ANALYSES OF JOB CONTENT OF TECHNICIAN-ENGINEER ROLES

A Thesis

presented for the degree of

Master of Engineering in Mechanical Engineering

in the

University of Canterbury

Christchurch, New Zealand

by

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1988

ABSTRACT

This study outlines the analysis of a post trade curriculum development system called **Dacum**. The term Dacum is an acronym for Developing A Curriculum. The system is generally considered to be a standard approach to competency based curriculum development and is used to plan the technical and vocational programmes for technician engineers.

The analysis of the work roles for technician engineers is to show the range of activities they are engaged with in industries. Data for the study was collected through a survey conducted on behalf of New Zealand Engineering Industry Training Board.

The generation of Dacum charts and subsequent task analysis identifies the skills and beliefs required by technician engineers to perform successfully on a job and shows the relevance of the polytechnic studies as applied to their work. This also serves as a guideline to review curriculum design and training programmes for technician engineers that will render more effective practical application in their occupational roles.

CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

C H A P T E R 1

INTRODUCTION

The accelerating pace of technological and social change has resulted in a large number of jobs, skills and professions being either obsolete or dramatically reduced in numbers and importance. The pace of job obsolescence is likely to accelerate rapidly in the 1990's when full effects of the second industrial revolution based on dramatic advances in electronics and computing are implemented throughout industry and commerce. The resulting change will mean an unprecedented need for flexibility and retraining.

Job obsolescence is not however a new phenomenon. An obvious example is the wiping-out of the whole infrastructure supporting horse drawn transport which have altogether disappeared in the most of the modern cities in the world.

Similarly, in recent years jobs like railway engine firemen, bus conductors and railway signalmen have been dramatically reduced in number following advances in technology and operating methods. Similarly, hundreds of skilled,semi-skilled and unskilled jobs have disappeared in the manufacturing sections as a result of advances in automation and improved production techniques. If we still try to pull along with the old system without being able to

supply trained manpower for changing job styles and technology, a large section of the potential working population are likely to be marooned.

1.1 Purpose of the Research

Technological change causes obsolescences of technical skills and knowledge requiring new skills and conceptual understanding. The objective of the research was to provide sufficient information on the work content of technician-engineers in industries so that a formalised technical and vocational education programme could be implemented to suit changing industry needs.

1.2 Aim of the Research

The inquiry into the employment and training of technician-engineers was a research designed to collect data and information required for technical manpower studies and had the following objectives:

1 to formulate a system for tremendous flexibility in training and education to cope with the compounding effects of technology - this includes longer term restructuring of basic education as well as short term provision to fill immediate gaps in skill.

2 a formal and acknowledged system for providing for all industry - specific skills required not just

basic trade qualifications.

3 continuing evaluation of training programmes and nature of work carried out by technician-engineers as required by employers.

4 to develop a pattern of job analysis using Dacum (Developing A Curriculum) for technician-engineers which can be used as a tool for a closer working relationship between industry and education authorities to enable courses to be kept up to-date with industry requirements.

C H A P T E R 2

THE TECHNICIAN ENGINEER

Education and training of technicians has been accepted as a crucial sector of manpower development in achieving the socio-economic goals by all developing countries. Each country has initiated measures to improve the education and training of technicians curriculum design and development has received priority in this effort to improve the preparation of technical manpower for the economic development activity. Thus there had been a need for appropriate validated models of curriculum development which could suit the requirement of developing countries.

2.1 Technician Engineer and His Activity

An attempt to define the term 'technician' is not profitable and may lead to a good deal of controversy and disagreement. The Engineering Industry Training Board of United Kingdom in their research report (1970 Page 64) has given the definition for a technician engineer as:

"Technician engineers are that group whose education and training enables them to operate immediately in support of professional engineers, sometimes supplying detailed information on which professional decisions are made and later becoming responsible for implementing them and sometimes

working independently.

Six main abilities appear to be demonstrated to a greater or lesser degree by all technician engineers in whatever branch of the engineering industry they may be working. These are:

1 The ability to use and communicate information.

2 The ability to measure or make use of measurements which involve a variety of tools and/or instruments.

3 The ability to choose material and components and to understand the processing of materials.

4 The ability to understand manufacturing activities and the general commercial organisation and practice of their companies.

5 Diagnostic ability.

6 The ability to organise (but not necessarily to supervise) and give direction to the work of others."

Hence this indicates that there is a sufficient common ground between the skills and knowledge used by them to make this the basis of their identification.

McCallion (1987) has made an elaborative list of basic psychological properties required by technician-engineers to be effective in a particular role involving both technical and managerial functions. The properties (shown Appendix D) will

serve as a guideline to analyse the information obtained from the survey of technician-engineers in various occupational roles.

2.2 Qualification and Employment

For a technician-engineer in New Zealand, the qualifying examination is an NZCE (i.e. a five stage New Zealand Certificate in Engineering). NZCE is awarded by the AAVA (Authority for Advanced Vocational Awards). Full course description and appropriate practical training required for the NZCE is described in the AAVA Handbook (1987).

Attempting to group technician-engineers into various areas of their work can be a complicating problem as they are involved in a wide range of activities. Colombo Plan Staff College (1982) has placed the technician-engineer as one who occupies a middle level position between the tradesperson and technologist. His work requires the application of technical knowledge higher than the tradesperson but below that of a technologist; whose work moreover requires a proficiency in skills higher than that of a technologist but lower than that of a tradesperson. This leads to the belief that technician-engineers can be distributed over a wide range of industries and undertakings, various levels of work and responsibility. The EITB of United Kingdom in a report (1970) has attempted to classify technician-engineers into four major functions in which he works and is shown in Appendix B.

Technician-engineers are employed in industries under various designations and titles. The EITB of UK in a report (1970) published a list of typical job titles held by technician-engineers in industry and is shown in Appendix C. This shows little value in identifying either the level or the nature of work being undertaken. Hence job title can be quite misleading, in a small establishment he may be designated under one name and in a large one under a different title. Also with the varying amount of experience in work, the classification by designation for technician-engineers becomes very difficult.

2.3 The Technician Curriculum

Fundamental to all these and other related issues is the curriculum, how it is developed and planned, implemented and evaluated both for its effectiveness and for its relevance within each country's socio-economic setting. In technician education to limit one's perspectives to institutional processes is to ignore the equally important process of technician-engineer development, which takes place in industry in the form of apprenticeship and on the job training. When the two processes are allowed to diverge instead of complementing each other, the technician education system will suffer from the rapid advancement of technology.

The technician curriculum is to determine how best to plan and organise education and training so that

technician-engineers may be equipped with all the abilities needed for the occupation. The concern of ILO and UNESCO for a broad rationale was shared by the Haslegrave Committee on Technician Education (1969) which established four guiding principles which serve as a most appropriate rationale for curriculum development:

"1 Technician courses should produce people capable not only of meeting an immediate need for skill and knowledge, but of adapting to changing requirements of technician occupations.

2 Course should produce people capable of being adapted to the changing needs of technician education as changes in industry make this necessary.

3 Course provisions should be able to meet all reasonable manpower and be adaptable to regional and local requirements as well as lending themselves to a simplified administrative structure leading to the award of nationally acceptable qualifications.

4 The pattern of course should be geared to the requirements of students who transfer from school to further education, but should allow for horizontal and vertical transfer within the technician training system and to systems of training craftsmen, technologist etc. "

Many suitable models have been presented for curriculum design of technician-engineers by the Colombo Plan Staff College (1982). None may be wholly adequate for any specific system of technician education, but all may contain ideas which could be fruitfully adapted. The role of the technician-engineer is a transient one. His education and training must be designed so that he can adapt and perform competently to changes in products, equipments and techniques.

In our study, the Dacum model is used as a curriculum design system to meet the flexibility in both educational and training needs of technician-engineers.

C H A P T E R 3

INTRODUCTION TO DACUM

The Dacum, coined as an acronym for "Design A Curriculum" was developed during the late sixties in British Columbia. Since then it has evolved into a programme planning model and can use it both as a curriculum plan and an evaluation instrument for occupational training programmes.

Over the years, from its initial development, Dacum has changed considerably and educators and trainers have taken the fundamental ideas from it and adapted it to suit their own requirements. As a result, there is now a great diversity of opinion about what Dacum is and how it is applied.

3.1 Historical Perspective

An Experimental Projects Branch was formed in the Department of Manpower to study the total training needs and methods of various areas in Canada (Dacum 1983).

Officials from the Experimental Projects Branch came across a new method of programme planning operated by Dr. Oliver Rice in Cliton, Iowa. It was a residential training programme for women between sixteen and twenty-one who were unemployed. The training programme devised by Dr.Rice was to chart the entire curriculum for each student, stating the

objectives in clear, behavioural terms. A copy of the chart was given to each trainee and was encouraged to colour each objective as she completed it.

In 1968, as a result of success with such a curriculum charting, Dr.Rice was invited to work at the Division of Technical/Vocational in British Columbia. It was here the first text "Designing a Curriculum" was published by the Federal Department of Regional Economic Expansion in 1969.

3.2 Dacum: Then and Now

There have been many changes in the Dacum over the years. Originally, it included all the developmental stages in curriculum design from identifying the skills to producing the instructional plans and resources.

However, with new development in the ones of adult learning, there has become a clear distinction between curriculum and instruction. Curriculum describes what skills are needed to be competent in a particular occupation, instruction is the means by which skills can be achieved. Thus a curriculum outline should reflect the needs of all the parties concerned, including the learner, the educational institute and the employer who will hire the graduate.

The Dacum has undergone many changes, users and instructors only follow its guideline. They need to make

modifications to meet the individual needs of their learners and to work within the constraints imposed by their own institutions.

The history of Dacum has been one of refinement and evolution. It is beyond the scope of this study to detail all the changes but a table showing in its refinement to the present day is given in Table 3.1.

3.3 Dacum: Principles and Procedures

The basic principles of Dacum remains the same, whether it is used to develop a small training course for a few workers in a particular company or a complete programme for an entire occupational area. It places the emphasis on the learner's meeting specific objectives to a set standard. A task analysis approach is used to identify precise learning outcomes. These outcomes represent the training goals which have been identified by individuals who work in the field under study.

The process involved in Dacum is to conduct a job analysis to determine the range of skills required to perform the job. This is generally done in a Dacum workshop setting which involves a number of participants in the same occupational field from various industry and a job profile chart is documented in behavioural terms. Then the objectives which reflect the required skills or outcomes documented in

the job profile chart is established. Then from the job profile chart translation of the objectives which reflects the required skills into instructional design remains.

3.4 Dacum: Use and Advantage

Dacum is a systematic process which begins with the establishment of specific goals and works "backwards" to determine all the requirements to reach the training goal. It is particularly suited to the development of vocational, technical and career training programmes, where the ultimate goal is to prepare individuals for employment. Hence, it is revolutionary to the traditional training programmes where the emphasis is on what individuals should know rather than what they can do competently as a result of training. This practical goal-oriented approach is generally described as performance based or competence based education.

DACUM 1967		DACUM 1968		DACUM 1977		DACUM 1982	
STEP I	Describe terminal behaviour	STEP I	Conduct task analysis	STEP I	Conduct job analysis	DACUM I	Introduction to DACUM
STEP II	Prepare terminal measurement	STEP II	Set behavioural objectives	STEP II	Set performance objectives	DACUM 2	The Dacum Workshop
STEP III	Describe learning unit measurement	STEP III	Identify learning resources	STEP III	Choose instructional techniques	DACUM 3	From skill profile to objectives
STEP IV	Prepare learning measurement			STEP IV	Organise instructional resources	DACUM 4	From objectives to instruction
STEP V	Prepare learning activities			STEP V	Select evaluation procedures		
STEP VI	Prepare individual student programmes						

TABLE 3.1 The Development phases of Dacum 1967-1982 (Adapted from Macklin N.E. - A Descriptive Analysis of Dacum as a system curriculum design in Post Secondary Education)

C H A P T E R 4

THE DACUM WORKSHOP

The first step in the process of developing a competence based training programme is by a Dacum workshop. It is important for educators and employers to work with a close co-ordination, for the aim of training programmes for individuals, are for preparing them for an employment career. Such a Dacum workshop provides the ground for consultation and for the negotiation of training goals. The philosophy behind Dacum is that:

1 Competent workers are better able to describe their jobs.

2 Any job can be efficiently described in terms of tasks that a worker has to perform for the successful accomplishment in his occupational role.

3 These tasks have an implication for the knowledge and attitude that workers must have in order to perform them successfully.

The proceedings of the workshop is facilitated by a co-ordinator who has the techniques of extracting the required information from workers. The participants include representatives from a range of typical employers in the occupation under review.

4.1 Reason for a Workshop

The constant technological advances have created new inventions requiring people to handle various new roles. Hence, new jobs are created requiring people to have new skills and knowledge or updating their existing ones. This calls for new training programmes, or re-evaluating existing ones to meet the changing needs.

The Dacum workshop is a method to store information on the requirements that workers should have, as envisaged by the industry presently or in the near future. Both the known and projected requirements are reviewed thoroughly in the Dacum workshop. This brings fresh insights to establish perceptions of what is needed.

4.2 The Dacum Participants

Usually eight to fifteen employer representatives participates in a Dacum workshop along with a co-ordinator. The participants are chosen from industries on the basis of regional representations, the size of scope of its operation and co-operation with training institutions. Employers are encouraged to send individuals who work in the occupation under review. For example, if the occupational area were that of "production engineers" then production engineers would have the most immediate and thorough knowledge of what skills are required for employees. To see if the needs of the employers

are properly conveyed, even representatives at supervisors or managers level may participate in the workshop.

4.3 Role of Participants and co-ordinator

The co-ordinators job includes the administration, co-ordination with employees and the final handling of the Dacum workshop. The location for a Dacum workshop is a classroom with an unbroken wall so that cards identifying the duties and tasks that workers do can be listed during the workshop.

The role of the co-ordinator in the workshop is to encourage the participants to contribute the activities they do at work in the workshop. Up to 3 days of active involvement between the participants and co-ordinator during the workshop will produce the duties and the related tasks for these duties they perform at their work place. Then upon mutual agreement between all the participants the Dacum chart for a particular occupational role is developed.

C H A P T E R 5

SURVEY OF TECHNICIAN ENGINEERS

The survey was initiated to gain information as to what technician-engineers are actually doing in industries. Hence by looking into the range of activities performed by technician-engineers, the needs of the industries could be identified.

Professor McCallion with the long term acquaintance with the VTC (Vocational Training Council), EITB (Engineering Industry Training Board) and AAVA (Authority for Advanced Vocational Awards) felt the need for formulating a technical and vocational curriculum which will prepare technician-engineers to suit industrial requirements. Hence, the Dacum approach for developing occupational training programmes for technician-engineers was tested. Once the needs of the industry is evaluated, a training programme using the Dacum methodology could be implemented. The job analysis of a technician-engineer role using Dacum embodies a systematic analysis to identify what knowledge and skills one should possess to perform competently in his occupational role.

5.1 Sampling Plan

The subject of the research was that category of manpower

within the engineering industry described as technician-engineers. However the category of technician-engineers which the survey is based on is the mechanical/production technician-engineers. The technician-engineers who were selected to participate in the survey were those holding NZCE in the mechanical or production option and who were in the twenty-three to thirty age group. The reason for selecting technician-engineers in this age group was because it was felt that in this age bracket, both the practical and technical skills are required to perform the job successfully after which they serve more of an administrative function. Technician-engineers who were selected to participate in the survey was chosen from 18 companies. The companies were selected by the EITB of New Zealand and is listed in the Appendix A.

5.2 Limitations in the Survey

However in conducting the survey, some difficulties were encountered. One was the sample of the survey could not be extended to a larger number of companies covering all the industrial regions in New Zealand. The survey was confined only in the Christchurch and Lower Hutt areas. One of the reasons was due to the financial restrictions. Another constraint was the limitation of time. It would be difficult to educate the many employers about the use of Dacum and allow their technician-engineers to co-operate in the survey in a limited period of time.

5.3 Method of Survey

The method adopted here in conducting the Dacum analysis was totally different from the actual method in which it is practised. However, the fundamental rules in developing the Dacum chart remains the same.

