CHAPTER II

METHODOLOGY

SAMPLE : ITS COMPOSITION

The sample of the study comprised 2,318 subjects of which 930 were operatives from nine textile mills located in Ahmedabad (India) and three mills located outside Ahmedabad centre but in the same state (i.e., Gujarat). The rest 1,388 were fresh applicants seeking employment as operatives in textile industry.

The 930 workmen belonged to below mentioned seven skilled operative positions in composite textile mills.

1. Doffer-cum-piecer.
2. Tenter.
3. Drawer and Reacher.
4. Weaver (auto and non-auto loomshed).
5. Folder.
6. Tackler in the automatic loomshed.
7. Fitter.

The sample was thus fairly representative of operatives in the textile manufacturing process. Of the approximately one million textile operatives in the organised mill sector in the country, the jobs which are represented in the sample
involve approximately seventy percent operatives in a composite mill.

These operatives positions were chosen for the study for two reasons. First, because these positions involve to a great extent the application of skills related to abilities and aptitudes. Second, that there are wide individual differences among the operatives in performing the job operations.

At this juncture it would be worthwhile to note in brief the job operations the incumbents perform in the aforesaid positions. It is contended that this information will provide justification for the chosen positions as well as the tests in the study.

**Doffer-cum-Piecer and Tenter**

These two are the critical operative positions in the "Spinning" department. Doffer is ancillary to Tenter whose job is to replace the empty bobbin with full ones. He does so by using both his hands simultaneously. The Tenter keeps the spindle in operation by rapidly mending strands of cotton that break on the machine, and replace the exhausted bobbins of roving on the holding pins (skewers) at the top of the machine.
Drawer and Reacher

The major work of the Drawer and Reacher is to prepare beams for the weaving department. This is a pair preparing warp beams by drawing the ends of the yarn through the reed space and healds eye according to a specified shed opening pattern. The complexity of the jobs increases in relation to the fancy weaves. The Reacher holds cluster of threads, separates them one by one and passes the appropriate thread end in sequence to the drawer sitting opposite him on the other side of the stand. This thread is drawn in by the drawer through the heald eye by means of a hook. The process is repeated for as many times as there are threads in a beam. This operation has to be carried out very swiftly and both the Drawer and Reacher have to coordinate their speeds of working.

Weaver

The weavers' is the most critical operative position in a textile mill. A mill's productivity and profitability depends to a large extent on the weavers' efficiency. It is a highly skilled job wherein a weaver has to perform various operations rapidly. For instance he has to do the shuttle change, shuttle refill, mend end breaks, so on and so forth, which are quite frequently required in order to keep the looms running and maintain a high standard of quality and quantity of production. There is a positive relationship between the
speed of working and the production. The weavers in an non-automatic loomshed are allotted two to four looms while weavers in the automatic loomshed look after 12 to 24 looms.

**Folders**

The cloth is folded as fresh, seconds, or rags and fents according to quality and piece length specifications. Such classification depends on the damage free length of the cloth. Folders' job is to inspect the cloth for type of damages it contains; decide whether the cloth possess the criterion laid down for damage-free fresh cloth or is to be cut at appropriate places for making seconds, rags or fents. They have also to note down the meterage on fresh pieces. They are also required to classify the remaining cloth as seconds, rags and fents according to the piece length. It is their job to see that the fresh pieces do not contain damages more than the prescribed standard for calling a piece as fresh; to cut cloth in such a way that maximum possible length goes as fresh and record correct length on each piece. In performing the above jobs both the accuracy and speed is warranted.

**Tackler and Fitter**

Tacklers and Fitters are the maintenance crew and their work is of a highly specialized nature. The machine break-down time depends on how well the machinery is maintained. The quality of production and the consumption of accessories also
depends to a very large extent on the job of fitters and tacklers. The major job of Tacklers and Fitters is to effect the machine settings, diagnose machine faults and rectify the same within the shortest time possible.

A knowledge of what all the various operatives do on their job it is possible to identify the abilities and aptitudes required in carrying out those jobs. The ability and aptitudes that seem to be commonly pertinent for the above mentioned job are stated below:

(a) flexibility of gross-arm movements,
(b) flexibility in manipulation of fingers,
(c) ability to coordinate the working of eye and hand,
(d) quickness of reflexes,
(e) perceptual motor coordination,
(f) physical strength,
(g) span of attention, etc.

