar hydraulics) and its superior product characteristics should be preferred by the farmers to other models. However, the industrial licences already issued by the government would raise the number of producers from six to 15 and production capacity from 40,000 to 1,23,000 if the new licensed units do start manufacturing. The demand, however, is unlikely to be higher than 50,000 even by 1978-79, while licences were issued in 1971 on the basis of a demand estimate of 90,000 tractors in 1973-74.¹⁴ With such relatively small-sized producers (only six of them may eventually have a capacity of more than 10,000 units) and proliferation of models based on foreign collaboration, the market would become highly competitive and unfortunately it would not be possible for any producer to lower its production costs with the unit size as fixed by the licensing authorities. Swaraj then would have to evolve a sound distribution and service machinery in order to compete effectively with the other producers. But even then, its returns are not likely to be adequate, what with its small size — 5,000 units — and government price con-

trol. A: We do not envisage any problem in marketing. We are to have an efficient dealer network with staff trained by the PTL to provide after-sales service and spare parts. In addition, we will have our own regional centres. Further, the field tests carried out on Swaraj in 1970 have created a good impression on the Punjab farmers. Because of its better product features and its superiority in field performance with more tilling potential at less fuel consumption in the 20-30 HP range, we are unlikely to face a marketing problem.

Q: The sale of tractors depends crucially on the availability of credit facilities to the farmers. Under the proposed World Bank scheme, the banks would be able to finance tractor-purchase by farmers as they would get reimbursement from the World Bank line of credit. We do not know whether Swaraj is included in this scheme. A: The World Bank team did not visit us, nor has it tried to inquire into the evolution of the Swaraj tractor. With the prejudice against indigenous research and technology at the Central Government level and also in the World Bank, it is unlikely that the Swaraj would be included in the World Bank scheme. However, we would try to persuade the Indian banks with the assistance of the IDBI to provide the required credit facilities. But this would certainly be a problem to be faced.

Q: The construction implementation schedule appears to be rather tight without much flexibility; it may not be possible for the PTL to complete the project by end of March 1974, that is, within 105 weeks after the sanction of financial assistance (March 1972), as the PTL proposes to put up its own tool room to manufacture all the toolings required. A: In fact this project has matured over a period of years -- since 1965, when the design work on the new tractor was undertaken -- and we have formulated it with great care. Further, we are using the 'Precedence Network' technique for the first time in India, which is an improvement over the conventional PERT/CPM and we are to review its network on a computer. We propose to adopt Open-web Portal Frame Steel Structures for construction -- this concept too is being introduced in India for the first time -- and this will result in speedy erection and substantial economy in structural costs by as much as 30 per cent. We are confident that if financial arrangements are completed by March 1972, we would be able to commence production from April 1974.

After this exchange, the project promoters left and the IDBI asked the ACA about its views on the project. The ACA approved the project; in their view, it was technically sound and would be able to produce and sell

a good quality tractor at competitive prices. However, they felt that it may take longer than expected to complete the project and in any case, in view of its small size -- as noted above, there are economies of scale in the tractor industry -- and government control on tractor prices, the project will not be able to have an internal rate of return of 15 per cent, one of the two IDBI selection criteria.

The IDBI then prepared a memorandum for its Board, recommending more than 85 per cent financial assistance (in collaboration with the other financial institutions) for the project: the memorandum argued that the exchange rate criteria was met -- the domestic resource cost of saving one US dollar was less than Rs 9.5 -- and this showed that the project was efficient. Obviously, an innovative project of this small size would not be able to have an internal rate of return of 15 per cent or more; but this rate was not very much lower than the cut-off rate -- it was 13 per cent. The Board approved the project and sanctioned the required financial assistance, partly by way of long-term loan and partly as equity, in February 1972. The technical research for designing this tractor had started only in late 1965 and was completed in May 1970; the PTL was formed in 1970, the project report was completed in September 1971 and was submitted to the IDBI for assistance in November 1971.

The construction work as well as the installation of plant and equipment started immediately after the IDBI sanction of financial assistance in March 1972. The performance of the PTL since 1972 has been remarkable with regard to both its cost and time schedules, as well as the manner in which it faced and tackled the problems as they arose.¹⁵

(i) The project was completed in 105 weeks by the end of March 1974 as was anticipated; the ACA had expressed scepticism about this time schedule.

(ii) The actual project cost was more or less the same as expected -- in fact it was somewhat lower -- with regard to not only the total cost but also the cost under each head.

(iii) The PTL started manufacturing Swaraj tractor -- Swaraj-724 -- from April 1, 1974 and reached its full capacity output (5,000 tractors) in 1977 -- again as was anticipated, in spite of raw material shortages, inflationary pressure and financial stringency.

For the IDBI, this performance was unique. There was hardly any project, financed by the IDBI, that had been completed in time without any cost overrun. Again, there was hardly any project that had reached its capacity output within the planned time frame.

