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THE EDUCATION AND TRAINING OF TECHNICIANS IN THE CONSTRUCTION INDUSTRY

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SUMMARY OF THE RESEARCH INTO THE EDUCATION AND TRAINING OF TECHNICIANS IN THE CONSTRUCTION INDUSTRY

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Some six years ago the research commenced by investigating students following the Construction Technicians' Certificate in a number of Colleges in the West Midlands.

The purpose was to ascertain whether this particular course of study met the needs of certain technician functions of the Construction Industry and also satisfied the individual needs of the student.

Simultaneously, data was collected from employers in the Yorkshire region regarding the employers' view of the technician's function. Further evidence was also collected from the Construction Industry Training Board and other Regional Bodies.

This data, in the form of questionnaires, was then analysed and collated by computer. A number of interviews with private and public employers then took place, followed by an in-depth study with a National Private Contractor.

The data collected in this way was also analysed and summarised.

During the period of this research the Technician Education Council was formed and developed courses which were to replace the courses being investigated. The research was directed towards these courses and the development of new concepts of both education and training arising from the interpretation of T.E.C. policies. This resulted from the implementation of the Hazelgrave Report.

During the period of this research the industry has suffered two major economic recessions. This has inevitably influenced responses from companies and many of the trends forecast have been significantly influenced by the general economic climate.

The Construction Industry is in a state of rapid change and the significance of this research is to develop education and training to match these rapidly changing needs of the industry. This has necessitated an objective approach to the design and realization of a course of study and a re-examination of the technical competence and skills required for the current situation.

The research has taken cognizance of the shift of responsibility between employers, colleges, trade unions and the various training organisations.

CONSTRUCTION
TECHNICIAN
EDUCATION
TRAINING

APPRECIATION

I wish to express my sincere thanks to Professor A. W. Pratt for his pertinent observations and guidance.

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SUMMARY OF THE DIAGRAMS AND TABLES

THE EDUCATION AND TRAINING OF TECHNICIANS IN THE CONSTRUCTION INDUSTRY

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CHAPTER I - INTRODUCTION

The construction industry has many established traditions which are fundamental to the way in which building contracting companies operate in relation to both the training of personnel and management of the business. To examine traditions of a Craft based industry responsible for providing homes for the community at the beginning of this century would be of little relevance in relation to the rapid social and technological changes to be faced in the next fifty years.

The developments in the construction industry following the 1939/45 war have been very considerable both in technological achievements and management attitudes. When one considers that in 1946 the construction industry was just coming to terms with the tower crane, or the concept of high rise buildings which was in its infancy, it is difficult to appreciate by today's built environment. The advancing technology has questioned the competence of companies to continue with a labour force following traditional crafts and management skills associated with those traditions. New materials such as plastics, adhesives, pre-stressed concrete and the whole influence of applied science associated with the internal environment in our buildings is far removed from the era of the master builder approach. That approach is both unacceptable and of little relevance in the construction processes of today, let alone the 80s, when the young man now being trained will reach maturity. When one considers a modern hospital or a central development programme in a township of moderate size it can be readily appreciated that the complex services and use of modern materials which lead to a de-skilling of traditional

techniques, require a very different labour force to both manage and construct such buildings.

Domestic construction has become more complicated as a result of clients having greater expectations in a modern dwelling. Here again the influence is one of fragmentation of the work involved, coupled with a division of the labour force and responsibilities in completing the individual parts of a construction process. Complex mechanical services, alongside modern materials, coupled with the economic pressures of a competitive commercial world, offer a challenge to any employer in the construction industry that is comparable to any other commercial business or industry. It is therefore self-evident that the traditions of an industry associated with craftsmen and management of an early post war period are rapidly changing. These changes demand very different attitudes from the production team, in particular the personnel responsible for the successful management of a building project.

At some stage this work will attempt to identify or assess what is meant by the successful management of a building project.

Technological changes mean on the one hand new materials and new construction techniques not previously possible, on the other hand demand new skills and attitudes from the labour force.

A logical development is the introduction of automation techniques and greater use of prefabricated off-site preparation e.g. pre-cast concrete units, heart units, or

any repetitive units of construction which offer mobility from factory or site compound to the position on site which may be in these days a distance of half a mile on the actual site. Consider these factors against the erection of an individual home and we readily see a different management and future training need for the construction industry.

Social changes in the post war period giving expanding educational opportunities, social security and the re-distribution of the G.D.P. are useful indicators of the changing influences and demands being made on the labour force associated with the industry. Any advancement in the use of applied science whether technical or social will increase these demands. Many of our technical failures result from an ill-informed labour force failing to carry out work to the specification required.

Advanced technical competence in any industry requires the norms of individual members of the total labour force to be continually advancing to take full advantage of the innovations available.

National statistics indicate that the labour force has fluctuated whilst the percentage G.D.P. has remained fairly constant in relation to the construction industry which embraces both civil engineering and building. The statistical evidence (Table 1) indicates this fact quite convincingly.

Between 1965 and 1975 approximately half a million construction workers were no longer required whilst the percentage of gross domestic product used in the construction industry was only slightly changed between 1965 and 1975.

TABLE I

NATIONAL STATISTICS ON EMPLOYMENT AND INVESTMENT

	Employees in Employment: The Construction Industry	Permanent Dwellings completed in the U.K.	Kilometers of motorway completed	Total Contribution of the Construction Industry to the GDP (in £ millions)	% of the GDP	National Unemployment Figures
1975	1273000	322113	142	6411	6.68	869,828
1974	1290000	278363	132	5645	7.50	543,079
1973	1338000	304128	85	5006	7.69	576,256
1972	1258000	330749	399	3873	6.71	806,066
1971	1222000	364475	213	3162	6.35	762,144
1970	1294000	362226	93	2840	6.37	578,751
1969	1415000	378325	58	2732	6.73	533,816
1968	1476000	425834	145	2578	6.71	552,760
1967	1515000	415455	130	2388	6.71	539,149
1966	1604000	396009	60	2260	6.66	291,674
1965	1700000	391234	101	2153	6.69	305,334
1964	1659000	383192	160	2007	6.72	349,000
1963	1582000	307714	80	1740	6.49	497,000
1962	1552000	313643	24	1636	6.49	406,000

SOURCE - ANNUAL ABSTRACT OF STATISTICS, 1976

It could also be assumed that with this dramatic reduction in the work force many of the more able craftsmen were possibly absorbed into new and more responsible positions whilst the casual labour that was associated with the industry was, of course, dispensed with.

On examining the information one must remember that social pressures change the emphasis of the use of our national budget e.g. from motorways with high investment in plant to homes for the general public with a labour intensified investment. These political decisions can change the construction industry's destiny annually, and at all times the construction industry is most sensitive to the economic climate resulting from social pressures and political responses. A good example of these influences can be illustrated by the recent decision to offer financial support in updating or upgrading domestic dwellings to a more acceptable standard. These national grants, administered through local government officers, although socially desirable, require a different labour force to that associated with new construction or contracting work.

The flexibility and adaptability of an industry is a national problem. Individual companies or organisations, reflect their effectiveness by their response to changing demands. Unlike the "line process" of the factory conditions, the construction industry has many more variables to combat in its day to day work. Not least of course the bad weather conditions which is a hazard to the construction industry as opposed to the controlled environment of workers in a factory or enclosed environment.

The whole of commerce and industry in this country seeks its share of the talents of the community. Although many executives in British industry in general have not had the opportunity of an under-graduate course of study or formal technical education beyond the statutory school leaving age, there is increasingly greater sympathy and acceptance that continued training and education of all types is becoming an essential service in the competitive technical world which we are currently developing. This applies to the building industry as to other areas. This is shown by comparing the number of graduate courses in building in 1938 with approximately 30 graduates from three universities and the present when we have 12 graduate courses available supplying approximately 200 graduates annually. Alongside this development part-time technician courses have grown over the years and at present students are following a wide variety of technician courses.

The intention of this thesis is to examine in depth the success and future potential of the students receiving this type of training.

Craftsmen in the industry are still continuing to receive education and training which has been firmly established for the last 50 years; the introduction in 1964 of the Industrial Training Act is evidence of the national concern for the need to ensure all industries had the opportunity to provide adequate training facilities at all levels within the industry concerned. It could be seen as an indication that techniques associated with education and training in the recent past were no longer fulfilling the needs of

particular industries. Changing attitudes between journeymen and apprentices resulting from incentives directed at output have deterred the social responsibility of mature craftsmen assisting in the training of young entrants at all levels. These influences with different attitudes to training middle management and supervisors mean that all institutions primarily concerned with vocational education and training have also adjusted their philosophy to meet these changes. Many progressive industries can only survive by offering continuing re-training and staff development programmes to match the advancing technology. More traditional service industries have been somewhat sheltered from this demand, but as all industry competes for a fair share of the talents of young people the demands for a structured education and training for all industries are becoming increasingly obvious. The national expenditure subsidising education and training is now closely scrutinized by industrialists and those responsible for the training. To levy industry for training personnel is a new concept in this country but more widely accepted in Europe. With the advent of E.E.C. and closer links within the community both qualifications and training are now being re-examined. A judgment on the investment for training and development of a particular industry is another indicator which serves to show our concern. Assuming every industry used 5% of its turnover for re-training, staff development and research would offer a more realistic approach to the problem.

Management attitude to any change can be judged against the company's investment to meet the objectives associated with employees' awareness of the need for rapid change or flexibility.

The vanguard for change results from the pioneering spirit of researchers followed by educationalists whose professional responsibility is to disseminate the knowledge recently acquired. The question then becomes one of ways and means in relation to the communication of information. What learning techniques will be best suited to the level of activity the employee is involved in or for which he is responsible.

The major part of the work to follow will endeavour to identify criteria for the education and training offered to future technicians in the construction industry to ensure that in a short space of time they are an effective part of the middle management of the construction team. With the fragmentation of responsibilities already referred to, there is a greater need for personnel to act in a co-ordinating role whether it is in the production team on site or in an administrative capacity at some central control. There have been many empirical rules presented by national administrators and management researchers regarding the span of control, the number of technician staff needed to support a technologist, or the number of craftsmen and operatives one can successfully supervise on any building contract or project. Although one could always question empirical rules they are a useful guide when attempting to relate the needs of individual companies. The more acceptable method of approaching the education and training of our students both to industrialist and educationalist would arise from clearly defined objectives which should be agreed by the trainers of personnel and mutually agreed with interested employers. This approach is more demanding as any long term

training programmes tend even in objective terms to be intuitive and initiated by a small group of people often referred to as progressives.

A division of opinion often arises when today's requirements in training terms can be readily seen but aspects of a training programme and curriculum for five to ten years ahead have not been accepted by the present management or executive. Having posed the recurring problem it is generally being accepted that technicians in their training will all receive an agreed amount of formal and factual information, but more particularly be given opportunities in problem solving. This would equip the person concerned with an ability (which can be assessed) to meet new and changing demands resulting from changes in the industry. (This is not a new concept as the criteria often placed on a general education is stated to be a "preparation for life". An extension of this preparation for life is the role we may accept in a particular industry.) Many of these general observations will be examined in specific detail under the investigation carried out with a sample of students following the Construction Technician course which has been operating for some eight years. These particular students have been selected by either employers or college staff to follow a reasonably broad based technical course.

The investigation will attempt to identify the possible compatability between employers' requirements and students' potential, within the limits of any course of education and training associated with the industry.

OFFICIAL PUBLICATIONS INFLUENCING THE EDUCATION AND TRAINING OF PERSONNEL IN THE CONSTRUCTION INDUSTRY

In 1961 a significant White Paper entitled "Training Opportunities" identified for the first time in our history demarcations of categories of employment which subsequently have been used to relate appropriate education and training needs. The White Paper identified the Operative, Craftsman, Technician and Technologist. A further significant development towards the end of 1962 arose from the "Industrial Training: Government Proposals": Cmnd. 1892 - The print is made in "The Evolution of British Manpower Policy" - Author: P.J.C. Perry.

'The White Paper's proposals were revolutionary. It began by spelling out the reasons for the Government's departure from a policy which, until recently, it had defended with undeviating single-mindedness.

'At its best, the standard of training in this country is high; unfortunately this is by no means universal. Much is barely adequate and some definitely unsatisfactory. Many firms do not make adequate use of the facilities for technical education. Our overseas competitors, particularly in Western European countries, have paid great attention to the need to maintain an adequate supply of well trained skilled labour. We must be quite sure that our own arrangements do not fall behind.' '

In 1964 the Industrial Training Act was introduced in this country which might be considered an indictment against our competence to offer adequate training for the work force in this country. If one considers the significance of these two developments in relation to trends that subsequently followed, they were possibly the major contribution in providing the impetus for investigation and organised training and education at the present time.

Further significant Government action relating to progress in the formulation of Technician Education was the establishment of the Technician Education Council in March 1973. This arose from the recommendation of the Haslegrave Committee on Technician Courses and Examinations (National Advisory Council on Education for Industry and Commerce (1969) Report of the Committee on Technician Courses and Examinations).

It is always appreciated that any decision relating to either a White Paper or Government Legislation acts as a catalyst in prompting meaningful action where previously deficiencies were becoming apparent. Following the 1961 White Paper and the 1964 Industrial Training Act many Courses of Education and Training were significantly changed.

'The range of functions which the Boards would be empowered to undertake would be set out in the proposed Bill. These might include:

(1) Establishing policy for training in the industry, including such questions as admission to training (apprenticeship or otherwise), length of training, registration of trainees, and a provision for appropriate attendance at colleges of further education,

(2) Establishing standards of training and syllabuses for different occupations in the industry, taking into account the associated technical education required.

(3) Providing advice and assistance about training to firms in the industry.

(4) Devising tests to be taken by apprentices and other trainees on completion of training and, if necessary, at intermediate stages - for example, at the end of the first year.

(5) Establishing qualifications and tests for instructors.

(6) Establishing and running training courses in its own training centres.

(7) Paying grants to firms to reimburse them all or part of the costs incurred in the provision of approved training.