The usual Dacum approach in which it is conducted as a 'workshop' was not adopted. One of the reasons is that in New Zealand industries there is no significant differences in the frequences of the types of knowledge required and tasks performed in their jobs by professional engineers and technician-engineers and hence there is no clear demarkation between the two engineering classes. Most of the manufacturing industries employ technical personnel by judging their ability to do the work rather than basing it on their qualification. This was gathered in a survey "Manpower and Technical Training Requirements of Engineers and Technicians" for the EITB(1978). Thus, it was not always possible to identify eight to fifteen technician-engineers engaged in similar kind of work within an occupational role due to the varying structure of New Zealand companies. Hence it was decided to extend the Dacum approach on an individual basis through personal interviews as the main idea was to find out what abilities they needed to perform successfully in their occupational roles.

Before being taken to the industrial field, the Dacum method of formulating the job analysis chart was first tried and used with the technicians at the Mechanical Engineering laboratory at the University of Canterbury. Here the interviewing techniques and ways of identifying the skills and knowledge required for the jobs was further developed and refined so that during the actual study in firms, the job profile chart could be successfully drawn up. It was decided to conduct the interview over a period of three days to formulate the job analysis chart for an individual technician-engineer. This was first tried at a firm in Christchurch. However, some of the other employers were reluctant to allow their technician-engineers to spend too much of time in the survey as it might interrupt the working conditions within the company and hence this proposal had to be dropped. It was decided to cut short the interview from 3 days to about 4 hours.

As this was only an indicative study to test the adaptability of the Dacum approach, first time being used for technician-engineers, the modifications used could be justified. As from the minimization of cost and restrictions from employers, the intention was to show the ability of Dacum to provide a job analysis for an occupational role and hence formulating educational and vocational training programmes.

C H A P T E R 6

DACUM ANALYSIS

The Dacum analysis was not carried out in its usual 'workshop' procedure due to reasons described earlier. However the key procedures involved in developing the Dacum chart through personal interviews were kept as close as possible as those recommended in the Dacum Handbook (National Centre for Research in Vocational Education 1985). Certain procedures in developing the chart has also been modified to accommodate the occupational analysis of technician-engineers for their roles cover a wide area of work and may not be distinctive from company to company.

On the actual interview with the technician-engineer, he is first familiarised with Dacum as to what it is about, how it is developed and its usefulness. This will give the interviewee a background on the objective of the study. In this chapter, a step by step procedure is explained as how the Dacum chart has been developed in an interview session with a technician-engineer.

6.1 Review the Occupation

Following the orientation, on the background about Dacum, the first step is to clearly establish the parameters of the occupation to be analysed. From the job title, one has to give

a general outline on the areas of work he is engaged in with the company. This will form a basis for analysing the job content for that particular work.

6.2 Identify General Areas of Responsibility/Duties

The duties for an occupational role is a broad area under which all specific tasks will fit. The identification of duty areas in an occupational role is where the brainstorming begins. The interviewee might have problems in distinguishing between tasks and duties. One way of clarifying this is by telling him that each duty area can be broken down into four or more tasks.

It has been shown that for tradesperson, eight to twelve duty areas are common for most occupations analysed (VTC 1987). But in the case of technician-engineers in which, where jobs are not very specialised and cover a wider area the number of duty areas will be less.

After the discussion, the duty areas for the occupation should have been listed on the left side of the sheet in a vertical column. These are the functions an individual tries to accomplish in fulfilling his occupational role. After listing the duties, the interviewee should be asked if he wish to consider combining or modifying any of them. It should be made clear, that any duty that cannot be sub-divided into four or more specific tasks should not remain as a separate

duty. Similarly, a single area should not be so broadly stated so as to include an excessive number of tasks. Sample duty areas for a Production Engineer is shown in Figure 6.1.

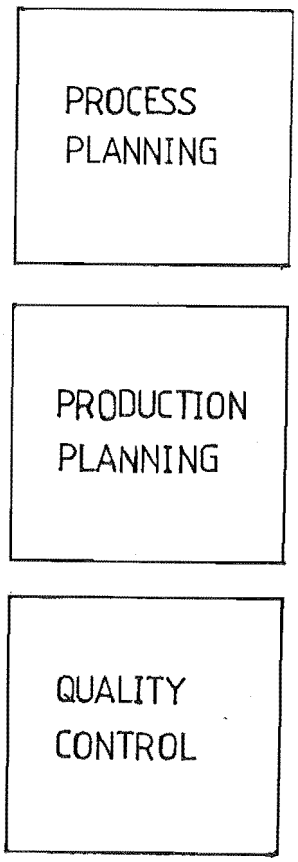

Figure 6.1 - Duty Areas for an Occupation

6.3 Identification of Tasks

A task is a meaningful unit of work activity, generally performed on the job by one individual worker within some limited period of time. Tasks are concise descriptions of units of work as the worker functions in his occupation.

A task constitutes a significant part of a duty area. A combination of tasks in a duty usually forms logical work activities necessary to perform successfully in the role.

This is also a brainstorming session in which information on tasks are extracted form the interviewee. This is a very important phase in the Dacum chart built up, because specifying the tasks correctly leads to the development of the core of the chart. Later, it is around these tasks in which instructional objectives and training programmes are structured.

The tasks developed must be clear so that it is easily and correctly understood by workers and trainees in that occupational area. The terminology used must be consistent with that used in industry so that others will be able to apply the same interpretation.

The first step here is to identify the tasks that are related to a duty area taking one at a time. Each task that is described for a duty area is one which can be seen performed by an individual. That is, it should reflect what is actually done on the job under typical working conditions. A guideline in writing the task is it should begin with the unwritten prefix:

"The worker must be able to ....."

An approximate verb should be chosen to express the task. That is the person involved, the process involved in which the skill is demonstrated must be well described.

Usually, tasks can describe activities which range from simple to complex activities and sophisticated process like problem solving. It represents a typical job assigned for which an employer would pay.

Here, most of the tasks required to complete the duty in one area is extracted. This process is continued until all the duties are delineated. Some examples of task statements for a duty area are shown in Figure 6.2.

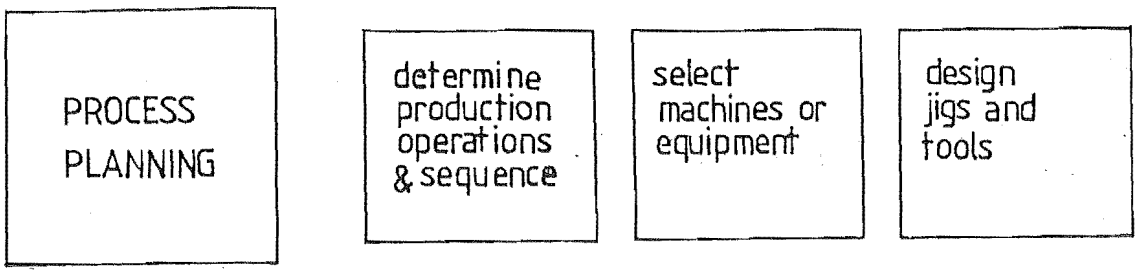

Figure 6.2 - Tasks for a Duty Area

6.4 Review and Refine Chart

The initial charting of duties and tasks might have to be modified to give a better appearance and understanding for the chart. A systematic review is done to identify gaps, overlaps and imprecisely worded statements.

The sequencing of tasks for each duty area could have been quite random. Usually, tasks are sequenced left to right in a natural chronological order in which they are performed or from simple to complex. Duty areas can also be sequenced from top to bottom representing the order of importance and frequency at which it is done at the work place. It is suggested that the vertical shifting of one or more duties should have adjacent to it, an area of similar tasks required for that duty. This sequencing is done primarily for the systematic review later on when instructional plans and resources are developed from the chart.

The Dacum charts developed for various technician-engineer roles through interviews is shown in Appendix F.

C H A P T E R 7

TECHNICAL CONCEPTS AND EDUCATIONAL STANDARDS

The UNESCO (1974) in their recommendation covering technical and vocational education standards suggest that the technical institute's role is:

"1 to facilitate the acquisition of broad knowledge and basic skills applicable to a number of occupations within a given field so that individuals are not limited by their education in their freedom of occupational choice, and later transfer from one field to another.

2 to offer a thorough and specialised preparation for initial employment and effective training within employment.

3 to develop the skills, knowledge and attitudes for continuing employment related education at any point in the the individual's work life.

4 to utilise curriculum design around core knowledge and skill requirements and standards identified by industry as meeting its present and known future needs."

Are the New Zealand Polytechnics preparing technicians with the above qualities? The NZ Employers Federation (1985) feels:

> "Qualifications have been sought by employers in the hope that they will permit the holder to carry out the tasks embodied in the job. Qualification payments have often been demanded, despite the fact that the holder might lack the ability to apply the knowledge supposedly acquired."

Hence, it is important that technical and vocational programmes should develop skills, knowledge and attitudes for continuing employment-related education in students to seek professional role in the light of larger human goals.

7.1 Requirements of Technician Engineers

The purpose of vocational education is to equip students to perform specific tasks or functions. The theoretical knowledge that is taught is given in order to enhance the ability of students to do the tasks for which they are trained. Therefore, the goal of vocational education must be the acquisition of competence and the ability to transfer skill. The Colombo Plan Staff College (1982) in the Figure 7.1 below shows the approximate theoretical/skill mix required for different levels of engineering occupation. The boundaries between the occupations are not clear cut and is indicated in dotted lines.

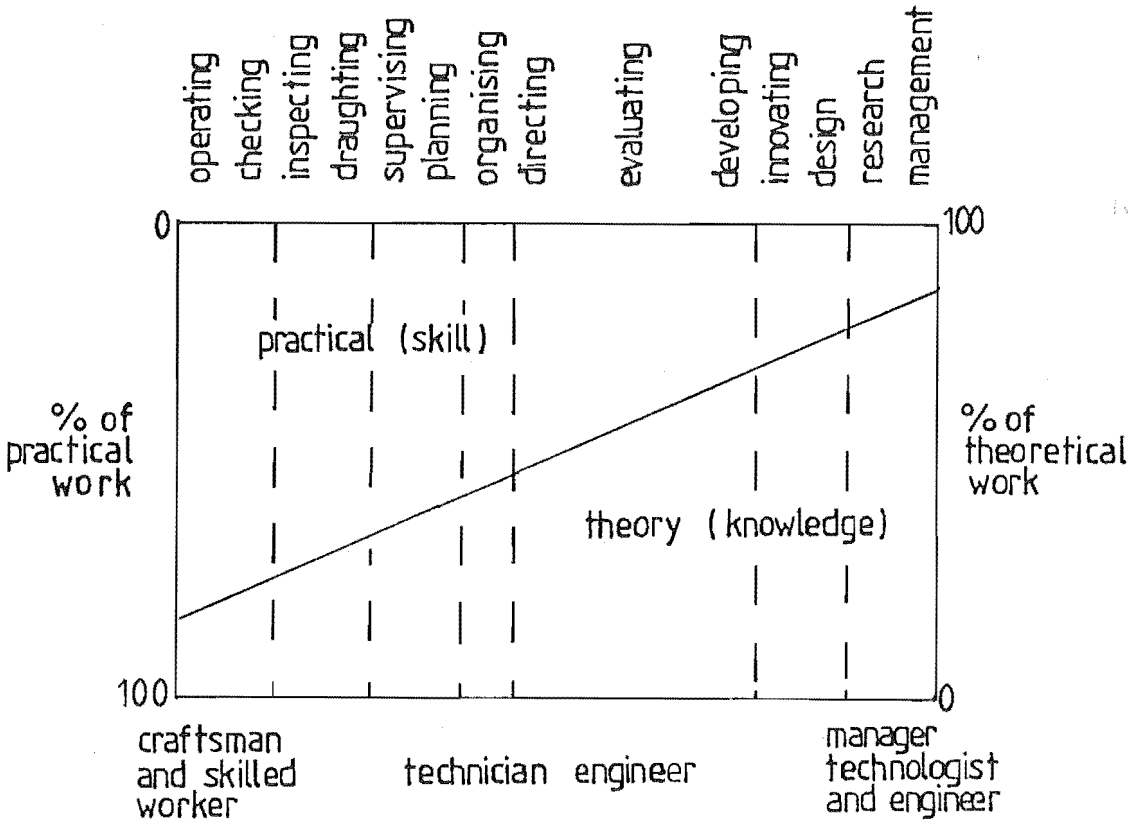

Figure 7.1 - Activities and Knowledge/Skill Mix of Different Occupational Catagories (Adapted from Colombo Plan Staff College)

The development for a technician-engineer role thus requires a phase of training and education for effective performance in industry. The NZ Employers Federation (1985) feels that to achieve this:

> "It is the responsibility of industry to define and determine its own needs and standards and the responsibility of the technical institutes to determine the educational means to meet these needs."

7.2 Work of Technician Engineers

Is there a common ground for the comparison of the expectations of the industry and the roles of the technical institutes in preparing the technician-engineers? This can be explained if we look at the work of technician-engineers in industry. McCallion (1987) has given a broad classification of duty areas under which the activities of technician-engineers in industry may be grouped:

"1 Planning the actions to be performed or the goals to be achieved by a group of people in the future; eg. planning for the production of goods, for the erection or installation of equipment, for the maintenance, repair or operation of complex equipment and plant etc.

2 Designing new objects or systems such as jigs, tools, fixtures, instruments, mechanical components and machines, structures, process plants, factory or departmental layouts, computer software and hardware etc.

3 Assembling, installing maintaining, repairing or operating complex equipment and plant.

4 Diagnosing causes of poor performance or low reliability of plant, equipment, production methods, maintenance procedures etc. and recommending or implementing suitable remedial action.

5 Supervising the activities of other people by organising and regulating their behaviour so that their activities are integrated and co-ordinated towards the efficient achievement of desired goals.

6 Communicating advice and instruction to other people including suppliers of materials and equipment and customers of their own employer."

Looking at various roles of technician-engineers in the survey, their duty areas consists of a number of tasks. These tasks, if carefully noted, could be classified into one or more of the groups listed above. For example, a duty to 'service products' the tasks includes as shown in Figure 7.2.

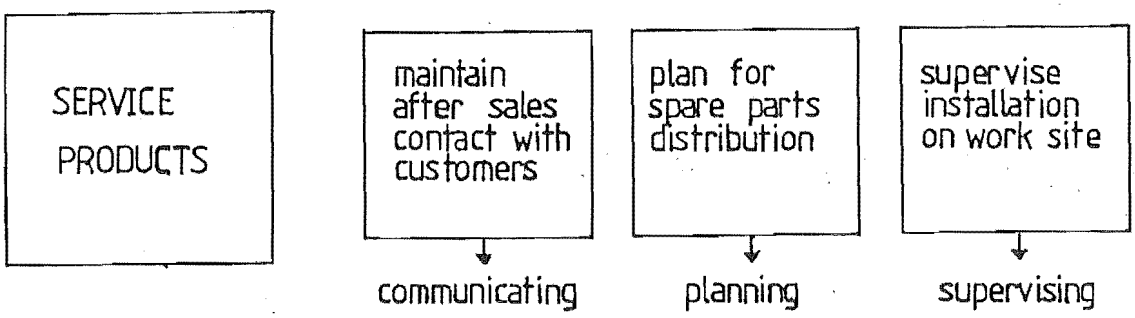

Figure 7.2 - Grouping tasks into various activities

Similarly, most of the tasks in a duty area as seen from the survey could be classified likewise.

What are the essential basic requirements to perform the activities like supervising, planning, communicating, designing etc.? McCallion (1987) has listed some basic psychological properties a technician-engineer should have to

be effective in a particular role involving one or more of the above activities (as shown in Appendix D). If these fundamental concepts are well developed, they can be applied to any task involving one of the above activities.

For an example, in the duty of "product design" some of the tasks include as shown in Figure 7.3.

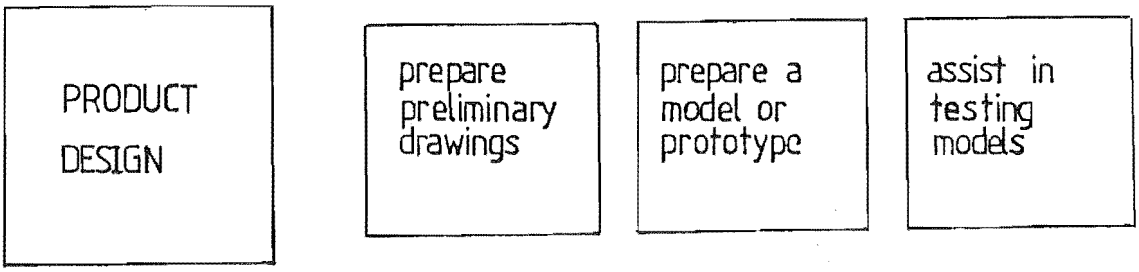

Figure 7.3 - Tasks for a Duty Area

Some of the fundamental learning objectives required to complete the above tasks include in producing mental images, making free hand sketches, showing clarity and neatness in work, making mathematical calculations, applying new ideas, correcting faults in work, making logical inferences from tests, taking responsibility for tools, showing concern for safety etc. If a technician-engineer is taught to acquire all these fundamental skills and sets of beliefs correctly and effectively during his theoretical course and training periods in design, he can apply these to any product design (eg. automobile components, material handling equipments) as all design follow similar fundamental and basic rules.