Even the way in which the PTL identified its problems and tackled them reflected top management efficiency. During the first 15 months (April 1974 to June 1975), as was expected, it suffered from irregular supplies from the ancillaries at rising costs -- this was a period of acute inflationary pressures in India. The PTL suffered a cash loss of Rs 7.8 million as a result. The top management was aware that it would have to face this problem; the IDBI and the ACA had drawn pointed attention to this aspect of the project. But till November 1973, PTL had no inventories and its relationship with its ancillaries had still not been formalised. At this stage, the PTL could not afford more than one source of supply for each component; the initial production was inevitably limited by the available supplies of components and to develop new sources required intensive technical inputs from the PTL.

Since November 1973, the PTL concentrated on developing multiple sources of supply for each component. It promoted itself new ancillaries near the location of the Swaraj by providing technical assistance to new entrepreneurs. Thus its materials pipeline improved and it was able to increase its output to full capacity level before the end of 1977.

But its production costs rose steadily as input prices rose. Unlike the other manufacturers, its output had no import content; others imported their inputs to the extent of 20-30 per cent of requirements and the prices of imported inputs were significantly lower than those of the domestic inputs. For example, the HMT had started the production of Zeteor-20 by this time with an import content of more than 45 per cent. A Ministry of Finance study indicated that the cost of inputs was lower by about Rs 4,000 per tractor for the Zeteor as compared to that for the Swaraj. Even this figure does not accurately reflect the Zeteor advantage. For Zeteor, all imported inputs did not require further processing as the HMT was largely doing assembly operations. Yet the Swaraj price was comparable to that of the Zeteor; but its margin was much lower -- the cost of inputs rose from 77.5 per cent in June 1973 to 93 per cent of ex-factory

selling price by March 1975.

Hence, the PTL suggested to the Government of India that Swaraj should be exempt from excise duty of 10 per cent (about Rs 3,000 per tractor) to offset its higher input prices of domestically bought components. This exemption was granted by the end of 1975 and since then the PTL's financial performance approached the planned level by the middle of 1977, with manufacturing efficiency superior to that of the HMT, producing the Zeteor in the Swaraj HP range.

In addition, the PTL took several measures to reduce its costs and diversify its products through intensive R and D work. It developed a new design — Swaraj-735 (35 HP) — during 1974-75 and introduced it by the end of 1975 — the second year of its operation. For this 35 HP tractor the additional costs were only Rs 2,000 per tractor, while the price advantage was of the order of Rs 4,000 per tractor; because of historical reasons, it appears that the farmers regarded a higher price product as a superior product¹⁶ (they were used to the Massey-Ferguson tractor of 35 HP — a tractor which had passed the TTTS test and was the most popular tractor since 1961). By 1977, its output composition was 4,200 Swaraj-735 and 800 Swaraj-274. It has started work on developing a third model and expects to start its production by the end of 1977. No other tractor manufacturer has given such attention to R and D work for product planning — developing new designs and models in response to local conditions and farmers' preferences.¹⁷

Swaraj has been, as was expected, a successful model judging from the farmers' response. The PTL has been able to sell its entire output: at a point in time orders booked number 500 tractors. Its distribution-cum-service system has been superior to that of any other manufacturer. It has, however, one handicap. Swaraj was not included as an eligible tractor for the World Bank line of credit under which finance is provided to farmers at a concessional rate through the Agricultural Refinance and Development Corporation (ARDC); quite surprisingly, this scheme is meant for tractors in the range of 26 HP above and this scheme does not mention Swaraj as a tractor worthy of financial support. Anyway, the PTL has devised appropriate financing schemes with the help of the ARDC.

It is worth mentioning that this new

experiment in developing a product based on indigenous technology and knowhow won recognition from the Central Government — *which was not prepared to sponsor the Swaraj project in 1972*; in 1975 the PTL was awarded the National Gold Shield for the country's highest award, for its contribution to the development of indigenous technology, knowhow and consultancy services. The Central Government then began to emphasise, in actual practice, technological self-reliance.

III

Problems and Conjectures

Such is the story of the Swaraj Tractor. It raises several problems for analytic inquiry — problems relating to the behaviour of various units. In this section we try to examine the problems relating to the Swaraj case proper; in the next section we deal with the problems with regard to the industrial licensing process.

The following questions arise with regard to the Swaraj story:

(i) Why did the Central Government not sponsor this project?

(ii) Why did the Punjab Government take the risk of undertaking this project? What were the nature and characteristics of its decision-making that accounted for its success?

(iii) Why was this experiment in the creative adaptation of modern technology fruitful?

Let us proceed to examine these questions and try to draw some inferences — conjectures — about the public sector decision-making process.

