CHAPTER IV

METHOD

DESIGN

The present investigation was undertaken to study the work efficiency of technical personnel in relation to their aptitudes, personality and motives. The sample comprised of male students of Indo-Swiss Training Centre and industrial workers taken from the Punjab Tractors Ltd and Accumeasures Punjab Ltd. The scores of aptitude, personality and motives were obtained by administering standardized tests. Work efficiency was obtained from the academic records of practical and theory for the ISTC males; and the monthly efficiency records for the industrial workers from the supervisors-in-charge.

SAMPLE

A total of 194 male subjects ranging from 18-35 years was taken. The ISTC males were third and fourth year students and were 93 in all. The industrial workers were 64 from PTL and 37 from APL. The tests were administered individually because in the industrial situation the workers could not be spared in a group. The schedule was spread over four/five different sessions which in some cases took more than 7/8 days to administer all the tests.

* Indo-Swiss Training Centre will henceforth be referred to as ISTC, Punjab Tractors Ltd as PTL and Accumeasures Punjab Ltd as (APL).
MATERIAL OR TOOLS FOR TESTING

For the collection of the desired data the tools used were:

(a) Measurement of Intelligence was done through the Standard Progressive Matrices (SPM) Raven 1960.

(b) Aptitudes were gauged by the following tests of Differential Aptitude Test (DAT) Battery (Form A)
   (i) Mechanical Reasoning (MR)
   (ii) Abstract Reasoning (AR)
   (iii) Numerical Ability (NA), and
   (iv) Space Relations (SR) Bennett Seashore and Wesman, 1966.

(c) Personality was assessed by the Eysenck Personality Inventory (Eysenck and Eysenck, 1964).

(d) Measurement of Motives (achievement, affiliation and power) was done through the projective devise of an adapted version of Thematic Apperception Test (TAT) (SIET 1964).

(A) Standard Progressive Matrices (SPM)

The general intellectual ability, basically intelligence was measured by the Standard Progressive Matrices, henceforth referred to as SPM. It is a non-verbal and culture fair test constructed by Raven (1960) as a measure of "a person's capacity... to apprehend meaningless figures presented for observation, see relations between them, conceive the nature of..."
the figure completing each system of relations presented and by doing so develop a systematic method of reasoning. A total of sixty problems divided into five equal sets A, B, C, D and E constitute the test. The opening problems of each set are simple; however, the ensuing problems become progressively more difficult from Set A to Set E. Each figure is boldly presented in geometric design and is accurately drawn. Every problem consists of finding the missing piece of the pattern out of a choice of six. An individual's total score is an index of his intellectual capacity.

The SPM can be confidently used in the present research since it has been used on an Indian sample by Malhotra (1975), Mohan and Kumar (1975, 1976), Mohan (1976); and by Vohra (1977) on a similar sample of technocrats. The scale has retest reliability varying from .83 to .93. The scale is extended to cover the entire range of intellectual development from the time a child is able to grasp the idea of spotting a missing piece to complete a pattern. An individual's capacity to "form comparisons" and "reason by analogy" was assessed quite easily as the test was sufficiently long.

(B) Differential Aptitude Test Battery (DAT)

Requirement for multiple measurement and various tests of specific abilities have gained considerable importance in the Industrial sector. For career possibilities and professional courses, the DAT (1940) was developed. In aptitude measurement
the most widely used tests are the tests by Bennett, Seashore and Wesman (1940-54). Students superior in numerical ability, spatial relations, in addition to mechanical reasoning will do better in engineering courses (Bennett, Seashore and Wesman, 1960). Spatial Relations and Mechanical Reasoning relate to students ability to visualise, correlate objects and manipulate those visualizations and to recognise day-to-day physical forces and principles. They are particularly important in dealing with things rather than popular words. Mechanical Reasoning and possibly Spatial Relations and Abstract Reasoning require consideration in the case of technical and scientific matter. In the technical group Numerical Ability may be connected with cost accounting and industrial purchasing.

(i) **Mechanical Reasoning (MR)**

According to Bennett, Seashore and Wesman (1966) the ability measured by the MR test may be regarded as one aspect of intelligence. An individual rating high on this test should find it easy to learn principles of operation and repair of complex devices. The test is useful in those curricula and occupations where an apperception of the principles of common physical forces is required. The score is affected by the previous experience of the subject but not to a degree that calls forth for serious difficulties in interpretation. In the case of a subject, who intended joining a major in a physical science field or in a technical or manual training course, does not score very well on this test, should, however, expect to find
the work difficult. Each item in the MR booklet consists of pictorially presented mechanical situations ensured by simply worded short questions which do not require special knowledge. An individual rating high on this test should find it easy to learn principles of operation and repair of complex devices. This test has been used by Mohan and Kumar (1976) on Panjab University students and by Vohra (1977) on a sample of polytechnic students of Madras.