Taking each of the tasks, it shows a series of steps are involved in accomplishing the task, for example, the task statement 'preparing a design drawing'. Some of the learning objectives involved in accomplishing the task can be classified into different categories as proposed by Bloom(1956):

1 performing physical skills (classified as psychomotor domain) eg. making sketches of component to be designed.

2 knowing facts and information (classified as cognitive domain) eg. define engineering terms and stating specifications in drawing.

3 exhibiting personal attitudes (classified as affective domain) eg. clarity and neatness in drawings.

It is seen that these learning objectives of making sketches, defining terms and showing clarity and neatness could be classified under one or more of the three domains. Most of the other objectives as seen from the task analysis needed to accomplish a task could be classified similarly. This is shown in Appendix G. Hence, the learning objectives gathered from the task analysis supports the basic psychological properties listed by Professor McCallion to be effective in technical and managerial functions. The Table 7.1 shows some examples of behavioural terms for the three domains which could be used as a guideline in analysing the information and skills required by technician-engineers in performing the various tasks.

Domain	Illustrative Behavioural Terms for Stating Specific Learning Outcomes
Cognitive	Appraises, breaks down, changes, computes, categorises, combines, compiles, composes, creates, compares, concludes, contrasts, converts, criticizes, defines, demonstrates, discovers, differentiates, discriminates, distinguishes, devises, designs, describes, estimates, explains, extends, gives example, generalises, generates, identifies, illustrates, infers, interprets, justifies, labels, lists, matches, manipulates, modifies, names, operates, outlines, organises, paraphrases, plans, predicts, prepares, produces, points out, reproduces, relates, rearranges, reconstructs, recognises, revises, selects, states, separates, sub-divides, supports, shows, solves, tells, writes.
Psychomotor	Assembles, builds, calibrates, changes, cleans, composes, connects, constructs, corrects, creates, designs, dismantles, drills, fastens, fixes, follows, locates, makes, manipulates, mends, mixes, nails, paints, sands, saws, sharpens, sets, sews, sketches, starts, stirs, uses, weighs, wraps.
Affective	Asks, assists, adheres, alters, arranges, acts, chooses, complies, conforms, combines, compares, completes, describes, discusses, differentiates, depends, discriminates, displays, explains, follows, forms, gives, greets, generalises, holds, helps, identifies, initiates, invites, integrates, influences, joins, justifies, locates, labels, listens, modifies, names, orders, organises, points to, performs, practices, prepares, proposes, presents, qualifies, questions, replies, reads, recites, reports, relates, revises, selects, sits erect, shares, studies, synthesizes, serves, solves, tells, uses, verifies, writes, works.

Table 7.1 - Examples of Behavioural Terms for the three domains
(Adapted from Gronlund N E -Stating Instructional Objectives for Classroom Instruction)

The New Zealand EITB(1982) has laid down the guidelines of training mechanical-technician engineers and is listed in Appendix E. Thus during this training in industry covering one or more of the area recommended by the EITB, it is important to develop these concepts correctly in each of the area so that they can be applied to any range or level of complex activity in industry.

7.3 Writing Instructional Objectives

By classifying the psychological properties required in fulfilling a task into one of the three domains instructional objectives could be written. For the technician-engineer education at the level of a single course of study or curriculum, the objectives of instructional design depend upon the tasks and activities expected to be carried out in real life situations.

It has been shown by using the Dacum method the complete activities of technician-engineers in industry can be described. It is also seen from the task analysis that some of the learning objectives could be linked up with the appropriate topics in the NZCE syllabi as prescribed by the AAVA. These shows the relevance and importance of the subjects that is being taught in the technical institutes as compared with what technician-engineers use from them in their work. It is necessary to translate these identified needs of the employers into educational objectives.

There is no single best way to institutionalise the use of Dacum charts. With a Dacum job profile chart and a list of learning objectives derived from the task analysis and the relevance to the technical institute's syllabi, institutions can use teams to revise the existing curriculum or develop an entirely new education or training programme based on Dacum findings. From the study, the following could be taken into consideration:

1 the importance of each task and the most appropriate place for its training.

2 select the best possible instructional techniques to assist learners to achieve the outcome of the tasks.

3 choose the best available resources to aid learners during the instructional process

4 determine when, how and what kind of evaluation is necessary to ensure that learning has taken place.

This translation into educational objectives for ultimate curriculum and training development is beyond the scope of this study and requires the expertise of educationalist, curriculum planners and the industry.

C H A P T E R 8

TRAINING REQUIREMENTS FOR TECHNICIAN-ENGINEERS

The scope of the vocational education as defined by the NZ Employers Federation (1985) includes:

"1 the training, either on or off the job, arranged by particular employers to meet their own immediate or foreseeable needs.

2 the training, usually institutionalised, given to individuals to meet the national economic needs, going beyond the obvious needs of particular industries.

3 the training, either on or off the job, given to individuals to enable them to take new or better jobs which they cannot get without first acquiring new skills. "

Hence, what the technician-engineers are doing at work is the requirement of the industry. The industry is a business enterprise and require the technical education to be related to the world of work. The expectation of the industry from technician-engineers is the application of knowledge and conceptual understanding to industry related problems.

8.1 The Philosophy of Training

The NZ Employers Federation (1980) states:

"The training decision is a business decision. It is directly related to financial results to economic survival and consumer satisfaction."

Most employers will want to impart training to their technician-engineers which will meet each employer's immediate and foreseeable needs. They will not necessarily like to provide a wide range of training so as to cover all the activities that generally technician-engineers are engaged with in industry due to economic and financial reasons.

It is also seen from Table 8.1, the movement of New Zealand Certificate holders on qualification, that they are a very mobile group. The Table does not give the figures for NZCE holders but it gives the general trend of NZ Certificate holders' mobility.

Hence most NZ Employers (1985) expect that qualification for New Zealand Certificates which include skills and knowledge should be competency based, national in scope and portable. Such a system will allow the technician-engineer to be mobile from industry to industry and also save employers from providing long-term on the job training for fresh graduates.

	From employer at certification to second employer	From second to third employer %	From third to fourth employer %
Within 1 year	53	11	2
Within 2 years	23	35	18
Within 3 years	11	17	33
Within 4 years	5	15	16
Within 5 years	4	10	11
After 5 years	4	12	20
	N=523 100%	N=156 100%	N=45 100%

Table 8.1 - Job Movement of NZ Certificate Holders After Gaining their Qualifications (Adapted from National Conference on Technician Training 1972)

As we see from the Dacum charts developed for the various occupational roles, most of the activities of the technician-engineers in their work place are those covered during their 3 years (or 6000 hours) training for work/practical experience. Even though they may work in different occupational roles or various industrial sectors, the fundamental engineering skills and knowledge required by them to perform in any role and situation remains the same eg. preparation and extraction of information from engineering drawing, trouble shooting in various machines, industrial safety, plant layout etc. Once the basic skill and knowledge

required to do any of the activities are achieved the technician-engineer can adapt to similar or different situation in various industrial sectors.

Hence it is very important to provide a systematic training to cater to all industry related skills and knowledge. The three years practical training programme in industry should be carefully organised and planned in modules to cover all the major activities that technician-engineers are generally concerned with. In each of the modules covering one of the major activities (eg. supervising, planning, designing etc.), the stress should be laid in acquiring the fundamental concepts. Such a training programme will make the technician engineer portable in moving from industry to industry and job to job. Competency based as he can apply his training immediately to real industrial situations as the objectives of training was derived from industrial needs (Dacum charts) and equality in training and thus a common national standard can be established as all trainees would have undergone the same training requirements.

8.2 Importance of Practical Work Experience

The importance of a planned and formalised training for the social and economic benefit for the industry as well as the technician-engineer has been explained. Now the question is why such a training is essential?

The activities of technician-engineers, with only theoretical knowledge without practical experience will make them handicapped in adapting to the real situation of work. A balance of institutional course work along with compulsory work experience prepares an individual to apply most of his theory immediately on the job, makes the theory more relevant by actually applying his knowledge in real life situations. Here, he will encounter the consequences and penalities if he miscalculates one of the many duties assigned to him and also see what can actually happen to his assigned work due to a wrong judgment.

As seen from the Dacum charts, much work of the technician-engineers lie in the application of subject theories eg. to design a product, he should be able to know the properties of material, make mathematical analysis, understand all the manufacturing process etc.

The pure academic lectures only create an awareness and appreciation for the various technical concepts but do not prepare an individual to confront the many problems. Examination prescriptions at polytechics is only a means to check whether the student has understood the sets of beliefs for the occupational role but not in its application. As gathered from the interviewees, almost everybody was in the opinion that it was the practical training/job experience which prepares them to correctly use and apply their sets of beliefs and skills in real industrial situations.

Experience in decision making is only achieved through practical problem solving. The technical theory as well as the mathematics and science sustaining it can be illustrated only through practical applications. This develops the planning, designing and motor manual skills that will allow the translation of knowledge and ideas into practical realities.

C H A P T E R 9

DISCUSSION, RECOMMENDATION AND CONCLUSION

9.1 Discussion

The main purpose of this survey and job analysis is not to identify technician-engineers but to understand their nature of work, so as to best plan and organise the education and training so that they may be equipped with the abilities needed for their occupation. By making use of Dacum, a complete job analysis for a technician-engineer role has been developed. This shows the work he is engaged in or what is expected by the employer. From the various job analysis, it is seen that all their major activities are one or more of those listed by Professor McCallion. The initial experience in some of these would have been acquired during his three years practical work experience in industry. Hence it is important that during this period, the fundamental generic skills including conceptual and reasoning skills are acquired correctly and effectively with a correct background in these skills and knowledge he will have the mobility and adaptability in any job situation.

If the tasks in each related duty area from the Dacum charts is further analysed, it would highlight the fundamental skills and knowledge required in performing the various tasks competently. Some of these could be linked up with specific

topics in a subject in the NZCE mechanical/production option. This is shown in the task analysis in Appendix G.

From the task analysis, it is seen that many of the work that technician-engineers do cannot be institutionalised. For example, locating faults in machine, making comparitive study between equipments etc. could only be gained through practical experience in his work. This shows the importance of practical training for a technician-engineer to be competent in his job.

The task analysis also shows that no one single subject may serve the purpose of imparting all the knowledge required to do a task. It may be acquired from a number of subjects. When analysing the tasks and linking them to various subjects show, technician-engineers require in their work some subjects which are not part of their syllabi in their NZCE option. For example, it is seen that a technician-engineer with NZCE mechanical qualifications might do work related to quality control and production planning. However, the subjects for these, quality control and engineering measurement and production planning and tooling are subjects which constitute for the NZCE option in production and not in mechanical.

The Dacum chart and the task analysis showing the learning objectives required to accomplish each task and some of their relation to the subjects in the NZCE syllabi serve as an important framework to revise curriculum and training programmes. This framework gives educationalists a better

chance to revise existing subjects so that the topics will impart more job related knowledge, new subjects could be introduced that will up keep with the latest technology used in work, devise methods in teaching such that the theories could be illustrated in a more practical approach. As seen much of the knowledge and skills are also acquired from on job training. Here the training programmes could be better formulated to see that the essential ideas are conveyed effectively.

In the real industrial setting, there is a wide diversity of technician-engineer jobs and it is impossible to design a course for each job. Apart from practical difficulties, too narrowly specialised courses restrict horizontal mobility from job to job and employer in New Zealand. The Dacum process of training needs analysis has given the industry the opportunity to participate in the assessment of its own training needs. Hence it is important to formulate a carefully structured training programme in modules covering the major activities during the work experience emphasising in building the fundamental engineering beliefs and skills in each area, such a training programme if implemented, will have many advantages.

The present system of keeping track of the training is by a work experience record book which is signed by the trainee's employer annually. This way there is no proper method to check what the trainee has covered and what remains, if there is a break in the training or if he moves to another employer.

With the present regulation of not requiring concurrent work experience, if the training is in the form of modules one is able to monitor the progress of the training. Even if there is a change in employer, one will be able to see what has been covered and what is there left to be trained in.

Since the needs are supplied by industry, the trainee can be assured that he is trained in the current level of technology as used in industry. Some fixed training programmes which are identified without industry co-operation might suffer from the ills of obsolete technology. A modular training programme will have the flexibility of including new areas or updating current ones with changing trends in industry. Such a training will also prevent in the specialisation and hence there will be more flexibility for the trainee to take up new jobs or move to other employers and save employers in giving training to fresh graduates.

9.2 Recommendation for Further Study

1 The NZCE options in Aeronautics, Mechanical, Production,Power and Plant, Road Transport and Plastics have a common core subject for the first four stages of study and specialisation is only in the final stage of study. It is seen from the Table 9.1 the number who are enrolled and the number gaining certificates is quite insignificant.

NZCE-option	1982		1983		1984		1985		1986	
	Regis	Cert	Regis	Cert	Regis	Cert	Regis	Cert	Regis	Cert
Aeronautical	31	7	25	4	36	6	26	16	61	10
Mechanical	489	96	648	94	675	94	631	141	763	121
Plastics	9	6	18	2	19	3	15	5	20	3
Power & Plant	11	2	41	3	11	11	15	10	28	9
Production	36	16	32	7	45	5	38	17	32	29
Road Transport	17	-	24	1	18	-	16	1	10	3

Table 9.1- Number of registrations and certificates in NZCE options (source AAVA Handbook 1985-1987)

If a study is taken to analyse the occupational roles of those with NZCE in Aeronautics, Power and Plant, Road Transport and Plastic, one is able to judge their content of work in industry. A task analysis would show the essential requirements in fulfilling the tasks of the job and through what subjects they are imparted in the technical institutes. It would also show what kind of practical experience is needed and how they can be acquired. If the NZCE graduates in the above options show a common ground in their work, then one or more of the options could be combined. This will assist the technical institutes to discontinue courses in which only a few students are enrolled and will give better and more time to develop and administer new curriculum and training programmes.

2 The translation of industry needs to educational objectives and to formulate a moduled training programme covering all the major activities emphasising on developing the fundamental skills and knowledge should be undertaken. The study should also be based on what level of competence the training programmes should reach and to what depth of theoretical knowledge should be conveyed in each of the subjects.

Also the Dacum chart and task analysis, once it has been developed for an individual technician engineer could be validated. The validation may be done in the presence of the technician-engineer who has participated in the interview and his immediate superior who oversees his job. This will help to include any component in the chart that has been left out during the job analysis. This will also show that the analysis in the chart has been mutually agreed upon by the worker and the person who delegates the job to him.

3 Dacum could also be tried in the training needs analysis of managers and those at the top management level. The outcomes from such a training will help them to adapt to the changes in business systems and policies so that they would not become obsolete in their working environment.

9.3 Conclusion

The Dacum chart has been developed to a stage where a job analysis and content of work for technician-engineers can be determined. The flexibility of Dacum makes it an ideal choice for the use in curriculum design, training needs analysis and continuing evaluation of training programmes. The Dacum system may be applied equally successfully to both staff training where the objectives define employee performance on the job and public training programme where objectives define what the learner will be able to do as a result of training.

From the various job profiles developed, shows what technician-engineers are doing in industries. It has shown the actual requirements of the industry to sustain their business. The task analysis has shown the basic skills and knowledge required in performing various tasks. The framework has also shown the relevance of the subjects in the NZCE curriculum. This will serve the purpose of revising existing curriculum and also introducing new ones which will have better use in the work application of technician-engineers. To cater to both industry and students need, has led to the belief of a carefully structured training programme in modules to cover the major activities in which technician-engineers are generally engaged. It has also showed that most of these activities involve the application of fundamental engineering concepts and beliefs and developing these will enable them to

adapt quickly to any of the technician-engineer roles and in turn make them mobile.

The technical institutes will fail its students if it does not provide them with marketable skills for the ultimate consumer of technical education is the industry. Hence it shows the necessity for a better integration and co-ordination between industries and technical institutes in setting up educational and training strategies.

