PROJECT TWO

PRESENTATION OF LEAD PAPER 2 BY DR CHANDRAKANT AND SUMMARY REPORT OF PLENARY SESSION

In presenting his lead paper, Dr Chandrakant thanked the Commonwealth Secretariat for inviting him to the seminar and for providing him with an opportunity to share his experiences in the area of technician education and industrial co-operation. Through conferences, the Commonwealth Secretariat had brought together distinguished educationists to cross-fertilize ideas and experiences, to present newly-acquired perspectives and to point new directions. The Huddersfield Conference of 1966 was in his view an important landmark in technician education and training, because it was the first to be concerned in depth with planning and developing technician education systems in relation to other socio-economic needs. An important sequel to the Conference was the book (circulated to delegates) under the authorship of Mr MacLennan. Dr Chandrakant considered that, in the entire Commonwealth literature on technical education and training, this was the most comprehensive book, and gave the best appreciation of the complexity and magnitude of the problem of technician education development. The Huddersfield Conference also underscored the importance of co-operation between education and industry. It was appropriate that this Regional Seminar was specifically devoted to the subject.

Dr Chandrakant emphasized that a technician's education and training and the development of his professional competence was a process which must take place partly in an institution and partly in industry. The institution must equip him with basic knowledge in the fundamental sciences, mathematics, and technology appropriate to his specialization. This education must be cross-fertilized with experience of industry, because only then would he understand how theory was translated into practice, how the practical aspects of design, construction, production, etc. were applied to industrial situations. Therefore education and training must be integrated, and it was no more possible to make clear-cut distinction between education and training than to say how cold was hot water or how hot was cold water. To co-ordinate theory with practice and to elaborate the complementary functions of educational institutions and industry was the heart of the problem of technician education; therefore technical manpower development, whether one thought of engineers, of technicians or of skilled workers, was a shared responsibility of technical institutions and industry.

In his lead paper Dr Chandrakant had preferred "shared responsibility" to the weak word "co-operation". Unless national policy reflected this shared responsibility, many of the problems of providing education and training in the right quantity and quality would persist.

He therefore put forward six axioms:

(a) Technician education and training must be relevant to employment in industry, commerce and other sectors of the economic life of a country. It must fulfil the employer's aspirations for trained manpower.

(b) As technology advances, the technician must be capable of adapting himself to new situations and his education must equip him with the knowledge and skills needed to help him meet new challenges.

(c) Technician education systems must provide for the further education of working technicians to enable them to advance in their profession, and continuously determine what additional knowledge and skills are needed for their purpose.

(d) Technician education is part of both the social and economic systems and as such is influenced by a complex of social and economic factors. It must be responsive to the attitudes, values and work styles of future technicians so that they become useful and productive members of the community.

(e) The interaction of technician education with the economic system implies partnership responsibility within industry and institutions so that curricula, teaching/learning processes and methodological approaches are vitalized continuously.

(f) All forms of technical education and training are expensive because of the heavy investments involved in buildings, equipment and running expenditure. The resources of a country must be optimized.

In the context of these six axioms, Dr Chandrakant found much of relevance in the education systems of all the 21 Colombo Plan countries. All were aware of the importance of mid-level manpower groups and all were establishing and developing their own systems of technician education and training. Their general characteristics were that all technician education was at the tertiary level after 10, 11, 12 or even 13 years of school education, depending upon the elementary and secondary structure; and that, by and large, the courses were full-time, of two to four years' duration. Curricula embraced the whole range of engineering and technological subjects such as civil engineering, mechanical, electrical, electronic, textiles, chemical, there were also some curricula offerings in the narrower fields of e.g. building construction technology, automotive mechanics, electrical communications. Differing levels of curricula were recognized in some systems, with engineering technician, higher and lower level technician courses, etc. The curricula were a mix of knowledge and skills; in the so-called industrial technician courses, there was a larger proportion of the manual, manipulative, or operational skills. In the higher technician or engineering technician courses, the theoretical part of technology and the sciences predominated. Most systems were wholly institution-based, but Singapore and Hong Kong for example made some provision for part-time and block-release courses; and by and large they were for persons with a secondary education. A last important characteristic was that very few systems provided for the further education of working technicians.