Central Government Behaviour:

One part of the Government — the Planning Commission took the deliberate decision to develop an indigenous tractor design. The CMERI did successfully evolve the Swaraj tractor: it passed the TTTS test. The HMT, a Central Government enterprise, which was facing the impact of industrial recession on the demand for machine tools, wanted to undertake a tractor project to use its surplus capacity and thus improve its financial results. At this stage, the NRDC considered Swaraj a risky project and advised the HMT to take up the assembly of Zeteor which had also passed the TTTS test. This suited the HMT as Swaraj would have involved a gestation lag of two to three years, while the assembly of Zeteor could start immediately. Doubtless, the HMT decision was a rational one from its own point of view. But the question is:

Why did the Central Government not sponsor another public sector enterprise to manufacture the Swaraj?

One answer could be that bureaucrats in Delhi had no technical knowledge about the tractor industry and probably considered an enterprise based on mere research result a risky venture. They simply did not want to take this risk. However, this explanation does not seem to be valid. After all, the Central Government had adequate technological competence; did it not have CSIR, NRDC and even the CMERI, which had developed Swaraj? And the CMERI personnel were quite confident about the superiority of the Swaraj tractor in the Indian context.

Could it be that the technical personnel in the CSIR and the NRDC and hence the bureaucracy had no confidence of faith not only in the competence of the CMERI personnel but also with regard to indigenous technology and consultancy ability generally? After all, foreigners had experimented with their designs in actual commercial production for a long time and it was much less risky to take their help than to undertake an enterprise on the basis of commercially unproved indigenous knowhow.

It appears from the available evidence that such indeed was the response of the Central Government scientists, technologists and the bureaucrats. If this be true, how could India ever creatively adapt modern technology to its local conditions? Again, in that case, what could be the rationale of setting up scientific and technological research institutions as part of the Central Government machinery for decision-making in the technological field?

Another explanation could simply be inter-institutional rivalry and jealousy. Suri, the record shows, was not much liked by the CSIR or NRDC personnel; with the change in the political set-up after 1968, Suri did resign from the CMERI. By 1971, thus, within the Central Government apparatus, there was no leadership — either at the political level or at the technological level — to sponsor an active technology policy that could raise policy issues above the field of inter-personal and inter-institutional rivalries and jealousies.

In this connection, a fact about the World Bank mission is worth mentioning. In 1971, the World Bank sent a mission to study the growth and structure of the tractor industry in India

in order to make policy recommendations to the Central Government and find out the nature and magnitude of financial assistance that the World Bank should offer. This was the time when the Swaraj model had already evolved and passed the TTTS test and the PTL was organised to implement the Swaraj project. It is surprising to find that the World Bank mission did not contact either the CMERI personnel or the PTL and, in fact, made no reference to the Swaraj project in its report except to mention in a footnote that it was one of the three tractors that had passed the TTTS test. As a result, the World Bank line of credit was not available to farmers purchasing Swaraj, while it was available for the purchase of all domestic tractors in the HP range above 25. It is somewhat ironical to find this World Bank study recommending improved product planning to upgrade designs by the domestic producers with the technical assistance of their foreign collaborators. "Indigenous capabilities will grow through collaboration agreements but, in addition, firms should initiate co-operative programmes with indigenous universities and engineering research centres (such as, for example, the Central Mechanical Engineering Research Institute) aimed at developing tractor features especially suitable for India." Does this require any comment? The question is: Why did the Central Government officials keep the World Bank team in the dark about the Swaraj, the CMERI and the PTL? Did one party reinforce the inferiority complex of the other with regard to indigenous technological competence? Why this emphasis on foreign collaboration in a technologically simple product like a tractor?

Decision-making at the State Level: In spite of the scepticism about the Swaraj project on the part of the various Central Government agencies, how did it come to pass that another unit of the government — the Punjab state government — decided to undertake this project in 1970?

The Punjab government and the Punjab farmers were familiar with the whole process of evolution of the Swaraj. After all, the field trials were largely undertaken in the Punjab. The farmers had in a sense become a part of this venture, and they had approved this new product which was expected to save on both capital and operating costs. Further, the Punjabis are proud of their mechanical talents; one of the farmers had in fact success-

fully done 'reverse engineering' with regard to an East European tractor and had made a similar tractor in his own workshop. (Patent rights violation prevented this farmer from undertaking small-scale production of this tractor.) They were thus able to judge Swaraj on its merits and had a certain pride in owning a tractor based on technology and knowhow developed in India — and more particularly by the Punjabis. (Suri happened to be from the Punjab.)

This was one consideration. The other was the potential employment impact of the tractor project. The Swaraj was to purchase more than 80 per cent of the components from the ancillaries, mostly from Punjab which has the most thriving small-scale industrial sector in India.

Thus the PSIDC was confident about the farmers' response, the employment impact and the financial success of the project. The PSIDC is an independent agency of the Punjab government with the function of promoting industrial development of the state. It is aware that it can perform this innovating function effectively only if projects succeed in financial terms. For the Punjab government would not — could not — provide subsidies on a continuing basis; and even if it did, such subsidies would affect its ability to function with a degree of independence and thus its ability to take risks and innovate.

