

THE 5 YEAR PLAN: SOME COMMENTS ON THE ROLE OF THE TECHNOLOGIST

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The Five Year Plan

1. The essence of the Five Year Plan which must be borne in mind at all stages in its implementation is the development of a new selfreliance in the individual and in the community. The Technologist has to play the chief role in this drama; and any frailty of the prevailing system should not be allowed to prevent achievement of this objective.

Under-development and Development

2. I would like to present some general comments on the background to under-development and development on this occasion before going on to offer some comments on the role of the technologist in the implementation of the Five Year Plan. Francisco Sagasti is an Economist whose first degree and training was in industrial engineering. As a part of his doctoral thesis in the Management and Behavioral Science Centre of the Wharton School of Finance and Commerce, in the University of Pennsylvania, Philadelphia, he prepared a study for the Organisation of American States entitled "Towards a Methodology for Planning Science and Technology in the under-developed Countries." This Methodology had been applied to the Andean Pact countries, Peru, Chile, Equador, Bolivia and Columbia. The Methodology states that:

"Underdevelopment is a phenomenon on its own right, it cannot be adequately studied and interpreted as a "stage" in a sequential development process or as an interval in a sequential development continuum along which all countries can be placed and through must proceed in order to become "developed". Underdevelopment is a part of the historical process of industrialisation on a world wide scale, which implies that both development and underdevelopment are two facets of the same process of expansion of capitalist society beginning in the XIX century. This process involved the creation and spread of modern technology and the establishment of an international division of labour with a few more advanced countries producing manufactured goods and a large number of backward countries supplying raw materials and primary commodities. Underdevelopment and development evolved simultaneously, they were and are functionally related, and they also interact and condition each other.

These two phenomena must, therefore, be understood as inter-dependent partial structures which form part of a single system. The key factor differentiating these structures is that the developed one, by virtue of its endogenous capacity for growth, became dominant and the underdeveloped one, given the induced and passive character of its dynamics, became dominated and dependent.

The main characteristics of an underdeveloped country are that it is dominated, disarticulated, and incapable of covering the costs of a human status for the majority of its population. Domination implies that the UDC does not have an autonomous capacity for decision and that it has little control over its own destiny. External environmental factors, beyond the control of the underdeveloped country, are the main determinants of the direction taken by its economic, social and even political structures."

"It is important to point out that developed countries have been continuously shifting their modes of domination over underdeveloped ones in response to changing conditions and to pressures from them. From the control of raw materials extracted from, and manufactured goods supplied to the UDC through export-import trading measures, they moved to the control of industrial production facilities through direct investment, and are now shifting to the control of technological know-how required in manufacturing industries. This last form is often exercised through direct investment and also through licensing agreements, sales of patents, etc. The primary vehicle through which these various forms of domination have been and are exerted has been and is the international or multinational corporation."

"Economic development, taking the point of view of the under-developed country, is considered a dynamic process of structural change characterised by three factors: (1) absolute and sustained economic growth, (2) scientific and technological progress, and (3) social propagation of the effects of (1) and (2) to all sectors of the population.

The first factor, economic growth, traditionally has been considered as synonymous with economic development. Although a necessary condition, it is not sufficient by itself for economic growth, without technological progress and the propagation of their effects, does not lead to overcoming the conditions of domination and disarticulation which characterise underdevelopment.

The second factor, technological progress, refers to the autonomous capacity in the part of the country to generate, diffuse and utilise scientific and technological knowledge, incorporating it in its productive processes. However, this autonomous capacity does not imply autarchy and rejection of technology imported from abroad, it rather implies the capacity for importing, absorbing and modifying the foreign know-how, adapting it to local conditions and even re-exporting it after further elaboration. Only through a process of creating its own scientific and technological capacity, the under-developed country will be in a position to counteract

the effects of technological domination, establishing relations of interdependence with other countries which would not become asymmetrical and unbalanced.