(8) Paying allowances to trainees not taken on by firms while being trained in public, or the Board's own centres.

(9) Collecting money from establishments in the industry by means of a levy.'

This specific investigation and research takes account of these responsibilities. It is also mindful of the responsibilities given to the Technician Education Council who are responsible to the Under Secretary of State for Technician Education.

"The Technician Education Council was established in March 1973 in fulfilment of a recommendation of the Haslegrave Committee on Technician Courses and Examinations, which reported in 1969. When the creation of the Council was announced in the House of Commons by the then Secretary of State for Education and Science, its terms of reference were summarised as follows:

> 'The Council will be concerned in the development of policies for schemes of technical education for persons at all levels of technician occupations in industry and elsewhere. To this end it will, as proposed in the Haslegrave Report, plan, administer and keep under review the development of a unified national system of courses for such people and will devise or approve suitable courses, establish and assess standards of performance, and award certificates and diplomas as appropriate.'

Significant innovation is also anticipated in new areas of study, also in the teaching-learning process creating learning situations and an assessment procedure that will be the responsibility of the professional teachers in Colleges. All these expectations can only be fulfilled if there is sufficient guidance and help given to the teaching staffs associated with the courses of study.

CHAPTER II

INVESTIGATION PROCEDURES USED IN THIS RESEARCH

Over a period of some four years the research has entailed an analysis of a questionnaire given to students following a particular Technician Course of Study. Simultaneously a series of sampling tests using questionnaires and interviews with employers has also been carried out. The major objective which had to be achieved was that the JOB PROFILE identified with the student/employee had a relationship with the EDUCATION PROFILE organised in the College in response to the needs of industry.

Collecting the appropriate data and processing the questionnaires has involved a field investigation described in detail in this chapter under the sub-heading "Field Investigation". Other supporting information was collected independently in the Yorkshire Region with the assistance of some twenty-four companies (Table 2) who responded to a questionnaire (Tables 3 and 4) giving an indication of the functions and responsibilities associated with the various categories of technicians employed.

All responses to the questionnaires on the subject of functions performed assists in determining some order of priorities in relation to those skills or aptitudes which are frequently called upon by the employers in the construction industry.

The Summary of twenty-four companies' responses to the functions listed resulted in identifying a rank order of priorities (Tables 3 and 4).

The rank order has also been listed for the category of Construction Technician which relates to the detailed evidence provided by the field investigation conducted in the Midland Region. These details appear in Chapter III.

A further follow-up with a number of employers who agreed to be interviewed and responded to a questionnaire (Table 15) on the training and education of technicians in their own companies, provided further collaborative information in support of conclusions and predictions of future developments in further education and training.

TABLE 2

LIST OF COMPANIES WHO REPLIED TO THE QUESTIONNAIRE

1. Main activity - Building. No. of Employees 950+
2. Main activity - Building and Small Civil Engineering Works. No. of Employees 1200+
3. Main activity - Building and Small Civil Engineering Works. No. of Employees 950+
4. Main activity - Building and Public Works Contractors. No. of Employees 1300
   Contract value up to £3,000,000.
5. Main activity - Building and Civil Engineering Contractors. No. of Employees 1800
   Contract value up to £4,000,000.
6. Main activity - Spec. Building. No. of Employees 800.
7. Main activity - Civil and Building, Housing and Civil Contractors. Regional Office of National Firm. Contract value up to 2½ million.
8. Main activity - General contracting, Housing, Schools, Small Factories. No. of Employees 85.
9. Main activity - Building and Civil Firm, working in a 40 miles radius from Head Office.
   No. of Employees approximately 200.
10. Main activity - Building and Civil Engineering Company of medium size.
11. A rapidly expanding national group of companies with a multi-million pound turnover involved with major industrial commercial and public buildings, doingits own designing and installation of ancillary services.
12. Main activity - Building and Civil Engineering Group. No. of Employees 450.
13. A progressive and expanding building and contracting company. No. of Employees 75.

TABLE 3

TECHNICIAN FUNCTIONS

SUMMARY - FIRMS 1 to 24

FUNCTIONS	Construction Technician	Civil Eng. Technician	Architectural Technician	Highways Technician	Mech. Services Technician	Elec. Services Technician	Surveying Technician	Rank Order for Construction Technicians
1. Construction Drawings	13	8	11	1	5	1	1	4
2. Site Investigation	10	8	5	1	1	1		6
3. Testing Materials - Quality Control	15	9	4		1			2
4. Site Surveying and Setting-out	17	9	1	1	1		1	1
5. Contract Organisation and Administration	14	5	5	1	2	2	1	3
6. Costing, Estimating, Economic Control on site	17	9	1		2	1	1	1
7. Design and Erection of Temporary Structures	12	9	4					5
8. Design and Construction of Formwork	12	9	3					5
9. Technical Supervision	13	6	1	1	3	1		4
10. Planning and Control Production Team	14	7	2		5	2	1	3
10a. Planning and Control Finance	7	2	4		1	1	1	8

TABLE 4

FUNCTIONS	Construction Technician	Civil Eng. Technician	Architectural Technician	Highways Technician	Mech. Services Technician	Elec. Services Technician	Surveying Technician	Rank Order for Construction Technicians
11. Plant Organisation and Control	13	8				1		4
12. Development of Site Practice	12	4		1	2	2		5
13. Technical Reporting	15	10	7	1	5	2	1	2
14. Testing of Services	7	2			6	2		8
15. Appraisal and Selection of Plant	9	5		1	1	1		7
16. Supervision of Maintenance	7	6	2	1	5	1		8
17. Fault Diagnosis and Remedial Work	10	4	2	1	4	2		6
18. Responsibility for Statutory Requirements	14	10	9	1	5	2	1	3
19. Communication - (a) Management and Technologist (b) Foreman and Operational Work Force	 12 10	 6 6	 5 3	 1 1	 3 2	 1 2	 1	 5 6
20. Process of Experimental Investigation e.g. Techniques of Construction	3	2	5			1		10
21. Personnel Management	4	1	1			1	1	9
22. Functional Management	7	4	3		2	2		8
23. Industrial Relations	10	4	3		2	2	1	6
24. Awareness of his Role in the Society	10	9	8	3	5	2		6

FIELD INVESTIGATION

The field investigation was organised around a questionnaire which was presented to students following the Construction Technicians Course C.G.L.I. Part II. The questionnaire has been used over a period of three years at a number of colleges in the Midland Region. All the colleges listed have run the particular course of study for some six years or more; it can therefore be assumed that the students concerned and their employers have been accustomed to the possible value of this course which has catered for those technicians who in many instances have not the required entry qualifications for the traditional national certificate route. The structure of the course and the variety of student backgrounds afforded the opportunity to those teaching the course to design projects and student assignment work. This appraisal was encouraged and agreed with the City and Guilds of London Institute who offered this relatively new course of study. This teaching approach was a significant departure from the more formalised subject discipline structure, normally adopted by colleges. It is with these two major differences in mind that the questionnaire was constructed.

Possibly the most important matter affecting this investigation is the range of employers involved. At one end of the spectrum students are employed by very small companies employing less than 10 employees, whilst at the other end students are employed by companies having in excess of 400 employees. The variety of employment is also far ranging. To indicate this range the following examples have been selected.

i) Employment by Small, Medium and Large Building/ Civil Engineering employers.

ii) Employment by Local Authorities.

iii) Employment by Private Consultants, e.g. Quantity Surveyors, Architects, Building Surveyors.

Accepting these wide variations it is still possible to identify in the analysis a frequency of demand for both the employee and employer's needs.

Although ideally a job analysis for each individual technician would be a more accurate appraisal, for the purpose of this large scale investigation broad areas of activities have been analysed.

METHOD OF ENQUIRY

The following colleges agreed to allow me to present the questionnaire (Table 5), to students following the C.T.C. Part II. The students are normally in the age range of 18 years to 24 years (with exceptions who are senior in age).

1) WOLVERHAMPTON POLYTECHNIC
2) WARLEY COLLEGE OF TECHNOLOGY
3) COVENTRY TECHNICAL COLLEGE
4) BASFORD HALL COLLEGE OF F.E.
5) STOKE COLLEGE OF BUILDING & COMMERCE
6) SHIRECLIFFE COLLEGE

It is important to appreciate that colleges have very little control over the annual intake of students.

TABLE 5

TOTAL SUMMARY OF RESPONSES
TO QUESTIONNAIRE
CONSTRUCTION TECHNICIANS' COURSE
PART II C.G.L.I. 314

Total = 146 Employees

Name: Date of Birth:

Employer:

Present Occupation:

Please place a tick in the appropriate answer box

	None	YES	NO
1. Have you received any craft based training?	1	53	92
What was the craft in which you received training?			
2. Brickwork	28	12	106
3. Carpentry and Joinery	28	31	87
4. Plumbing	29	5	112

Please state any other below

What is the title of your immediate superior?

5. General Foreman
6. Trade Foreman
7. Supervisor
8. Manager
9. Surveyor
10. Site Agent

None	YES	NO
2	11	133
2	3	141
2	12	132
2	22	122
2	22	122
2	10	134

Please state any other below

11. In your present job, are you responsible for a number of workmen or staff?

None	YES	NO
2	42	102

What number of people are employed in your company?

12. If less than ten give number in box
13. 10 to 20
14. 20 to 50
15. 50 to 200
16. 200 to 400
17. over 400

None	YES	NO
5	11	130
5	20	121
4	25	117
5	11	130
5	57	84

What is the occupation in the industry you hope to take in the future?

	None	YES	NO
18. General Foreman/Site Agent	8	13	125
19. Buyer or Estimator	8	6	132
20. Quantity Surveyor	8	14	124
21. Contract Manager	8	31	107

Please state below any other

What are your present qualifications?

	None	YES	NO
22. C.S.E.	20	81	45
23. G.C.E.	26	82	38

Craft Certificates:

	None	YES	NO
24. Brickwork	29	5	112
25. Carpentry and Joinery	30	19	97
26. Plumbing	32	2	112

Please state any other below

Please give brief details of qualifications below.

THE COURSE OF STUDY

27. At what stage of the course did you commence?

(Please tick appropriate box)

None	T1	T2	T3	T4
2	38	93	13	

28. Do you consider this course of study adequate for the appointment you are aiming for?

29. Is the subject matter you receive of direct use in your present job?

	None	YES	NO
28.	5	99	42
29.	10	89	47

During your course of study you will have been involved in the following forms of "Learning". State your views.

(Please answer in the appropriate column by means of a tick)

	None	A Poor Method 1	A Useful Method 2	A Good Method 3	A Very Good Method 4
30. Formal Teaching	2	10	53	66	15
31. Site Visits	6	5	33	41	61
32. Workshop Visits	19	8	50	37	24
33. Project/Student Assignments	2	14	23	48	59
34. Practical Exercises	11	3	28	47	57
35. Slides or Films	3	5	61	49	28

Do you feel that your subject knowledge is sufficiently advanced?

	None	YES	NO
36. To carry out your present job?	5	122	19
37. To carry out your future job?	7	48	91

CONTINUOUS ASSESSMENT

38. During your course of study you have received "assignments" which are assessed as part of the qualification you are aiming for

Do you consider this to be useful?

None	YES	NO
7	128	11

Please comment giving reasons for your answer.

Tasks you are called upon to carry out at your place of employment.

(Please answer in the appropriate column by means of a tick)

	None	Totally	Frequently	Occasionally	Never
Administrative Work in the Office					
39. Detailed Drawing	8	22	38	45	33
40. Measuring and Preparation of Estimate	16	10	22	38	60
41. Preparing Schedules of Materials	12	8	28	49	49
42. Preparing Schedules of Purchases	17	-	15	24	90
43. Working up Bills of Quantities	19	3	10	20	94
44. Programming and Planning	15	7	16	42	66

Production Work	None	Totally	Frequently	Occasionally	Never
45. Setting out on Site	11	12	17	51	55
46. Site Measurement	9	15	43	48	31
47. Supervision on Site	13	8	32	48	45
48. Checking and Ordering Materials	9	4	33	48	52
49. Measurement for Bonus Payment	15	8	16	9	98
50. Inspection-Quality Control of Work carried out	14	8	23	41	60
51. Bonusing	16	7	15	8	100
52. Costing	17	4	14	24	87
53. Small Works - Responsible for total supervision	15	9	17	32	73
54. Plant	13	3	9	29	92

DESIGN OF THE QUESTIONNAIRE

In designing the questionnaire it was important to ensure the following criteria were satisfied:

1) What reliability could be justified from the responses received.

2) What range of information could be identified under the following headings:

   2.1. Students previous Academic background.

   2.2. Students present roles and technician functions being performed in their place of employment.

   2.3. The recurring technical functions performed by students. Frequency in relation to total weekly work load.

   2.4. Students aspirations in relation to future employment in the industry.

   2.5. Students appreciation of both the Course Content and the teaching approaches used.

   2.6. Students attitude to Progressive assessment and Learning objectives of the course of study.

A large number of the questions required a simple YES/NO reply. It is assumed where a definitive answer is possible, that statistically a degree of reliability associated with established formulae would be acceptable in forecasting or predicting trends. (T test) - (Reference: Tables 11, 12, 13 and 14).

A smaller number of the 54 questions required students to discriminate on a four point scale. One of the questions was open ended giving the students an opportunity to make comment on the value of the technical projects or assignments set. This open ended question (No. 38) was intended to give

students the opportunity to express their personal views having received individual or, in some instances, group projects, which are intended to reflect current technical solutions being used in the construction industry. From the answers received it is also possible to make certain assumptions about the students' attitudes towards a teaching approach where both students and teacher are attempting to make value judgements on both technical and economic grounds. Value judgments are automatically encouraged with this teaching approach and the subjective comments can be used as an indicator to those assessing the students' comments in postulating the future curriculum content and learning objectives associated with the industries' needs.

From the questionnaire the following evidence has been collated.

ANALYSIS OF DATA

1) The Students' Educational Background.
2) The frequency of the functions performed by the Technicians at their place of work.
3) The students' aspirations and career opportunities.
4) The objectives being achieved by the course of study and subject content.
5) The standards achieved by the students and the responsibilities currently accepted by the students.