How do we account for the remarkable performance of the PTL? The comprehensive and illuminating detailed project report, the timely completion of the construction phase without any cost overrun, the timely realisation of capacity output, the ways in which the top management tackled problems as they arose and the new models developed through continuing R and D work — all these characteristics of project performance were indeed unique in the financing experience of the IDBI.

The factors which seem to account for this performance are the following:

- (i) Selection of the project by the PSIDC on the basis of its visible and direct potential impact on its financial resources, Punjab farmers and employment in small industries;
- (ii) selection of technical consultants and top management personnel — persons who were associated with the design of the Swaraj;
- (iii) the powerful non-economic motivation of the technical consultants and top management in

making a success of the project, the managing director was to be paid only a salary fixed on the basis of Central Government scale (he was on deputation from the CMERI) and Suri's fees were much below the fees charged by the other consultants, Indian or foreign; and

(iv) enlightened development orientation of the IDBI top management and policies; without the IDBI financial assistance and its own motivation to make it a success, the project would not have seen the light of day.

Creative Adaption of Modern Technology: This case has relevance for the decision-making process not only with regard to the Swaraj project but also with regard to the process of creative adaption of modern technology. The organic and sequential relationship among the following tasks and functions seems to have been the crucial factor in the success of this experiment.

Identification of a project idea on the basis of development strategy was the critical first stage. This was done by the Planning Commission. The identification of available technological choices for this was the second; this was the function of a Technical Consultancy Service Centre (TCSC); in this case, the CMERI performed this function. Identification of a research problem by a TCSC, in this case, the CMERI, was the third stage. The research on the problem by a Technological Research Centre (TRC), in this case, the CMERI, and the transmission of this research result to the TCSC, in this case, Suri and Associates, was the fourth stage. The detailed project report by the TCSC to the project promoter (PTL) and the financial system (IDBI) was the fifth stage. The association of the TCSC with the top management for project implementation was the final stage.

In this organic sequential relationship, the critical functions were performed by the TCSC and the IDBI — the functions of identifying relevant research problems, embodying the research results meaningfully into a concrete project, and facilitating its implementation. Without the TCSC, neither the relevant research problem nor a concrete project would have been identified; and without the link between the TCSC and the IDBI, the project would not have become an operational project. It thus appears that the critical links in the process of creative adaptation of modern technology are the TCSC and the Financial

System (IS); without these two functional agencies the production system and the technological research system are likely to evolve on parallel lines.¹⁹

IV

Decision Process : Industrial Licensing

In India, the volume and pattern of investment in the manufacturing sector are regulated by the Industrial Licensing System (ILS) in the light of the development objectives and strategy, as worked out by the Planning Commission. In the case of the tractor industry, the actual operation of the ILS raises several questions: (1) After the decision to manufacture tractors was taken (after 1959), why did the ILS issue licences to five units, each to produce on relatively small scale a distinctive foreign model in the HP range above 26? (2) Why did the ILS issue licences and letters of intent to raise capacity much in excess of potential demand for tractors? (3) After the Swaraj model was developed and had passed the TTTS test in 1970, why did the ILS issue licences to manufacture tractor models of foreign designs during 1970-71?

Behaviour of ILS : Pre-1965 : It is true that the demand for tractors in India was growing, particularly after 1955. However, no agency seems to have examined the question: Was it essential to mechanise agricultural operations when employment was a problem? As it turned out, substitution of tractor for animal power was worthwhile; for timely and dependable results in areas with multiple cropping and because of rising opportunity cost of animal power with sharp increases in land productivity in irrigated areas as a result of the green revolution.²⁰ Anyway, it is pertinent to note that an agency in charge of regulating industrial development did not raise this basic question before issuing licences to five units by 1965.

Several further questions arise: in spite of the economies of scale in tractor production and distribution, why did the ILS license five units with relatively small capacities? Why did the ILS not insist that each tractor model should pass the TTTS test before applying for a licence? Why did the ILS not examine the suitability of each tractor design to local conditions and farmers' resources?

The ILS choices were governed by 11 criteria which the public sector decision-making process had to take

into account; briefly these were:²¹ (1) Promotion of industrial development; (2) Promotion of a self-reliant and self-generating economy; (3) Preventing concentration of economic power; (4) ensuring balanced regional development; (5) setting high welfare standards for labour; (6) increasing employment opportunities; (7) Strengthening the defence potential of the country; (8) enlarging the cadre of highly trained engineers and technicians; (9) setting healthy and clear standards of management; (10) keeping down prices; and (11) financial viability. These were the criteria for the public sector projects; for regulating private sector investment, it appears from the operation of the ILS that it chose the first four and the eleventh from this list. The industrial sectors that need to be promoted were, in a sense, indicated by the Planning Commission. Thus the operating criteria for the ILS actually were: prevention of concentration of economic power, ensuring balanced regional development and financial viability of the project. It is pertinent to note that there is no mention of the price-quality suitability of the industrial product to be produced and the impact of these characteristics on the Indian consumers, costs of import substitution and industrial exports.

