TECHNICAL EDUCATION AND INDUSTRIAL EMPLOYMENT

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1. The System of Formal Technical Education and Training

Development of industrial manufacture has to be based on an appropriate system of technical and managerial education. We will describe the present educational structure for skilled workers, technicians and engineers in order to examine the manpower aspect of industrialisation in Tanzania.

Primary school, Standard VII is the necessary entrance requirement for the National Vocational Training Programme (NVTP) which is responsible for the formal training of skilled workers. The present intake capacity is 400 students per annum into the centre in Dar es Salaam. After one "basic year" specialising in a particular trade the trainee undergoes "in-plant training" for three years under contract with an enterprise. After each year the students under "formal" as well as under "non-formal" training (workers without basic year and training contract) may sit for "trade tests" conducted by the NVTP. If the trainee passes all three tests in the first attempt then he finishes his in-plant training as a skilled worker grade I. Further upgrading is available through supervisor, or instructor courses conducted at the NVTC or the Dar es Salaam Technical College respectively.

The Dar es Salaam Technical College (DTC) recruits 200 students annually for the technician course, all from technical secondary schools, Form IV. After three years they get the "Full Technician Certificate" (FTC) and leave for industrial employment.

The diploma course at the DTC requires the FTC and two years industrial experience. 50% of the 50 students annually with the "Diploma in Engineering" (DE) are supposed to become technical teachers at technical secondary schools or lecturers for the FTC course, others join industry.

The Faculty of Engineering, UDSM (FOE) recruited students before 1975 directly from secondary schools, Form VI and some special entry cases with DTC certificates. The major change after the "Musoma Declaration" is the requirement of two years industrial experience of Form VI leavers or a DTC certificate with the appropriate practice before entering the FOE. The "B.Sc. Eng. Degree" is based on a four years course. The first 60 engineers trained in Tanzania will leave the UDSM in 1977. The annual output in future will be 120 students.

Postgraduate Studies for "M.Sc. and Ph.D. Eng." are still conducted abroad. A postgraduate programme for M.Sc. Eng. at the FOE, UDSM is in preparation.

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Fig. 1

SYSTEM OF FORMAL TECHNICAL EDUCATION AND TRAINING IN TANZANIA (1975)

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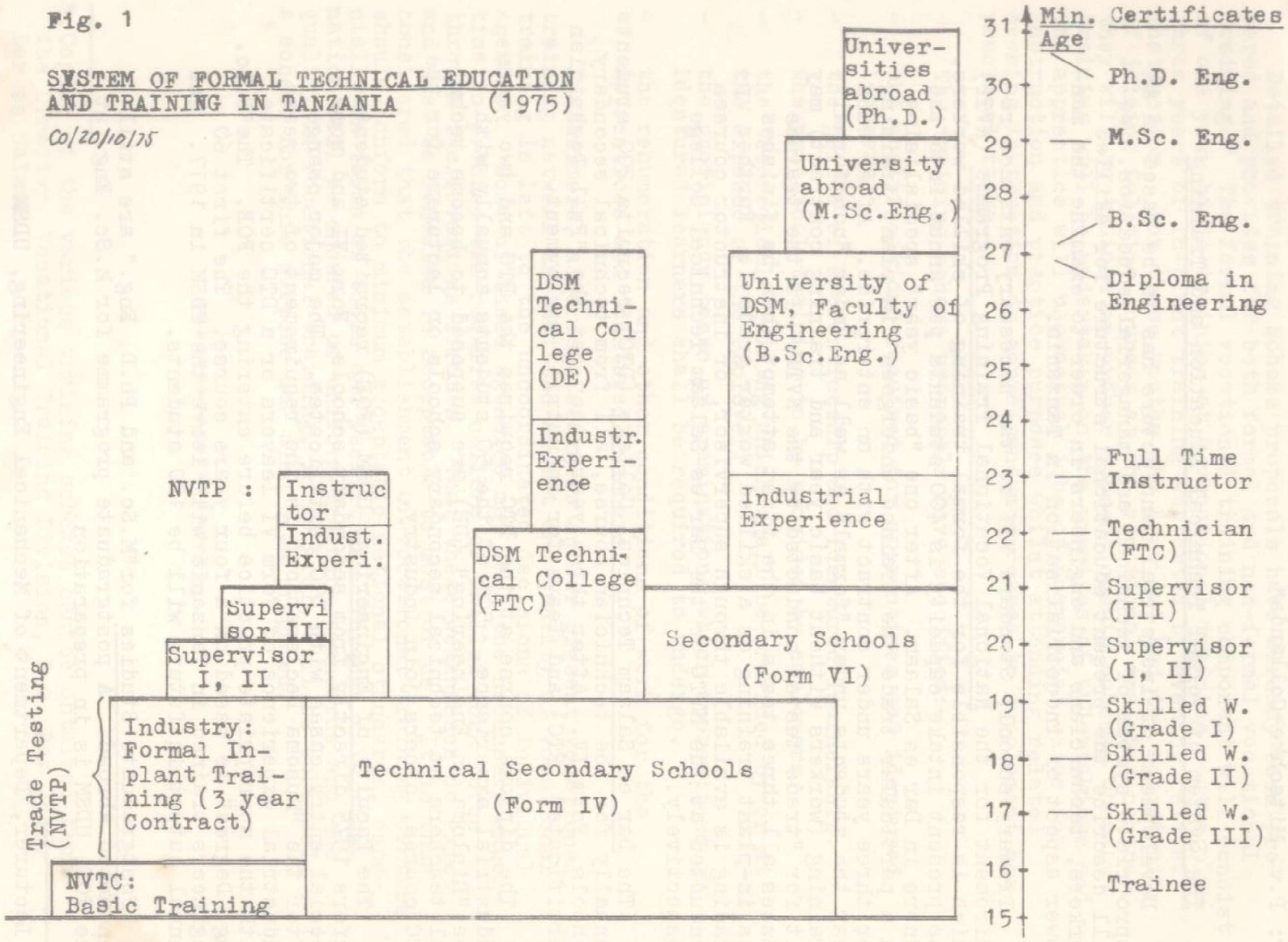