The third and last factor refers to the social propagation of the effects of economic growth and technological progress to all sectors of the population. This would be equivalent to breaking down the disarticulation which characterises underdeveloped countries, making the benefits derived from the two preceding factors of a development process available to the various regions of the country and to all segments and sectors of its society."

Technology

3. Up till recently Technologists in Ceylon have been to a large extent content to permit the uncontrolled inflow of foreign technology into the country. In fact, many of us by virtue of the nature of our training, have inclined to think that this was the easy way out compared to the hard way of developing our own technologies. We all know the contempt in which a locally manufactured product is held, compared to the imported item. The shop keeper apologising for the "local product" usually strikes a sympathetic chord in the purchaser as well. Few of us realise that in the process of despising locally manufactured goods and going in for imported products, we are displaying the lack of selfreliance, and tendency to be dominated and dependent, which are characteristics of underdevelopment. Even fewer understand, even if they recognise, the subtle propaganda against local efforts to create indigenous technologies, in order to increase imports and the dependence on foreign technology, that goes on all the time, for example in the daily press.

4. The justification for import of technology is that the productivity of such technology is high, and therefore the creation of economic surplus will be so high as to pay back the money borrowed to purchase this technology in a short time, and the surplus will be available within the country thereafter. For this reason we have had wholesale import of foreign technology in the past, on a number of projects, in the form of package deals where the bundle of technology could not be unbundled during the purchase transaction and the engineering profession by and large has been ineffective in stopping the smuggling in of superfluous or inappropriate foreign technology in this fashion.

5. However, in recent times in the engineering world in this country there has been a new and unprecedented effort to achieve self-reliance, even in the face of competition from the best foreign technology. This was in the State Engineering Corporation. The very rapid growth of that Corporation resulted in an unfortunate anticlimax caused by the absence of business acumen manifesting itself in the form of a financial crisis. Nevertheless, I for one believe that the growth of an attitude of self-reliance amongst the engineers, technicians and workers in this Corporation was not unlike a revolution - while it lasted. This thought came to my mind on reading the following sentence in Edward Boorstein's classic. 'The Economic Transformation of Cuba':

"When I was in Cuba I found that visitors or technicians from developed countries would some times misunderstand the confusion, disorganisation and inefficiency they ran into because they failed to see them in perspective. But you cannot understand revolutions - or their economics if you look at them through the eyes of a bank teller who has to tidy up all his small change and balance every little account every night."

6. In the implementation of the Five Year Plan it is vitally necessary to prevent a swing back to dependance on foreign technology and other foreign expertise, which could easily result as a kind of rebound from the recent experience of the State Engineering Corporation. Fortunately, at the present time there is a growing awareness of the need to unbundle technology packages which come into the country under so-called aid projects. However, the Ministry of Planning and Employment generally, and its External Resources Division particularly should be geared to doing this, to prevent the developed countries from using their well-known "lines of credit" as if they were life-lines thrown to a sinking economy, to capture markets with this new brand of sophisticated and heartless salesmanship. All foreign aid should therefore be subjected to technical screening, and this could be done either by a properly staffed Technical Division in the Ministry of Planning or by the proposed NERD Centre. (See Annex 1).

7. Some examples may be given. Recently the Paddy Marketing Board needed Platform Weighing Scales to weigh paddy harvests which had previously been measured by volume. Under a British "line of credit" a leading manufacturer was awarded the contract for the supply of £. 50,000 worth of weighing machines. In fact, this supplier was given a new market for £. 50,000 by the Government of Ceylon without even the normal competitive bidding of the market economy. In this instance, local industry was quite capable of manufacturing these weighing machines. More-over, local manufacturing industry was running with under utilisation of foundry capacity ranging from 30% to 70% and under utilisation of machine-shop capacity up to about 50% at the time; neither was there any problem of raw materials.