The private firms, it was assumed, would take into account the financial viability of their projects. By this process of elimination, only two criteria of choice effectively remained for the ILS: prevention of concentration of economic power and the promotion of balanced regional development. Both these criteria indicated multiplicity and dispersal of firms and limitation on the size of the production capacity of each unit.

With these two criteria there was a risk: financial viability may not be ensured. The solution was: to issue licences to established firms which could enter into collaboration with reputable foreign firms. Such firms, it was argued, would have adequate management capacity to ensure financial success of their projects. There was thus an obvious bias in the ILS against indigenous technology and knowhow, and new entrepreneurs.

Such seems to have been the logic governing the behaviour of the ILS. But this logic had the following results by 1971: (i) underutilised capacity because of poor management and farmers' rejection of tractor models produced by three out of five firms;

(ii) complete neglect by the majority of producers of the crucial functions: product engineering and planning, and distribution and after sales service; and (iii) lack of resources to expand and diversify tractor output.

Behaviour of ILS : 1970-71 : Such was the state of the tractor industry by about 1971. Tractor capacity was underutilised, while imports were substantial (about 40 per cent of total supply). The demand for tractors, however, was expected to grow to about 90,000 by 1973-74. The solution to this problem was to license more units and permit six more units (this was the logic of issuing letters of intent) to obtain licences in future if they could finalise that production programmes. The potential capacity of the licensed eleven units was raised to 1,07,000 tractors; while production in 1971-72 was only 23,469 tractors with imports of 14,000 tractors. (See Appendix, Statements III and IV.)

The Ministry of Agriculture had the benefit of other demand estimates; estimates of Indian Society of Industrial Engineers and Tractor Manufacturers. Both these estimates of demand for 1973-74 were much lower (52,000 and 65,000 respectively) than that of the Ministry of Agriculture. Why did the ILS disregard these estimates?

One reason, of course, was that the Ministry of Agriculture was closer to the ILS and, for the ILS, it was probably natural to trust the ministry's estimate. Further, it is likely that the ILS may have taken the view that the ministry was in possession of data relating to registration for tractors—data which were not available to the outsiders.

But these data were in fact crude; in a controlled system, obviously there were multiple registrations¹ each farmer registering for several tractor models, in the hope of obtaining whichever was available as early as possible. Further, farmers' demand is a function of tractor prices as well as the nature and terms of credit facilities. These facts were not taken into account.

By 1972, the controlled prices of tractors were raised and the credit facilities became scarce. The demand for tractors did get affected; the new revised demand estimates made in 1972 were nearly 50 per cent lower than those made earlier.

Swaraj and the ILS : By 1965 it was known that to suit local conditions the farmers required a tractor in the HP range of 20 to 30; by 1970 the

Swaraj had passed the TTTS test.

In this context one would have expected the ILS to issue a licence only to such a firm which could produce the Swaraj. Because of economics of scale in production as well as distribution, the choice should have been in favour of a public sector firm; for the private sector the argument of concentration of economic power would apply. Why did the ILS not suggest such a course of action?

Probably, the ILS simply did not know the history of the Swaraj; this information was available elsewhere in the government and there was no communication channel developed for transmission of relevant information to the ILS.²² And this channel did not develop because the ILS criteria of choice — its agenda — did not require such information. If it is difficult even for a private firm to modify its agenda — taking account of new decision variables — how much more difficult would it be for the administrative bureaucracy where persons, before they rise to decision-making positions, are already indoctrinated in the virtues of the pre-existing agenda?²³

The agenda selected by the ILS were eminently rational if one viewed them in the context of the political process and the bureaucratic politics. Concentration of economic power and regional balance were the political issues raised by the politicians in a federal democracy. The agenda suited both the ministers as well as the bureaucracy; and the risk inherent in this agenda was reduced by issuing licences to established firms with foreign collaboration. Thus, this agenda also suited the interests of Indian and foreign big business.

There was yet another merit. If technical decisions were to be made predominantly on technical grounds, it would be essential to set up an expert machinery for the purpose. Such a machinery, however, would not be set up because of the reasons mentioned earlier in connection with the demand studies. The agenda had the merit that it did not require such expert machinery. For dealing with the minor technical issues that the administrative bureaucracy may not understand, it is possible to have a technical bureaucracy under the administrative civil service. But industry would obviously have more expertise than this technical wing; so the technical wing too would have to accept this agenda. Its technical examination and modification of projects would merely relate to such

minor technical changes that can be made, given the constraints of the agenda. This was precisely the role of the Directorate General of Technical Development (DGTD)²⁴ in the ILS.