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A P P E N D I X A

List of companies involved in the survey of technician-engineers

Christchurch

Southern Cross Engineering

Scott Penfold Ltd

P.D.L. Plastics Ltd

Wellington

Southward Engineering

Philips (N Z) Ltd

Brugger Industries Ltd

Acme Engineering Ltd

Atlas Copco

William Cables Ltd

G.E.C. (N Z) Ltd

Holyoake Industries Ltd

A.E. Tilley Ltd

General Motors (N Z) Ltd

Lowes Industries

D.S.I.R.

A P P E N D I X B

Generalised classification of four major work functions in which technician-engineers work.

1 Commerce

Activities directed outwards to the supplier and customer; includes the following:

a General - work which does not fit into any one of (b),(c),(d) and (e).

b Marketing - selling the products of the organisation from market analysis to contract with customer; includes market analysis, market research, advertising, publicity, sales, sales promotion, contracts, trade relations, licensing, systems/applications engineering (pre-tender stage), product specification, quality specification, customer service, technical information.

c Distribution - the movement of products to customer; includes despatch, external transport.

d Purchasing/Supply - procrument or buying of goods and raw materials; includes procurement, buying, supply.

e Services - services directed solely towards commerce.

2 Research, Design and Development

Technical activities leading up to decision to produce on a commercial scale; includes the following:

a General - work which does not fit into any one of (b),(c) and (d)

b Research - work undertaken for the advancement of knowledge includes:

Basic Research - work undertaken for the sole advancement of knowledge; pure research, fundamental research, background research.

Applied Research - research undertaken with either a general or a particular application in view; application research, process research, product research.

c Development and Design - work directed to the introduction or improvement of specific products or applications up to and including the prototype or pilot stage includes:

Development engineering, product development, product design engineering, instrumentation development, standards engineering, standards specification, reliability engineering, prototype development, pilot plant operations.

d Services - services directly solely towards research and development includes; scientific information/library, scientific computer service.

3 Production

Activities from the point of decision to produce up to the stage of the finished product includes the following:

a General - work which does not fit into any one of (b),(c),(d), (e),(f),(g) and (h).

b Exploration - which may include site surveying.

c Construction - the erecting and repairing of buildings and civil engineering work of all kinds; includes erection, excavating, demolition.

d Power Services - includes power generation.

e Engineering - includes production engineering, facilities planning, process planning, process engineering, industrial engineering, methods engineering, instrumentation, tooling, plant provision, plant engineering, plant erection, plant maintenance, plant replacement.

f Manufacturing - the execution of production programmes; includes plant operations, product manufacture, production planning, production control, production co-ordination, quality control, test and inspection.

g Installation - the reassembling of installation on customer's site; includes installation commissioning, post-commissioning services, field services.

h Services - services directed solely towards the function; includes internal transport, internal

haulage, packing, warehousing, depots.

4 Services

Activities which support two or more of the above; includes the following:

a Computer services, central: includes systems analysis, data preparation, programming, computer operation.

b Education and Training

c Finance - includes accounting, management accounting, cost accounting, cost control, budgetory control, internal audit, cashier services, wages and salaries payment.

d Legal - includes investment, share register, insurance, patent protection.

e Medical

f Personnel - includes manpower forecasting, manpower planning and control, recruitment, salary administration, industrial relations.

g Other Management Services - includes economic, intelligence, economic, information, statistics, organisation and methods, operation research, work study.

h Office Services - includes central typing, reproduction services, printing, duplicating, communications, telex/telephone, postal services, central registry.

i Other Services - includes site management, site maintenance, accommodation, security, safety, fire precautions, passenger transport.

(From U K EITB - The Technician in Engineering 1970)

A P P E N D I X C

Commonly held job titles by Technician-Engineers in Industry obtained by UK EITB.

Commerce

Chief Estimator

Technical Sales Engineer

Home Sales Manager

Estimator

Customer Service Engineer

Applications Engineer

Research, Design and Development

Designer

Design Draughtsman

Development Draughtsman

Chief Draughtsman

Section Leader

Design Engineer

Consultant Design Engineer

Electrical Designer

Development Engineer

Product Development Engineer

Numerical Control Applications Engineer

Senior R & D Engineer

Assistant Research Engineer

Trainee Stress Engineer

Production

Structural Designer

Assistant Designer

Senior Design Draughtsman

Jig and Tool Draughtsman

Production Engineer

Chief Planning Engineer

Projects Engineer

Manufacturing Engineer

Chief Test Engineer

Senior Methods Engineer

Machine Shop Methods Engineer

Maintenance Engineer

Sub-contracts Engineer

Work Measurement Engineer

Senior Metallurgist

Works Technician

Performance Dept Supervisor

Production Controller

Design Draughtsman

Services

Work Study Engineer

Technical Writer

Technical Liaison Engineer

(From U K EITB - The Technician in Engineering 1970)

A P P E N D I X D

Basic psychological properties needed to fulfil managerial and technical functions:

a to be able to recognise and name the form and function of tools, machines, etc. and their components, associated with the role.

b be able to produce mental images of the forms of items in (a) from drawings, descriptions and other representations.

c be able to recognise structural and functional faults or other deviations from specification of items in (a)

d familiar with and able to use the set of well-established concepts necessary for the role (eg. stress, voltage, pH, reliability, efficiency, productivity, profitability, legal liability).

e be familiar with and able to use the accepted physical, chemical, biological, psychological etc. models or technical belief-system necessary for the role.

f be familiar with legal determinants that affect choices made in the role.

g have intellectual skills to make the logical inferences necessary to produce other views of reality, as required in the role (i e to produce geometrical, mathematical and other logical transformations of information using models and

belief-systems of (e).

h be able to observe and record accurately important information from role situations.

i have the motor-manual skills required to perform role functions (such as keyboard skills, drawing and freehand sketching skills, skills in use of hand-tools and machine tools, skills in operating plant).

j have the interpersonal communication skills (oral, written, graphical, enactive) necessary to inform, or instruct, or motivate people with various levels of engineering technical understanding, eg. when reporting to them, when making requests to them, when training, organising, leading or controlling them, when negotiating with them etc.

k be able to extract role information and knowledge from communications (oral, written, graphical, enactive) produced by other people.

l know the plans and procedures usually used in the role, for example, plans or procedure.

i for producing other plans (eg. for producing production erection or maintenance plans).

ii for designing tools, machines, instruments, plant or production.

iii for diagnosing faults in tools, machines etc. or deviations from plans.

iv for correcting faults or deviations from plans.

m have correct beliefs about the system of roles of which he or she performs one, and about the layout and functions of the divisions or departments or sections of the organisation in which he or she is employed and with which he or she interacts.

n have correct beliefs about the commercial, economic, social etc. environments of the employing organisation.

o be able to weigh up available evidence, make decisions and arrange for the decisions to be executed.

The above list is not claimed to be exhaustive but it could serve as a guide to analyse the information and skills required in a particular technician-engineer role.

(From McCallion H - On Developing People for Technician Engineer Roles 1987)

A P P E N D I X E

Training Requirements recommended for NZCE by EITB

To become a Technician-Engineer, it is necessary to satisfy the examination and operational experience requirements for the award of a five stage New Zealand Certificate in Engineering (NZCE) as set out in the Handbook produced annually by the Authority for Advanced Vocational Awards (AAVA).

A minimum of three years (6000 hours) training in operational situations is required. Without this, the trainee will not achieve the required balance between theoretical knowledge and practical training necessary to reach a level of competence expected of a Technician-Engineer.

The EITB recommends that to become a Technician-Engineer (Mechanical), a trainee should study the formal subjects for the NZCE (Mechanical, Production, Power and Plant, Plastics, Aeronautics, Heating, Ventilation and Air Conditioning or Road Transport options), or the formal subjects for the NZCE in fire technology, and gain three years of practical/operational experience as follows:

1 Not less than twelve months (2000 hours) of engineering workshop experience involving:

a the use of tools used in the industry;

b the operation of machine tools and machine setting;

c selection of materials and heat treatment;

d preparation and extraction of information from engineering drawings;

e the use of measuring instruments and inspection methods;

f accident prevention.

During this time the trainee should seek to develop skills in manipulating tools and instruments, in observing, measuring and interpreting information, in process planning, and in communicating operational information.

2 A period of not less than twelve months (2000 hours) gaining operational experience with actual production processes and/or with the development and/or maintenance of production machines in a branch of engineering particularly related to the NZCE option being studied. The trainee should seek to develop skills in planning, diagnosing, and communicating technical and/or operational information.

3 A period of not less than six months (1000 hours) in one or a combination of the following functional areas. The activities performed should be relevant

to the NZCE option being studied and the skills developed should be relevant to the specific roles in which the trainee expects to be employed after qualifying. Examples of specific roles are:

Design (of product, process machines, of tools or of materials handling systems, etc.)
Estimating and tendering
Budgeting and cost control
Process planning
Methods Engineering
Plant Layout
Materials planning, scheduling and control
Quality control
Maintenance (of machines or of plant)
Industrial safety
Industrial relations
Sales and marketing

It should be emphasised that each of the above roles involve knowledge of how to manage people in addition to knowledge of specific technical procedures.

Therefore, during this time the trainee should seek to develop skills in supervising the activities of other people and to develop further skills in planning, designing, diagnosing, estimating, or

communicating technical and/or operational information depending upon the roles which they expect to fill after qualifying.

(From N.Z. EITB - The Training of Mechanical Technician Engineers)

A P P E N D I X F

Presented in this Appendix are Tables of job-analysis of technician-engineers using the Dacum approach. The Dacum charts have been developed by interviews conducted on technicians-engineers based on their activities at work.

TABLE F.1

Functions: Manufacture of General Household Electrical Equipments eg. Heaters, Toasters, Electrical Switches

Job Title: Production Engineer

Dept : Engineering

Report to: General Manager

DUTIES	TASKS				
PRODUCTION PLANNING	Advise suitability of Product Design for production	Co-ordinate design changes	Determine optimum method of production operations	Determine production operation and sequence	Investigate percentage of scrap produced
	Analyse and record work eg., Process Chart				
DEVELOPMENT OF WORK STANDARDS	Assist in Charting Operations	Assist in calculating operation time	Assist in job rate calculation	Implement new and altered work standards	
DESIGN AND MANUFACTURE OF MACHINES AND TOOLS	Make alterations to drawings and sketches	Advise tool room personnel on manufacture	Assist in manufacture of tools/dies	Help in commissioning of tools & machines	Perform try-outs of new tools
	Plan and Progress manufacture of fixture/tools	Re-design standard machine tool			
INVENTORY CONTROL	Set targets with sales on delivery dates	Supply and maintain stock of in-house manufactured parts	Supply and maintain stock of bought-out items	Control production to attain daily targets	Prepare data base system for the movement of stock

IMPLEMENT TEST STANDARDS FOR MANUFACTURE & PROTOTYPE	Specify Q. C. standards on manufactured items	Decide tolerances with design department	Advise vendors of firms' Q. C. standards	Carry out test with pre-production samples	
INVESTIGATE PROCESS FAULTS	Trace Process Faults	Rectify process faults	Advise on machine breakdowns	Develop optimum methods of operation for selected jigs & tools	
LAYOUT OF PLANT	Evaluate existing floor area of factory	Determine size and type of machinery	Layout machinery for flexibility	Balance production lines for continous producton	Assist in resiting part of production line
SOURCE NEW EQUIPMENT	Evaluate usage of all existing equipment	Check if equipments can be made in tool room	Advise on latest production m/c's	Advise on new test equipments	Locate sources of new equipment

TABLE F.2

Functions of Firm: Manufacture of General Household Electrical Equipments eg., Heaters, Toasters Electrical switches

Job Title: Test Engineer

Dept: Test Lab.

Report to: Laboratory Manager

DUTIES	TASKS				
INSPECT PROTOTYPE	Receive Prototype from design/sales department	Carry out visual inspection on items	Disassemble parts individually	Check ratings for for voltage, power current	Check each individual component for reliability
	Check all wiring connections and mountings				
INSPECT PRODUCTION LINE AND BOUGHT OUT ITEMS	Receive samples from production line	Receive samples from local/foreign Vendors	Test models as per set sampling plans	Check models as per test specifications	
CONDUCT RELIABILITY TEST	Assist in design of test rigs and fixtures	Set up test rigs and fixtures	Conduct test under actual working conditions	Conduct test under intensive working conditions	Conduct test under accelerated working conditions
	Recommend test equipment requirement				
PREPARE TEST DATA AND REPORTS	Schedule test for prototype	Prepare test procedures for prototypes	Prepare test specifications for individual items	Write reports of tests	Report faults/ observations to Lab. Manager

ANALYSE RESULTS AND ASSIST IN FAULT FINDING	Record generated data, values from tests	Tabulate recorded results from test in proper form	Evaluate results to make comparative study	Review and Devise test to find specific faults	Check and calibate equipments
LIAISE WITH PRODUCTION/DESIGN/ Q. C. DEPT	Communicate results to production dept.	Give suggestions to design dept.	Communicate with vendors on faults	Conduct tests as requested by other departments	Liaise with external research laboratories

TABLE F.3

Functions: of Firm — Manufacture of General Household Electrical Equipments eg., Heater, Toasters

Job Title: Design Engineer

Dept: R & D

Report to: Design Manager

DUTIES	TASKS				
DESIGN OF PRODUCT	Receive suggestions on product required	Evaluate all existing products in the market	Evaluate requirements to satisfy customers	Develop rough sketches of new idea	Use CAD/CAM for extensive refinement
	Prepare preliminary drawings	Prepare a model/prototype	Assist in testing model	Evaluate model for production and refine model	
DESIGN OF MACHINES AND TOOLS	Sketch tool/ machine as per requirement	Prepare layout of individual component	Prepare parts and material specifications	Evaluate the usage of hydraulic, pneumatic controls	Assist in tool/machine try-out
	Investigate faults occuring to tool/machine	Modify design of machine/tool			
PURCHASE OF EQUIPMENTS	Identify requirements of required equipments	Communicate with customers/regular suppliers	Send purchase orders, requisitions	Evaluate quotations	Receive Orders and test samples
MANAGEMENT OF DRAWING OFFICE	Use standard drawing office equipments	Develop a numbering system for drawings	File master drawings	File Media materials	Retrieve drawings and materials
	Maintain Handbooks and Standards				

PREPARATION OF FINAL DRAWINGS	Produce Layout Drawings	Draw detailed Drawings	Write details and specifications	Make assembly drawings	Check drawings for completeness and accuracy
LIAISON WITH OTHER DEPARTMENTS	Evaluate test reports from Q.C. Department	Set up tolerance standards for manufacture	Assist in fault finding during manufacture	Assist in tool/ fixture manufacture	Assist in tool/ machine try-out

TABLE F.4

Functions: Design and Produce one-off special purpose equipments of firm

Job Title: Design Engineer

Dept: Design

Report to: Engineering Manager

DUTIES	TASKS				
DESIGN OF MACHINES AND TOOLS	Detail jigs and fixtures	Sketch tools, jigs, fixtures as per requirements	Prepare parts and material specifications	Evaluate the usage of various controls	Assist in tool and machine built up
	Investigate faults occuring to tool and machine	Modify machine and tool design			
PURCHASE OF EQUIPMENT	Identify requirements of required equipments	Communicate with customers/regular suppliers	Send purchase orders and requisitions	Evaluate quotations	Receive orders and test samples
MANAGEMENT OF DRAWING OFFICE	Use standard drawing office equipment	Develop a numbering system for drawings	File Master drawings	File Media materials	Retrieve drawings and materials
	Maintain handbooks and standards				
PREPARATION OF FINAL DRAWINGS	Draw Layout Drawings	Draw Detailed Drawings	Write Details and Specifications	Make Assy. Drawings	CheckDrawings for completeness and accuracy

LIAISE WITH OTHER DEPARTMENTS	Set up tolerance standards for manufacture	Assist in fault finding during manufacture	Assist in tool or machine try-out	Prepare maintenance manuals	