SAMPLE: ITS DISTRIBUTION

The distribution of 2,318 subjects is given in Table 1. For the purpose of the study this distribution was segmented into eight categories as shown in Table 2. The demographic information of the various sub-samples is given in Table 3.

As all the 2,318 subjects were not administered all the tests, the sample size for the different analyses varies.
However, for each analysis the sample size was considered to be adequate.

The sample for the reliability analysis comprised 154 operatives randomly selected from the original sample from five positions. The cases drawn from each category of operative position for the reliability analysis are shown in Table 4.

**TABLE 1**

**DISTRIBUTION OF THE SAMPLE: OPERATIVE POSITIONWISE**

<table>
<thead>
<tr>
<th>Operative Position</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Doffer-cum-piecer</td>
<td>95</td>
</tr>
<tr>
<td>2. Tenter</td>
<td>204</td>
</tr>
<tr>
<td>3. Drawer and Reacher</td>
<td>103</td>
</tr>
<tr>
<td>4. Weaver</td>
<td>155</td>
</tr>
<tr>
<td>5. Folder</td>
<td>154</td>
</tr>
<tr>
<td>6. Tackler</td>
<td>124</td>
</tr>
<tr>
<td>7. Fitter</td>
<td>95</td>
</tr>
<tr>
<td>8. Freshers (candidates for positions 1 and 4 with no job experience)</td>
<td>1,388</td>
</tr>
<tr>
<td>Grand Total</td>
<td>2,318</td>
</tr>
</tbody>
</table>
TABLE 2

SEGMENTATION OF THE TOTAL SAMPLE INTO SUB-SAMPLES

<table>
<thead>
<tr>
<th>Sub-samples</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gujarat - Urban</td>
<td>898</td>
</tr>
<tr>
<td>2. Gujarat - Rural</td>
<td>95</td>
</tr>
<tr>
<td>3. Maharashtra</td>
<td>61</td>
</tr>
<tr>
<td>4. Tamil Nadu</td>
<td>50</td>
</tr>
<tr>
<td>5. Uttar Pradesh</td>
<td>62</td>
</tr>
<tr>
<td>6. Rajasthan</td>
<td>40</td>
</tr>
<tr>
<td>7. Freshers - Urban</td>
<td>190</td>
</tr>
<tr>
<td>8. Freshers - Rural</td>
<td>922</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,318</strong></td>
</tr>
</tbody>
</table>

TABLE 3

MEANS AND STANDARD DEVIATIONS (SDS) OF THE DEMOGRAPHIC VARIABLES OF THE SUB-SAMPLES

(In Years)

<table>
<thead>
<tr>
<th>Sub-samples</th>
<th>Demographic Variables</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age</td>
<td>Mean</td>
<td>SD</td>
<td>Education</td>
</tr>
<tr>
<td>2. Gujarat - Rural</td>
<td>25.98</td>
<td>2.40</td>
<td>6.73</td>
<td>2.46</td>
</tr>
<tr>
<td>3. Maharashtra</td>
<td>31.02</td>
<td>9.63</td>
<td>7.38</td>
<td>2.61</td>
</tr>
<tr>
<td>4. Tamil Nadu</td>
<td>37.04</td>
<td>9.80</td>
<td>5.90</td>
<td>2.93</td>
</tr>
<tr>
<td>5. Uttar Pradesh</td>
<td>30.08</td>
<td>9.53</td>
<td>8.39</td>
<td>2.55</td>
</tr>
<tr>
<td>6. Rajasthan</td>
<td>34.87</td>
<td>11.09</td>
<td>6.90</td>
<td>3.87</td>
</tr>
<tr>
<td>7. Freshers - Urban</td>
<td>20.29</td>
<td>2.13</td>
<td>9.29</td>
<td>1.58</td>
</tr>
<tr>
<td>8. Freshers - Rural</td>
<td>20.30</td>
<td>1.78</td>
<td>9.06</td>
<td>1.95</td>
</tr>
</tbody>
</table>
TABLE 4
CASES DRAWN FROM THE OPERATIVE POSITIONS FOR RELIABILITY ANALYSIS