Hence the DGTD did not raise the basic issues relating to economies of scale or farmers' preference. In the tractor case, it did not occur to the ILS that farmers' preferences are determined by history; in a durable commodity like this, they cannot afford to experiment. So they demand such products which they have got used to. They would not know the quality of the other alternative products; and quite likely, the lower priced product would be regarded as an inferior product.²⁵ In a sense, this is what happened. Farmers had become used to 35 HP Massey-Ferguson and International Harvester tractors; they were dependable. A cheaper tractor in HP range below 30 came to be regarded as an inferior product. It was thus that price difference between 20 HP and 30 HP tractors was much greater than the cost difference. The change-over by the PTL to a 30 HP tractor in 1975 was largely because of these reasons; its additional cost was only Rs 2,000 per tractor, while its additional price advantage was Rs 4,000 per tractor. Neither the ILS nor the Ministry of Agriculture considered it essential to provide full information to the farmers on the relative merits of the different tractor models. It is pertinent to note that the ILS did not insist on the TTTS test before issuing a licence nor did it insist on good distribution and after sales service set-up-key elements for decision-making if the farmers' interests were to be safeguarded.

For some such reasons the ILS did not consider the Swaraj development as a key factor for its licensing policy. But for the CMERI, the PSDC, Suri and Associates and the IDBI, the Swaraj tractor would not have seen the light of day; this success, however, is likely to become a 'coercive fact' and has the potential of modifying the 'agenda' — the decision criteria of the Central Government agencies. Whether this potential would be realised depends on so many complex factors; one cannot be certain about the direction of change.

V

Decision-Making Process : Some Central Observations

It seems possible to make some conjectures of general relevance about

the problem of public sector decision-making in the developing countries. These conjectures point towards some hypotheses around which it may be possible to formulate a theory of public sector behaviour.

(1) Socio-economic development is not an isolated process; it is an integral part of the process of nation building. But this effort at nation building does give rise to a variety of tensions and pressures — a conflict among structural principles of social fabric. These conflicts are aggravated in a country with a federal democracy and a mixed economy. Anyway, the fact to be recognised is that the two processes — process of nation building and the process of socio-economic development — are interrelated and one affects the other.²⁶

(2) Such is the context for the decision-making process. Obviously, government cannot be a monolithic structure with a given consistent set of objectives. But this does not imply that each participant in the decision-making process takes irrational decisions. Given his context, he is rational. If the total outcome of the process appears to an outside expert observer as irrational, the reason is not the irrationality of decision-makers but the analyst's incapacity to understand the problem.²⁷ Because of the nature of the political-bureaucratic structure, the range of choice with regard to objectives has to be very wide. This range can be narrowed in technical terms if the trade-offs among the given objectives can be settled. But this technical requirement can be in some sense approached only by a profound change in the socio-political process.

(3) This choice-range for objectives creates even a wider range of choice for policies and policy instruments (projects) for each decision-making unit. Paradoxically, this fact makes it possible for each decision-making unit to make a choice on the basis of a limited agenda and thus delimits his search for relevant information even from the other parts of the government. The policy decisions or choice of projects in the same broad field may appear to be inconsistent to an outsider but may still be based on rational considerations from the point of view of each decision-making unit.

(4) In a socio-economic process with these choice characteristics, plurality of decision-making units with different agendas seems to be essential.²⁸ Such plurality makes creative experimentation possible and since the re-

sults of such experiments are concrete and easily observable, the information content of the decision making process would improve and this may tend to narrow the range of choice with regard to both objectives and instruments (projects). Thus a learning process based on experience and experimentation can be set in motion.

(5) This study suggests that for effective and efficient choices, it may be advisable to evolve an institutional structure, where actual decisions with regard to projects and policies are made by units, whose growth, development and vitality critically depend on the results of choices made.

(6) It is possible to improve the decision making process by institutionalising certain key functions and thus delimiting the range of purely political decision-making. The institutions that seem to be essential are: Project Promoting Agency, Industrial Development Bank, Technical Consultancy Service Centre (TCSC), and Technological Research Centre (TRC); each of these institutions should have an identity and a function, distinct from the administrative bureaucracy.²¹

(7) Such an institutional structure is essential also for the process of creative adaptation of modern technology; from this point of view, the roles of TCSC and the IS (Industrial Development Bank) are critical; they provide the effective link between the technological research system and the production system.²²

(8) This study also suggests that implementation and operation of a manufacturing project is likely to be more effective and efficient if its top management is vitally associated with the selection and formulation of the project which it has to administer, than if it is not.