(ii) Abstract Reasoning (AR)

In the AR test each problem presents a series in which the subject is required to apprehend the operating principle in the changing diagrams and designate the diagram which should logically ensure the selected from the answer figures. This test gives a non-verbal measure of the subjects reasoning ability - thinking with abstract symbols. As the test advances it increases in conceptual difficulty. It entails the ability to perceive relationships in abstract figure patterns, form generalization of principles and give evidence of this by allocating the design that must necessarily follow. The score of the test is useful when the curriculum, profession or vocation requires perception of relationships among other things rather than words and numbers. This ability to reason with abstract figures is essential in Mechanical Engineering, Civil Engineering and Electrical Engineering and this test was used by Vohra (1977) on polytechnic students and by Mohan (1979) on a Panjab University sample.
(iii) **Space Relations (SR)**

The SR test is a measure of ability to deal with concrete material through visualization - an ability to manipulate things mentally, to create a structure in one's mind from a plan. The ability to visualise a constructed object from a picture of a pattern has been often used in tests of structural visualisation. Likewise, in space perception the ability to imagine how an object would appear if rotated in various ways has been used effectively. These tests require a three dimensional mental manipulation of objects. Item forms referring to two dimensional space alone are less useful because there are comparatively fewer which call for its perception (Bennett, Seashore and Wesman 1966). In the fields of drafting, architecture, art, die making or wherever there is need to visualise objects in three dimensions this ability is required. Vohra (1977) used this test on polytechnic students of Madras.

(iv) **Numerical Ability (NA)**

NA test is a good measure of a subject's ability to reason with numbers, to manipulate numerical relationships and to deal intelligently with quantitative materials. The problems are framed in the type called "Arithmetic Computation" rather than what is usually called "Arithmetic Reasoning" though the ability to reason is called to play. A comprehension of numerical relationships is required by many items though some items test only skill in numerical processes. Though computationally simple
they are as problems fully complex as a measure of NA (Bennett, Seashore and Wesman, 1966).

Mohan and Randhawa (in press) used this test with school children. In the field of education, the importance of this test cannot be minimized. Production in Mathematics, Commerce, Physics, Chemistry, Engineering and other curricula in which quantitative thinking is essential can be affected by means of this test. Also the job of a technician and supervisory level require the use of NA in purchases and in maintaining accounts, calculating and designing jobs in civil construction and electrical current strengths and mechanical job designing. Vohra (1977) used this test on polytechnic students and Mohan (1979) on Panjab University students.

(C) Eysenck Personality Inventory (EPI)

For measuring the personality dimensions of Extraversion and Neuroticism Eysenck's Personality Inventory in English (Eysenck 1964) and a translated version in Hindi (Mohan V., 1977) was used. The test consists of 57 statements, 24 for Neuroticism and 24 for Extraversion/Introversion, and remaining 9 constitute the Lie Scale. Response was made either by a 'Yes' or a 'No'. This test has been successfully used in India on groups of University students, prisoners, polytechnic students, MBAs and executives by Mohan and Mann (1970), Mohan and Kumar (1974), Jaspal (1977), Vohra (1977), and Mohan J. (1975, 1977, 1979) respectively.
(D) Thematic Apperception Test (TAT)

To measure achievement, affiliation and power motives* an adapted version of TAT (McClelland et al., 1953) was administered. The test consists of six pictures of McClelland's multiple purpose Set A (Atkinson, 1958, p.835) which were adapted for use in India by the staff of Small Industries Extension Training Institute (SIET) at Hyderabad, India in 1964. The stimulus figures in the pictures were all males. In the stories the number of certain pre-identified content categories is said to be proportional to the strength of the motive.

A brief description of the six pictures in serial order is as follows -

(1) An older man talking to a young man in an office like room.

(2) A man seated at a drafting board

(3) Conference group. Seven men variously grouped around a conference table.

(4) A man working alone at a desk in an office.

(5) A boy and a middle-aged man chatting in a rural setting.

(6) A man with a book and spectacles in his hands, relaxing in an easy chair, possibly in an airplane.

The original set of six pictures has been used by McClelland (1961) in a number of countries and the Indian ♦ Henceforth these motives will be referred to nAch, nAff and nPow respectively.
adaptation was used in the achievement motivation training programme of Indian businessman (McClelland and Winter, 1969). Hundal (1971), Hundal and Jerath (1972), S. Singh (1974) and S. Singh and Kaur (1976) used this adapted set, successfully in India on small scale industrialists, university students, farmers and women teachers respectively.

**WORK EFFICIENCY**

Work Efficiency was gauged in terms of academic achievement for the ISTC subjects and percentages for both PTL and APL workers. The details are as follows -

(i) The academic achievement records of the ISTC sample were obtained from the official registers. The efficiency was judged by their performance in the previous examination in terms of grades in both practical and theory. The following table shows the scale for awarding remarks of theory subjects and practicals.