Table F.5

Functions: of firm — Design and Produce one-off special purpose equipment

Job Title: Project Engineer

Dept: Projects

Report to: Engineering Manager

DUTIES	TASKS				
SET TARGETS AND DELIVERY DATES OF PRODUCT	Set target dates with customers on delivery of items	Supply and maintain stock of in-house manufactured items	Supply and maintain stock of bought-out vendor items	Control progress of production to meet scheduled target	
PRODUCTION PLANNING	Determine optimum method of production operation	Determine production operation and sequence	Investigate percentage of scrap produced, analyse and record work	Enter jobs onto computer	Check material list and assess implication for production schedule
	Prepare Production Planning information sheets for management as requested				
DESIGN AND MANUFACTURE MACHINES AND TOOLS	Advise tool room personnel on manufacture	Assist in manufacture of tools/dies	Plan and monitor manufacture of fixtures/tools	Perform try-out of new tools	Modify design of existing tools or machine
INSTALLATION OF INSTRUMENTATION SYSTEM	Determine and give advice on instrumentation requirements	Purchase instrumentation equipments	Install instrumentation equipments	Maintain instrumentation equipment	Identify and rectify faults in instrumentation systems
	Liaise with customers inspectors				

LIAISE WITH DESIGN OFFICE	Advise design dept. in the preparation of layout of drawings	Assist in preparation of a general assembly drawing	Carry out specified modification to existing production drawings	Compile material and part list	
COMMISSIONING	Ensure safety of equipment in transport and shipping	Use test equipments on site	Investigate and resolve customer problems	Estimate length of time and number of staff required for installation	Train customers personnel
SOURCING OF EQUIPMENT	Find sources of instrumentation and control equipments	Evaluate usage of all existing equipments	Advise on new test equipments	Locate sources for proprietory items	Identify and negotiate with vendors
IMPLEMENT TEST STANDARDS FOR MANUFACTURE AND FOR VENDOR ITEMS	Specify Q.C.Stds. on sub-contracted work	Decide on tolerance with design dept. and vendor	Carry out test with pre-production sample	Assist in the preparation of maintenance manual	

INVESTIGATE PROCESS FAULTS	Trace Process faults	Rectify Process faults	Advice on machine breakdowns	Develop optimum method of operation for selected jigs and	tools

Table F.6

Functions: Design and supply of cable climbers and material handling equipment

Job title: Project Engineer

Dept: Engineering

Report to: Project Manager

DUTIES	TASKS				
CHECK QUOTATION FOR PRODUCT SALE	Receive contracts from Manager	Clarify details of customers enquiry	Verify equipment offered is appropriate to customers requirement	Check feasibilty of delivery dates with production and sub-contractors	Prepare all relevant engineering drawings and document for project
	Place orders on work and sub-contractors to commence work				
MODIFY STANDARD PRODUCTS TO MEET CUSTOMER REQUIRE-MENTS	Study details of customer require-ments	Obtain necessary technical data from customers	Produce sketches of system for Design office	Send final drawings to customers for approval	Prepare operating instructions for the system with Design dept.
	Investigate for new product develop-ment in market				
IMPLEMENT TEST STANDARDS FOR IN-HOUSE/CONTRACT WORK	Specify quality standards on sub-contracted work	Notify changes in technical data to sub-contractors	Carry out test on sub-contractors place before accepting delivery	Ensure quality of in-house items	Participate in trial run of entire system on customers' site
LIAISE WITH VARIOUS DEPARTMENTS	Attend contract meetings to clarify details of system	Attend to customers queries and complaints promptly	Arrange for customers to visit company	Explain operation of equipment to customers	Liaise with sales and service for spares and maintenance

COMMISSION PRODUCTS	Ensure safety during shipping and transportation	Organise team to install system on site	Make arrangements to rectify faults in system	Arrange for spares and other requirements	Train customers personnel on the use of system

Table F.7

Functions: Manufacture and supply Industrial and House-hold Air Conditioning Equipments

Job title: Sales Engineer

Dept: Sales

Report to: General Manager

DUTIES	TASKS				
SELL PRODUCTS	Keep up to date with new products and developments	Participate in sales meetings to promote application of existing products	Advise customers on suitable equipment to meet spcifications	Supply technical information relevant to sales	Obtain information on market trends
SERVICE PRODUCTS	Maintain after sales contact with customers	Keep contact with agencies, distributors of company products	Organise spare parts distribution and queries	Supervise installation work on site	Investigate field operating condition of equipments
	Give guidance and training to customer personnel				
ESTIMATING AND COSTING	Compile budget/ cost for projects	Arrange preparation of specifications, materials of items	Establish cost to meet customers specification and decide on selling price	Investigate the feasibility of sub-contracting work	Assist in the control of accounting aspects of contracts
PLANNING OF CONTRACTS	Secure requests for tenders	Submit tenders and quote delivery dates	Prepare contract letters	Investigate methods used in choosing particular equipments	Liaise between customers and engineering dept- on design and application problems
	Ensure delivery dates are kept in supply of equipment				

PURCHASING	Investigate supplier location and reliability	Remain aware of various suppliers range of products	Compare cost of each supplier for the products	Provide quality specifications on bought-out items	Establish stock level and control bought-out items
	Establish factory supply systems and records				

Table F.8

Function: Manufacture of firm Automobile Components eg., Mufflers, Exhaust

Job Title: Maintenance Foreman

Dept; Engineering

Report to: Plant Manager

DUTIES	TASKS				
INVESTIGATE FAULTS	Locate faults in machines and equipments	Analysis cause of faults	Provide systematic method of repair	Select correct maintenance tools	Identify damaged parts
	Use correct specifications for replaced parts				
SCHEDULE MAINTENANCE	Devise schedule for preventive maintenance	Estimate maintenance and overhaul cost of each breakdown	Prepare fault analysis check list for routine breakdown	Prepare time sheets for each work	Select efficient way of attending to breakdowns
	Keep maintenance records for reference				
COMMISSIONING AND INSTALLATION	Help in installation of new equipments and machines	Follow procedures as laid down by manufacturers for equipment	Conduct test and trial run on newly commissioned equipments	Ensure safe working conditions of equipments	Help in the calibration of equipments
	Assist in re-location of plant and equipment				
CONTROL INVENTORY OF SPARES AND TOOLS	Maintain stock of necessary spares	Maintain supply of lubricants and oil	Ensure proper usage of maintenance tools	Maintain safe storage of spares, tools and lubricants	Implement efficient delivery of spares

ORGANISE MAINTENANCE DEPARTMENT	Sub-contract urgent repair works	Ensure plant and equipment compliance with factory regulations	Give initial instruction on operation of machine to trainees	Report on recurring plant and equipment failure to management	Discuss with machine tool designers on Maintenance implications
	Assist in investi-gation of accidents involving plant and equipment				

Table F.9

Function: Manufacture of firm Automobile Components and Parts eg., Spring, Seats

Job Title: Industrial Engineer

Dept: Production

Report to: Operations Manager

DUTIES	TASKS				
LAYOUT OF PLANT	Evaluate existing floor area of factory	Determine type and size of machinery required	Layout machinery for flexibility	Balancing line for continous production	Assist in re-siting part of production line
PROCESS PLANNING	Determine production operation and sequence	Select machines or equipments	Investigate process problems	Develop safe and optimum method of operation sequence	Design jigs and tools and special equipments as per requirements
DESIGN AND PLANNING OF WORK	Check time alloted for particular operations	Study drawings and break operations down to elements	Determine standard time for operations from elemental time	Revise master planning sheet to show standard time	Allocate and distribute labour as per production requirements
	Design work layout in accordance with good ergonomic principles				
MANAGE MATERIAL HANDLING SYSTEM	Select material handling equipment relative to plant layout	Investigate use of hoists, conveyors, overhead cranes	Implement safe handling procedures and minimise movement of materials	Development of storage design for materials	Prepare maintenance schedule for material handling equipments

AUTOMATE PLANT	Ivestigate use of automated welding equipments and robots	Report on advantages of automated equip-ments to manage-ment	Provide safety standards for use of automated equipments	Implement the use of computers in data processing and analysis	
MANAGE INDUSTRIAL LABOUR RELATIONS	Use of factory rules and acts	Assist in solving union problems	Investigate bonus queries raised by operators	Use job evaluation for employees	Implement merit rating of employees

Table F. 10

Functions: of firm — Design and manufacture of industrial and house-hold electrical item eg., Lightings, motors

Job title: Production Engineer

Dept: Production

Report to: Engineering Manager

DUTIES	TASKS				
DESIGN OF TOOLS AND MACHINES	Sketch tool as per requirements	Prepare component and material specifications	Assist tool room personnel on interpreting drawings	Assist in tool/ machine try-outs	Investigate faults
SOURCE NEW EQUIPMENTS	Evaluate equipments available in the market	Identify suppliers with proper range of equipments	Compare equip-ments of various suppliers on cost/capacity/ reliability	Negotiate on price and technical specifications required	Fix delivery dates and spares for machines
CONTROL QUALITY	Implement test standards in production line	Ensure quality standards of bought out items	Organise quality circles	Monitor rejects and scrap in manufacture	Evaluate and keep records of test reports
INSTALL AND COMMISSION PRODUCTION PLANT	Install N.C. machines	Prepare and test production try-outs of N.C. machines	Diagnose faults in N.C.machines	Implement safe method of operation of N.C.machines	Help in the programming of N.C.machines

LIAISE WITH OTHER DEPARTMENTS	Liaise with design dept on new product development	Supply details on tolerance and capacity of machines	Liaise with maintenace on breakdown of machine	Co-ordinate with planning department on job allotment and sequencing	

Table F.11

Functions of firm: Supply of Compressors, Motors

Job title: Service Engineer

Dept: Service

Report to: Service Manager

DUTIES	TASKS				
INVESTIGATE DEFECTS AND CLAIMS	Investigate a variety of claims on company's product	Assist in the diagnostic tests of equipments	Use of electronic testing equip-ments for diagnostic test	Process warranty claims for faulty equipments	Prepare report on investigation of faults
	Provide feed-backs to various departments concerning faults				
TEST AND SERVICE PRODUCTS	Assist in installation of equipment on site	Organise test run on site	Analyse faults and damages	Perform service to re-instate equipment	Investigate different methods of repairing
SUPPLY AFTER SALES SERVICE	Contact and advise customers on breakdowns	Arrange for spares to rectify breakdowns	Prepare service manual for equipment	Prepare report on distribution of spares	
SUPPLY SERVICE TO RETAILERS	Assist retailers on company's system of operation	Diagnose faults and determine warranty action	Train retailer personnel on servicing	Assist in presentation in retailers showroom	Recommend optimum stock levels at retailers place

INFORM RETAILERS AND CUSTOMERS ABOUT PRODUCT	Organise courses for company's product range	Prepare cut-away models for presentation	Give practical demonstration to retailers fitters	Give advice on correct tools and handling while servicing	Answer queries relating to breakdown installation

Table F.12

Functions of firm: Manufacture of Electronic Devices

Job title: Quality Assurance Technician

Dept: Quality Control

Report to: Quality Control Manager

DUTIES	TASKS				
INSPECT RANDOM SAMPLES FROM PRODUCTION LINE	Implement specified procedures for sampling from line	Prepare check list for each item for inspection	Check items as per specifications	Use process control sampling plan to select items	Keep records of inspection
INSPECT RPOCESS EQUIPMENT FOR CORRECT OPERATION	Carry out daily inspection against specification sheet	Calibrate equipments as per standards	Conduct test run after repair and calibration	Ensure periodical maintenance of equipment	Check handling operations and cleanliness of machines
	Ensure safe working environment for machine				
INSPECT QUALITY OF PRODUCTION LINE ITEMS	Carry out audit check on process control point	Report result of audit check to supervisor	Issue rejection notice to unsatisfactory items	Record details of all inspection on line	
INITIATE ACTION FOR FAULTY EQUIPMENTS	Make decisions about seriousness of equipment faults	Plan action required for faulty equipments	Inform Production department on faulty equipments	Check inspection records of batch before breakdown	Analyse areas where rejects occur

ANALYSE RESULTS	Record data, values generated from inspection	Tabulate recorded results in proper form	Evaluate results to make comparative study	Review and devise new inspection methods	Prepare report on quality of products to management

Table F.13

Functions: of firm — Design and Manufacture Electronic Items

Job title: — Instrumentation Technician

Dept: — Engineering Laboratory

Report to: — Development Manager

DUTIES	TASKS				
GIVE ADVICE ON INSTRUMENTATION REQUIREMENTS	Receive enquiry from development engineer	Discuss problems and determine instrumentation requirement	Install on plant equipments which exists	Liaise with suppliers for new equipments	
PURCHASE INSTRUMENTATION EQUIPMENT	Receive requests from Engineering Department	Specify equipment to meet requirements	Complete order forms and pass to purchase department	Receive equipment and carry out functional checks	Inform suppliers on faulty equipments
INSTALL INSTRUMENTATION EQUIPMENT	Organise installation schedule	Understand details of suppliers installation items	Pass details of large jobs to design dept. for panel drawings	Receive panels from suppliers	Check system for efficient working
	Participate in trial runs				
MAINTAIN INSTRUMENTATION EQUIPMENT	Receive requests on instrument malfunction	Examine equipment to analyse faults	Remove faulty equipments to workshop	Return faulty equipments to suppliers or call service	Re-install repaired equipment
	Organise maintenance schedule for equipment				

ADVISE MANAGEMENT ON THE USE OF PRODUCTION INSTRUMENTATION	Advise management on the use of instrumentation	Review literature and suggest instrument application	Write reports on suggested instrument application	Keep track of latest instrumentation in market	

Table F.14

Functions of firm: Design and Manufacture of Sheet Metal Items

Job Title: Planning Technician

Dept: Production Planning and Control

Report to: Production Manager

DUTIES	TASKS				
DETERMINE DELIVERY DATES	Receive request from sales engineer for a delivery date for customers	Analyse system and determine work content in component parts	Estimate time required by bought-out items	Check availability of irregular stock items	Study production control schedule to determine start of work
	Communicate delivery dates to sales department				
SCHEDULE JOBS ONTO COMPUTER	Receive details of order from various departments	Receive unit planning schedule from management	Complete planning sheets giving details of time required for design	Enter planning schedule onto computer terminals	
ASSESS IMPLICATIONS FOR PRODUCTION SCHEDULE	Check feasibility of material list from materials department	Modify production schedule if necessary	Amend entries to computer	Submit materials list to various departments	
SCHEDULE FOR BOUGHT-OUT MATERIALS	Receive bought-out material requisition form if date changes	Make amendments to material requisition form if date changes	Pass material requsition form to buyer	Revise production schedule if item cannot be obtained	

PREPARE REPORTS FOR MANAGEMENT	Prepare contracts completion sheet	Compile overdue export list	List outstanding miscellaneous job	Write reports on complete production plan for month	

Table F.15

Functions: Assembly of cars, and Light Commercial Vehicles of firm

Job Title: Production Engineer

Dept: Production

Report to: Production Manager

DUTIES	TASKS				
MANUFACTURE AND DESIGN TOOL	Determine tooling requirement as per component part	Prepare tooling drawing sketches	Prepare tooling schedule and method of manufacture	Make alterations to existing tooling arrangements	Use of tool records and charted tool drawings
	Estimate cost and material for tooling	Supervise and progress check for tool			
PROCESS PLANNING	Sequence assembly drawings	Calculate time allotment for assembly operations	Translate planning sheets and assembly drawings to shop orders	Carry out rate calculation per component	Verify capacity and capability of machine tools
	Develop optimum method of operations for machines	Plan for process faults			
PRODUCTION PLANNING	Advise purchase department on bought-out items	Organise parts inventory and supply from local vendors and imports	Allocate part numbers for drawings and sub-assemblies	Develop procedures for stocking	Organise supply of parts to assembly lines
	Maintain production targets on number of vehicles required				
SUPERVISE PRESS SHOP	Select machine tools used in stamping	Determine operations in press shop	Determine labour requirements	Administer safety precautions in press shop	

SUPERVISE ASSEMBLY AND PAINT SHOP	Supervise work force in assembly and paint shop	Follow progress of assembly operations in shops	Determine trimming and fnishing standards on car bodies	Balance production line for continous production	Establish safety standards on handling machines and hazardous chemicals
CONTROL QUALITY	Establish control over reject rates and scrap	Organise Q.C. circles	Inform vendors of company's quality standards	Develop methods to reduce scraps and rejects	

A P P E N D I X G

Presented in this Appendix are Tables of task analysis which have been prepared to identify the skills and knowledge required by technician-engineers in doing the various tasks that have been compiled in the Dacum charts. It also links the knowledge and skills to topics in the subjects for NZCE syllabi from which they may be obtained. The task analysis is shown for the first three occupational roles in Appendix F and the syllabi for the NZCE mechanical and production courses are also shown here.