<table>
<thead>
<tr>
<th>Operative Position</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tenter</td>
<td>46</td>
</tr>
<tr>
<td>2. Drawer and Reacher</td>
<td>29</td>
</tr>
<tr>
<td>3. Folder</td>
<td>25</td>
</tr>
<tr>
<td>4. Fitter</td>
<td>30</td>
</tr>
<tr>
<td>5. Winder</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>154</strong></td>
</tr>
</tbody>
</table>

DESCRIPTION OF THE APTITUDE TESTS USED IN THE STUDY

An analysis of the job performed by the selected operatives was made to identify the various aptitudes that seemed relevant for performing those jobs. On the basis of this identification of the aptitudes appropriate tools to measure the identified aptitudes were then chosen and included in the study. A description of each of these measures follows. It should be noted here that the number of tests/measures that were selected initially was much larger however, only those tests are being described here which were found relevant empirically.

**Hand Dynamometer**

One of the oldest instrument for the measurement of physical strength used in laboratory studies is the "Hand
Dynamometer. It consists of a semi-circular metal plate on which there are marking in Kilograms ranging from 0 to 100. There are two handles which are to be held together in the hand and when pressed the clock like needles move showing the strength of grip in the unit of kilograms. This instrument is manufactured in India, and is available from agencies supplying psychological tests.

The retest reliability of this measure is quite high and has been empirically tested in the studies on selection norms conducted at Ahmedabad Textile Industry's Research Association. (Dokke, et.al., 1975; Dolke, 1977, Dolke, 1979(a)(b); Sharma, 1979(a)(b), 1981,1982).

The General Aptitude Test Battery

The General Aptitude Test Battery (GATB) has been constructed and standardized by the Occupational Analysis and Testing Division of the United States Employment Services (USES), in 1947 (Dvorak, 1947; 1956; 1960; 1965a; 1965b; and 1965c).

The battery includes 12 tests of which 1 to 7 are the paper and pencil tests measuring six aptitudes namely, General Intelligence, Verbal, Numerical, Spatial, Form Perception, and Clerical aptitude. The parts 8 to 12 are psychomotor tests measuring three aptitudes namely, Motor Coordination (K), Manual Dexterity (M), and Finger Dexterity (F). Only the
last five tests were used in the present study. A description of these tests is given below:

Part 8: Mark Making

This test consists of a series of squares printed on a sheet of paper. The examinee has to make inverted pie like (II) pencil marks, in as many squares possible in the allotted time. The marks to be made are short lines, two vertical and the third one a horizontal line beneath the two vertical lines. This test can be administered in a group.

There are two practice trials of 10 seconds each and one test trial of 60 seconds. The score on the test trial is converted into standard score which constitutes the index of "Motor Coordination" (K).

Part 9: Placing

The equipment used for this test consists of a rectangular wooden pegboard of 20" x 21½", divided into two halves or sections, each half containing 48 cylindrical holes. In the upper section of the board there are 48 cylindrical pegs inserted in the holes. The pegs are coloured half red and this coloured part is facing the top. The testee removes two pegs simultaneously, one with each hand from the holes from the upper part of the board, and inserts them in the corresponding holes in the lower part of the board. There
are three trials of 15 seconds each during which the testee works rapidly to move as many pegs as possible. This test in conjunction with part 10 (turning) measures Manual Dexterity. Prior to the three test trials the testee is given practice to remove and place 20 to 21 pairs of pegs.

Part 10: Turning

The equipment described under test 9 is also used for this test. In this test the board is so placed that the sections are on both the sides i.e., on the left and right hand side. The testee picks up one peg from the filled-in section of the board with his preferred hand using his thumb and middle finger and turns the peg upside down with his index finger and places the peg in the corresponding hole in the empty section of the board. The testee works rapidly to turn and replace as many of the 48 cylindrical pegs as possible during the time allowed. There are three test trials of 30 seconds each. Prior to the three test trials the testee is given practice to turn and place 30 to 40 pegs.

The score on this part along with the score of the Part 9 constitutes the index of "Manual Dexterity" (M).