The block diagram (Fig. 1) shows the structure of formal technical education and training in Tanzania and allows comparison of the different courses in terms of study time.

2. Industrialization in Tanzania

If we analyse technical education and manpower planning the major question arising is, do capacity and content of technical education and training match the development strategy of the country?

The strategy of industrialization in Tanzania is aiming at a "self-centered economy" emphasizing "basic metal working industries" which particularly require formal education, training, experience and creativity of fairly high standard at all levels, for workers, technicians, engineers and managers. The same time basic industries are the major "multipliers regarding skill-buildup" in industrializing societies.

Present industries however, are mainly of "assembly type"; capital equipment is chosen and imported from industrialised countries. Maintenance engineer and some technicians and skilled workers keep the factories going. That is why the present system of formal technical education and training is not yet appropriate in terms of content and capacity. This observation leads us to the following hypothesis:

The planners responsible for industrial development tend to overcome lack of manpower and lack of industrial experience by supporting highly mechanised capital investment. Technology rather than formal training of human skills seems to be a myth which makes people believe in sophisticated machinery and large scale enterprises as means of solving all technical, economic and social problems of development. A development strategy emphasizing capital investment in sophisticated technology (ST), however, has the following results:

- ST is costly hence, requires foreign currency and loans which both maintain economical dependency.
- ST is usually designed for large scale production and requires continuous utilisation of capacity. Due to high overhead costs under-utilisation of capacity will lead to high prices of products.
- ST represents highly mechanised manufacture with relatively little human labour involved. If we consider the fact that in Tanzania so far only 8% of the people have a regular income and respective purchasing power from salaries or wages then we understand that creation of employment is major prerequisite for development of local markets.
- The more sophisticated the technology chosen the greater the "technological lock-in", the lower the chances for local manufacture, maintenance and repair of the respective equipment, the less appropriate are industries as multipliers for build-up of both quantity and quality of skills required for indigenous industrialisation in a self-centered economy.

Table 1

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OUTPUT FIGURES OF FORMAL TECHNICAL EDUCATION AND TRAINING IN TANZANIA (1967-1977)

INSTITUTION	COURSES	67	68	69	70	71	72	73	74	75	76	77	Total Output up to 1977	Estimated Ind. Empl. in 1977	Empl. Ratio Tanzan. 1977	Empl. Ratio Indust. Country
Universities abroad (B.Sc. M.Sc., Ph.D. Eng.) a.)	all engineering courses	References: a.) Ministry of Nat.Ed. b.) Intake 1973 c.) Registrar DTC d.) Figures NVTP (..) Projections based on input data [..] Estimated figures											(513)	[600]	1	1
University of DSM, FOE (B.Sc. Eng.) b.)	Civil E.							-	-	-	-	(30)	(58)			
	Mech. E.							-	-	-	-	(20)				
	Elec. E.							-	-	-	-	(8)				
DSM Technical College (Diploma in Engineering)	Civil	-	-	-	-	-	-	2	20	17	(12)	(13)	(188)	[1,200]	2	5
	Mech.	-	-	-	-	-	-	5	7	4	(14)	(14)				
	Elec.	-	-	-	-	-	-	5	5	6	(13)	(11)				
	Electron.	-	-	-	-	-	-	-	8	8	(12)	(12)				
(OTD) | (FTC) c.)	Civ. | Civ.	25	28	35	91	33	55	71	64	58	(78)	(50)	(1,412)			
	Mec. | Mec.	18	29	19			50	23	49	51	(52)	(56)				
	Elc. | Telc.	16	-				22	23	45	50	(57)	(53)				
	- | Elc.	-	-	-	-	-	-	20	47	63	(53)	(28)				
Technical Secondary Schools a.)	Ifunda, Moshi, Tanga, Mtwara	-	-	316	321	321	355	360	397	(503)	(640)	(639)	(3,852)			
National Vocational Training Programme (24 Trades) d.)	Grade I	-	-	-	-	17	37	80	61				[20,000] Tests; [10,000] Workers	[4,000]	6	25
	Grade II	-	90	141	229	475	360	503	334	[4000]	[4000]	[4000]				
	Grade III	90	236	295	693	1377	1064	1331	1054	[1200]	[1300]	[1500]				
	% Failures		52	46	34	43	63	71.3								