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : (1) PRODUCTION PLANNING
Tasks : (A) ADVISE SUITABILITY OF PRODUCT DESIGN FOR PRODUCTION
(B) CO-ORDINATE IN DESIGN CHANGES
In performing these task the PRODUCTION ENGINEER will need to

TABLE G.1

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
A	1. Check drawing for completeness	Understand of all drawing details		*Freehand Sketching	Mechanical Drawing (3116)
	2. Produce detail drawings, if job is complex	Good draughting skills	Clarity & neatness	*Assembly Drawing	
	3. Complete sub-assembly, material list & information	Fill in all technical details, symbols, dimensioning etc.		*Dimensioning	
B	1. Change tolerance to suit production	IS tolerance standards		*Limits & fits	Mechanical Drawing (3116)
	2. Change design to suit existing M/C & fixture	Capacity & capability of all machines in factory		*Production Tooling	Production Planning & Tooling (5280)
	3. Change design to suit safety in manufacture		Safety concern	*Production Planning	

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : PRODUCTION PLANNING
Tasks : (C) DETERMINE OPTIMUM METHOD OF PRODUCTION OPERATION
(D) DETERMINE PRODUCTION OPERATION & SEQUENCE
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Idea of existing machine availability			*Process Selection	
C	2. Idea of age, capacity of each machine			*Process Selection	Manufacturing Technology (4144)
	3. Idea of accuracy involved in each machine	Quality of products that is manufactured		*Process Selection	
	1. Select the appropriate M/C	Operation of all machines in factory		*Production Process & Layout	Production Planning & Tooling (5208)
D	2. Balance the line for production	No. of products on line at one time		*Production Control Scheduling	
	3. Fix operation time for each machine	Sequencing of machines			

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : PRODUCTION PLANNING
Tasks : (E) INVESTIGATE PERCENTAGE SCRAP PRODUCED
(F) ANALYSE & RECORD WORK
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Investigate quality of items produced	Evaluate quality standards & do audit checks		*Quality audit	Quality Assurance & Engineering Measurement (5209)
E	2. Investigate for smooth operation			*Production Process & Layout	Production Planning & Tooling (5208)
	3. Check for % scrap	Using alternative machine or method			
	1. Check load schedule chart			*Production Planning	Production Planning & Tooling (5208)
	2. Check process chart	Ways of calculating UCL & LCL, mean		*Production Control	
F	3. Check routine production & rejection records			*Production Processes	

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : (2) DEVELOPMENT OF WORK STANDARDS
Tasks : (A) ASSIST IN CHARTING OPERATIONS
(B) ASSIST IN CALCULATING OPERATION TIME
In performing these task the PRODUCTlON ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
A	1. Explain to work study engineer the sequence of operation			*Production Control (Production Scheduling)	Production Planning & Tooling (5208)
	2. Write operation cycle sheet for a project	All machining operations involved		*Production Process	
	3. Write operation instructions for each machine	Proper usage of all M/C's	Safety Concern		
B	1. Receive request from chargehand to check time allocation for a particular job				
	2. See quantity of job involved	Know if job is one-off or produced in batch		*Method Study	Industrial Productivity (5191)
	3. Check operation to see the human capacity & comfort	Efficient way evaluating human productivity		*Work Measurement	

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : DEVELOPMENT OF WORK STANDARDS
Tasks : (C) ASSIST IN JOB RATE CALCULATION
(D) IMPLEMENT NEW & ALTERED WORK STANDARDS
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Determine quantity of each product required			*Production Control	Production Planning & Tooling (5208)
C	2. Determine target quantity at set date	Synchronize production with sales target		*Work measurement	Industrial Productivity (5191)
	3. Rate operators for efficiency	Factors affecting skill, speed & accuracy		*Management Services	
	4. Help in average bonus calculations				
	1. Investigate bottle necks at line	Reasons causing the faults		*Management Controls	Industrial Productivity (5191)
D	2. Relocate arrangements			*Methods Study	
	3. Implement new techniques				

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : (3) DESIGN & MANUFACTURING OF MACHINES & TOOLS
Tasks : (A) MAKE ALTERATIONS TO DRAWINGS & SKETCHES
(B) ADVISE TOOL ROOM PERSONNEL ON MANUFACTURE
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Make rough sketches of ideas			*Freehand sketches	Mechanical Drawing (3116)
	2. Assist tool draughtsman in preparation of layout drawings	Good interpretation of drawings		*Assembly Drawings	
A	3. Produce alternative design for a selected component by different method of manufacture	Knowledge of various manufacturing methods		*Production Tooling	Production Planning & Tooling (5208)
	4. Prepare assembly, drawings, detail drawings	Various components in the assembly			
	5. Prepare part list, material, specifications etc.			*Product Planning(Detail Drawing Bill of materials parts list)	Production Planning & Tooling (5208)
	1. Assisting in explanation of drawings	Functioning of each part		*Drawing Interpretation	Mechanical Drawing (3116)
B	2. Assist in choosing control circuitary	Various operation of pneumatic, hydraulic systems		*Production Machines	Production Machines (5210)
	3. Assist in employing design specification	Design & operation criteria for various electrical appliances	Safety	*Design & Selection	
				*Design	Engineering Design (5201)

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : DESIGN & MANUFACTURE OF MACHINES & TOOLS
Tasks : (C) ASSIST IN MANUFACTURE OF TOOLS/DIES
(D) HELP IN COMMISSIONING OF TOOLS & M/C'S
(E) PERFORM TRY-OUTS OF NEW TOOLS
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
C	1. Investigate different methods of manufacture	All manufacturing methods		*Primary & Contributory Process	Manufacturing Technology (4144)
	2. Suggest alternative machining	Different forms of machining		*Forming machines	Production Machines (5210)
D	1. Prepare foundation for machine	Employing different mixes & materials used			
	2. Help in installing M/C	Follow instruction manuals & use basic tools			
E	1. Check for smooth working condition of machine	Locate noise, vibration over-heating etc.	Safety concern of environment		
	2. Check quantity of pre-production samples	Inspection methods		*Process Capability & Control	Quality Assurance & Engineering Measurement (5209)
	3. Check for accuracy & settings	Calibration of machines & instruments		*Accuracy & Reliability	Production Machines (5210)

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : DESIGN & MANUFACTURE OF MACHINES & TOOLS
Tasks : (F) PLAN & PROGRESS MANUFACTURE OF FIXTURE/TOOLS
(G) RE-DESIGN STANDARD MACHINE TOOL
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
F	1. Charts out target dates for the completion of each section	Approximate time required for completion of each section		*Production Tooling	Production Planning & Tooling (5208)
	2. See that all required supplies are present	Keep regular supplies from vendors			
	3. Keep routine check on progress			*Processing Planning	
G	1. Try to provide better handling in production	Implement own ideas & incorporate them in machine	Good awareness of all machines	*Production Process & Layout	Production Planning & Tooling (5208)
	2. Re-model machine for other use	Knowledge of all working combination of machines		*Production Tooling	
	3. Salvage parts from machines that can be used elsewhere	Working, use, capability on each individual part, eg. motor, hydraulic arm, etc.		*Production Machines	Production Machines (5210)

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : (4) INVENTORY CONTROL
Tasks : (A) SET TARGETS WITH SALES ON DELIVERY DATES
(B) SUPPLY & MAINTAIN STOCK OF IN-HOUSE MANUFACTURING PARTS
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Receive details of orders from sales department			*Product Planning	Production Planning & Tooling (5208)
A	2. Communicate existing capacity, labour & M/C breakdown	General shop-floor management		*Methods Study (Supervision, control of meeting)	Industrial Productivity (5191)
	3. Pass written or verbal estimates of delivery dates to sales team		Communication skill		
B	1. Check for each component on the line to be made	Full information on the availability of stock & the consumption of each		*Production Control	Production Planning & Tooling'(5208)
	2. Check for quantity of sub-assemblys made	Full information on the availability of stock & the consumption of each		*Production Process	
	3. Check with existing stock for spare parts	Full information on the availability of stock & the consumption of each		*Casting & Stock Control	Manufacturing Technology (4144)
	4. Check for the production of optimum batch size	Calculation of quantity to be approved		*Process Selection	

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : INVENTORY CONTROL
Tasks : (C) SUPPLY & MAINTAIN STOCK OF BOUGHT OUT ITEMS
(D) CONTROL PRODUCTION TO ATTAIN DAILY TARGETS
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
C	1. Send bought-out material requisition to purchase			*Costing & Stock Control	Manufacturing Technology (4144)
	2. Determine date by which item is required	Basic inventory control calculations		*Costing & Stock Control	
	3. Check level of bought-out items	Basic inventory control calculations		*Costing & Stock Control	
	4. Check for E O Q for bought-out items	Basic inventory control calculations		*Costing & Stock Control	
D	1. Co-ordination of assembly of LBOF & in-house items	Good planning & monitoring		*Costing & Stock Control	Manufacturing Technology (4144)
	2. Revise production schedule if items cannot be obtained	Re-allocating manpower & machines		*Production Control	Production Planning & Tooling (5208)
	3. Make alternative arrangement for procrument of manufactured parts or manufacture				

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : (5) IMPLEMENT TEST STANDARDS FOR MANUFACTURE & PROTOTPE
Tasks : (A) SPECIFY Q C STANDARDS ON MANUFACTURED ITEMS
(B) DECIDE TOLERANCE WITH DESIGN DEPARTMENT

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Assist in suggestion of equipments to be used for checking	Various types of measuring instruments eg. digital vernier, height gauge etc.		*Metrology	Manufacturing Technology (4144)
A	2. Check the inspection procedure of staff	Various gauging practice & measuring techniques		*Control of Quality	Quality Assurance & Engineering Measurement (5209)
	3. Locate faulty batches through Q C report	Evaluating reports		*Causes & distribution of defects	
	1. Advise tolerance that can be achieved from existing machines	All machining facilities & their accuracy		*Establishing Quality Standards	Quality Assurance & Engineering Measurement (5209)
B	2. Advise design on advantages of production by changing tolerances	Quantity & cost calculations involved in these changes		*Specifications & Acceptance testing	Production Machines'(5210)
	3. Advise design on the changes that are needed to be made on the drawings	Procedure for engineering change notices		*Product Planning	Production Planning & Tooling'(5208)
				*Assembly Drawings	Mechanical Drawing (3116)

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : IMPLEMENT TEST STANDARDS FOR MANUFACTURE & PROTOTYE
Tasks : (C) ADVISE VENDORS ON FIRMS Q C STANDARDS
(D) CARRY OUT TESTS WITH PRE-PRODUCTION SAMPLES
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
C	1. Explain to vendors Q C standards on different items			*Establishing Quality Standards	Quality Assurance & Engineering Measurement (5209)
	2. Explain the minimum allowable limits to avoid rejection	Explanation of the tolerance structure		*Relations with vendors & customers	
	3. Check if vendor is confirming to all checks & test laid down by company	Various testing procedures		*Quality Audit *Reliability Estimation	
D	1. Locate faults in pre-production samples			*Process capability & control	Quality Assurance & Engineering Measurement (5209)
	2. Find causes for the faults	Analyse if its machining, material or human error		*Causes & distribution of defects	
	3. Give orders for commencement of regular production if samples are found satisfactory			*Organising for Quality	Quality Assurance & Engineering Measurement (5209)
	4. Implement changes to achieve more economic manufacture	Various manufacturing procedures		*Control of Quality	

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : (6) INVESTIGATE PROCESS FAULTS
Tasks : (A) TRACE PROCESS FAULTS
(B) RECTIFY PROCESS FAULTS
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Locate faults occuring from machine	All machining operation		*Management Control (Objectives of Quality Control)	Production Planning & Tooling (5208)
A	2. Locate faults occuring from material	All incoming material & their shelf life	Careful observation of incoming materials		
	3. Locate faults occuring from workmanship	Proper feeding, handling & holding methods		*Causes & distribution of defects	Quality Assurance & Engineering Measurement (5209)
	4. Check to see if machines are calibrated correctly	Cablibration for zero settings		*Measuring Instruments & equipment	
	1. Investigate solutions for process faults			*Establish Quality Standards	
B	2. Inform concerning dept involved from where faults are originating	Send precise & detailed reports			Quality Assurance & Engineering Measurement (5209)
	3. Stop further production				
	4. Check components after rectifying problems	Normal inspection procedures		*Control of Quality	

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : INVESTIGATE PROCESS FAULTS
Tasks : (C) ADVISE ON MACHINE BREAKDOWNS
(D) DEVELOP OPTIMUM METHOD OF OPERATION FOR SELECTED JIGS & TOOLS
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
C	1. Attend to breakdown calls	Alternative arrangements for production			
	2. Assist in maintenance	General Maintenance of all machines			
	3. Schedule for maintenance	Different maintenance system like preventive, breakdown maintenance			
D	1. Change methods of fixing jobs	Methods involving better accuracy & speed in production		*Production Tooling	Production Planning & Tooling'(5208)
	2. Change methods of material handling	Various material handling systems		*Production Process & Layouts	
	3. Change setting for tools to obtain better results				

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : (7) LAYOUT OF PLANT
Tasks : (A) EVALUATE EXISTING FLOOR AREA IN FACTORY
(B) DETERMINE SIZE & TYPE OF MACHINERY
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
A	1. Check all available area in factory			*Production Project & Layout	Production Planning & Tooling'(5208)
	2. Check for proper floor utilization by M/C			*Method Study (Work place layout & plant layout)	Industrial Productivity (5191)
	3. Check possibility for overhead material storage	Different types of racks & storage facility, warehousing			
	4. Check for proper floor preparation	Use of dash pots, dampers etc.			
B	1. Select M/C to best fit & utilize space	Various machines available in market		*Production Planning	Production Planning & Tooling'(5208)
	2. Check if overhead conveyor & others can be used	Different type of material handling system		*Production Process & Layouts	
	3. Check for flexibility for increased production	Space availability for storage & handling			
	4. Arrange M/C for different flow pattern	Various flow patterns of lines eg. L-shaped, U-shaped			

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : LAYOUT OF PLANT
Tasks : (C) LAYOUT MACHINERY FOR FLEXIBILITY
(D) BALANCING FOR CONTINUOUS PRODUCTION
(E) ASSIST IN RE-SITING PART OF PRODUCTION LINE
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Flexibility for product & model change	Layout systems for process. product		*Production Process & Layout	Production Planning & Tooling (5208)
C	2. Safe working environment	Accident prevention	Safety concern	*Ergonomic of Machine Guarding	Production Machines (5210)
	3. Layout for better human comfort	Exhaust fans, installation, good ventilation, dust prevention		*Work Study Techniques	Industrial Productivity (5191)
	1. Smooth & continuous flow	Identify bottlenecks in production line		*Method Study (Work Place Layout)	Industrial Productivity (5191)
	2. Check for minimum movement for workers	General plant & human safety & comfort		*Production Process & Layouts	Production Planning & Tooling (5208)
D	3. Check for minimum movement for materials	General plant & human safety & comfort		*Production Process & Layouts	
	4. Integration of production between sub-assembly & main assembly	Proper planning & distribution of work			
	1. Check for site for further expansion	Locate new areas & adjust existing sites		*Production Layouts	Production Planning & Tooling (5208)
E	2. Assist in dismantling M/C				
	3. Assist in erecting M/C	Various commissioning methods as specified by suppliers of machinery			

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : (8) SOURCE NEW EQUIPMENT
Tasks : (A) EVALUATE USAGE OF ALL EXISTING M/C
(B) CHECK IF EQUIPMENTS CAN BE MADE IN TOOL ROOM
(C) ADVICE ON LATEST PRODUCTION M/C'S
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
A	1. Check accuracy of machine	Capacity & capability of machines in factory		*Design & Selection	Production Machines (5210)
	2. Check capacity of machine	Capacity & capability of machines in factory		*Process Selection	Manufacturing Technology (4174)
	3. Check maintenance cost of machine	Capacity & capability of machines in factory			
	4. Calculate depreciation cost & use expectancy	Capacity & capability of machines in factory			
B	1. Check facilities available	Various machines present in tool room		*Production Process & Layout	Production Planning & Tooling(5208)
	2. Check the work load				
	3. Check cost-effectiveness of manufacture in-house	Cost evaluation of fabricating M/C in-house & giving to contractors			
C	1. Check M/C used in similar factories			*Process Selection	Manufacturing Technology (4174)
	2. Specify equipments which will boost production	Idea of latest equipments	Reading journals		
	3. Plan for larger production volume in future			*Production Planning & Control	Production Planning & Tooling(5208)
	4. See trial runs on new M/C's at manufacturers sites	Evaluation of the performance of M/C			