All the five statements above are refinements of the following analysis.

1) Job Description/Analysis.
2) Objectives associated with the Job Analysis.
3) Performance requirements of the employer.

4) Personal Department of the employee/student.

5) Response of the Course of Study to meet the changing demands of the construction industry.

Although ideally a job analysis for each individual technician would be a more accurate appraisal, for the purpose of this large scale investigation broad areas of activities have been analysed.

The question now arises which was posed in Chapter I. What learning techniques will be best suited to the level of activity the employee is involved in or for which he is responsible? Analysis of questions 27 to 38 will be presented under the chapter on the Course of Study and appropriate learning methods for the technician student. Responses to a variety of learning experiences offered influences the attitudes of the learner which can be significant in assisting him in his present and future vocational needs.

RELIABILITY CRITERIA

Regression Analysis & Correlation

It can be shown (Neville 1964) that the relation between t & r is

$$t = \frac{r\sqrt{n - z}}{\sqrt{1 - r^2}}$$

This will give the calculated 't' test :-

$$t = \frac{0.9\sqrt{3 - 2}}{\sqrt{1 - 0.81}} = 2.06$$

from tables $t_{2,10} = 2.92$

Equations used in the Computer Programs:-

$$r_{xy} = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{n}\right)\left(\sum y^2 - \frac{(\sum y)^2}{n}\right)}}$$

$$m = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}}$$

$$c = \frac{(\sum x)(\sum xy) - (\sum y)(\sum x^2)}{(\sum x)^2 - n(\sum x^2)}$$

$$y = mx + c$$

Student's t test for two samples to see if both can be regarded as being from the same parent population when only the means & standard deviations of the two samples are known:-

$$\text{Calculated} \quad t = \frac{\bar{x}_1 - \bar{x}_2}{S_p} \sqrt{\frac{n_1 n_2}{n_1 + n_2}} = 1.6$$

$$\text{where} \quad S_p = \sqrt{\frac{U_1 S_1^2 + U_2 S_2^2}{U_1 + U_2}}$$

$\bar{x}_1$	= 1st mean	700
$\bar{x}_2$	= 2nd mean	760
S_1^2	= 1st variance	558^2
S_2^2	= 2nd variance	551^2
n_1	= number of classes in 1st sample	3
n_2	= number of classes in 2nd sample	3
U_1	= degrees of freedom in 1st sample	2
U_2	= degrees of freedom in 2nd sample	2

TABLE 13

t test for 2 means $\bar{x}_1$ & $\bar{x}_2$

calculated $t_4 = 1.6$

Table $t_{4,10} = 2.13$

(Should be normally distributed to be fully valid)

Graphs based on YES/NO results of both series

	None	Yes 1	No 2		
1st	211	555	1514	$\bar{x}$ 760	U = 2
2nd	116	531	1453	$\bar{y}$ 700	U = 2

Regression $y = 0.98x + 0.70$

$x = 1.01y - 0.69$

$r_{xy} = 0.9$

Actual	x	116	531	1453
Theoretical	y	114	521	1424

Calculated $t = 2.06$

from tables $t_{2,10} = 2.92$

We accept the correlation at the 10% (2 tailed test) level of significance.

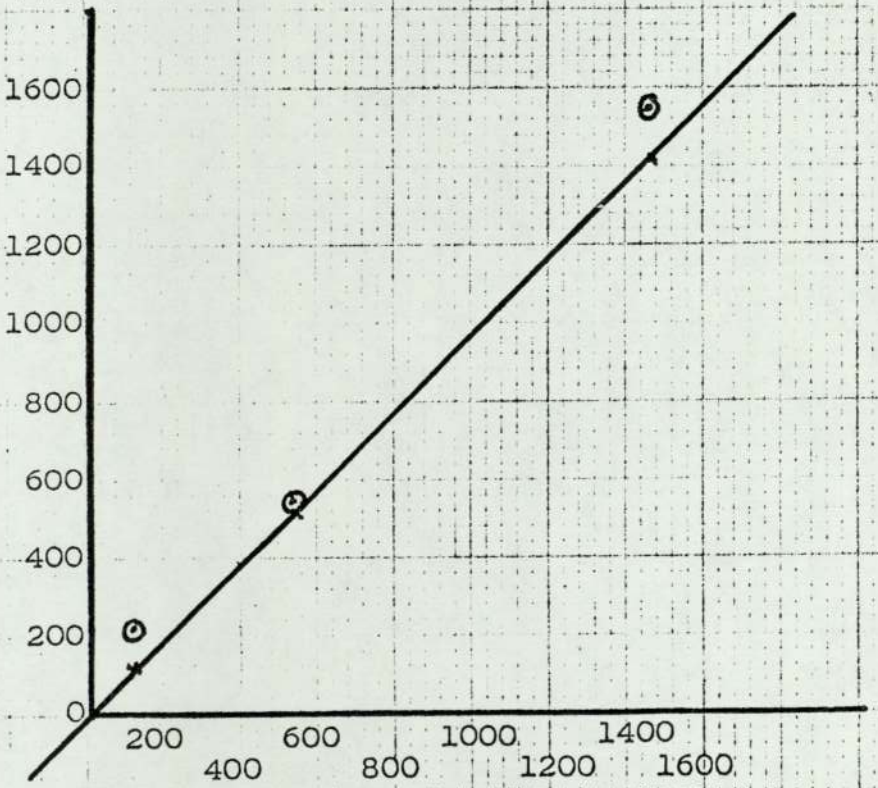
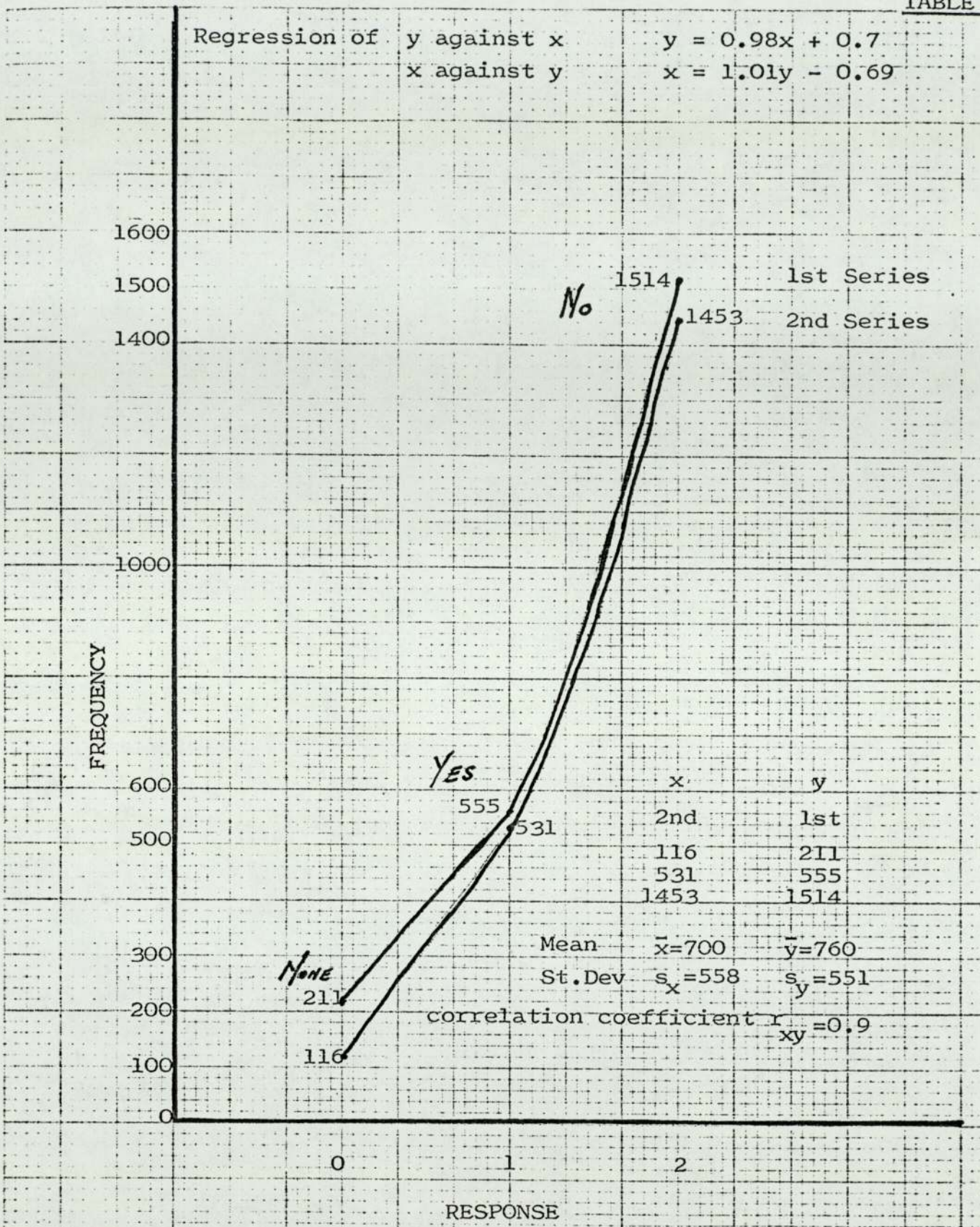


TABLE I


Regression of y against x
y = 0.98x + 0.7
x against y
x = 1.01y - 0.69
1600
1500
1400
1000
600
500
300
200
100
0
FREQUENCY
1514
1453
1st Series
2nd Series
No
Yes
555
531
None
211
116
x
y
2nd
1st
116
211
531
555
1453
1514
Mean
x̄=700
ȳ=760
St.Dev
s_x=558
s_y=551
correlation coefficient r_xy=0.9
0
1
2
RESPONSE

CHAPTER III - SUMMARY OF THE INVESTIGATION

Having established the degree of reliability (Tables 11 to 14) of the responses to the questionnaire, the following observations are an indication of trends which appear to be acceptable to students/employees following the particular course of study.

On examining Table 5 "Total Summary of Responses to Questionnaire" many significant developments can be identified. In response to question No. 1 it can be seen that there is an increase in recruitment for technician training by direct appointment to a company compared with promotion from craft based education and training.

Actual Response:

Question 1. Have you received any craft based training?

YES	NO
53	92

The size of companies inevitably influences the opportunities and responsibilities of the individual employees relative to the work load and work force. Within this sample approximately one-third of the students following the particular course are already responsible for a number of other employees. The span of control associated with these technicians would obviously be limited to the size of the company. It is well established that approximately 15% of the employers in the industry are responsible for between 40% and 50% of the work load, leaving 80% of the employers employing less than 50 employees to half the total work in the industry.

TABLE 5

TOTAL SUMMARY OF RESPONSES

TO QUESTIONNAIRE

CONSTRUCTION TECHNICIANS' COURSE

PART II C.G.L.I. 314

Total = 146 Employees

Name: Date of Birth:

Employer:

Present Occupation:

Please place a tick in the appropriate answer box

	None	YES	NO
1. Have you received any craft based training?	1	53	92
What was the craft in which you received training?			
2. Brickwork	28	12	106
3. Carpentry and Joinery	28	31	87
4. Plumbing	29	5	112

Please state any other below

What is the title of your immediate superior?

5. General Foreman
6. Trade Foreman
7. Supervisor
8. Manager
9. Surveyor
10. Site Agent

None	YES	NO
2	11	133
2	3	141
2	12	132
2	22	122
2	22	122
2	10	134

Please state any other below

11. In your present job, are you responsible for a number of workmen or staff?

None	YES	NO
2	42	102

What number of people are employed in your company?

12. If less than ten give number in box

13. 10 to 20
14. 20 to 50
15. 50 to 200
16. 200 to 400
17. over 400

None	YES	NO
5	11	130
5	20	121
4	25	117
5	11	130
5	57	84

What is the occupation in the industry you hope to take in the future?

	None	YES	NO
18. General Foreman/Site Agent	8	13	125
19. Buyer or Estimator	8	6	132
20. Quantity Surveyor	8	14	124
21. Contract Manager	8	31	107

Please state below any other

What are your present qualifications?

	None	YES	NO
22. C.S.E.	20	81	45
23. G.C.E.	26	82	38

Craft Certificates:

	None	YES	NO
24. Brickwork	29	5	112
25. Carpentry and Joinery	30	19	97
26. Plumbing	32	2	112

Please state any other below

Please give brief details of qualifications below.

THE COURSE OF STUDY

27. At what stage of the course did you commence?

(Please tick appropriate box)

None	T1	T2	T3	T4
2	38	93	13	

28. Do you consider this course of study adequate for the appointment you are aiming for?

29. Is the subject matter you receive of direct use in your present job?

None	YES	NO
5	99	42
10	89	47

During your course of study you will have been involved in the following forms of "Learning". State your views.

(Please answer in the appropriate column by means of a tick)

	None	A Poor Method 1	A Useful Method 2	A Good Method 3	A Very Good Method 4
30. Formal Teaching	2	10	53	66	15
31. Site Visits	6	5	33	41	61
32. Workshop Visits	19	8	50	37	24
33. Project/Student Assignments	2	14	23	48	59
34. Practical Exercises	11	3	28	47	57
35. Slides or Films	3	5	61	49	28

Do you feel that your subject knowledge is sufficiently advanced?

	None	YES	NO
36. To carry out your present job?	5	122	19
37. To carry out your future job?	7	48	91

CONTINUOUS ASSESSMENT

38. During your course of study you have received "assignments" which are assessed as part of the qualification you are aiming for

Do you consider this to be useful?

None	YES	NO
7	128	11

Please comment giving reasons for your answer.

Tasks you are called upon to carry out at your place of employment.