(9) The advice of outside experts and international agencies can be effective in improving the decision-making process, only if it is based on a sound understanding of the socio-economic process in a given country. Their advice quite often is ignored in practice or becomes counter-productive mainly because they try to impose their own objective functions on the government concerned. They could be more effective if they become in some way participants in the socio-political process of narrowing the range of choice rather than by urging governments to become more rational in their choice by attributing appropriate weights to their different objectives as if the government were monolithic.

structures with one mind and one will.²³ The international agencies and other experts can make a crucial contribution in accelerating the process of change if they helped these countries in evolving a sound institutional structure of the nature indicated earlier. But for this they need to understand the rationality and meaning of this process of change; just to say that it is irrational is not to understand it. What requires understanding is the Problem; without this, solutions offered are likely to be solutions to non-problems or pseudo-problems, however sophisticated be the language in which they are clothed.

Notes

[It would not have been possible to undertake this study but for the assistance of the Industrial Development Bank of India (IDBI) - of which the author happened to be general manager when the decision to finance the Swaraj Tractor project was taken. The IDBI made available several documents: the detailed project report prepared by the Technical Consultants (Suri and Associates), the IDBI project appraisal reports submitted to the Ad Hoc Committee of Advisers (ACA) as well as to its own Board of Directors, and its project supervision reports. In addition, the Punjab Tractors Ltd (PTL) - the firm operating the Swaraj tractor project - made available to us, through the Government of India, its progress reports and accounts. The author has also had the benefit of intensive discussions with the members of the project appraisal and supervision teams of the IDBI, Suri of Suri and Associates, Chandra Mohan, the managing director of PTL, and members of the ACA to the IDBI.]

- 1 For the role of the State in economic development, see V V Bhatt, "Employment And Capital Formation in Underdeveloped Economies", Orient Longmans, Bombay, 1960, Chapter VI.
- 2 On the complexity of the motivation pattern and the decision-making process, see: Richard V. Clemence (ed), "Essays of J. A. Schumpeter", Addison-Wesley Press, Cambridge, Massachusetts, 1951, pp. 216-227; Kenneth J. Arrow, "The Limits of Organisation", W W Norton, New York, 1971, Chapters 3 and 4; James Kornai, "Anti-Liberalism", North Holland, London 1971, Chapters 7, 11 and 12.
- 3 Robert T. Kudrle, "Agricultural Tractors: A World Industry Study", Ballinger, Cambridge, Massachusetts, 1975, p. 3.
- 4 *Ibid.*, pp. 19-22. To quote: "It appears that the innovations in farm machinery before World War II, so much admired by Schumpeter, has continued apace with some types of equipment while tractor design virtually stagnated. Once the Ferguson system was com-

pletely diffused, however, innovation in it has not been able to point to important areas of design neglect... the lack of advance is usually assigned to the rather simple nature of the product and the limited number of areas of possible design improvement. Continuing improvement of the hydraulic system has probably been the single most important area of advance", p. 203.

5 *Ibid.*, pp. 32-34.

6 *Ibid.*, pp. 208.

7 *Ibid.*, pp. 4-8.

8 "If the farmer could be made aware by his own organisations of the persistent and substantial discrimination practised against him in the past, it is not unreasonable to assume that he would become at least somewhat annoyed (his Canadian counterparts certainly did!), and the trust which is such a large part of the product differentiation barrier carefully nurtured by the companies over the years would be diminished thereby. A demonstration that fully comparable tractors have been sold for up to two decades in other parts of the world for vastly lower prices than offered to the US farmer should help convince him that a bargain tractor price is something to be carefully considered and not necessarily a sign of inferior design or manufacture", *Ibid.*, p. 222.

9 See Indrajit Singh and Richard H Day, "Tractor Utilisation and Substitution in Economic Development: A Green Revolution Case Study", *The Journal of Development Studies*, Volume II, April 1975, pp. 155-177.

10 The capital and operating cost of a tractor is a function of its horse-power, these costs are lower for tractors in the HP range below 35 than those in the HP range above 35. The horse-power requirement depends on the size of the farm, the cost of animal power and labour, and the characteristics of the soil and terrain. In North America and the UK, in 1970, only 10 per cent of tractors sold were units of less than 35 HP, while this proportion was 5 per cent in Germany and 23 per cent for Italy. In East European countries and Japan this proportion is even higher than 50 per cent. See Kudrle, *op cit.*, pp. 21-25, 87 and 90.

11 See G S Aurora and Ward Morehouse, "Dilemma of Technological Choice - The Case of the Small Tractor", *Economic and Political Weekly*, Special Number 1972, pp. 1633-1644.

12 See A. Basant, C. L. Chatterjee, "Public Enterprise Investment Decisions in India", MacMillan, Bombay, 1977, pp. 115-117.