The present systems in Dr Chandrakant's opinion had grown more in response to social forces than as a direct response to industry's needs for technical manpower. The systems therefore did not clearly identify the technician occupations to which the curricular offerings were addressed or the education and training these technicians required to meet the needs of industry. As a result, the precise objectives of the curricula in terms of subjects and topics were not clearly defined. A syllabus only indicated the topic headings to be covered, the subjects to be taught, the number of hours to be spent on each subject, both theory and practical. A syllabus did not answer the questions "Why do I teach this subject; at what level should I teach; what is the eventual outcome of this teaching in terms of employment?" Consequent concern was about the employability of the products of the system. He was aware of the very serious criticism by industry in many countries he had visited, including his own, that the products were not employable. Unfortunately, industry had remained merely as a critic and consumer of the products of the system, with no valid stake in their education and training. This was where shared responsibility between educational institutions and industry started. Three questions should be asked:

Who is a technician?

Where does he work?

What does he do?

There were enough definitions of a technician to be confusing, including those of the Huddersfield Conference, which he had had the honour to attend. These definitions placed the technician somewhere between a technologist and a skilled worker but went no further. The more important thing was to know how industry used a technician. Industrialists said that the word technician was rarely used in industry, as did Mr MacLennan's book. Industry looked upon a technician in terms of his functions; the job he did, where he worked, and what he did. Only a re-examination of education's definition of a technician and industry's understanding could bridge this gap between industry and education. In his lead paper he made a strong plea for a scientific, methodological approach to identifying technicians and determining what they did, and he had labelled this "Activity Analysis". This was the first joint responsibility of industry and technical institutions.

Dr Chandrakant explained Activity Analysis by reference to examples from the electrical and mechanical engineering industries. In these examples, technicians could be identified at work in four major functional areas:

One functional area where technicians were employed was those departments of an organization whose work was directed outwards to the suppliers and customers; departments concerned with commerce.

The second functional area was research, design and development - departments engaged in technical work leading up to decisions to produce on a commercial scale.

The third functional area was production, in departments whose work ranged from the point of the decision to produce to the stage of the finished product.

The fourth functional area was departments which provided services or supported the activities of one or more of the above departments.

Dr Chandrakant next illustrated, by chart, how to understand what technicians did in their jobs in these functional areas. His paper broke down the jobs into six groups and gave examples of sub-groups. The broad groups were communications, design, organizing work, diagnosis, practical work, and supervision of other staff. Further analysis should make possible a three-dimensional matrix or profile of technicians in industry by their functional classification, and by their work content in different functional areas. Dr Chandrakant could not see how a technician education and training programme could be developed. At one end of a broad spectrum the technician's functions were nearer the professional engineer's; more concerned with design, design drafting analysis and other types of what might be called higher technician duties and responsibilities. At the other end, there were technicians doing work like a craftsman's, but at a slightly higher level and with a better understanding of the skills involved. In between there were technicians with different mixes of knowledge and skill.

This picture could be elaborated by an activity analysis, which only industry and institutions together could carry out, to provide much-needed information for curriculum design. From the analysis, curriculum designers should be able to develop an understanding of the problems and to decide the broad content of the curriculum; what kind of mathematics and science needed to be taught and at what level; the precise objectives of teaching the subject; what type of educational theory, what type of technology and at what level; what technology practice, and what other general education subjects to develop communication, supervisory and management skills. The intention of this kind of analysis was to get the basic information needed to structure the curriculum by aggregating a large number of closely related technician occupations. Whether the technician went to work in a department of commerce, production, or design, Dr Chandrakant knew from experience that it was possible to aggregate the technician occupations on the basis of activity analysis; there was no implication that technicians were to be produced in this manner for a particular job in a particular organization.