(Please answer in the appropriate column by means of a tick)

	None	Totally	Frequently	Occasionally	Never
Administrative Work in the Office					
39. Detailed Drawing	8	22	38	45	33
40. Measuring and Preparation of Estimate	16	10	22	38	60
41. Preparing Schedules of Materials	12	8	28	49	49
42. Preparing Schedules of Purchases	17	-	15	24	90
43. Working up Bills of Quantities	19	3	10	20	94
44. Programming and Planning	15	7	16	42	66

Production Work	None	Totally	Frequently	Occasionally	Never
45. Setting out on Site	11	12	17	51	55
46. Site Measurement	9	15	43	48	31
47. Supervision on Site	13	8	32	48	45
48. Checking and Ordering Materials	9	4	33	48	52
49. Measurement for Bonus Payment	15	8	16	9	98
50. Inspection-Quality Control of Work carried out	14	8	23	41	60
51. Bonusing	16	7	15	8	100
52. Costing	17	4	14	24	87
53. Small Works - Responsible for total supervision	15	9	17	32	73
54. Plant	13	3	9	29	92

The technicians included in this sample questionnaire are mainly employed with companies having in excess of 50 employees which can be assumed to fall into the category of a middle sized company. It can be assumed that the students responding to this questionnaire were typical of the recruits associated with the Midlands Region and not untypical of other regions in many parts of the country.

It is significant that all the students appear to have aspirations beyond their present employment whatever the size of the company with which they are presently employed. Unfortunately it must be appreciated from this particular evidence that aspirations of existing employees cannot be satisfied by the industry and the decreasing opportunities is a significant issue to be acknowledged by the employees concerned.

Page 3 of the Questionnaire reveals the quality of entrant to the industries technician work force.

Extract from Questionnaire:

What are your present qualifications?

22. C.S.E.
23. G.C.E.

None	YES	NO
20	81	45
26	82	38

The general education achievements of the students is above average, approximately half have studied on a General Certificate of Education Course. If we consider the national norms then we can agree that at least half of the sample during school life have been within the top quartile of the general education spectrum. This indicates that the construction industry in the less selective area of recruitment is able to absorb a large number of quite able people.

It will be appreciated that the questionnaire in its present form is sufficiently demanding to generate a whole host of detailed investigations or analyses arising from responses to some of the questions.

Looking at the evidence provided on page 4 of the questionnaire, question 28 offers some assurances to employers and educationalists of the value of the particular course of study.

Question 28:

Do you consider this course of study adequate for the appointment you are aiming for?

None	YES	NO
5	99	42

Realising that two-thirds of the students consider the course of study adequate for their present employment then it might be reasonable to expect that a considerable number of the students concerned are already achieving their potential relative to their abilities and aptitudes.

To establish a balance of the following equation would be an important issue within the individual company, i.e. "Individual In-Service Training and Individual Aspirations equals Companies needs and Aspirations." Accepting that many companies are looking for a stabilising influence within their organisations then this particular equation has a significant influence to meet that objective.

Appreciating also the confidentiality and technical competence of the Technicians within a construction company which relies in no small measure on this level of employment. Furthermore, the consequences of under-estimating the importance of these

employees can have serious repercussions in a company's organisation and responsibilities to its clients.

It is gratifying to note that approximately two-thirds of the students agreed that the subject matter taught is directly relevant to them in their present employment.

Responses to the "Management of Learning" within the Colleges is indicated in questions 30 to 35.

Questions 30 to 35:

	None	A Poor Method 1	A Useful Method 2	A Good Method 3	A Very Good Method 4
30. Formal Teaching	2	10	53	66	15
31. Site Visits	6	5	33	41	61
32. Workshop Visits	19	8	50	37	24
33. Project/Student Assignments	2	14	23	48	59
34. Practical Exercises	11	3	28	47	57
35. Slides or Films	3	5	61	49	28

More detailed observations on the teaching methodology and organisation of learning experiences will be included in the chapter on the analysis of this research. From the responses 60% of the students were rating Project/Student Assignment work as a Very Good Method of learning.

Examining the following extract it can be readily seen that in a league table of appreciation under the discretionary response of A Very Good Method, we see

Rating No. 1 - Site Visits.

Rating No. 2 - Project/Student Assignments.

Rating No. 3 - Practical Exercises.

Rating No. 4 - Slides and Films.

Rating No. 5 - Workshops Visits.

Rating No. 6 - Formal Teaching.

A very impressive number of students agreed that the subject knowledge presently being taught them on this course of study satisfied their present employment needs. This could, in some instances, offer to the educationalists and employers an opportunity to be satisfied with their efforts. It could, however, be interpreted as a limited goal if we consider that both the course and the employees involved are only dealing with what in some people's eyes would be a modest level of technical and administrative functions.

A most important development in this course of study was the introduction of Continuous Assessment associated with the Project/Student Assignment work. The unanimous agreement of some 90% of the students seeing this as a most acceptable approach to their progress is re-assuring to say the least. As will be seen later in the research, employers also appreciate the value of simulated assignments given to their students; along with an assurance that they would wish to be involved with this particular development. This attitude found amongst more progressive employers of labour is a useful indicator for the future.

The analysis illustrated in Tables 6,7 and 8 in reply to Production and Administrative Functions is interesting to both employers and educationalists. Speculation on the correct emphasis of the course content can be made from this historical evidence.

The range and frequency of particular functions performed by the technicians identifies sharply the differences in career opportunity in relation to the size of companies involved in this investigation.

i.e. Company Size 0 to 9
10 to 19
20 to 49
50 to 199
200 to 399
in Excess of 400

In certain companies the technician is totally committed to one function. The following extract from the responses identified with companies employing in excess of 400 people and those employing 200 to 399, indicate the continuity of demand for specific functions associated with the administration and production teams activities.

TABLE 6

PRODUCTION WORK OF THE TECHNICIAN

QUESTION	45. Setting out on Site				46. Site Measurement				47. Supervision on Site				48. Checking and Ordering Materials				49. Measurement for Bonus Payment				50. Inspection - Quality Control of Work Carried Out				51. Bonusing				52. Costing				53. Small Works - Responsible for total supervision				54. Plant			
	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N
	12	17	51	55	15	43	48	31	8	32	48	45	4	33	48	52	8	16	9	98	8	23	41	60	7	15	8	100	4	14	24	87	9	17	32	73	3	9	29	92

KEY: T = Totally F = Frequently O = Occasionally N = Never

TABLE 7

ADMINISTRATIVE WORK OF THE TECHNICIAN

QUESTION	39. Detailed Drawing				40. Measuring and Preparation of Estimate				41. Preparing Schedules of Materials				42. Preparing Schedules of Purchases				43. Working up Bills of Quantities				44. Programming and Planning			
	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N	T	F	O	N
	22	38	45	33	10	22	38	60	8	28	49	49	-	15	24	90	3	10	20	94	7	16	42	66

KEY: T = Totally F = Frequently O = Occasionally N = Never

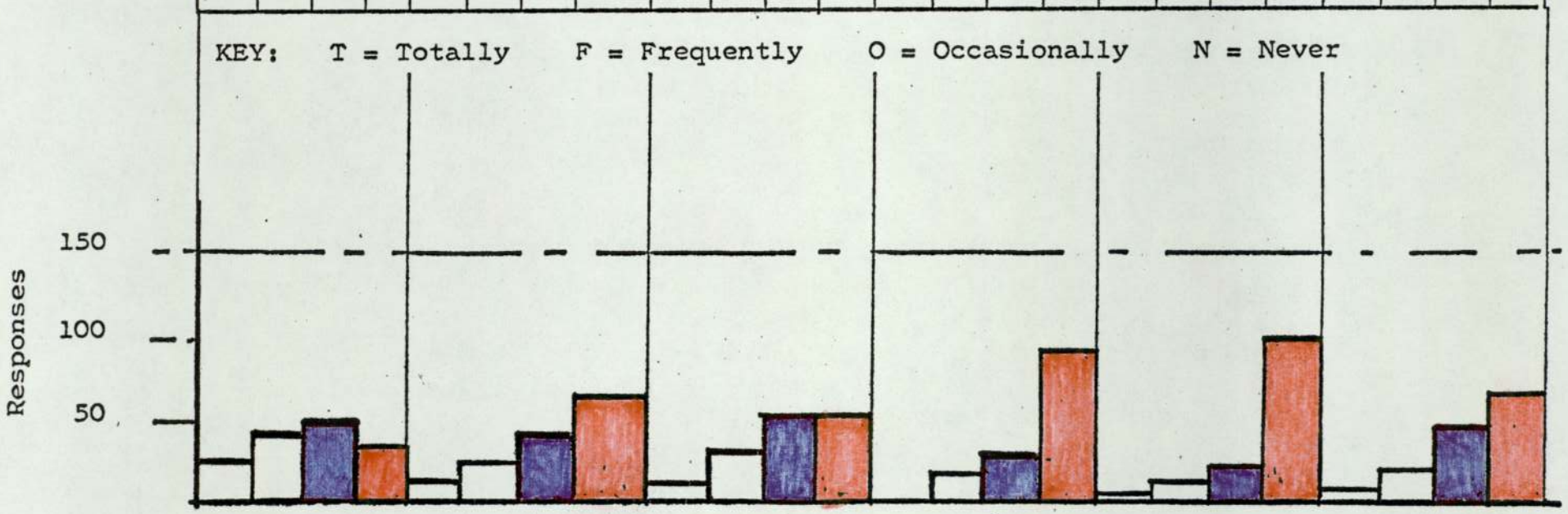


TABLE 8

TECHNICIAN FUNCTIONS IDENTIFIED IN ORDER OF PRIORITY

FUNCTION	PERCENTAGE RESPONSE	RANK ORDER
PRODUCTION WORK		
45. Setting out on Site	51	1
46. Site Measurement	48	2
47. Supervision on Site	48	2
48. Checking and Ordering Materials	48	2
50. Inspection - Quality Control of Work Carried Out	41	3
53. Small Works - Responsible for Total Supervision	32	4
54. Plant	29	5
52. Costing	24	6
49. Measurement for Bonus Payment	9	7
51. Bonusing	8	8
ADMINISTRATIVE WORK		
41. Preparing Schedules of Materials	49	1
39. Detailed Drawing	45	2
44. Programming and Planning	42	3
40. Measuring and Preparation of Estimate	38	4
42. Preparing Schedules of Purchases	24	5
43. Working up Bills of Quantities	20	6

TABLE 9

TECHNICIAN FUNCTIONS

SUMMARY - FIRMS 1 to 24

FUNCTIONS	Construction Technician	Civil Eng. Technician	Architectural Technician	Highways Technician	Mech. Services Technician	Elec. Services Technician	Surveying Technician	Rank Order for Construction Technicians
1. Construction Drawings	13	8	11	1	5	1	1	4
2. Site Investigation	10	8	5	1	1	1		6
3. Testing Materials - Quality Control	15	9	4		1			2
4. Site Surveying and Setting-out	17	9	1	1	1		1	1
5. Contract Organisation and Administration	14	5	5	1	2	2	1	3
6. Costing, Estimating, Economic Control on site	17	9	1		2	1	1	1
7. Design and Erection of Temporary Structures	12	9	4					5
8. Design and Construction of Formwork	12	9	3					5
9. Technical Supervision	13	6	1	1	3	1		4
10. Planning and Control Production Team	14	7	2		5	2	1	3
10a. Planning and Control Finance	7	2	4		1	1	1	8

TABLE 10

FUNCTIONS	Construction Technician	Civil Eng. Technician	Architectural Technician	Highways Technician	Mech. Services Technician	Elec. Services Technician	Surveying Technician	Rank Order for Construction Technicians
11. Plant Organisation and Control	13	8				1		4
12. Development of Site Practice	12	4		1	2	2		5
13. Technical Reporting	15	10	7	1	5	2	1	2
14. Testing of Services	7	2			6	2		8
15. Appraisal and Selection of Plant	9	5		1	1	1		7
16. Supervision of Maintenance	7	6	2	1	5	1		8
17. Fault Diagnosis and Remedial Work	10	4	2	1	4	2		6
18. Responsibility for Statutory Requirements	14	10	9	1	5	2	1	3
19. Communication -								
(a) Management and Technologist	12	6	5	1	3	1	1	5
(b) Foreman and Operational Work Force	10	6	3	1	2	2		6
20. Process of Experimental Investigation e.g. Techniques of Construction	3	2	5			1		10
21. Personnel Management	4	1	1			1	1	9
22. Functional Management	7	4	3		2	2		8
23. Industrial Relations	10	4	3		2	2	1	6
24. Awareness of his Role in the Society	10	9	8	3	5	2		6

TECHNICIANS TOTAL INVOLVEMENT IN THE LISTED FUNCTIONS

Questionnaire Question Number	Description	Company in Excess of 400 Employees	Company 200 to 399 Employees
ADMINISTRATION			
39	Detailed Drawing	18%	3%
40	Measuring and Preparation of Estimates	4%	4%
41	Preparing Schedules of Materials	3%	4%
42	Preparing Schedules of Purchases	0%	0%
43	Working up bills	0%	3%
44	Programming and Planning	3%	0%
PRODUCTION			
45	Setting out on Site	4%	0%
46	Site Measurement	12%	2%
47	Supervision on Site	6%	0%
48	Checking and Ordering Materials	3%	0%
49	Measurement for Bonus payment	7%	0%
50	Inspection - Quality Control of Work carried out	8%	0%
51	Bonusing	4%	0%
52	Costing	0%	0%
53	Small Works - Responsible for Total Supervision	0%	0%
54	Plant	0%	0%

GENERAL COMMENT ON ABOVE ANALYSIS

The major time involvement of the technicians completing the questionnaire is associated with detailed drawing, building measurement in various forms.

The production team spend a total of 26% of their time in some aspect of measurement, costing of materials and bonus payments.

The quality control and supervision accounts for 14% of the production team's time. Assuming that one is able to identify significant time allocation to these various activities, it might be reasonable to assume that a general job profile could be set up as a model to give a general profile which in turn could then be overlaid by the course of study to indicate whether we harmonise with current employment needs. It must also be appreciated that certain learning objectives and experiences have far wider aims than the immediate vocational need.