13 For the evolving role and functions of the IDBI, see *Annual Report of the Industrial Development Bank of India 1970-71 and 1971-72*, V V Bhatt, India Indus Development Publ. of India (ID-

- BI): Recent Evolution in its Role and Functions', Prajnan, Volume 1, Number 3, 1972.
- 14 For details regarding manufacturing firms, capacity output, actual production, tractor prices, and the industrial licences, see Table 3; and for the various demand estimates, see Tables 4.
 - 15 For the performance indicators of the PTL, see Tables 1 and 2.
 - 16 The US farmers seem to have behaved in a similar fashion; see Kudrle, *op cit*, Chapter 13.
 - 17 In addition, the PTL have initiated research, in collaboration with the Punjab Agricultural University, Ludhiana, on the development of a tractor-drawn paddy transplanter capable of handling six rows of paddy seeding at a time — that is, it could cover four acres of transplanting a day. Field trials of the prototype transplanter are completed.
 - 18 World Bank, *Survey of Tractor Manufacturing Industry: India* (Mimeographed.) Washington, May 1973, p 23.
 - 19 On the role of the ICSC and the FS in technology policy, see V V Bhatt, 'On Technology Policy and Its Institutional Frame', *World Development*, Volume 3, Number 9, September 1975, pp 651-663.
 - 20 See Inderjit Singh and Richard H Day, *op cit*.
 - 21 Government of India, Ministry of Information and Broadcasting, "Toward Prosperity Through Public Sector: Public Sector for Public Good", Delhi, 1971; see also A Besant C Raj, *op cit*, pp 109-111.
 - 22 See in this connection Raj, *op cit*, for an illuminating case study with regard to the Manual of Feasibility Studies.
 "...the major guidelines for capital budgeting decisions of public enterprises are contained in a Manual of Feasibility Studies prepared in 1966 by the Committee on Plan Projects of the Planning Commission....
 "The Manual was issued in 1966 and we conducted our interviews in 1970 and 1971. We expected that most of the senior executives of the public enterprises, particu-

larly the senior financial executives, would be very familiar with this Manual. To our great surprise, we realised that many of them had not even heard of the existence of such a Manual. As a means of cross-checking, we often referred to this Manual while conducting programmes on management for senior executives from the public enterprises. Except for a few on the whole, many of these executives were not aware of this Manual. Responses received to the questionnaire mailed to enterprises were most often categorical that no Manual or guidelines existed for capital budgeting decisions. Due to this consistent response, we decided to raise this issue in the interview we had with the Unit of the Planning Commission which was responsible for the preparation and circulation of the Manual. We were told that more than 1,500 copies of this Manual had been released for use by the various public enterprises. We can only conclude that while a large number of copies of this Manual have been prepared and released by the committee on Plan Projects of the Planning Commission, neither the existence of this Manual nor its contents are known at this level of executives in the public enterprises. It is likely that the copies of the Manual sent by the committee on Plan Projects have remained mainly at the level of the administrative ministries and Chairmen/Managing Directors of these enterprises.

"... However, the initiative and active interest of only one of the members of the Planning Commission was responsible for the birth of the Manual. Since this particular member of the Planning Commission had a strained relationship with other senior Secretaries of the administrative ministries, and the Finance Ministry, it became necessary to persuade the Deputy Prime Minister, who also happened to be the Minister of Finance, to issue that letter. Here is an instance of personality conflict among the top officials of the Government, which blocks the effective use of a system conceived for the purpose of improving capital budgeting practices and procedures by the administrative ministries. This also demonstrates the resistance of the sub-units of a large organisation even to use

a control system, designed and developed by another sub-unit of the total system". pp 183-184.

- 23 See Arrow, *op cit*.
- 24 Raj, *op cit*, pp 85-7.
- 25 The US experience is similar. See Kudrle, *op cit*, Chapter 13.
- 26 V V Bhatt, 'Perspectives on External Assistance', *Economic and Political Weekly*, Annual Number, February 1967.
- 27 See Joseph A Schumpeter, "Capitalism, Socialism and Democracy" Harper and Row, New York, Third Edition, 1975.
- 28 See P D Henderson, 'Two British Errors: Their Probable Size and Some Possible Lessons', *Oxford Economic Papers*, Volume 29, Number 2, July 1977.
- 29 See V V Bhatt, "Structure of Financial Institutions" Vora, Bombay, 1972.
- 30 See V V Bhatt, 'On Technology Policy and Its Institutional Frame', *op cit*. See also V V Bhatt, 'Development Banking: Top Management Tasks and Structure', *World Development*, Volume 4, Number 6, 1976, pp 519-527.
- 31 See Martin Rein and Sheldon H White, *op cit*.

To the problem of public sector decision making, some simple panaceas are being advocated by economists of the neo-classical tradition as well as the Marxian tradition. The former recommend the abolition of the public sector and the latter, the abolition of the private sector. These panaceas, of course, emerge from the Scriptures and not from the understanding of historical processes of socio-economic change. It does not occur to these interpreters of the Scriptures that there is a problem which needs to be understood: What is the logic and dynamic of the situation that has created mixed economies and, in particular, are responsible for the expanding role of the public sector in the field of industrial development. Of course, to examine this problem requires much more thinking than to churn out solutions to irrelevant problems on the basis of equally irrelevant economic or theoretical models.

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