The next stage of shared responsibility or partnership between industry and institutions was in the implementation of curricula. Because a going system of technician education and training was a process which would take place partly in an institution and partly in industry, curricula must be designed jointly. The practical work to be integrated with education in institutions was not just any kind of practical work, not any kind of training; it must have definite objectives, be part of a well-designed programme, and be supervised. His lead paper outlined some of the general principles to guide the designing of practical training programmes in industry. There must start with a period of induction when the aspiring technician was exposed to the industrial scene to understand how industry operated, its climate, community, and other conditions. A second component was training in the basic skills relating to production operation and use of tools, machines, and related aspects. To his mind, it made no difference whether these basic skills were given in separate training centres of industry or in workshops attached to institutions. This depended on the conditions of training in each country; but there must always be a well-designed programme of basic training before a technician trainee was sent for on-the-job training.

Dr Chandrakant thought the most significant improvement in apprenticeship schemes was the realization that basic training must be given away from the production shop; against the old concept of apprenticeship, of "sitting next to Nellie", when Nellie knew nothing, or you learned the bad things that Nellie knew. Basic skills development must take place under supervision as an education process in separate shops. The engineering practice, that is

the actual application of these skills on the job, on the shop floor, in departments, was the last stage of any apprenticeship programme. The country papers had shown that almost all countries had one form or other of apprenticeship, but few had extended apprenticeship to technicians. He realised that in some of the systems, students in institution-based education were required to put in six months to one year of practical work in industry; but unfortunately such training was not supervised, nor part of a well-designed programme, nor intimately related to the education element. Boys coming into industry became mere shop-walkers, gaining no really worthwhile experience. All this implied further aspects of partnership between institutions and industry. Industry and institutions together must lay down the training specifications in behavioural terms. Most training programmes did not do this; the trainer in industry, like the teacher in an institution, did not know the precise objectives. The specification should be accompanied by information about with whom or under whose guidance a trainee would work; what procedures he would follow; and by some training examples. Unless this kind of apprenticeship material complemented the institutions' curricular documents, the integration of theory and practice would not be realised.

Dr Chandrakant referred to the interesting Haslegrave Report on the education and training of technicians in Britain, where under the diversified systems of technician examinations run by various authorities, there was lack of coherence between courses. This Report called for some rationalization of the technician education programmes in Britain in line with the programmes of the Industrial Training Boards. This was again bringing industry and education together not merely on a conceptual plane, but over practical methods of working together.

Sandwich courses were not the domain of industry; they were as much education as the education given in institutions. To him, the question was exploiting the resources of industry so that industry and institutions combined to provide the type of education and training that a prospective technician required. There were different forms of sandwich course, thick ones, thin ones, medium ones. In his own experiences in India, there were 320 polytechnics and the constant complaint of industry was that the products of these polytechnics completing full-time three-year courses were not employable. Those arguments went back and forth, and a basis of understanding could not be formed, except through sandwich courses. According to his own survey of the results of the sandwich courses, they were not acceptable to industry in terms of the kind of technicians they needed.

Dr Chandrakant then returned to his last axiom, relating to the economics of education. Since education, including technical education, was regarded as a part of the social system, there was a limit to which a government could provide the means for the education and training of technicians. Educational costs were going up, including teachers' salaries and the costs of equipment. Unless ways and means could be found to minimize costs, countries would be unable to afford better-developed systems because of their additional financial burden.

Dr Chandrakant's paper, having dealt with activity analysis, work content, the knowledge/skill mix, and the types and levels of technicians required, had moved on to the stage of clustering technicians' occupations, which he thought very important. He had then identified the main technician specialities. Then came the planning of the technician education system itself; specifying its objectives; determining the course duration; specifying the entry requirements. Then the curriculum design part of the system, curriculum objectives, subject objectives, behavioural aspects, specifying

the training objectives, training specification, schedules of training, sequence matrix. Dr Chandrakant added that there must be a continuous feedback both from the institutions and industry to indicate where the total system needed to be modified or improved; and the role of industry was as important as any other in evaluating both the student's performance and the interaction between the many elements involved.