It will be appreciated that any data collected in the manner described, immediately becomes historical evidence. The significance of this research is the value of the number of correlations and comparisons which can be investigated as possible indicators for future trends or predictions. The researcher would claim that the questionnaire would be equally applicable to the industry some ten to twenty years from now. Trends or customs and practices within the construction industry are slow to change, particularly when one examines the management structure of companies. The size of a company relative to the increase in work load may accelerate the rate of change. This is reflected by fragmenting or departmentalising particular functions where demands outstrip the original number of technicians performing certain tasks. In the eyes of the cynic this would be Parkinsons Law at work,

by contrast an expanding company would see the division of responsibilities and the accompanying specialisation as a more efficient use of the employees involved.

The large number of possible investigations arising from the questionnaire and computer analysis could not be pursued in this research and, therefore, the analysis in subsequent Chapters has concentrated on what the researcher considers to be more crucial issues influencing the selection and education and training of future technicians. Trends relating to career patterns of individuals have a special significance, particularly where the industry has accepted for many years the contribution made by craftsmen as members of the management team both in the production and administrative activities.

CHAPTER IV

ANALYSIS OF EMPLOYERS RESPONSES

Employers locally were asked to complete the questionnaire (Table 15 - a sample of a response from a Private Contractor with 650 employees) and offered me the opportunity to visit their company and discuss their observations and suggestions on the present and future education and training of technician staff.

General Observations on the Questionnaire relating to selection and promotion of Personnel

Many people entering the industry as craftsmen have in the past transferred to technician occupations. From the questionnaire (Table 16) the analysis of an age group 23-25 revealed that those young men who were craftsmen had eventually taken a variety of other opportunities within their company or industry. It could be assumed that these employees were exceptional or alternatively the companies concerned afforded opportunities to young employees who appear to have the abilities to satisfy a wide range of technician functions.

It does, however, question whether the recruitment and career structures could be more effectively organised. Traditions which for many years have continued to transfer craftsmen to other duties might be questioned in the future. Other evidence would suggest that this is not likely to continue. National indicators or predicators could be associated with the sharp decline of craftsmen continuing to Full-Technological Certificate status. Although this national qualification is no longer available, recent decline in numbers would indicate candidates are either no longer available or are directed to other courses where prospects of promotion and

status are identified. Factual evidence on the numbers taking the Full-Technological Certificate are 2,500 candidates in 1974 to 1,000 candidates in 1976.

Employers are of the opinion that many site supervisors or managers should be recruited from craftsmen who followed the traditional crafts in the construction industry.

A general comment relating to the fluctuating employment prospects reflected in the annual statistics would lead one to believe that each economic crisis facing the country has led to a depletion of the trained personnel both at Craft and Technician level in the construction industry. With the custom and practice of up-grading craftsmen to perform technician or supervisory roles the effect over the past fifteen years is a gradual decline in the supply of competent craftsmen.

Evidence to support this hypothesis can be seen in (Table 16). The researcher extracted from the questionnaire those students aged between 23-25 years who commenced their working life as craftsmen. The analysis of the 77 students reveals the change of occupation in many instances, also the technician functions they are presently involved with.

In responding to the questionnaire, it is interesting to note that large companies who are able to fragment responsibilities tend to do so.

The narrow specialisation gives the employee the opportunity to develop a high performance as a specialist, e.g. Bonus Measurement, Scheduling and Ordering Materials, Detailed Drawings, Estimating in specific areas of the company's work.

The counter argument being job dis-satisfaction and lack of versatility in the work force, restricting the mobility of the technicians in the company's organisation. Smaller companies encourage versatility which may have the effect of producing jacks of all trades and masters of none. The optimum numbers of people in the various categories of specialist activities would always depend on a company's work-load and is a matter for company policy. This is another area for much more detailed research, identifying against the span of control the optimum of activities one individual is capable of successfully managing.

The sample questionnaire (Table 15) was the response from one of the middle sized companies visited. The detailed comment is included to illustrate the company's Training Adviser's observations. Although the researcher visited a number of companies ranging from a Works Department employing approximately 2,500 employees, also other private contractors who were at different stages of organising in-service training for their employees, the detailed observations following are associated with one company. For simplicity and detailed observations the researcher decided to concentrate on a private contractor's organisation where the Personnel Manager was most co-operative and obviously well in advance of many companies regarding the education and training of employees. This progressive large contracting organisation has recently successfully planned a housing development which will include leisure facilities, i.e. Swimming Pool, Golf Course, along with other communal services. This may serve to illustrate the enlightened way in which a progressive company is providing housing accommodation alongside the M1 Motorway for a 1980 clientele.

With this as evidence of the company's policy and attitude to future housing developments, alongside other quality building work the researcher has assumed that such evidence would serve as a useful subjective indicator in selecting this company for an in-depth investigation.

General Information on the Company

Name:	Henry Boot Limited
Range of Work:	Building, Civil Engineering and Private Housing
Annual Turnover:	Approximately £55 million
Number of Employees:	3,000
Number of Administrative Staff:	350
General Foremen and Supervisory:	120
Managers:	250

Investment in In-Service Training and Staff Development

Expenditure on Training Courses:	Approximately £25,000 plus £25,000 (Supervision and Overheads)
Total Operating Cost of Personnel Services, which includes Personnel Training, Safety, Security, Work Study, System Development	£200,000 (Approximately)

The researcher would not presume that there is a model answer in organising and planning of In-Service Training for Technicians in the construction industry. It would, however, be reasonable to suggest that the skill of management is to present to employees all the evidence associated with the individuals career prospects within the company's organisation.

From the company's confidential documentation the following evidence will serve to illustrate the information

communicated to employees on the policy statements and implementation of action associated with agreed policies within Henry Boot's organisation.

'GENERAL PERSONNEL POLICY

The policy of the Company is to create an environment for efficient, profitable and uninterrupted work, where the ability of Management can be used to bring in changes in the conditions of employment with the minimum of disruption. In order to achieve this the Company acknowledges the fact that complete integration of all aspects of the Personnel policy is essential.

An effective communications system is operated and the Company contributes to the updating of the industry's personnel and industrial relations policy at local, regional and national levels.

A professional approach is adopted when looking at all aspects of working life within the Company and we recognise that each employee has his/her individual needs and aspirations at work. Full account is taken of this factor at all times and particularly in recognising each employee's need to achieve a sense of satisfaction in his/her job.

We also recognise that in order to achieve maximum job satisfaction for all employees the Company will continually review all aspects of the personnel policy at regular intervals. The detailed aspects of the policy are contained overleaf.

MANPOWER PLANNING

The Company endeavours to ensure that all personnel (staff and operatives) are employed within agreed Company, Divisional or Regional budgets. These are made out on a current and five year basis.

The Company undertakes at all times to take stock of all existing manpower resources when working out future needs. We will endeavour to avoid unnecessary fluctuation in manpower levels to effect changes with as little disruption as possible and to maintain adequate transfer facilities for all employees.

Personnel records will be kept up to date at all times and due regard will be taken of them when manpower planning takes place.

RECRUITMENT

The Company endeavours:-

a) to engage staff and operatives whose conduct, capability and qualifications are appropriate to the available vacancies and to the duties and responsibilities involved.

b) to conduct recruitment so as to select fairly, avoiding discrimination on the grounds of sex, race, colour or creed.

c) to encourage the level of staff and labour turnover to remain as low as possible by encouraging harmonious working conditions at all levels and pursuing a policy of equal opportunities for all personnel.

d) to give full consideration to filling vacancies by transfer or promotion from within.

e) to regularly review recruitment and selection methods to ensure that they are effective and ensure that management carrying out company procedures are competent to do so.

f) to issue adequate job specifications to each category of employee.

INDUCTION

The Company ensures that all new employees are given systematic induction training to assist them to quickly take their place in their new environment. On induction they are made aware of all the conditions of employment which concern them including:-

(i) The requirements of his/her job and to whom he/she is responsible.

(ii) The applicable disciplinary rules and procedures.

(iii) The applicable grievance procedure.

(iv) The trade union arrangements which are applicable to the individuals concerned including the check-off arrangements.

(v) Opportunities within the Company for training and promotion.

In the case of young people who are entering employment for the first time special care is taken to give them full information on all aspects of the industry and the Company and their individual places within it.

STAFF APPRAISAL

The Company ensures that all staff are individually appraised on their performance in their own jobs at least at annual intervals. All assessments are carried out by line management and against agreed written management targets.

Individual training programmes are agreed as a result of the annual appraisal and each staff member is given his own personal copy.'

The Company's commitment to the education and training of their staff is reflected in a financial allocation which is well above the investment made by most organisations.

TABLE 15

Statement by Personnel Training Officer of the Company

This form has been filled in with a site management bias. I feel that the form as it stands indicates thinking towards a very wide ranging general training for technicians, with maybe a bias towards surveying.

Whilst I applaud and wholeheartedly support the move towards general training and away from excessive specialisation, I wonder whether this form indicates a move, whether it be unconsciously or not, towards producing a Jack-of-all-trades. It would seem to me that serious consideration could be given with specialisation in certain subjects during the final year of the course, by which time the student should have positive ideas as to which branch of the industry he is going to make his career, be it surveying, estimating, or site management.

FPA FINNEGAN LTD
863 Ecclesall Road
Sheffield

TABLE 15

QUESTIONNAIRE

For those training as Technicians and future middle management personnel would you reply to the following questions:-

(Please answer in the appropriate column by means of a tick)

Subjects to be Studied over the 4 Year Course	Not Required	Not Important	Important	Very Important
1. Construction Technology				✓
2. Science and Materials			✓	
3. Mathematics			✓	
4. Economics		✓		
5. Communications				
6. Surveying and Levelling			✓	
7. Costing and Estimating			✓	
Specialist Subjects relating to his employment				
8. Measurement of Building Work		✓		
9. Supervisory Studies				✓
10. Quality Control of Workmanship				✓
11. Quality Control of Materials				✓
12. Mechanical Plant				✓
13. Building Services				✓
14. Law		✓		

15. HOW MANY PEOPLE ARE EMPLOYED IN YOUR COMPANY?

1 to 9	10 to 19	20 to 49	50 to 199
200 to 399	Over 400	Over 1000	

16. Would you consider that part of a Technicians Course should involve simulated case studies or project work?

YES	NO
✓	

17. Do you as an employer wish to see the case studies or project work as a method of assessing the technicians competence?

YES	NO
✓	

Would you indicate from the following list the tasks given to your technicians?

ADMINISTRATIVE WORK

	Totally	Frequently	Occasionally	Never
18. Detailed Drawing			✓	
19. Measuring and Preparation of Estimate				✓
20. Preparing Schedules of Materials		✓		
21. Preparing Schedules of Purchases		✓		
22. Working up Bills of Quantities			✓	
23. Programming and Planning		✓		

PRODUCTION WORK

	Totally	Frequently	Occasionally	Never
24. Setting Out on Site		✓		
25. Site Measurement		✓		
26. Supervision on Site	✓			
27. Checking and Ordering Materials		✓		
28. Measurement for Bonus Payment			✓	
29. Inspection - Quality Control of Work carried out	✓			
30. Bonusing			✓	
31. Costing			✓	
32. Small Works - Responsible for total supervision		✓		
33. Plant		✓		

CRAFTSMEN RECRUITED FOR TECHNICIAN FUNCTIONS

TABLE 16

%	Detailed Drawing			Measuring & Prep. of Estimate			Preparing Schedules of Mats.			Preparing Schedules of Purch.			Working Up Bills of Quantities			Programming and Planning			Setting out on Site			Site Measurement		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
3.9	1			1		2	1		1			1			2	1	1	1			1		2	
2.6			1			2			3			1		2	1			2				2	1	
3.9		1	2	2	1			2	1		2			1	1		1	2			2		1	
2.6			2				2			1					1	1					1			
2.6																					1		1	
9.2		1	5	1	2	2		1	4			3	1	1	1		2	2		2	3	1	4	2
1.3																		1			1		1	
1.3																								
1.3			1					1			1							1			1		1	
2.6			1			1												1		1			1	
3.9		1	2			1			2									2	2		1		1	1
1.3			1			1									1		1		1			1		
1.3			1																1			1		
1.3	1					1														1				1
1.3			1		1			1			1				1		1		1			1		
1.3																			1					
1.3			1						1									1		1	1			2
7.0	5	6		1		5	1	4	5		3	2			1			2			3			4
1.8	4	5				2		2	4			1					1	5		1	3		1	7
3.9																					2			2
2.6																					1			
1.3																					1			
1.3	1			1			1														1			1
1.3																					1			
1.3		1				1			1			1									1			1
2.6			1						1												2			1
1.3																								
1.3		1																1			1			
1.3			1			1															1			1
9.2	1	1	3		1	2		2	3		2	1						3		1	3			4
100	13	17	23	5	5	21	5	13	26	1	9	10	1	4	9	2	7	24	6	7	32	6	14	27
	15.7%	22.3%	30.2%	6.5%	6.5%	27.6%	6.5%	17.1%	34.2%	1.3%	11.8%	13.1%	1.3%	5.2%	11.8%	2.6%	9.2%	31.5%	7.8%	7.8%	42.1%	7.8%	18.4%	35.5%

%	Super'n on Site			Checking & Ordering Materials			Management for Bonus Payment			Inspection Quality Control			Bonusing			Costing			Small Works Super'n			Plant		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
3.9		1				2		1	1					1	1	1	1				1			1
2.6			1			3		1						1			2	1						1
3.9		1	2		2							2				1		1			1			
2.6			1																					
2.6		1			1							1						1			1			
9.2	1	1	2		1	3		2		1	1	1		2			2	1	1	1		1	1	
1.3			1					1										1						
1.3									1															
1.3		1			1				1			1			1			1						1
2.6		1			1			1			1			1				1		1				1
3.9	1		2		2		2			1	2			1	1		2			1	1		2	1
1.3		1			1		1			1			1								1		1	
1.3		1				1				1									1					1
1.3		1										1									1			
1.3			1			1			1		1				1		1			1				1
1.3			1									1											1	
1.3	1	1				2			1		2				1			1	1				1	
7.0			2		1	5			2			2		1										1
1.8			6		1	2			1			5						2			4			
3.9			1		1																			1
2.6						1																		1
1.3			1																		1			
1.3						1																		
1.3			1			1																		
1.3		1				1					1										1			
2.6			1			1						1									1			
1.3						1																		1
1.3			1									1												
1.3																								
9.2	1	1	3		5			1			2	2					1	1	1	1	2		1	1
100	4	12	27	-	17	25	3	7	8	4	10	18	1	7	5	2	8	11	4	5	15	-	7	12
	5.2%	15.7%	35.5%	-	22.3%	32.8%	3.9%	9.2%	10.5%	5.2%	13.1%	23.6%	1.3%	9.2%	6.5%	2.6%	10.5%	14.4%	3.9%	5.2%	19.7%	-	9.2%	17.1%

CHAPTER V - RECOMMENDATIONS

PART I

To recall the general theme of the research it would be useful to again establish the concept that the Construction Industry is made up of a wide range of personnel ranging through Technologists, Technicians, Craftsmen and Operatives. A recent letter in "The Times" published on behalf of the President of the Royal Institute of British Architects on the subject of 'Improving the quality of architecture' is appropriate as background information to many aspects to be covered in the analysis. Accepting that the Technologist or Design influence is only as good as the Technicians and Craftsmen associated with the production aspect of the Construction Industry then the following article has a much greater significance than simply alerting people to the dissatisfaction of both the Architect and hopefully the client:

'Sir, Lord Eccles is to be congratulated on tackling some basic and controversial problems in his article on August 4. Not everybody will agree with his solutions or even with his analysis, but he will have led many to face some of the underlying qualitative issues in our society which are too often deliberately ignored.