Under these circumstances a proposal has been drawn up for the original British supplier to assemble the machines in Ceylon under their own brand name, with 85% locally manufactured components but the project has still not been finalised. Since this supplier is a multinational corporation, the successful implementation of this proposal can have far-reaching effects. (Although a local supplier was prepared to market a 100% locally manufactured machine, in the absence of a brand name there was some doubt as to the quality of the latter product).

8. The second example concerns mammoties. Every now and then we hear that another consignment of mammoties has to be imported. (This is hardly the type of linkage between the agricultural sector and the industrial sector that is envisaged in the Plan). The State Hardware Corporation has a plant which could produce about 200,000 mammoties per year on

one shift or 400,000 on 2 shifts, compared to an annual requirement said to be more than 600,000 per year.

9. Traditionally the rural village blacksmith used to make mammoties for the village farmer for centuries, until the plantation economy introduced imported mammoties as well as various other agricultural implements. Under these circumstances, the village blacksmith could not compete with the imported products, and the quality of the local mammoty deteriorated. Consequently, the village farmer needed no special inducement to purchase the imported item. The State now conspires to continue suppression of indigenous technology through State-controlled imports, whilst more than 3000 village blacksmiths who could easily supply the country's total requirements of mammoties are ignored. The size, shape, weight and other characteristics of mammoties made by local craftsmen and used by local farmers varies from district to district according to soil characteristics, cultivation practices, etc. etc. The salesmanship that succeeded in introducing the more or less standard imported mammoties has now to be confronted and overcome and indigenous products brought back into use. The engineering profession must play a leading role in tackling the various problems that will arise in the process.

Research and Development

10. In this context the need for engineering research and development has to be mentioned. A proposal to set up a National Engineering Research and Development Centre in the Ministry of Industries had been made in the latter half of 1970 but finality has still not been reached on how this proposal is to be implemented. Whereas the original intention was to use local skills wherever available, and particularly in the Research & Development section of the State Engineering Corporation, in building up this institution, a suggestion had been made at a later stage, that this proposal should be implemented as a UNIDO Aid Project. In due course a team of foreign experts prepared a project report which suggested amongst other items the need for 24 foreign experts, each of whom would work for a 6 months to 3 year period during which local counterparts would be trained! This is yet another example of the hallmarks of under-development so vividly described by Sagasti – an absence of self-reliance and a tendency to be dominated and dependent. The proposed UNIDO Project will not commence till June 1973 because the country programme for aid for Ceylon is full up until then. It is left to be seen whether the engineering profession will be able to stand on its own feet with this project or whether the country will be at the receiving end of yet another foreign-oriented project of limited use in the short-run and a definite handicap in the long-run.

11. In the meanwhile, the 5 Year Plan emphasises the need for employment oriented small-scale projects for which the appropriate technology has to be developed. Manufacture on the small scale of a variety of products such as sugar and jaggery, hand made paper, manioc starch, dolomite powder, coconut shell powder etc., etc., present a wonderful opportunity for the local light engineering industry to develop progressively

if the Government would encourage the necessary research and development work which is a pre-requisite to local manufacture of such manufacturing plant. However, a sadly uninformed view which expresses itself in such clichés as “there is no need to reinvent the wheel” or “why set out on a voyage of discovery” or “lets get it down from India or China and copy it” is often heard. But the people who repeat these statements at every imaginable opportunity rarely have any idea of what “copying “entails” – indigenous research and development, appropriate to our available skills manufacturing capacities and other resources, especially in the small scale sector in the rural areas to maximize “the capacity for importing, absorbing and modifying foreign know-how, adapting it to local conditions and even re-exporting it after further elaboration” Such research should be institutionalised. This is the urgent need for the NERD Centre to be set up using local talent instead of depending on foreign experts. Further, the unbundling of technology packages that come under lines of credit, such as plant for manufacture of boron-treated rubber-wood for the NSIC, farm tanks and other equipment for the Milk Board, and various other plant and equipment for the projects in almost every public Corporation, should be done by the NERD Centre.