TASK ANALYSIS

Job Title: PRODUCTION ENGINEER
Duty : SOURCE NEW EQUIPMENT
Tasks : (D) ADVISE ON NEW TEST EQUIPMENTS
(E) LOCATE SOURCES FOR EQUIPMENTS
In performing these task the PRODUCTION ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
D	1. Advise on equipments with good accuracy	Cost, accuracy, availability of new equipments	Accuracy in measurement	*Design & Selection	Production Machines (5210)
	2. Advise on equipments with good speed in inspection	Cost, accuracy, availability of new equipments			
E	1. Check various vendors connected with parti cular machines	Review technical details of all M/C by various vendors		*Relations with vendors & customers	Quality Assurance & Engineering Measurement (5209)
	2. Ask for quotation on prices	Make comparative study on prices		*Costing & Stock Control	Manufacturing Technology (4144)
	3. Write reports on suggested application & use to management				
	4. Visit trade shows & vendors				

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : (I) INSPECT PROTOTYPE
Tasks : (A) RECEIVE PROTOTYPE FROM DESIGN/SALES DEPARTMENT
(B) CARRY OUT VISUAL INSPECTION ON ITEMS
In performing these task the TEST ENGINEER will need to

TABLE G.2

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
A	1. Check & see condition of packing on receipt	Identify damaged & crushed packages	Alertness for inspecting		
	2. Enter name & date of item received	Correct & systematic entry into log books	Careful entry of data		
	3. Check if previous such samples were inspected	Locate records of these samples			
	4. Allocate storage for various samples	Ensure safe storage conditions for the items			
B	1. Inspect for surface finish	Standards for smooth finishes	Careful inspection		
	2. Check for moulding defects	Locate blow holes, burrs etc.	Careful inspection	*Engineering measurements	Quality Assurance & Engineering Measurement (5029)
	3. Check for hardness	Use of Brinell & Rockwell hardness testers	Careful handling of inspection tools		
		Brinell & Rockwell hardness standards	Proper recording of measurements, readings	*Primary & Contributory Process	Manufacturing Technology (4144)

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : INSPECT PROTOTYPE
Tasks : (C) DISASSEMBLE PARTS INDIVIDUALLY
(D) CHECK RATINGS FOR VOLTAGE, CURRENT, POWER
In performing these task the TEST ENGINEER will need to :

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
C	1. Disassemble in proper sequence	Read & understand assembly drawings		*Assembly Drawings	Mechanical Drawing (3116)
	2. Use proper & correct tools	Recognise each part & its location in assembly			
	3. Use proper & correct tools	Different types of service tools eg. power & hand tools	Avoid damaging parts while disassembling		
	4. Check for discrepancies in assembly	Firm & proper connection sequence in assembly			
D	1. Check for rated voltage	Use of multimeters & other measuring instruments & the evaluation of results	Proper recording of values & identification of faults	*Electricity	Engineering Science (3117)
	2. Check for rated current	Use of multimeters & other measuring instruments & the evaluation of results	Proper recording of values & identification of faults		
	3. Check for rated power	Use of multimeters & other measuring instruments & the evaluation of results	Proper recording of values & identification of faults		
	4. Check for capacitors, resistors ratings	Use of multimeters & other measuring instruments & the evaluation of results	Proper recording of values & identification of faults		

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty: INSPECT PROTOTYPE
Task: (E) CHECK EACH INDIVIDUAL COMPONENT FOR RELIABILITY
(F) CHECK ALL WIRING & MOUNTING CONNECTIONS
In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
E	1. Check each part for proper working & functioning	Working & operation condition of each individual item			
	2. Check parts as per drawings	Read assembly drawings	Correlate dimensions with drawings	*Assembly drawings	Mechanical Drawing (3116)
	3. Check each part for proper assembly	Identify if other parts are used instead of those specified			
	4. Check printed circuit board	Basic knowledge of electronics			
F	1. Check insulation of all wires	Use of insulation testers	Check neatness of work		
	2. Check for proper soldering		Check neatness of work		
	3. Check for proper mountings		Check neatness of work		
	4. Check for continuity of wires	Use for multimeters	Check neatness of work		

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : (2) INSPECT PRODUCTION LINE & BOUGHT OUT ITEMS
Tasks : (A) RECEIVE SAMPLES FROM PRODUCTION LINE
(B) RECEIVE SAMPLES FROM LOCAL/FOREIGN VENDORS
In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
A	1. Check if samples arrive with proper tags	Identify the production batch			
	2. Allocate storage area for samples				
	3. Perform visual inspection	Locate external defects	Sharpness in identifying faults		
	4. Inspect as per drawing specifications	Read assembly drawings		*Assembly Drawings	Mechanical Drawing (3116)
B	1. Check if samples come with proper identification			*Establish Quality Standards	Quality Assurance and Engineering Measurement (5209)
	2. Differentiate samples from various vendors		Memory of different items associated with various faults	*Relation with vendors & customers	
	3. Re-test units at the request of vendors	Locate faults in the presence of vendors		*Inspector Errors	
	4. Provide test certificate for parts				

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : INSPECT PRODUCTION LINE & BOUGHT OUT ITEMS
Tasks : (C) TEST ITEMS AS PER SAMPLING PLANS
(D) CHECK ITEMS AS PER TEST SPECIFICATION
In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Use process control sampling plan to select items from line	Interpret process control charts		*Process capability & control	Quality Assurance & Engineering Measurement (5116)
	2. Schedule for test of items	Assess the work load present			
C	3. Select sampling methods	The various sampling methods available	Careful data entry	*Acceptance sampling	
	4. Tabulate results				
	5. Issue warning or rejection notices	Proper form of submitting reports with details	Communication skills		
	1. Use proper test conditions & environment	Know various conditions & parameters at which test is to be conducted		*Reliability Estimation	Quality Assurance & Engineering Measurement (5116)
	2. Use proper instruments & tools	Working & operational functions of testing instruments	Proper handling & usage		
D	3. Compare results obtained with specifications	Evaluate the results	Draw conclusions		
	4. Check all dimensional specifications	Identify faults when comparing with drawings		*Distribution of deflects	

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : (3) CONDUCT RELIABILITY TEST
Tasks : (A) ASSIST DESIGN OF TEST RIGS & FIXTURES
(B) SET UP TEST RIGS & FIXTURES
(C) TEST UNDER ACTUAL WORKING CONDITIONS

In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Identify the test needed	Methods of testing			
A	2. Make rough sketches of jigs of fixtures	Making free hand drawings	Neatness and clarity	*Freehand sketching	Mechanical Drawing (3116)
	3. Assistance in tool room	Explanation of detailed drawings	Convey ideas correctly	*Production Tooling	Production Planning & Tooling (5208)
	1. Assist in assembly	Basic fitting procedures			
B	2. Modify rigs to suit testings			*Production Tooling	Production Planning & Tooling (5208)
	3. Conduct trial run	Evaluate correct working			
	1. Specify conditions for normal usage	Correct handling, hours of usage, probable ways of damage		*Reliability Estimation	Quality Assurance & Engineering Measurement (5209)
C	2. Simulate actual conditions	Build & run test rigs as per specified conditions			

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : CONDUCT RELIABILITY TEST
Task : (D) TEST UNDER INTENSIVE CONDITIONS
(E) TEST UNDER ACCELERATED CONDITIONS
(F) RECOMMEND EQUIPMENT REQUIREMENT
In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
D	1. Overload conditions	Intensify voltage, frequency ratings	Safety procedures	*Errors	Quality Assurance & Engineering Measurement (5209)
	2. Analyse when failure occurs	Identify the parts which has failed		*Reliability Estimation	
	3. Identify weak spots & parts				
E	1. Run rigs & test continuously	Operating conditions of rigs	Safety procedures	*Reliability Estimation	Quality Assurance & Engineering Measurement (5209)
	2. Monitor all performance	Schedule routine checks			
	3. Record all details	Specify details of failure			
F	1. Availability of existing test equipments				
	2. Availability of latest equipments	Flexibility & accuracy of latest machines			
	3. Locate vendors	Different equipments supplied by various vendors			

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : (4) PREPARE TEST DATA & REPORTS
Task : (A) SCHEDULE TEST FOR PROTOTYPE
(B) PREPARE TEST PROCEDURES FOR PROTOTYPE
(C) PREPARE TEST SPEC. FOR INDIVIDUAL COMPONENT.
In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Enter date of test in log books	Proper entry in log books			
A	2. Chart test programme date	Availability of work load & test rigs			
	3. Set target for completion		Responsibility		
	4. Check availability of materials required for test	Procrument of materials Property of materials		*Plastics	Materials (4145)
	1. Identify test rigs to be used	Operating conditions of all test rigs			
B	2. Write sequence of testing				
	3. Specify conditions	Parameters like temperature, pressure, voltage etc. to be used		*Heat & Electricity	Engineering Science(3117)
	1. Separate items by various vendors		Clarity & neatness in tabulating data		
	2. Write all technical details	Read drawings & understand function of each component		*Conventional Presentation Detailed Drawings	Mechanical Drawing (3116)
C	3. Write all dimensions				
	4. Write parameters to be observed				
	5. Specify measuring instruments to be used	Usage of all measuring instruments			

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : PREPARE TEST DATA & REPORTS
Tasks : (D) WRITE REPORTS OF TESTS
(E) REPORT FAULTS TO MANAGER
In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Make detail observations of results	Obtain correct readings from all instruments			
D	2. Make general layout of reports	Report writing procedures		*Control of Quality	Quality Assurance & Engineering Measurement (5209)
	3. Write precise reports	Ensure coverage of all details	Good writing skills		
	1. Look for anamolities in results	Differentiate between normal & obtained values			
	2. Check for safe functioning of jigs &	Proper working of instruments			
E	fixtures				
	3. Able to stop tests immediately	Identify dangerous operating conditions	Safety concerns		
	4. Report faults to suppliers on their faulty equipments		Communication skills	*Relations with vendors & customers	Quality Assurance & Engineering Measurement (5209)

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : (5) ANALYSE RESULTS & ASSIST IN FAULT FINDINGS
Tasks : (A) RECORD GENERATED DATA FROM TESTS
(B) TABULATE RESULTS FROM TESTS IN PROPER FORM
(C) EVALUATE RESULTS TO MAKE COMPARATIVE STUDY
In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks
A	1. Make visual & preliminary observations	Parameters to be observed	Careful Observations	
	2. Check if specified conditions are attained			
B	1. Observe & record values carefully	Proper usage of instruments		
	2. Use appropriate forms	Availability of various formats		
	3. Make calculations & conversations	Basic mathematics & units usage	Avoid errors in calculations	Mathematics
C	1. Make up results for statistics	Calculation of averages, mean	Accuracy	Mathematics
	2. Check previous test records	Comparison of previous & present results		
	3. Draw graphs	Different forms and methods of drawing graphs	Accuracy & neatness	Mathematics

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : ANALYSE RESULTS & ASSIST IN FAULT FINDINGS
Tasks : (D) REVIEW & DEVISE TEST TO FIND SPECIFIC FAULTS
(E) CHECK & CALIBRATE EQUIPMENTS
In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Re-design test to observe failure more closely	Changing & employing new test rigs			
D	2. Revise testing methods	Re-write operation sequence			
	3. Revise testing parameters	Re-set conditions like voltage, current etc.			
	1. Check zero setting of instruments before test			*Metrology	Manufacturing Technology (4144)
E	2. Schedule calibration for instruments	Frequency of calibration needed before which error can occur		*Metrology	
	3. Calibrate instruments with masters	Using master gauges & perform trial on a component after calibration	Accuracy in calibration	*Metrology	

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : (6) LIAISON WITH OTHER DEPARTMENTS
Tasks : (A) COMMUNICATE RESULTS TO PRODUCTION DEPARTMENT
(B) GIVE SUGGESTIONS TO DESIGN DEPARTMENT
(C) COMMUNICATE WITH VENDORS ON FAULTS
In performing these task the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Chart results systematically				
A	2. Detail all results & give comments	Highlight causes of specific problems		*Primary Contributory Processes	Manufacturing Technology (4144)
	3. Give suggestions	Ways of improving quality in production		*Process Selection	
	1. Suggest on tolerance & fits	Is standards for holes, shafts, threads		*Limits & fits	Mechanical Drawing (3116)
B	2. Suggest safety standards for appliances	Electrical & mechanical standards for use in appliances in different countries			
	3. Communicate problems due to design	Failure due to short circuiting, dust collection etc.			
	1. Analyse results of vendors component statistically	Usage of statistical methods in calculation	Accuracy in calculation	*Quality Audit Establishing Quality Standards	Quality Assurance & Engineering Measurement (5209)
C	2. Check components against standards	Highlight failures & problems		*Relation with Vendors & customers	
	3. Give suggestions to vendors	Ways of improving quality in production		*Control of Quality	
	4. Conduct vendor surveys	Assessing vendors on their various facilities			

TASK ANALYSIS

Job Title: TEST ENGINEER
Duty : LIAISON WITH OTHER DEPARTMENTS
Tasks : (D) CONDUCT TESTS AS REQUESTED BY OTHER DEPARTMENTS
(E) LIAISE WITH EXTERNAL RESEARCH LABORATORY
In performing these tasks, the TEST ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Perform special tests as requested by design department	Understand the idea of design			
D	2. Conduct test on samples with new tools & settings	Identify the problems & defective areas	Sharpness in identifying faults		
	3. Conduct test on competitors' products	Evaluation of quality & performance standards on competitors' products	Awareness of all products in the market	*Organising for quality	Quality Assurance & Engineering Measurement (5209)
	1. Clarify details with research organisation	Chart up problems and queries relating to product			
E	2. Conduct test at DSIR	List unavailable tests in house which are to be performed elsewhere			

TASK ANALYSIS

Job Title: DESIGN ENGINEER

TABLE G.3

Duty : (1) PRODUCT DESIGN

Tasks : (A) RECEIVE SUGGESTIONS ON PRODUCT REQUIRED
(B) EVALUATE ALL EXISTING PRODUCTS IN MARKET
(C) EVALUATE REQUIREMENTS TO SATISFY CUSTOMERS

In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Receive suggestions from sales		Develop self awareness of product		
A	2. Receive ideas from director of engineering			*Machine Tools *Cutting Tools *Process Selection	Manufacturing Technology (4144)
	3. Understand existing facility	All machines & manufacturing method			
	1. Check existing products of market	Up-to-date reading of all media reltaing to products & their performance	Awareness of all products		
B	2. Check product of overseas companies	Up-to-date reading of all media reltaing to products & their performance			
	3. Check competitors products	Up-to-date reading of all media reltaing to products & their performance			
	1. Check customer's choice	Recognise present trend in market			
	2. Evaluation on cost structure	Basic electronics & PCB layout & circuit diagram design		*Costing & Stock Control	Manufacturing Technology (4144)
	3. Evaluation on servicability				
	4. Evaluation of reliability				
C	5. Ergonomic features	Satisfy customers on usage		*Reliability Estimation	Quality Assurance & Engineering Measurement (5209)
	6. Ideas according to standards	Should pertain to all electrical appliance standards on safety			

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : PRODUCT DESIGN
Tasks : (D) DEVELOP ROUGH SKETCHES OF NEW IDEA
(E) USE CAD/CAM FOR EXTENSIVE REFINEMENT
(F) PREPARE PRELIMINARY DRAWINGS
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
D	1. Sketch new ideas from existing products	Skill in making rough sketches & borrowing ideas circuit	Neatness & clarity in drawings	*Freehand sketching	Mechanical Drawing (3116)
	2. Sketch new ideas from competitors products	Diagram design, relays & spring pressure calculation	Neatness & clarity in drawings	*Freehand sketching	
	3. Apply own ideas	Diagram design, relays & spring pressure calculation	Neatness & clarity in drawings	*Freehand sketching	
	4. Keep & maintain notes on ideas	Combining all ideas	Systematic recordings		
E	1. Use of computer	All keyboard operations			
	2. Use various packages	All packages available pertaining to design			
	3. Add new details	Apply ideas at different orientation from looking at screen & modify sketches	Perspective idea & imagination		
F	1. Consolidate all ideas from book			*Freehand sketching	Mechanical Drawing (3116)
	2. Sketch all details & specifications	Good drafting skills	Neatness & clarity	*Design, Applied loading Fatigue	Engineering Design(5201)
	3. Prepare part & material list	Good sequence in writing details		*Material strength beams	Mechanical Technology (4143)
	4. Add additional details as requested by Director of Engineering	Incorporating additional details		*All general properties of materials	Materials (4145)