All architects will have been struck by his comments on housing, building and the quality of places. On the importance of these I believe he is absolutely right. But is it true that discrimination in these things is just a matter of taste and education? Maybe we are not, as he says, born knowing the difference between good and bad in architecture; and maybe discrimination in the niceties of Gothic, Classical or Art Nouveau will always be a minority

pleasure like the enjoyment of Palestrina or the novels of Henry James. But I simply do not believe that people in general are unresponsive to great architecture: nor do I believe that they lack a sense of what is pleasant and congenial in the places in which they live, work and play.

After language our man made environment is our pervasive cultural heritage. Everybody uses it. It is all around us and inescapable, facilitating or frustrating our lives. The great monuments of the past, the cathedrals, palaces or even a building as crazy as Big Ben have something for everybody. Many were the creation of an elite - "positional goods" some of them. But their enjoyment has never been confined to the elite: they raise everybody's spirits. Likewise when people of all classes and kinds find opportunities to express choice in the matter they show a ready ability to make and get nice places for themselves.

Particularly in the more modest and under stated types of building British architects have done some marvellous things since the war. Nevertheless, they have always been asked to use too much of their inventiveness and ingenuity in making buildings cheaper and less agreeable than they should have been. The public has become numbed into an acceptance of much that is second rate in the interests of commercial expediency and public accountability. In housing particularly they have had to take what speculative builders and local authorities offered: there has been very little choice and very little scope for the satisfaction of individual desires.

I believe that latent demand is there, and I believe dissatisfaction with the mediocre is at last finding expression. Let the public test and stretch architects in the task of satisfying an awakened appetite for better things.'

I am, Sir, yours truly,
GORDON GRAHAM, President
Royal Institute of British Architects
66 Portland Place, W1

August 10th 1977.

PART II

RECENT RELEVANT RESEARCH COLLECTED FROM INDUSTRY

A number of investigations and surveys have been carried out since 1970. The particular investigations to which this research has been influenced are:

1. CITB Research Paper I
   Management/Technician roles in the Construction Industry, June 1970.

2. Technicians within the Construction Industry
   East Anglian Regional Advisory Council Building Sub-Committee.

3. Technician Survey, Yorkshire Regional Working Party.

4. Technician Survey 1975
   ILEA Steering Group TEC.

In all these surveys there has been an increasing sophistication in the collation of information which relates primarily to technician roles, career structures and the appropriateness of existing and future training needs. The following evidence highlights the recurring agreement of all the surveys particularly in relation to the technician role and the order of priority placed upon certain functions carried out by the technician in the construction industry.

The objectives associated with each of the investigations offers sufficient information which is relatively compatable for national, regional or local decision making in providing appropriate background evidence in planning courses of

study relating to the employees existing and future needs. The major part of the present analysis will be confined to this important aspect.

The collection of job profile data and how we might use them as evidence in planning the education and training of future technicians should emerge in the following pages.

From the comments of the President of the R.I.B.A. the question arises, what are the Technologist and Technicians managing?

The investigations into the production team of the large private contractor used in this research, revealed a number of trends which are interesting but rather disturbing. On examining the histograms over the page both Fig. 1 and 2 indicate the lack of recruitment in replacing the retiring work force. It might also be assumed that between the age of 30 and 40 years a craftsman would be at his peak in relation to experience and efficient production. Although this may be a reasonable assumption to make it must now be remembered that legislation associated with employment brings into question security of tenure alongside expenditure incurred in the case of redundancy pay. All these factors influence a company's potential and economic viability. A reliable criteria in measuring a company's influence, efficiency and contribution to the total industry can be illustrated by the age groupings of the craftsmen. Continuity of experience and a company's efficiency could also be assumed from this information.

Overriding all these observations must inevitably be the continuity of the work load offered to the industry. Government policies and investment supporting approximately 70% of the industry's employees is always affected when the industry is used as an economic regulator.

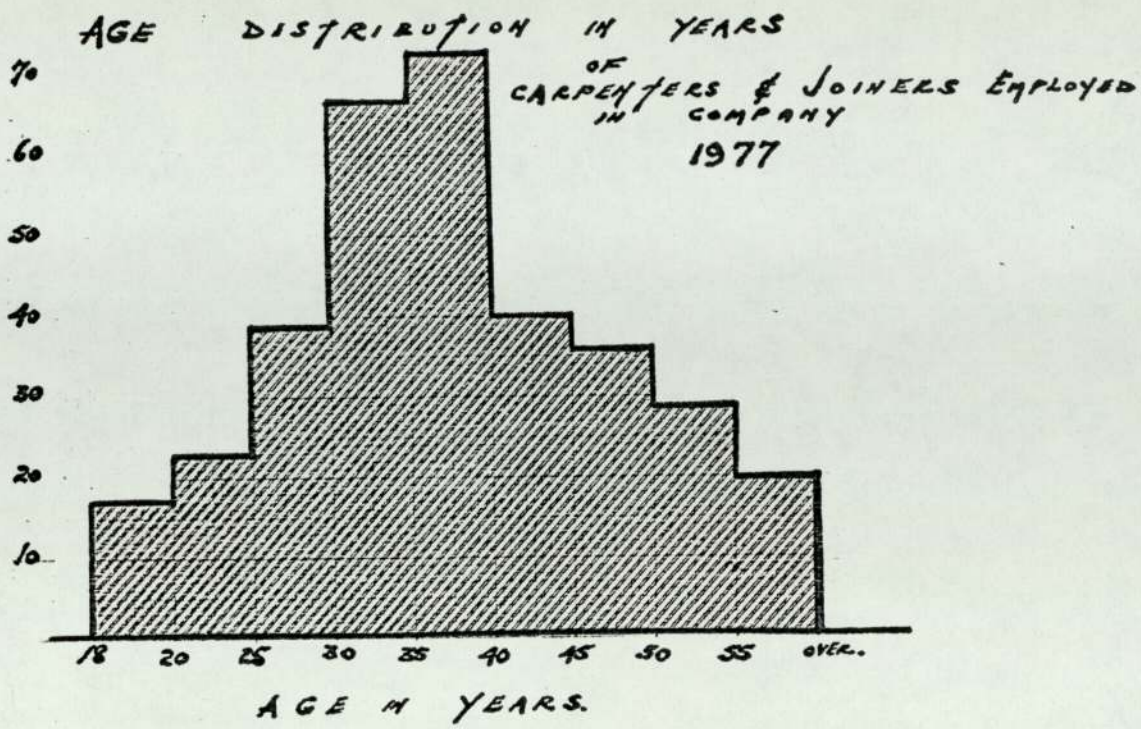


FIG. 1

Reliable criteria for any company in measuring efficiency and contribution to the Construction Industry's training and development of craftsmen.

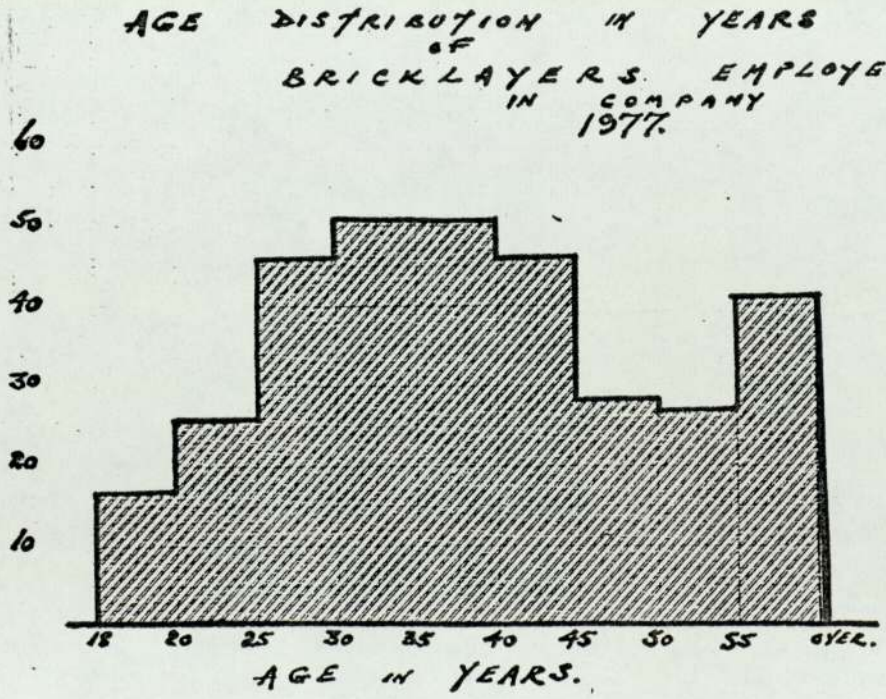


FIG. 2

The age groups of craftsmen offering experience and skills in the production activity shows a severe decline of men under the age of 30 years. This trend could have serious consequences assuming we are interested in maintaining a service industry which is competent to utilize existing materials and technology and also maintain many previous generations' contribution to buildings we have fortunately inherited.

To speculate on the production skills of a work force in future years is a research programme in itself. For this summary it may be sufficient to speculate on the existing shortfall of competent craftsmen in an industry where de-skilling has reached a disturbing level. New materials and techniques in construction processes offering large scale repetitive activities have tended to dominate the industry for the last twenty years. One important side effect has resulted in the lack of versatility and stability of the work force. To correct this trend it will be necessary to encourage recruitment of a quality of labour capable of the craftsmanship which was one proud tradition we used to associate with this industry.

General Comment

Concern was expressed by the Chief Officer responsible for the 3,000 employees in the Sheffield Works Department on the ratio of production supervision and administration to production workers.

1960	1976
1 : (17 or 18)	1 : (8 or 9)

It may be assumed that more advanced techniques in production methods have encouraged this trend. The observer suggested that the increasing legislation and bureaucracy had some influence on this trend. Incidentally, this 1976 ratio is similar in many companies.

Functions of Employees

The following extract from the I.L.E.A. Steering Group's TEC Sector B Technician Survey 1975 offers a rank order of functions in relation to technicians work. As suggested, this information offers support to the general conclusions on job profiles and the detailed nineteen categories cover a wider group of employment categories compared with the sample taken in this research.

Extract from

ILEA - STEERING GROUP TEC SECTOR B

TECHNICIAN SURVEY 1975

Functions of Employees

An important part of the questions posed in the section entitled 'Information about your Work' dealt with the principal types of work or roles undertaken by students. The Technician Education Council require submissions by Colleges to identify the Technician role. Respondents were asked to list the different sorts of tasks they were required to undertake. The list of tasks were required in a hierachical order of the amount of time spent on each task. Clearly, the range of functions specified was very diverse, but a grouping under nineteen major headings was used to establish a rank order list.

Namely:	Rank	Score
1. Drawing and Detailing - Tracing, details	677	38%
2. Supervision - Foreman, Clerk of Works, Building Inspectors	233	13%
3. Measuring (QS) - All QS duties, measuring, final accounts	156	9%
4. Design - calculation, layout drawings	104	6%
5. General - young students just started work, no specific function	93	5%
6. Operative - site works with no regular supervisory duties	85	5%

	Rank	Score
7. Full-time students	71	4%
8. Estate Management - valuations	69	4%
9. Site Surveying - levelling, surveys, plotting, map making	65	4%
10. Building Surveyors - inspection of buildings, specifications, maintenance	57	3%
11. Setting out - mostly first year technicians	36	2%
12. Planning - traffic studies, Town and Country, Building Control	32	2%
13. Measuring (Bonus) - Bonus Surveyors, Work Study	29	2%
14. Estimating - Engineers, Analysis of quotes, estimates	24	1%
15. Unemployed	20	1%
16. Computer Operations, Punch card operators, coders	11	0.5%
17. Technicians - laboratory, college, testing	11	0.5%
18. Cost Clerks - Cost Control	11	-
19. Statistics	2	-

PART III

IN-SERVICE STAFF DEVELOPMENT PROGRAMMES FOR THE TEACHING STAFF AND TRAINING ADVISERS CONCERNED WITH TECHNICIAN EDUCATION

The changing needs of industry have made greater demands on the further education service. Although most of the developments are not new concepts, the teaching staff involved are expected to accept a greater responsibility in the partnership of employment needs and appropriate further education response.

A closer relationship with industry identifying the appropriate teaching methods and assessment procedures of the technician following the course of study. A better understanding on the part of employers of learning achievements of employees where teaching methods such as projects or student assignments, tutorials, role playing activities, case study work alongside traditional lectures and course work have been used.