The Kotmale Project

12. Meanwhile, if the talent available in the artisan class of people in our country can be effectively combined with the theoretical knowledge available with the scientifically trained and qualified people, we could move a long way towards achieving economic self-reliance. An example of an effort in this direction is the Industrial Co-operative in the Kotmale DRO's division. Some 50 odd existing smithies in 6 villages in this division had been organised into an industrial co-operative by the DRO, who had made arrangements to supply them with necessary raw materials, scrap steel, charcoal etc., and obtained firm orders from some Government organisations as well as helped them to market their produce in other ways. As a result each of these blacksmiths was able to devote a full 8 hours or more to productive work in his work place each day, instead of having to waste about 3 hours (on average) looking for raw materials and markets for produce, or in the alternative trading the equivalent of 4 hours of productive work to a middle man who would provide this service. The Faculty of Engineering, Peradeniya, and the Industrial Development Board's Technical Services Agency, are providing engineering consultancy services for this project, co-ordinated by the Ministry of Planning and Employment.

An Island-wide Scheme

13. Arising from the successful Kotmale experience, the Ministry of Planning has accepted a suggestion made by the DRO., Kotmale, to promote a revival of the traditional village blacksmith throughout the country. The Industrial Development Board of Ceylon has compiled a directory of small-scale industries throughout the island from which the necessary information has been abstracted and sent to individual Government Agents and DRO.O. It is proposed to set up at least 10 such industrial co-operatives in areas with a tradition of blacksmith works within the next 6 months.

14. The economics of the proposed projects are as follows:

A village smithy employing 3 blacksmiths

Capital equipment	No.	Rate	Amount
Bellows	1	700	700
Anvil	1	500	500
Benchwise	1	400	400
14 lb. sledge hammer	3	100	300
7 lb. " "	3	50	150
4 lb. " "	3	30	90
2 lb. hammer	3	20	60
1 lb. " "	3	10	30
Tongs	6 prs.	20	120

2350
+ 15% 350

2700

Cost of shed 15' x 10' at Rs. 5/-
per sq. ft.

750

Total 3450

Say - Rs. 3500/-

Production of various items per day

Item	No.	Producer's Price	Total Products
Mammothies with handle	4	10.50	42
Pruning knife	12	4.50	54
Axe 9"	4	11.00	44
Alavangoes	3	22.50	67.50
		207.50	

Average possible production

4

Say Rs. 50/- per day.

At 300 working days per year, possible annual production = Rs. 15,000/-

Cost of materials per day:

Charcoal	56 lb. @ 25/- per cwt.	12.50
Scrap steel	20 lb. @ 25 cts. per lb.	5.00
Oil	say	1.00
Grinding wheels and files	say	5.00

Total: 23.50

Say Rs. 25/-

Therefore nett value added per day = Rs. 25/-

Nett value added per year = Rs. 7500/-

Benefits

15. There is a mark up of 15% in the producer's price by the Industrial Co-operative; more than 10% represents the economic surplus i.e. the savings for reinvestment or capital formation.

In the 5 Year Plan, the following assumptions have been made:

r = rate of investment = 20% (Approx.)

(of this 17% will be from domestic savings and the balance from loans)

$\frac{c}{o}$ = capital output ratio = 3.25

hence $r = \frac{20}{3.25} = 5.8\%$ which is the gross overall growth rate of the economy

but in the village smithy project $\frac{c}{o} = \frac{3500}{7500} = 0.47$

The corresponding rate of investment required to maintain the same gross overall growth rate of 5.8% is only 2.8% but we see above that there is a mark up on production of 15% giving a re-investible surplus of more than 10%, so that this project is really contributing very much more than the expected average in the whole Plan.