<table>
<thead>
<tr>
<th>Grades</th>
<th>THEORY MARKS (%)</th>
<th>PRACTICAL MARKS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90-100</td>
<td>93-100</td>
</tr>
<tr>
<td>1.5</td>
<td>80-89</td>
<td>81-92</td>
</tr>
<tr>
<td>2</td>
<td>67-78</td>
<td>69-80</td>
</tr>
<tr>
<td>2.5</td>
<td>55-66</td>
<td>56-68</td>
</tr>
<tr>
<td>3</td>
<td>36-54</td>
<td>44-55</td>
</tr>
<tr>
<td>4</td>
<td>15-35</td>
<td>25-43</td>
</tr>
<tr>
<td>5</td>
<td>0-14</td>
<td>0-24</td>
</tr>
</tbody>
</table>

(ii) The industrial workers' work efficiency, in terms of percentage was obtained from the supervisors-in-charge for
three consecutive months. The average efficiency was taken for the computation and analysis. A brief description of the work efficiency as used in the two factories is briefly presented below.

(a) For the PTL workers the cut off point in assessing their efficiency is 60%. Below 60% the worker is not included in the incentive bonus scheme. The efficiency is measured in accordance with the time and motion study used worldwide in the industrial sector. A typical process sheet on such technical information is attached (Appendix A, Table I).

(b) The APL industrial plant being a comparatively newer factor has not introduced the incentive bonus scheme yet. They are using a rating scale of percentages where exceptional is rated 90%, superior 80%, good 70%, average 50% and below 50% is unsatisfactory. The details of the work efficiency chart is attached in Appendix A (Table II).

PROCEDURE

All the tests were administered to the 194 subjects - out of which 93 were students of ISTC and 101 were industrial workers. Owing to the industrial situation where more than a single worker could not be spared at a time, the tests were administered individually and were very time consuming. A rapport with the subjects was established and they were convinced that the information obtained from the tests was highly confidential. Physical comfort was ensured. In the industry, each subject was given seven tests not more than two a day;
sometimes just one so as to avoid confusion. The total time taken by each subject was, to receive instructions and do the test, approximately 6 to 7 hours. The tests were grouped in order to avoid monotony and also two long tests were not given together. The SPM and EPI were given together; AR and MR together and SR and NA. The TAT was given separately. The time bound tests were individually timed with the help of a stopwatch.

The instructions for the DAT tests were printed on the booklets. These were read out and everything was clarified before the subject commenced the test. The EPI forms also had printed instructions which were simple to follow. For the SPM which was an untimed test the Ss took twenty to sixty minutes on an average. Likewise, the EPI was not time bound so the Ss took about fifteen to twenty minutes. For each picture of the TAT, four minutes to write the story were given but the Ss were unable to finish within this limit and were given extra time. There were six pictures in all.

(a) Administration of SPM

The instructions for the SPM were verbally delivered in a uniform manner as prescribed by Raven (1960). The illustration was done by opening the booklet at the first design A1 saying, while pointing to the upper figure. "It is a pattern with a bit missing. Each of these bits below is the right shape to fit the space, but they do not all complete the pattern." Explanation
was adequately given as to why the bits 1, 2, 3, 5, 6 were wrong and 4 correct. If the subject failed to comprehend, further explanation was made till the nature of the problem was grasped. After waiting for the subject to finish writing the answer, further instructions were administered, "on every page you have to decide which of the bit is the right one to complete the pattern and write its number on the answer form. The designs are simple at the beginning and get harder as you go on. If you pay attention to the way the easy ones go, you will find the later ones less difficult. Try each in turn from the beginning to the end of the book. Do not miss any out. Do not turn back. Work at your own pace." For the first five items a close watch was kept on the subjects to see whether they had followed the instructions correctly. If not, they were instructed again, otherwise they continued for all the sets A, B, C, D and E.

(b) Administration of Mechanical Reasoning, Abstract Reasoning, Numerical Ability and Space Relations

The subjects were comfortably seated. The instructions were delivered verbally as given in the DAT manual (Bennett, Seashore, Wesman, 1959) for MR, AR, NA and SR. For MR and NA a time limit of 30 mins was permitted; and for AR and SR twenty-five minutes were given as per manual.

(c) Administration of the EPI

This personality inventory was given as per instructions printed on the EPI forms. For the first few responses a close
watch was kept to ensure that the S had followed the instructions. This was an untimed questionnaire.

(d) Administration of the TAT

The subjects were given six papers each, with four questions printed on each paper. The questions were as follows:

(1) What is happening? Who are the persons?
(2) What has led up to this situation? That is, what has happened in the past?
(3) What is being thought? What is wanted? By whom?
(4) What will happen? What will be done?

The following instructions (SjET 1964) were delivered - "This is a test of creative imagination. You are going to see six pictures one at a time and your task is to tell a story that is suggested by each picture. Answer the four questions and write as complete a story as you can, a story with plots and characters. You will have 20 secs to look at a picture and then 4 mins to write your story about it. Write your first impressions and work rapidly. There are no wrong or right stories or kinds of pictures, so you may feel free to write whatever story is suggested to you when you look at a picture. Spelling, punctuation, and grammar are not important.

Notice there is one page for writing any story. If you need more space for writing any story use the reversed side of
Thus the data collected by the aforementioned procedure was ready for the scoring and computation for the final analysis.