Part 11: Assembling

The equipment used for this test consists of a small rectangular board of 6" x 9" containing 100 holes distributed equally into two parts of the board. The board is so
placed that the holes in the upper half are filled-in with metal rivets. In the center of the board and on both the sides a hole has been provided to screw a metal rod which holds the metal washers. This rod holding the washers is kept on the side opposite to the preferred hand of the testee.

The testee picks up a metal rivet with the thumb and index finger of the preferred hand and with the other hand simultaneously picks up a washer from the rod, inserts the rivet in the washer from the top, hold the assembled part with the preferred hand and keeps it in the corresponding hole in the lower part of the board. The testee works rapidly to move and replace as many rivets and washers as possible during the 90 seconds test trial. This test in conjunction with part 11 (disassembling) measures "Finger Dexterity" (F).

Part 12: Disassembling

The equipment used for this test is the same as that described for Part 11. In this test the testee removes the assembled rivet and washer by picking up the rivet with his preferred hand and with the other hand slides the washer to the lower edge of the board, replacing the rivet in the corresponding hole in the upper part of the board and the washer on the rod. Again, the testee works rapidly
to move and replace as many rivets and washers as possible during a sixty second test trial. The score on Part 11 and Part 12 together constitute the score for the aptitude "Finger Dexterity" (F). Prior to the testing of on Parts 11 and 12 the testee is given 6 row practice to assemble as well as to disassemble the rivets and washers.

Reliability of the GATB

Reliability studies on GATB have concentrated on two types of reliability measures - stability and equivalence. The GATB Manual, Section III, Development (U.S. Department of Labour, 1970a) reports reliability coefficients obtained for GATB aptitude scores on various types of population - males, females, local employment service office applicants and high school and college students. The reported coefficient are quite high. Studies conducted at ATIRA (Dolke, et.al., 1975; Dolke, 1977; Dolke, 1979(a)(b); Sharma, 1979(a)(b), 1981, 1982) on various operative positions have found the test retest reliability of Motor Coordination, Manual Dexterity and Finger Dexterity to be quite high (ranging from .85 to .93). The GATB tests are manufactured and supplied by ATIRA with the permission from the originators.

Pursuit Rotor

The Pursuit Rotor, an instrument commonly used in laboratory experiments, was treated as a measure of "Perceptual-
Motor Coordination" in this study. The operations to be performed by the subjects on this test seemed pertinent for some of the operative positions described earlier in this Chapter. Operatives in some of the jobs are required to use "Perceptual-Motor Coordination" in carrying out the operations on rotating parts of the machine. For this "Face Validity" the Pursuit Rotor was preferred over "Two-Hand Coordination" apparatus. The Pursuit Rotor consists of a circular disc about the size of a phonograph turntable and is usually made of a non-conducting material such as bakelite. A small metal target about the size of a 25 paise coin is imbedded in the turntable levelled with the surface an inch or two from the periphery of the bakelite disc. The disc moves at different rpms in the clockwise direction when operated. In this study the speed was kept at 60 rpm.

A stylus with a wooden handle and a metal rod bent 90 degrees at the tip about half an inch is circuited with an instrument called "Chronoscope". The Chronoscope shows the time in centi-seconds.

The testee has to hold the stylus in his preferred hand and keep the tip of the stylus on the rotating target. He has to maintain the contact between the stylus and the rotating target for as much time as possible in a test trial of 30 seconds.
Test-retest reliability coefficient for this test obtained in the ATIRA studies ranges from .53 to .55 (Dolke, et al., 1975; Dolke, 1977; Dolke, 1979(a)(b); Sharma, 1979(a)(b), 1981, 1982).

This instrument is manufactured in India and is available from agencies supplying psychological tests.

**Reaction Time**

In classical experiments the speed of response to a given stimuli is measured by an apparatus called "Reaction Time".

The Reaction Time apparatus used in this study consisted of a rectangular device with two press keys on the subject's side and several press keys on the experimenter's side. A screen is kept in between the subject and the experimenter. The instrument is connected with a Chronoscope which measures the reaction time in centi-seconds.

The testee places his index finger of the preferred hand on a press key on hearing a ready signal (auditory) and lifts the finger from the pressed key as soon as the visual stimuli is given. The time to respond the stimuli is indicated on the Chronoscope. This test of responding when the choice of response is not given to the subject (the subject is only to respond by lifting his finger) measures the Simple Reaction Time (SRT).
In case of Choice Reaction Time (CRT) the testee uses both his hand and makes a choice in responding to the visual stimulus of two colours. For example on seeing a "red-light" the testee has to lift the left hand finger and on seeing a "white-light" has to lift the right hand finger.