Further benefits can be spelled out as follows:

1. Employment - at 3 men per work place.
2. Foreign exchange savings by import substitution:
Rs. 2500 per man per year minimum and up to Rs. 5000/- per man per year maximum.
3. Progressive development of indigenous technology to develop self-reliance, reverse dependance and domination etc., which cannot be quantified, and the linkage effects arising therefrom.

Progressive Development

16. It is proposed that each industrial co-operative will consist of about 50 smithies and ultimately will be provided with a central heat treatment plant estimated to cost about Rs. 50,000/-. This development of technology is being planned by the Metallurgist of the Faculty of Engineering. Each individual smithy will also be provided with its own power; this service is being planned by the Technical Services Agency of the Industrial Development Board and is estimated to cost Rs. 1500/- per work place.

At this stage, the economics of the project will be as follows:

Cost of 50 smithies 5000/-	Rs.	250,000
Cost of central heat treatment plant	„	50,000
Total	„	300,000

Quality control of production will be achieved and maintained by giving the workers a basic knowledge of metallurgy. Initial steps in this direction have already been taken at Kotmale. A handbook for use by the village blacksmiths is being prepared by Dr. A. R. T. de Silva, Metallurgist, Faculty of Engineering, Peradeniya.

Raw materials (scrap steel) are being purchased presently from the CGR and the CTB and will also be obtained from the State Hardware Corporation where trimmings from production of mammothies, and off-cuts from pruning knives are available.

Firm orders have been obtained from the Ministry of Irrigation, Power and Highways and the plantations sector. Orders are pending from the Building Materials Corporation, and the Hotel School. The latter order has future export possibilities.

Special case of the mammoty

17. Annual requirement estimated at between 600,000 (minimum) and 1,000,000 (maximum)

State Hardware Corporation is geared to produce, 200,000 per shift per year.

Last year's (1972) actual production was 125,000

This year (1972) target is 360,000.

1972 imports: already paid for .. 250,000

Further orders placed for .. 500,000

Average cost of mammoty .. £ 0.5

i.e. Rs. 7/- in free foreign exchange.

Actual output of mammoties from an Industrial Co-operative

18. 4 per day x 50 smithies x 300 days = 60,000 Nos.

Value at Rs. 12/- per mammoty = 720,000

Allowing 50% for cost of

materials nett value added = 360,000

Nett capital output ratio = $\frac{300,000}{360,000} = 0.83$

With 10 such industrial centres the minimum annual requirements of mammoties can be met.

In combination with the State Hardware Corporation the maximum annual requirements can also be met.

19. It is proposed to send typical samples of different types of traditional mammoties used in different areas to the Faculty of Engineering for metallurgical analysis. Thereafter the quality of the mammoty will be improved according to the technical directions given by the consulting metallurgist and samples of these will be used in different areas during the coming cultivation

season. The reports on the performance of these mammoties will be studied and further improvements effected so that a larger number may be used during the next cultivation season. It is hoped that within a period of about 2 years complete import substitution will be possible.