A continual difficulty arises in any consultation where terminology used in current developments is not familiar to the employers concerned. For the purpose of this investigation these have been classified as follows:

1. Modular Course Structure.
2. Learning Objectives.
3. Integrative Course of Study.
4. Assessment of Intellectual Skills.
5. Assessment of Practical Skills.
6. Assessment of Attitudinal Skills.
7. Agreed methods of Validating Assessment Procedures.

8. Agreed methods of Monitoring Students Progress, particularly appropriate in relation to the present employment legislation.

9. Recognition of a Course structure capable of a rapid response to changing industrial needs.

10. Agreed commonality of subject matter relating to national standards in the following disciplines: Applied Science, Numeracy, Literacy, as fundamental subjects in all the industrial activities using the appropriate technology in the industry.

The social consequences relating to the responsibilities of the industry influence the individual employees attitude to in-company retraining and awareness of adaptability in the changing demands upon the construction industry. In assisting students to assimilate the consequences of political decisions relating to the structure and influence upon the total environment the General Studies programme should make a valuable contribution. Many group activities and individual tasks using the expertise of the students can be accommodated within the communication skills programme. Effective use of all facets of communication, drawing offce practice and administration, tabulated and numerical information skillfully presented is an essential technician function in any industry. Interpretation of information both literal and oral requires constant practice and development by technicians. Their ability to translate or

interpret a design proposal into a product utilising the most effective communication techniques should take a high priority in any course of study. The overall ability to organise and administer an information retrieval service is equally important. All these aspects must be the thread interwoven between each subject area and the total course structure.

SUMMARY OF RECOMMENDATION ORGANISING THE APPROPRIATE COURSE OF STUDY

To propose a sequence of activities and formulate a plan which would adequately respond to the changing needs of any industry requires a policy for action which will deal with this dynamic activity resulting in responses as indicated in the following tables.

TABLE A - EXPLANATION

This table offers sufficient information to suggest that, given the company's Job Profiles,more realistic Education Profiles can be prepared.

It will be appreciated that the list of subjects and the variety of employment categories could be expanded. This condensed summary indicates the rating and recurring general subject needs acceptable to the company involved.

The correlation of employment category and importance given to each subject is a useful way of monitoring the training needs which in turn reflects the training/ education advisers responsibility to the company. The advantage of this table is the comprehensive summary offered to the responsible personnel expected to advise on future education and training policies for individual career patterns available in the company.

Table A

SUMMARY OF CATEGORY OF EMPLOYMENT AND RATINGS GIVEN TO SUBJECTS BY THE COMPANY

Subjects to be studied over say 4 years / Category of Employment in the Company	PURCHASING	ESTIMATOR	ENGINEER	QUANTITY SURVEYOR	PLANNING	MIDDLE MANAGEMENT	COMMENTS OVERALL RATING 4 Units - Very Important 3 Units - Important
1. Construction Technology	4	4	4	4	4	4	
2. Science & Materials	4	4	4	4	4	4	
3. Mathematics	4	4	4	4	4	4	
4. Economics	3	3	2	3	3	3	
5. Communications	3	3	3	3	3	3	
6. Surveying & Levelling	2	2	4	2	3	3	
7. Costing & Estimating	3	4	2	3	4	3	
Specialist Subjects Relating to his Employment							
8. Measurement of Building Work	2	3	2	4	3	4	Ratings appear to be appropriate.
9. Supervisory Studies	1	2	3	2	2	4	" " "
10. Quality Control of Workmanship	1	1	4	1	2	4	" " "
11. Quality Control of Materials	3	1	4	1	4	3	" " "
12. Mechanical Plant	3	4	4	2	4	3	Concern indicated.
13. Building Services	3	4	4	3	4	3	" "
14. Law	3	4	2	4	3	3	Interesting Ratings.
TOTALS	39	43	46	40	47	48	Reasonable Correlation

Key: Very Important 4
Important 3
Not Important 2
Not Required 1

TABLE B - EXPLANATION

The educationalist should offer the employee/student experiences which reflect both competence in performance and identifies the intellectual skills required to achieve reasonable success for the learner. This table illustrates a wide spread of intellectual skills capable of containing the range of technician functions and supporting educational experiences. As can be seen in the curriculum plans, this analysis of intellectual skills encourages the tutor to express the required intellectual level against the appropriate learning experiences.

This approach does offer some safeguard in relation to standards both for the education imput and the employers related planned experience.

INTELLECTUAL SKILLS			
CLASS		LEARNING OBJECTIVES	
LEVEL	DESCRIPTION	GENERAL	SPECIFIC
INFORMATION	Remembering of previously learned material such as specific facts and complete theories.	KNOW	Define. Describe. Label. Identify. List. Match. Name. Outline. Select. State. Recognise.
COMPREHENSION	Grasping the meaning of material. Explaining, interpreting or summarizing material Estimating and predicting consequences or effects.	UNDERSTAND INTERPRET ESTIMATE	Distinguish. Estimate. Specify. Explain. Summarize. Solve. Calculate. Compare. Discuss. Demonstrate. Express. Predict. Re-write. Give example.
APPLICATION	Ability to use learned material including rules methods, concepts, laws, principles and theories.	APPLY SOLVE UNDERSTAND DEMONSTRATE	Demonstrate. Operate. Solve. Relate. Use. Prepare. Apply. Manipulate. Predict.
INVENTION	Evaluate the relevancy of data. Formulate new processes. Propose plans for experiment. Judge validity of conclusions supported by data. Judge the value of a report.	ANALYSE RECOGNISE DISTINGUISH EVALUATE JUDGE	Differentiate. Distinquish. Identify. Illustrate. Outline. Point out. Relate. Select. Appraise. Categorize. Compile. Compose. Create. Devise. Design.Explain. Modify. Organise. Plan. Re-arrange. Re-construct. Relate. Re-write. Summarise. Write. Evaluate.Criticise. Create. Compare.Describe. Justify. Interpret.

TABLE C - EXPLANATION

This table is intended to offer the range of practical skills on a graduated basis to indicate, as in Table B, the level of performance and ability required to fulfil particular functions associated with the technicians in the industry.

PRACTICAL SKILLS			
CLASS		LEARNING OBJECTIVES	
LEVEL	DESCRIPTION	GENERAL	SPECIFIC
PERCEPTION	Recognition of objects. Knowledge of the effect of the operation. Ability to follow instructions. Knowledge of the feel of tools and equipment.	KNOW	Select. Identify. Recognise.
READINESS	Knowledge of preparatory work: - setting out. - appropriate tools and materials for specific operations.	KNOW PREPARE DISTINGUISH	Measure. Set-out. Select. Position. Set-up.
GUIDED RESPONSE	Response to teacher's demonstration. Gets the job done.	DEMONSTRATE OPERATE PERFORM SET UP USE	Manipulate. Saw. Use. Mix. Set. Chisel. Rasp. File. Cut. Hammer. Reamer. Thread. Drill. Solder. Braze. Weld. Connect. Grind. Heat. Joint. Join. Fasten. Sharpen.
PROFICIENCY	Ability to perform basic skills and operations proficiently with confidence.	INSTALL COMMISSION. SERVICE DIAGNOSE REMEDY	Fit. Fix. Assemble. Build. Calibrate. Change. Construct. Dismantle. Locate. Make. Sketch. Use. Measure. Remedy. Carry-out. Change. Repair. Follow. Trace. Test. Check.
ADAPTATION and ORIGINATION	Adapting to new situations using learned basic skills. Creating new methods or ways of carrying out work situations	EVALUATE ANALYSE	Design. Redesign. Analyse. Build.

TABLE D - EXPLANATION

Although this area of analysis is much more subjective and ultimately many more safeguards in interpretation, this table attempts to offer a range of attitude skills appropriate to the learning objectives frequently required by the employee/students involved. The success in using this type of analysis can be greatly improved when the whole team of teachers involved attempt to agree a profile of responses for individual students.

ATTITUDE SKILLS			
CLASS		LEARNING OBJECTIVES	
LEVEL	DESCRIPTION	GENERAL	SPECIFIC
RECEIVE	Willingness to give attention.	LISTEN SHOW ACCEPT	Ask. Choose. Describe. Follow. Identify. Locate. Name. Select. Point-out. Point-to. Select Reply. Use.
RESPOND	Willingness to participate	COMPLETE PART- ICIPATE SHOW ENJOY VOLUNTEER	Answer. Assist. Comply. Conform. Discuss. Help. Perform. Practice. Present. Report. Select. Write. Tell.
VALUE	Attaches values to products, behaviour and situations.	DEMON- STRATE APPREC- IATE SHOW	Complete. Describe. Explain. Differentiate. Form. Join. Initiate. Justify. Propose. Report. Select. Study.
ORGAN- ISE	Brings together different values and makes comparisons. Commonly expressed a Value Judgement.	RECOG- NISE ACCEPT UNDER- STAND FORMU- LATE	Adhere. Alter. Arrange. Combine. Compare. Complete. Defend. Explain. Generalise. Identify. Integrate. Modify. Organise. Prepare. Relate. Synthesize.
CHARAC- TER	Develops a philosophy of life.	DISPLAY DEMON- STRATE PRACTICE USE	Discriminate. Display. Use. Influence. Listen. Modify. Perform. Practice. Prepare. Qualify. Question. Revise. Solve. Verify.

TABLE E - EXPLANATION

FULL-TIME DIPLOMA COURSE

This diagram is an illustration of a course structure which indicates how individual subject imputs should lead to the problem solving teaching approach of an integrated course of study.

Each circle indicates the relative importance of the subject matter and the contribution to the learning experience of the 'Design Studies'.

PROPOSED COURSE STRUCTURE. NATIONAL DIPLOMA COURSE.

Table E

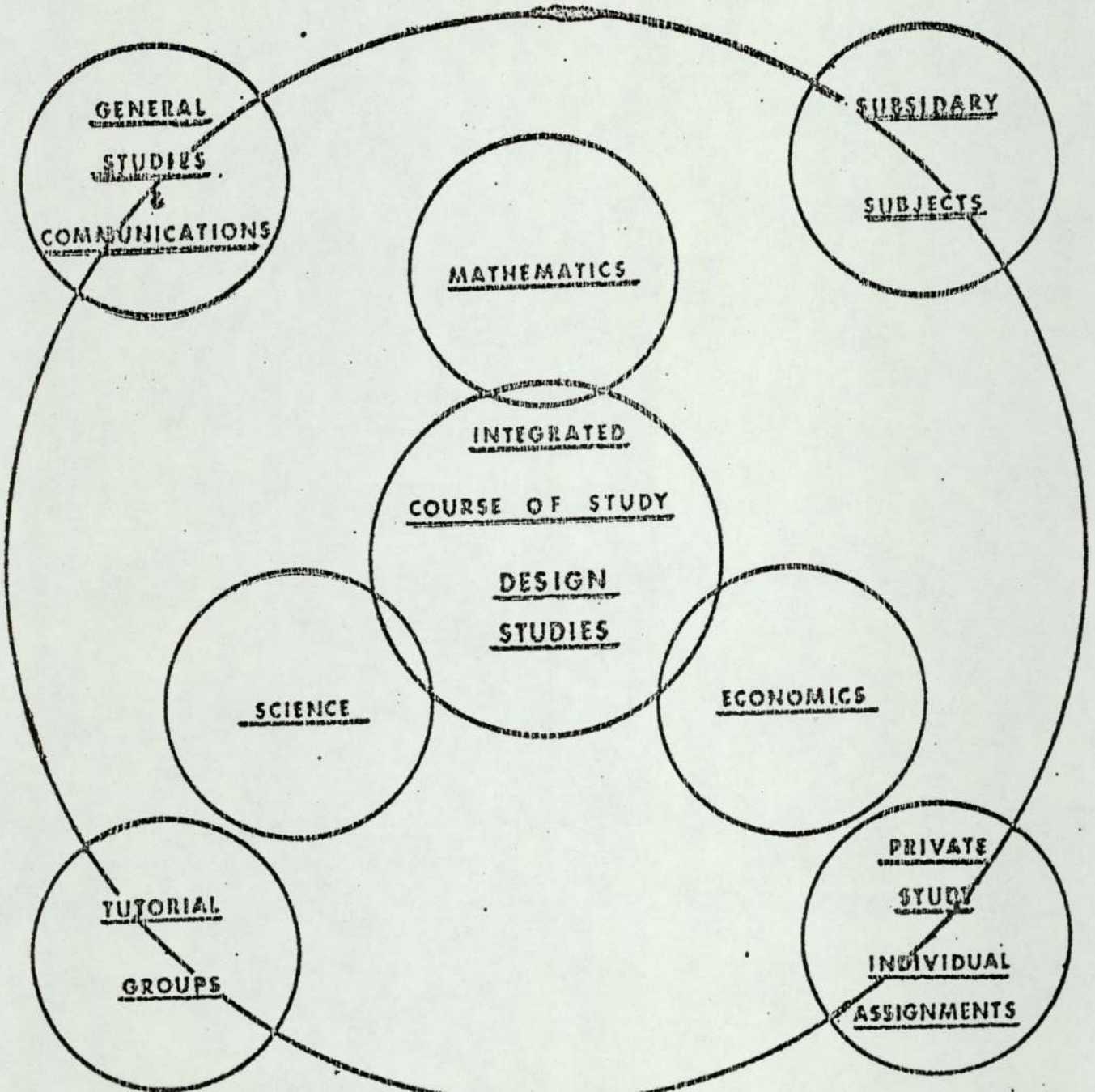


TABLE F - EXPLANATION

The diagram indicates a similar approach to the diagram at Table E offering the part-time student an integrative approach through 'Project Work'. For success the teaching team have all to agree to identify the individual subjects imput or contribution to appropriate project work. This approach is very demanding on the teaching team involved.