Test-retest reliability coefficients of the reaction times obtained in ATIRA studies ranges from .50 to .55 and from .60 to .75 for SRT and CRT respectively. This apparatus is available in India and is supplied by agencies supplying psychological tests.

DATA COLLECTION

The data on 2,318 subjects were collected for a long-term project undertaken by the researcher in the Human Resources Division at ATIRA, on development of battery of aptitude tests and establishment of norms for the selection of operative personnel in textile industry. The project is still continuing. The data on freshers were collected as and when the researcher got the opportunity of helping the mills in selecting the job incumbents.

Prior to data collection in each mill a preliminary meeting was held with the management and the labour representatives. The background of the study, the objectives and procedural steps were explained. Care was taken to clarify doubts
and remove misgivings, if any, regarding the end uses of the data. The departmental heads were requested to allow their operatives to take part in the study. These meetings helped greatly in obtaining the required facility and cooperation, and in arranging sessions for conducting the test administration.

For the actual data collection operatives were called in pairs at an appointed time. A room on the mill premises free from outside disturbances and equipped with prerequisites for data collection served the purpose of an experimental laboratory. It took about two hours to test a pair of subjects and around 6 to 8 pairs were tested in a day by two test administrators.

Prior to the administration of the tests on the subjects, a rapport was established. Proper instructions either in vernacular or in Hindi were given to each subject. In order to acquaint the subjects on how they were to work, a few practice trials were given on each tests. Rest pauses were given after each test.

For assessing the retest reliabilities the tests were administered on a part of the subjects from the original sample again after an interval of 15 to 30 days. The distribution of subjects in the retesting sample in various operative positions is shown in Table 4.
For the purpose of testing the effect of practice/exposure on the performance on aptitude tests, fresh data were collected on 41 operatives. These 41 subjects were tested for four times, keeping an interval of 30 days among testings.

DATA ANALYSIS

The performance on the various aptitude tests were scored according to the nature of the test. The raw score on Motor Coordination (GATB, Part 8), Manual Dexterity (GATB, Parts 9 and 10) and on Finger Dexterity (GATB, Parts 11 and 12) were converted into standard scores using the Conversion Tables prepared at ATIRA for the purpose. Appendix I gives the Conversion Tables for GATB, Parts 8 to 12. The average of three pulls on the Hand Dynamometer constituted the score on strength of grip. Similarly, average of five trials on the Pursuit Rotor, and average of 20 trials each on Simple and Choice Reaction Times constituted the scores on these tests respectively.

With the software packages currently available for statistical analysis in social science research, the data could be subjected to various statistical treatment. An IBM 360/44 Computer was used for the analyses carried out in this study. However, a few analyses were carried out manually. The following analyses were carried out to test the hypotheses and to meet the objectives of this study:
(a) **Central Tendencies**

Means and Standard Deviation for the variables in the study were calculated.

(b) **Correlational Analysis**

The data were subjected to correlational analysis to examine the relationships between the independent and dependent variables and among the trials of practice/exposure. Depending upon the distribution of scores "Pearson-Product Moment" (r) or "eta" coefficients (n) were calculated. 'F' test was used for testing the curvilinearity. Correlations were also calculated between test-retest scores on various tests.

(c) **Regression Analysis**

Treating the demographic variable viz., the age, education and experience, as independent and the ability/aptitude test scores as dependent variable, multiple regression analysis was performed in order to determine the contribution of each of the demographic variable to the variance in the performance on the ability/aptitude tests.

(d) **Analysis of Variance**

One way analysis of variance was carried out to test the significance of difference in distribution of test scores among different sub-samples. 'F' ratios were calculated.
(e) **Significance of Difference Between Means**

Mean scores on the ability/aptitude tests of the groups differing in age, education, experience, state ethnicity and rural-urban background were tested for the significance of difference between groups classified on demographic variables. "t" ratios were calculated.

(f) **Factor Analysis**

Scores on various tests used in this study were analysed for studying the factor structure of tests.