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : PRODUCT DESIGN
Tasks : (G) PREPARE A MODEL PROTOTYPE
(H) ASSIST IN TESTING MODEL
(I) EVALUATE MODEL FOR PRODUCTION & REFINEMENT
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
G	1. Assist in making wax models	The different process involved		*Machine Tools *Cutting Tools	Manufacturing Technology (4144)
	2. Assist in preparing templates	The different process involved			
	3. Assist in pattern making	The different process involved			
	4. Explain drawings to tool room		Communication skill	*Assembly Drawings	Mechanical Drawings (3116)
H	1. Schedule test with laboratory				
	2. See all operating factors	Use of shadow graphs to see working of levels & calculation of spring pressure, conductivity etc.			
	3. Evaluate all details				
I	1. Consider existing M/C's in factory	All manufacturing process & tolerances that can be obtained	Know all company projects	*Machine Tools *Processes *Fabrications & all other topics	Manufacturing Technology (4144)
	2. Consider the supply of material & parts	See if materials are easily & cheaply available			
	3. Consider the tooling changes required	Consider the cost & time		*Material Selection	Materials (4145)
	4. Make alterations from test report	Changes in engineering calculations & specification			

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : (2) DESIGN OF MACHINES & TOOLS
Tasks : (A) SKETCH TOOL/MACHINE AS PER REQUIREMENT
(B) PREPARE LAYOUT OF INDIVIDUAL COMP
(C) PREPARE PARTS & MATERIAL SPECIFICATION
(D) EVALUATE USAGE OF CONTROLS
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
A	1. Sketch tool as per new product requirement	The complete structure of new product		*Freehand Sketching	Mechanical Drawing (3116)
	2. Implement ideas from existing M/C	Working & application of M/C		*Assembly Drawing	
	3. Receive suggestion from tool room	Correlating all ideas		*Production Tooling	Production Planning & Tooling (5208)
B	1. Layout items individually				
	2. Explain functions of each item	The different electrical & mechanical parts		*Production Tooling	Production Planning & Tooling(5208)
	3. Produce assembly were write up	Ways of fabrication & commissioning			
C	1. Function of each it items	Usage, working of electrical & mechanical parts			
	2. List all components required	Usage, working of electrical & mechanical parts			
	3. List all materials required	Usage, working of electrical & mechanical parts			
D	1. Evaluate the control systems used	All mechanical, electrical & pneumatic controls	Awareness about different systems for journals	*Mechanisms *Stress Analaysis *Balancing	Mechanical Technology (4143) & (5200)
	2. Calculate operation time required by each of these controls	Making calculations on linkages, forces	Accuracy		
	3. Incorporate safety	Reliability & safe working conditions	Safe environment		

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : DESIGN OF MACHINES & TOOLS
Tasks : (E) ASSIST IN TOOL MACHINE TRY-OUT
(F) INVESTIGATE FAULTS OCCURING TO TOOL/MACHINE
(G) MODIFY TOOL/MACHINE DESIGN
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
E	1. Choose method of manufacture	All machining & manufacturing process		*Primary & Contributory Processes	Manufacturing Technology (4144)
	2. Explain drawings	Clarify doubts & specification		*Assembly Drawing	Mechanical Drawings (3116)
	3. Assist in commissioning				
	4. Schedule for try-out				
F	1. Check accuracy of product	Ways of locating these problems & their causes & rectifying them	Sharpness & patience		
	2. Check for oil leakages/ over heating	Ways of locating these problems & their causes & rectifying them			
	3. Check for excessive vibration & noise	Ways of locating these problems & their causes & rectifying them			
G	1. Evaluate results from products which underwent first try-out	Locate faults from results		*Primary & Contributory Processes	Manufacturing Technology (4144)
	2. Evaluate all tests that were conducted on machines	Locate faults from results		*Primary & Contributory Processes	
	3. Incorporate ideas to rectify problems	Locate faults from results		*Primary & Contributory Processes	

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : (3) PURCHASE OF EQUIPMENT
Tasks : (A) IDENTIFY VARIOUS REQUIREMENTS
(B) COMMUNICATE WITH REGULAR SUPPLIERS
(C) SEND PURCHASE ORDERS REQUISITIONS
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
A	1. Evaluate things that can be made in tool room	Tool room facilities & skilled personnel available			
	2. Investigate & write requirements	Good writing skills	Clarity & neatness in conveying ideas		
	3. Check various equipments related to the area in which it is required	Good idea of all trade journals			
B	1. Check various manufacturers & dealers	Knowledge of all the vendors & their products	Memory of various equipments available	*Related topics from manufacturing technology	Manufacturing Technology (4144)
	2. Check all product ranges	Knowledge of all the vendors & their products			
	3. Specify technical details to dealers	Usage of these technical specifications			
	4. Visit various dealers	Evaluate product at vendor's site		*Relation with vendors & customers	Quality Assurance & Engineering Measurement (5209)
C	1. Communicate by letters	Good writing skills	Authority		Communication Skills (1040)
	2. Specify special requirements	Good writing skills			
	3. Schedule to receive orders	Good writing skills			

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : PURCHASE OF EQUIPMENT
Tasks : (D) EVALUATE QUOTATIONS
(E) RECEIVE ORDERS & TEST SAMPLES
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
D	1. Receive quotations from various vendors	Filing & reviewing reports		*Costing & Stock Control	Manufacturing Technology (4144)
	2. Make comparative cost study			*Process Selection	
	3. Make assessment in terms of the features/ service	All technical details & their superiority over others			
	4. Recommend to management	Write reports	Communication Skill		
E	1. Make periodical visit vendors	Assess progress of manufacture		*Primary & Contributory Process	Manufacturing Technology (4144)
	2. Advise on manufacturing problems	Different manufacturing Process			
	3. Assist in try-out of machines at vendors sites	Highlight the areas in which faults are occuring to product	Authority	*Process Selection	
	4. Set delivery dates of new equipments	Estimate time taken to fabricate machines at vendors place		*Cost of Quality	Quality Assurance & Engineering Measurement (5209)

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : (4) MANAGEMENT OF DRAWING OFFICE
Tasks : (A) USE STANDARD DRAWING OFFICE EQUIPMENT
(B) DEVELOP A NUMBERING SYSTEM FOR DRAWINGS
(C) FILE MASTER DRAWINGS
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Assist in selection of drawing equipment	Various equipments available in market		*Drawing Office Reprographics	Mechanical Drawing (3116)
A	2. Set up drawing office equipment				
	3. Select latest drawing office stationaries	Knowledge of stencils, papers etc.			
	4. Help in the maintenance of equipments	Schedule for maintenance & proper usage			
	1. Keep log for drawings	Proper entry system			
	2. Develop drawing number for new prospects	Devising a numbering system			
B	3. Develop drawing number for sub-assembly	Devising a numbering system			
	4. Generate job orders or worksheets	Devising a numbering system			
	1. File master drawings for security	Proper storage facility			
C	2. Make blue prints of drawings	Operation of printing M/C		‡Drawing Office Reprographics	Mechanical Drawing (3116)
	3. Keep account of prints taken	Maintaining log book			

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : MANAGEMENT OF DRAWING OFFICE
Tasks : (D) FILE MEDIA MATERIALS
(E) RETRIEVE DRAWINGS & MATERIALS
(E) MAINTAIN HANDBOOKS & STANDARDS
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Collect materials relating to products				
D	2. Collect material relating to equipments/ machines				
	3. File material for reference	Proper filing procedures			
	1. Select type of reproduction	Different drawing sizes		*Drawing Office Reprographics	Mechanical Drawing (3116)
	2. Make reproduction from blue prints	Operation of ammonia printer			
E	3. Account of drawings given to sub-contractors	Proper entry in log book			
	4. Account of drawings being reproduced	Proper entry in log book			
	5. Retrieve media material for reference	Location of all files & cabinets they are in			
	1. Keep all electrical standards	Standards of electrical appliances in different countries		*Limits & fits	Mechanical Drawing (3116)
F	2. Keep all codes concerning materials	Usage of manufacturer's drawings & standards		*Materials	Materials (4143)
	3. Keep mechanical & electrical handbooks	Usage of manufacturer's drawings & standards			
	4. Do library research				

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : (5) PREPARATION OF FINAL DRAWING
Tasks : (A) LAYOUT DRAWINGS
(B) DRAW DETAILED DRAWINGS
(C) WRITE DETAILS & SPECIFICATIONS
In performing this task, the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
A	1. Determine type & size of medium	Different sizes of drawings		*All drawing Practices	Mechanical Drawing (3116)
	2. Prepare surface for drawing	Drawing board arrangement & mounting			
	3. Develop working sketches	Schematically layout sketches to cover drawing sheet			
B	1. Apply basic principles of drafting	Correct drawing procedures	Neatness	*Drawing Standards & Reproduction	Mechanical Drawing (3116)
	2. Use appropriate line weights, pens, stencils	Proper usage of equipments	Clarity	*Drawing Standards & Reproduction	
	3. Use appropriate lettering	Various forms & sizes of lettering			
C	1. Make all dimensioning angles				
	2. Make use of all symbols	Welding, surface finish symbols		*Conventional Representation	Mechanical Drawing (3116)
	3. Write material specifications	Different material, composition, hardness		*Assembly Drawings	
	4. Write process specifications	Heat treatment, machining specifications			

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : PREPARATION OF FINAL DRAWING
Tasks : (D) MAKE ASSEMBLY DRAWING
(E) CHECK DRAWINGS FOR COMPETENESS & ACCURACY
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
D	1. Draw isometric views	Different projection methods & geometric constructions	Neatness & clarity	*Projection	Mechanical Drawing (3116)
	2. Draw perspective views	Different projection methods & geometric constructions		*Auxiliary Views	
	3. Make use of hatchings				
	4. Make tracings				
E	1. Check accuracy of dimensions & scale	Basic drawing principles	Neatness & clarity	*Dimensioning	Mechanical Drawing (3116)
	2. Check co-ordination of points	Basic drawing principles	Neatness & clarity	*All Engineering Drawing Practices	
	3. Check line quality	Basic drawing principles	Neatness & clarity		
	4. Write engineering change orders		Neatness & clarity		
	5. Verify compliance with standards	Refer standard books for values	Neatness & clarity		
	6. Check clarity of notes		Neatness & clarity		

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : (6) LIAISON WITH OTHER DEPARTMENTS
Tasks : (A) EVALUATE TEST REPORTS FROM Q.C.
(B) SET UP TOLERANCE STANDARDS FOR MANUFACTURE
(C) ASSIST IN FAULT FINDING DURING MANUFACTURE
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
	1. Check results concerning tests	Interprete data & results correctly			
	2. Try to diagnose faults				
A					
	3. Locate the faults precisely	Find the causes of faults			
	4. Modify test rigs for better investigate results	Operation of test rigs		*Production Tooling	Production Planning & Tooling(5208)
	1. Specify machining tolerance as required from production	Reading drawings & various tolerances	Concern for effective manufacture & quality	*Assembly Drawings *Limits & fits	Mechanical Drawing (3116)
B	2. Specify strength of materials	Stress, strain, factor of safety of materials for various designs		*Material Strength	Mechanical Technology (4143)
	3. Specify heat treatment of materials	Various types of heat treatment		*Heat Treatment	Materials (4145)
	4. Specify surface finish	Various standards on surface finish		*Equipments	
	1. Identify faults on products after manufacture		Sharpness in identifying faults		
C	2. Assist in modifying results for better quality & production			*Process Selection	Manufacturing Technology (4144)
	3. Assist production staff to investigate process faults	Various manufacturing operations		*Primary & Contributory Processes	

TASK ANALYSIS

Job Title: DESIGN ENGINEER
Duty : LIAISON WITH OTHER DEPARTMENTS
Tasks : (D) ASSIST IN TOOL/FIXTURE MANUFACTURE
(E) ASSIST IN TOOL/MACHINE TRY-OUT
In performing these task the DESIGN ENGINEER will need to

	COMPLETE THESE STEPS/SKILLS	KNOW THE FOLLOWING	EXHIBIT THESE ATTITUDES	N.Z.C.E. SYLLABUS Topics and subjects relevant to the tasks	
D	1. Produce free-hand sketches of tool/ fixture arrangement	Basic drawing skills	Clarity	*Freehand Sketching	Mechanical Drawing (3116)
	2. Assist in the explanation of drawings	Representation of symbols	Clarity in conveying ideas	*Assembly Drawings	
	3. Assist in the progress check of fixture development				
	4. Assist in the production of detail assembly drawings of selected machine or tools	Drafting skills with detailing of symbols etc.		*Production Tooling	Production Planning & Tooling (5208)
E	1. Check to see smooth operation	Excessive noise, vibration, oil leakages, overheating etc.	Alertness & awareness of faults		
	2. Assist in checking pre-production samples	Use of measuring instruments		*Metrology *Establishing Quality Standards	Quality Assurance & Engineering Measurement (5209)
	3. Assist in the formulation of minor alterations in machines or tools			*Production Tooling	Production Planning & Tooling(5208)

New Zealand Certificate

0106 ENGINEERING: MECHANICAL

Stages 1 & 2

SUBJECTS

1040	Communication Skills	2051	*Mechanics
1011	Mathematics	1020	Drawing
1013	*Physics	2018	Mathematics
1003	*Chemistry	2019	*Physics

NOTE: Stage 1 of a subject must be passed or exempt before commencing the subject at Stage 2. 1011 Mathematics must be passed or exempt before studying 2051 *Mechanics.

Stage 3

SUBJECTS		PREREQUISITES	
3031	Mathematics	2018	Mathematics
3117	*Engineering Science	2019	*Physics and
		1011	Mathematics
3118	*Mechanics	2051	*Mechanics and
		2018	Mathematics
3116	Mechanical Drawing	1020	Drawing

Stage 4

4144 +	*Manufacturing Technology	4174	+Workshop Practice (no fee)
4146	*Fluids Technology	3118	*Mechanics
4142	*Heat Transfer and Electrical Machines	3117	*Engineering Science and
		2018	Mathematics
4143	*Mechanical Technology	3118	*Mechanics
4145	*Materials		

NOTE: 4142, 4143, 4145, 4146 are classed as half subjects.

Stage 5

5200	*Mechanical Technology (must be studied prior to or concurrently with 5201)	4143	Mechanical Technology
		3031	Mathematics
5201†	*Engineering Design	4144	Manufacturing Technology
		4145	Materials

and ONE of:

5202	*Industrial Thermodynamics	4142	Heat Transfer & Electrical Machines
		4146	Fluids Technology
5203	*Control Systems	4142	Heat Transfer & Electrical Machines
		4144	Manufacturing Technology
		4146	Fluids Technology
		3031	Mathematics

*Subjects marked thus have a practical laboratory requirement.

New Zealand Certificate

0107 ENGINEERING: PRODUCTION

Stages 1 & 2

SUBJECTS

1040	Communication Skills	2051	*Mechanics
1011	Mathematics	1020	Drawing
1013	*Physics	2018	Mathematics
1003	*Chemistry	2019	*Physics

NOTE: Stage 1 of a subject must be passed or exempt before commencing the subject at Stage 2. 1011 Mathematics must be passed or exempt before studying 2051 *Mechanics.

Stage 3

SUBJECTS		PREREQUISITES	
3031	Mathematics	2018	Mathematics
3117	*Engineering Science	2019	*Physics
		1011	Mathematics
3118	*Mechanics	2051	*Mechanics
		2018	Mathematics
3116	Mechanical Drawing	1020	Drawing

Stage 4

4144 +	*Manufacturing Technology	4174	+Workshop Practice (no fee)
4146	*Fluids Technology	3118	*Mechanics
4142	*Heat Transfer and Electrical Machines	3117	*Engineering Science
		2018	Mathematics
4143	*Mechanical Technology	3118	*Mechanics
4145	*Materials		

NOTE: 4142, 4143, 4145, 4146 are classed as half subjects.

Stage 5

5208	*Production Planning & Tooling	4144	Manufacturing Technology
		4145	Materials
5191	*Industrial Productivity	2018	Mathematics
and ONE of:			
5209	*Quality Assurance & Engineering Measurement	4144	Manufacturing Technology
5210	*Production Machines	4142	Heat Transfer & Electrical Machines
		4143	Mechanical Technology
		4144	Manufacturing Technology
		4146	Fluids Technology

* Subjects marked thus have a practical laboratory requirement.