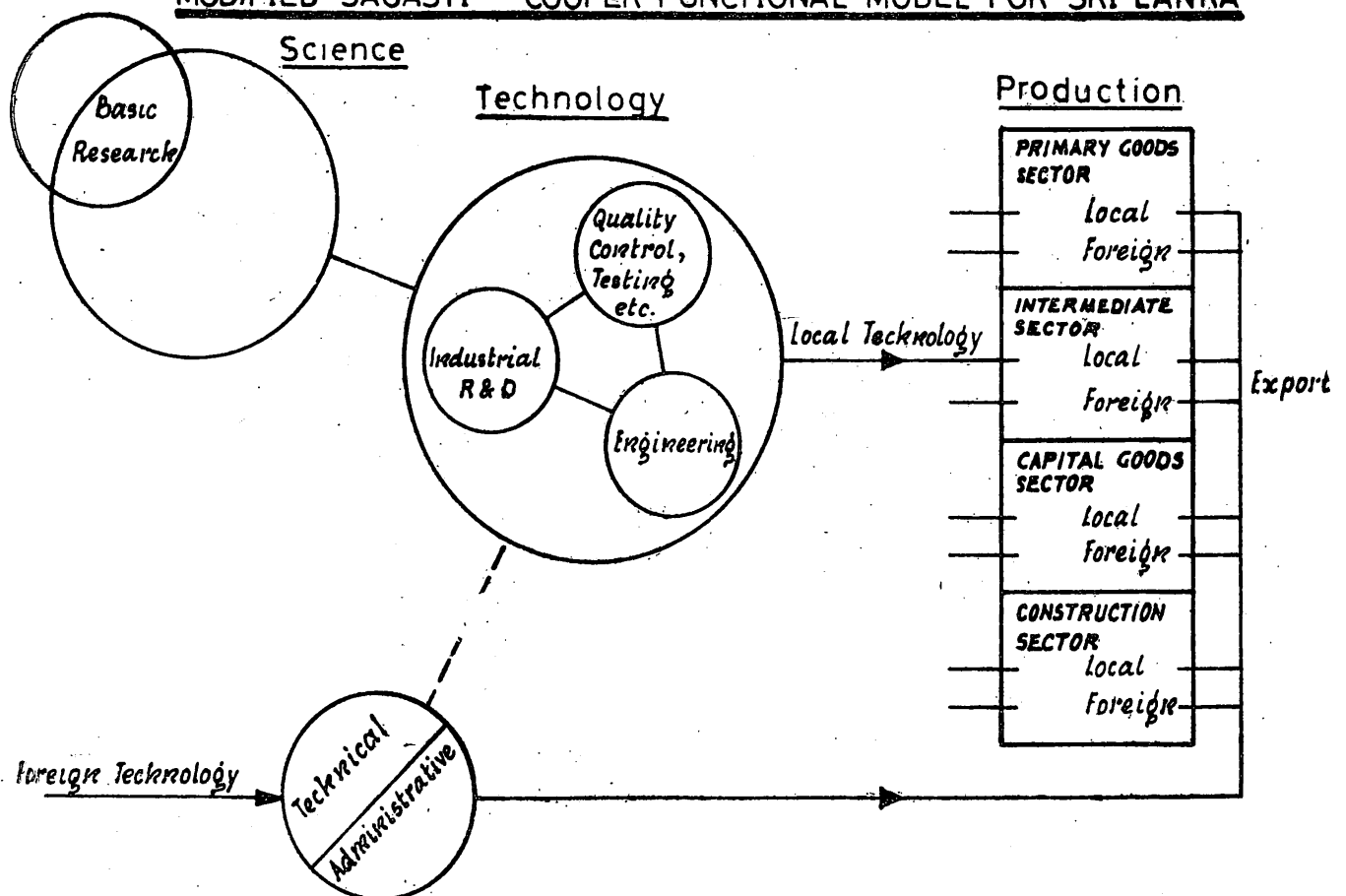
20. Another scheme to rebuild worn out imported mammoties is also to be implemented at the same time. This would involve welding and would, therefore, be done in small workshops rather than in the village smithies.

Conclusion

21. The 5 Year Plan stresses the need to economise on foreign exchange; to increase import substitution, and to develop new agricultural and industrial exports. It also emphasises the need to provide new employment and therefore recommends the use of labour intensive methods in preference to capital intensive large scale projects.

22. When economists speak in terms of labour intensive methods and advocate employment oriented engineering practice, technologists should be alert to the implications of such policy. There is danger that employment for its own sake may result from careless application of these rules so that productivity goes down and the economy is further impoverished. In order to prove that this does not necessary follow, one's attention is often drawn to the experience of China and even sometimes India. I have attempted in this Paper to draw the attention of our Technologists to the unused potential in our own country which is after all our greatest resource.

MODIFIED SAGASTI - COOPER FUNCTIONAL MODEL FOR SRI LANKA



Annex I.