- Hence, higher education is still conducted abroad, i.e. in industrialised societies, and follows the technological and economical requirements of these countries. The experts returning have highly specialised know-how but not the industrial experience necessary for solving practical problems in Tanzania. The situation will slightly improve now that the DTC and FOE, UDSM are established, but only if teaching and research are linked to industrial needs.
- Much too little emphasize in contrast to higher education is given at present to general education and formal training of skilled workers. The training capacity and facilities are not sufficient. Major trades of engineering like tool making and foundry work are so far not considered in the curriculum of the NVTP.

3. Educational Output and Industrial Employment

Considering the given structure of formal education and training and the strategy of industrialisation lead to the question, do actual output and employment figures prove the appropriateness of industrial development in Tanzania?

It is quite useful to compare some figures regarding 1977, when the first locally trained engineers will join industry. In industrialised countries the employment ratio of engineers/technicians/skilled workers is in average 1:5:25. In engineering industries there is usually an even higher percentage of technicians and skilled workers. We will apply this ratio for the purpose of comparison.

It is relatively easy to get output figures from the institutions concerned (see Tab.1). However, the number of annual tests published by the NVTP may be misinterpreted. E.g. the same workers who passed in 1971 grade III, in 1972 grade II and in 1973 grade I are accounted for three times in terms of successful pass. Hence we only consider the grade III intakes which gives us the true number of 10,000 skilled workers up to 1977.

On the other hand we have to distinguish carefully between output figures of technical education and training and data of industrial employment. It is quite difficult to follow up demand by industries and employment of the respective people.E.g. we find large scale textile enterprises of 900 employees out of which only four or five workers have a grade of the NVTP. This phenomenon leads to the question, where do skilled workers find their employment?

Careful analysis of the trades trained and tested by the NVTP shows that only part of the 24 trades are related to "industrial work", out of which again very few are of engineering nature. That means the NVTP is more related to "traditional crafts" like carpentry, or shoe making required by medium or small scale industries. Large scale industries, however need relatively few formally skilled workers due to technical and economical reasons; The chosen machinery and layout of manufacture determine a degree of specialisation of work which requires"on-the-job-training" only. Employment policy is also determined by the principle of reducing training and labour costs; From a survey we know that most enterprises in Tanzania so far do not even have facilities, instructors

or training officers with technical experience, either for "formal training" or for "systematic on-the-job-training".* The same enterprises do not ask for skilled workers because their wages are significantly higher than those of unskilled workers.

4. The Pyramid of Industrial Employment and Conclusions

If one includes all directly productive workers in public utilities, construction and manufacturing excludes those who only work in these sectors for short periods there must have been around 150,000 industrial workers in Tanzania in 1975, about one third of them employed in 452 manufacturing enterprises.

Most probably the employment ratio between engineers/technicians/skilled workers of 1:5:25, necessary for self centered technical development, will not be achieved in the near future.

It is doubtful that the NVTP will reach its target of 4,000 successful tests annually before 1977. The increasing percentage of trade test failures (see Tab.1) seems to prove lack of facilities, instructors, evening courses particularly up country. That means there will be less than 4,000 skilled workers in Total in 1977 if we consider qualifications of the higher NVTP grades II and I only.

Many of the DTC technicians and diploma engineers will join university courses for upgrading till 1977. We estimate that less than 1,200 technicians will be employed in industry.

The actual number of Tanzanian engineers available in 1977 from abroad or from UDSM will be more than 600, increasing annually by 120 from the FOE, UDSM.

The actual output ratio in 1977 will be then 1 : 2 : 6, considering the formally trained engineers, technicians and workers only. Hence a relatively high number of engineers and technicians will be facing many semi-skilled workers but particularly in engineering industries only very few skilled and experienced workers who are qualified to implement technical designs.

This lengthy argument seems to prove that there is neither strong request from industry for formally skilled manpower - at workers level - not sufficient supply from the NVTP, necessary for setting up basic metal-working industries. Major reasons are choice of scale and technology in assembly industries, slow growth of manufacturing industries, wrongly balanced technical education and training. The result will be an increasing number of engineers and technicians who will join administration if industries do not cope regarding provision of jobs in production.

Hence, it needs several corrective actions regarding educational and manpower planning in terms of political pressure from the Government vs the enterprises for relatively more investment in industrial in-plant training at all levels, for engineers, technicians and workers as a longterm perspective and particular support of the efforts of the NVTP. Implementation of the strategy of "basic metal-working industries" asks for emphasizing development of workers and practical inter-linkage of institutions of technical education and training with industrial production.

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* Bhagavan/Barker/Wield/Mitschke-Collande, "Transfer of Technology", Institute of Development Studies, draft report, 1975.

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