After thanking Dr Chandrakant, the Chairman invited preliminary questions and comments, and the following points were made:

Partnership

More than one delegate reported a lack of response in his own country to approaches made by education to industry, and one delegate said that the willingness of industry to make its contribution to a partnership was minimal. Dr Chandrakant said that he had encountered this problem, but thought that sufficient goodwill could sometimes be generated among a few small industries for a break-through to be achieved. Direct contact on practical matters was important. Asked to define the term "common goal", he said that educational objectives were usually expressed in terms of educational standards, but it was important to have a clearer definition of what a technician was to do; industry needed technicians with a well-defined technical content, and this definition of industry's requirements was the common goal.

The partnership as it existed in Hong Kong was described by a Hong Kong representative. He said there were many committees under the Hong Kong Training Council, and its industrialist members spent much time in attending meetings during normal office hours. Industry did not on the whole favour the imposition of a general levy but there was a levy system operating in two industries. The generally accepted view in Hong Kong was that technical education was the responsibility of the Government and in-plant training the responsibility of industry. Some industrialists wanted government to subsidize apprenticeship training, but this was unacceptable to government. In certain industries some units were too small to have their own training programmes; the garment industry (the largest in Hong Kong) had established its own vocational training centre for the training of garment workers, and a levy was imposed on the industry. The construction industry was the other industry with its own levy system. Partnership was, in short, reasonably well-developed in Hong Kong.

Representation of Industry at the Seminar

The same delegate asked why industry was not more widely represented at the seminar. He and others regretted that the delegates were nearly all drawn from technical education, and the voice of industry was therefore not heard on many issues that closely affected it.

Mr B.F.C. Fong said that the Commonwealth Secretariat would very much like to have seen more industrialists participating, but governments had nominated a great preponderance of delegates from education (though it should be remembered that quite a few of these had previous experience in industry). The point would be borne in mind for any similar occasions in the future.

Correspondence Education

In reply to a question about the use of correspondence education for technicians, Dr Chandrakant said that he had no experience of correspondence courses but could see definite advantages in their use. The experience of the Open University in Britain led him to believe that new media like television, radio and programmed learning had tremendous potential at technician education level. In New Zealand and Australia a substantial part of technician education was through the medium of correspondence, sometimes allied with other media. Correspondence courses were certainly as not as narrow as they used to be and there was no doubt that they had a part to play.

Apprenticeship for Technicians

The plenary session was told that one of the seminar's groups had already reached the point of recommending that apprenticeship should be extended to technicians and not confined to craftsmen.

Further Education and Training

In reply to a question, Dr Chandrakant said that providing further courses for trained technicians who could not return for more education posed certain problems, but these could be overcome. The feeling that current education and training programmes were a dead-end sometimes created pressure from students to upgrade courses to degree level; but this upgrading should only arise from actual development needs of a country's system. It was important that the national system should provide further education both for student technicians and for qualified technicians, to help them to higher qualifications.

Sandwich Courses

Asked about constraints that operated against organizing courses on a sandwich basis, Dr Chandrakant said that in India sandwich courses had been introduced to combat criticism from industry, and the system as implemented there involved the employment of additional teachers because some had to accompany the student in industry. Another problem was that sandwich courses were of longer duration than full-time courses, and sandwich course students did not have long summer holidays. A delegate added that the location of educational institutions vis-à-vis industries was also an important consideration. Dr Legg said that his 13 years' experience at Loughborough, a pioneer of sandwich training, caused him to sound a word of caution. The lack of sufficient places for trainees was a constraint, and there came a stage when the institutions could not go on approaching industry. If industry could not accept all trainees, and if sandwich-type course became considered as an integral part of an education system, institutions would have to introduce some quasi-industrial practical training within the institutions themselves.

FLOW CHART FOR TECHNICIAN EDUCATION PLANNING & IMPLEMENTATION