General Course Structure for a T.E.C. Certificate Programme

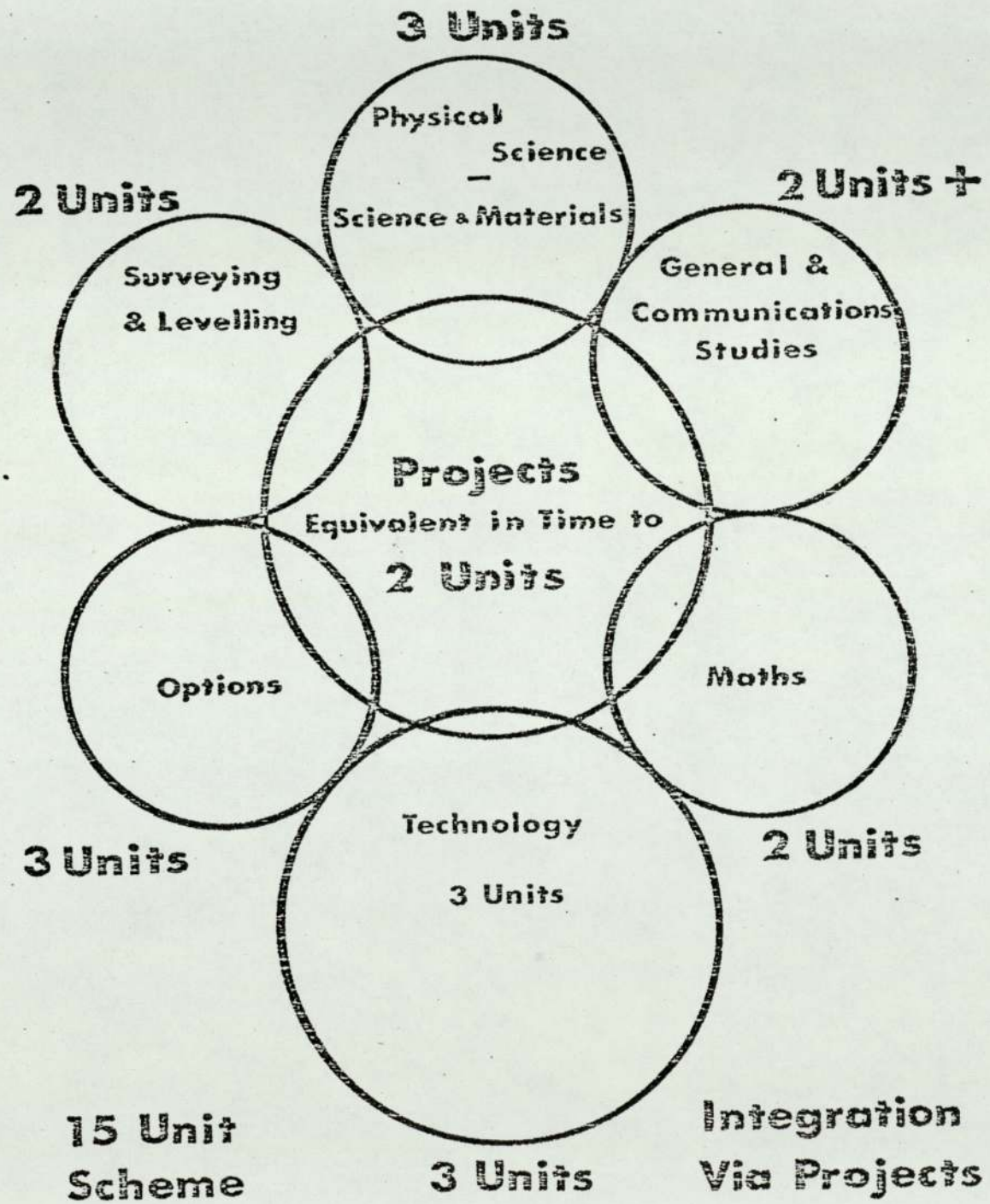


TABLE G - EXPLANATION

The Technician Education Council curriculum development has used educational objectives as a more informed method of presenting intended learning experiences for the students following their courses. This particular example is simply one of the individual subject units contributing to the course of study leading to a Technician Certificate Award.

Table G

COMMUNICATIONS AND COMPLEMENTARY STUDIES II

A. PERSPECTIVE IN DRAWING AND PAINTING

1. Knows that objective drawing is an analytical skill and demonstrates that a line is a visual symbol expressing a relationship of distances and angles between points.
   - 1.1 Knows that visual perception relates to the vertical and horizontal.
   - 1.2 Knows that a drawing is a two-dimensional representation of three dimensional phenomena.
   - 1.3 Determines and draws the angular and distance relationships between points connected on a vertical rectangular plane.
   - 1.4 Determines and draws these relationships on a horizontal rectangular plane.
   - 1.5 Derives the concept of foreshortening.
   - 1.6 Determines and draws relationships observed in horizontal and vertical at different heights.
   - 1.7 Compares drawings and deducts concept of eye level and vanishing point.
   - 1.8 Applies knowledge from previous objectives to freehand drawing of interior and exterior built environment.

2. Demonstrates a knowledge of the historical development of perspective reflected in the visual arts. Presents an illustrated written report.
   - 2.1 Compares examples of Renaissance and pre-Renaissance art and relates to the scientific nature of the Renaissance.

2.2 Comments on the perspective investigations of Durer and the use of proportion in the human body.

2.3 Analyses the perspective of a work by Cannaletto.

2.4 Comments on perspective distortions by Escher and Hogarth.

2.5 Relates to experiments in visual perception.

2.6 Comments on the approach to perspective in Cubist painting.

2.7 Organises personal research.

3. Executes a simple two point perspective from plan and elevation.

3.1 Determines and understands position of plan on drawing paper.

3.2 Determines and understands line of vision.

3.3 Determines and understands station point and cone of vision.

3.4 Determines and understands picture plan.

3.5 Determines eye level.

3.6 Determines vanishing points on picture plane.

3.7 Determines vanishing points on eye level.

3.8 Determines and understands height line.

3.9 Determines and understands ground line.

3.10 Draws the projection.

4. Understands how tone reveals volume and assists perspective. Determines the textural and rendering of monochromatic media.

4.1 Makes a tonal scale.

4.2 Determines the tonal relationships of a still life group and draws in an appropriate media.

4.3 Determines the possibilities and limitations for material rendering of a variety of monochromatic media.

4.4 Determines and records how tone is related to atmospheric perspective.

4.5 Discusses how tone is used to reveal form and depth in a selection of monochromatic drawings.

4.6 Discusses how texture is suggested in a selection of drawings.

4.7 Applies knowledge and observation in making freehand architectural drawings.

5. Draws a perspective projection in a chosen media or mixed media with added landscape detail.

5.1 Applies previously learned skills to simple plans and elevations.

5.2 Researches landscape detail and symbolism.

5.3 Investigates figure proportions and use of figures in landscape painting.

5.4 Solves problems of integrating details in correct scale.

5.5 Researches methods of achieving shadow perspective.

5.6 Shows the final projection with detailed report of investigations and supporting evidence.

B. INFORMATION SOURCES

6. Understands common systems of storing and retrieving information and is aware of available specialist reference literature relating to the construction industry.

6.1 Knows how to find in a library and use specialist literature relating to construction industry.

6.2 Identifies other sources of such information.

6.3 Knows the function of and retrieval system for British Standards Institute publications.

6.4 Collects information on a topic related to built environment.

6.5 Presents an annotated bibliography of this information.

6.6 Discusses methods of personal information storage and retrieval.

C. COMMUNICATIONS SYSTEMS AND THE MASS MEDIA IN INDUSTRY

7 Is aware of the authority/accountability structure within his own place of work and the uses made of the mass media by his section of the industry.

7.1 Investigates authority/accountability structure and channels of communication within their place of work.

7.2 Presents this in class on OHP slides in diagram form with oral explanation and any other relevant back up material.

7.3 Examines the use of the media in the locality by firms in their industry.

D. JOB/HIGHER EDUCATION: APPLICATIONS AND INTERVIEWS

8. Understands the procedure for job/higher education applications and interviews.

   8.1 Writes letter answering job advertisement.

   8.2 Completes given form applying for job/course.

   8.3 Discusses preparations for attending interview.

   8.4 Applies 7.3 in "dummy interview" situation.

   8.5 Evaluates own performance and that of other students.

E. FURTHER WRITTEN AND ORAL COMMUNICATIONS AT WORK

9. Is familiar with certain further forms of written and oral communication having particular relevance to the work situations of technicians in the construction industry.

   9.1 Discusses examples of algorithms/flowcharts.

   9.2 Devises algorithm to illustrate decision making on a topic of his own choice.

   9.3 Discusses the function of specification writing.

   9.4 Discusses the appropriate language for specification writing,

   9.5 Writes specifications for a given job (integrate with technology teachers).

   9.6 Discusses examples of accident/occurrence report forms.

   9.7 Completes examples of such forms.

   9.8 Takes and leaves a telephone message.

   9.9 Leaves a telephone message with automatic answering service.

   9.10 Discusses methods of running meetings.

   9.11 Discusses preparations for attending a meeting.

   9.12 Co-operates in decision making at a mock-up meeting.

F. THE MASS MEDIA: FACT AND OPINION

10. Approaches the role of the mass media in disseminating facts and opinion.

10.1 Discusses the responsibilities of the mass media as purveyors of information/comment/propaganda.

10.2 Evaluates given examples of (a) news reports, (b) party political broadcasts (c) advertisements distinquishing between fact and opinion/ propaganda.

PART IV

ASSESSMENT OF TECHNICIAN STUDENTS

Assessing standards of competence as distinct from standards of excellence require different but exacting professional skill. For many years the construction industry has tended to move towards standards of competence required by craftsmen and technicians. This trend has also been reinforced by legislation and codes of practice which when interpreted appear to achieve minimum requirements; to what extent the craftsmen or technicians have any control over this disturbing development is open to question. Minimum standards appear to be the norm provided for many clients' construction projects. The most disturbing influence is of course political decision making (Ref. R.I.B.A. President's letter) which inevitably is governed by financial controls and the economic viability of any project has tended to overshadow any qualitative technical judgements.

Recently, serious consideration has been given to the notion which has been advanced by D. R. Harper (Professor Emeritus in Building at the University of Manchester) that a building which has performed very successfully for the last twenty five years might be selected for some award or recognition, presumably for the building's operational success. It would also illustrate that building skills have maintained some credibility over the last quarter of a century. When such buildings have been selected then it should be possible to offer future decision makers some objective information on

how the functional success of these selected buildings has been achieved.

Having illustrated the general national concern it follows that the individual members of the building team at technician level would also have contributed in some measure to the success of such buildings. It follows that the education and training of the future construction technicians need access to this sort of information to avoid the syndrome which rediscovers the wheel each year.

Having advocated what the structure and possible approach to technician courses might be, one further essential ingredient is to build in a system of continued assessment which will ensure frequent monitoring and evaluation to ensure both the course content and teaching team concerned are responding to the ever changing needs of industry and society.

Over the last three years many significant developments have taken place, and others proposed, resulting from the very recent implementation of the Technician Education Council policies.

The increase in demands and responsibilities placed on the partnership between Colleges and Industry has established a greater importance. National Programme Committees have devised a Modular Course Structure to provide wider opportunities and reflect both the needs of industry and students' aspirations. The joint consultation between employer and college staff in counselling, assessing and progressing through appropriate levels of subject modules

which requires a closer monitoring arrangement is now more obvious. The need to ensure a totally integrated course of study for the particular technician category has attracted more attention from industrial representatives which will inevitably lead to more active participation of employers. National Committees in consultation with representatives from industry, professional bodies and education have produced a vastly increased range of subject needs. The challenge is whether our resources both physical and human can match this new challenge at local, regional and national level.

MONITORING AND ASSESSING STUDENTS - RECOMMENDATIONS

The following list of recommendations is essential if only to create a better understanding of the sophistication which is required in the educational training support service in the future:

1. In-Service Training on a national and regional basis will be required.

2. Awareness of validation procedures which relate to national, regional and local standards being safeguarded.

3. Validation exercises to involve Industry and Education at least on an annual basis.

4. A team of colleagues with a balance of professional expertise should attempt to satisfy the following. (Observation on the Management of Learning is the most important contribution Tutors can make).

    4.1 Correct interpretation of the curriculum and learning experiences offered to the students.

    4.2 Correct weighting in assessing technical competence and recognising students' ability to communicate information successfully.

    4.3 Clearer understanding of employers to appreciate large scale simulated project work organised in College. Preferably a joint involvement in designing such work and agreeing the students tasks.

4.4 Clearer understanding of an assessment profile which should include

Intellectual Skills	-	as Table B.
Practical Skills	-	as Table C.
Attitude Skills	-	as Table D.

4.5 Encourage industry to provide organised training experiences for employees in their place of employment, with a joint assessment procedure involving College staff and industrial representation.

4.6 A willingness to involve company training advisers/course tutors in frequent monitoring of the total course of study through integrative projects as illustrated in the Course Structure Tables E and F.

4.7 A willingness of college tutors to involve themselves with industry in collecting appropriate data for simulated case study work.

4.8 A willingness for employing authorities to allocate time for teaching staff and training advisers from industry to be involved for at least one week each year on operation "up-date".

4.9 At least two days of this particular period to be involved in curriculum development and assessment of course objectives.

For all the above recommendations to be fulfilled it is becoming increasingly obvious that the responsibility and authority to ensure success of future education and training

of technicians in the construction industry should be totally organised within the education service. A supporting role for industrial certification and appropriate financial resource for such commitment will be necessary from the central funding arrangements of the Industrial Training Board. The key to all these proposals revolves around a partnership involving Lecturing Staff, Employers Representatives (Training Advisers) with a division of responsibility proportioned to resource imput to the Course of Study. The cost effectiveness of all these recommendations can and should be assessed by the education service in consultation with industrial representatives at regional and national level.

Finally, one must return to resources and their cost in implementing some of the suggested recommendations. It could well be that the Construction Industry as a service industry will always be a barometer of the economic problems of the country. But the now rapidly advancing technology means that this generation requires far better education and training for the labour force to maximise on present knowledge and potential.

Assuming the Construction Industry employs between 800,000 to 900,000 in the 1980s, then one must ask what percentage of the national investment reflects a realistic commitment to the education and training of this important industry.

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