3. RESEARCH METHODOLOGY

This chapter describes the methodology adopted in conducting this investigation under the following heads:

3.1 Locale of the study
3.2 Design of the study
3.3 Sampling technique
3.4 Variables, their operationalization and measurement
3.5 Development of instrument
3.6 Pre-testing
3.7 Reliability and validity
3.8 Data collection
3.9 Statistical analysis

3.1 LOCALE OF THE STUDY

Pradeshik Co-operative Dairy Federation (PCDF) Ltd., Uttar Pradesh, an implementing agency of operation Flood programme, was selected for the investigation. Operation Flood – II, a National Dairy Development Project sanctioned by the Govt. of India in 1978, was implemented in this state in November 1982. There were 28 districts covered under the above project which was launched in three phases. The first phase in 1982 covered 7 districts, second phase in 1984 covered 12 districts and the final phase in 1985 covered the last 9 districts (Table. 3).

Co-operative structure in dairying based on Anand Pattern, which is primarily concerned with the meeting of milk and milk products, has a three-tier structure, i.e. Federation at the state level, Co-operative Milk Producers Union at the district level and milk producers cooperative society at the village level. The milk producers cooperative societies have
joined to form the Co-operative Milk Producers Unions and these unions in turn have federated into the state level federation, the Pradeshik Cooperative Dairy Federation (PCDF) Ltd.

Table 3. Districts operated under OF – II in different phases

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Eastern Zone</td>
<td>A.</td>
<td>Eastern Zone</td>
<td>A.</td>
<td>Eastern Zone</td>
</tr>
<tr>
<td>2.</td>
<td>Fatehpur</td>
<td>2.</td>
<td>Ballia</td>
<td>2.</td>
<td>Hardoi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.</td>
<td>Lucknow</td>
<td>5.</td>
<td>Unnao</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.</td>
<td>Mirzapur</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.</td>
<td>Rai Bareli</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.</td>
<td>Sultanpur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Western Zone</td>
<td>B.</td>
<td>Western Zone</td>
<td>B.</td>
<td>Western Zone</td>
</tr>
</tbody>
</table>

* Selected Co-operative Milk Producer's Unions Cum Plants.

3.2 **DESIGN OF THE STUDY**

Research design is the plan, structure and strategy of investigation conceived so as to obtain responses to the research questions. It provides
the logical basis for drawing conclusions and for gaining knowledge, through quantitative representation of the observation made. There are different kinds of designs which vary from general and sketchy of intent, to carefully detailed and highly complex investigations. The research designs that are generally used for studying organizations can be divided into two types, i.e. exploratory and experimental (confirmatory), (Nunnaly 1978). In the present study, exploratory research design was adopted with the help of survey technique. According to Sharma et al. (1983), it has its broadest relevance and application to organizational research. The exploratory studies are the examinations of a given field for ascertaining the most fruitful avenues for predicting human behavior. The exploratory research paradigm in the present study consists of (i) formulating a problem for more precise investigation, (ii) defining objectives at various levels with precision, (iii) developing schedule and clarifying concepts, (iv) familiarity with the communication behavior in organizations, (v) studying individual traits and behavioral aspects and (vi) identification, association and prediction behavior based upon the description of interplay of variables.

3.3 SAMPLING TECHNIQUE

The sampling procedure adopted for this study comprises of three phases in the hierarchy of the organization structure. Firstly, federation at the state level was selected. Secondly, milk Producers Union (Fulfilling the criteria of having milk plant/product factory and milk union) were selected at the district level. The districts fulfilling this criteria were only three i.e. Meerut, Moradabad (western zone) and Varanasi (eastern zone), which were covered under phase I of Operation Flood – II. Finally, village level milk producers cooperative societies (MPCS) falling under
the selected district Milk Producers Cooperative Unions (MPCS) were selected at the grass root level (depicted in the map, Fig. 2).

The respondents present in the various distinct phases, namely Federation, Unions, Plants and Societies formed the broad universe, keeping intact with the objectives of the study. Since the investigation pertains to only one organization, a purposive sampling technique was employed. Thus, all the staff members in the managerial or officer cadre at the Federation, Union and Plant levels and the supervisors under the unions, looking after the MPCSs at the grass root level were purposively selected for the study (Fig. 3). In this way, the number of respondents at each phase were 35 (Federation), 50 (Plants), 40 (Unions) and 75 (MPCS level). In addition, the secretaries of 5 more successful and 5 less successful (based on their milk procurement and audit grade) MPCS under each district were selected randomly, numbering 30. Thus, the composite sample size of respondents was 230. The sampling plan is presented in Fig. 4.

Out of the total number of respondents selected for the purpose, a total of 100 respondents, who were identified as superiors in the hierarchy of the organization at varying levels, were seperated out for studying "superior's communication effectiveness" and tracing differences between various levels of organization for some selected personal, communicational and behavioral traits. The break-up consists of 17 respondents at the federation level, 25 respondents at plant level (all three plants), 20 respondents at union level (all three unions) and 38 respondents at grass root level (supervisors). However, the secretaries of various MSS and LSS, numbering 30, though not forming the part of organization were selected only to assess the communication
Fig. 2  Location of the area under study
Fig. 3 Organizational Flow Chart
**Federation**

(n₁ = 35)
(n₂ = 17)

---

**MILK PLANTS**

(n₁ = 50)
(n₂ = 25)

- **PLANT 1**
  
  (n₁ = 18)
  (n₂ = 09)
- **PLANT 2**
  
  (n₁ = 18)
  (n₂ = 09)
- **PLANT 3**
  
  (n₁ = 14)
  (n₂ = 07)

---

**MILK UNIONS**

(n₁ = 40)
(n₂ = 20)

- **UNION 1**
  
  (n₁ = 16)
  (n₂ = 08)
  Grass Root Level
  (Supervisors)
  (n₁ = 31)
  (n₂ = 16)
- **UNION 2**
  
  (n₁ = 14)
  (n₂ = 07)
  Grass Root Level
  (Supervisors)
  (n₁ = 26)
  (n₂ = 13)
- **UNION 3**
  
  (n₁ = 10)
  (n₂ = 05)
  Grass Root Level
  (Supervisors)
  (n₁ = 18)
  (n₂ = 09)

---

**Fig. 4  Sampling Plan**
effectiveness of their corresponding supervisors, who were looking after the societies. In the organizational chart and sampling plan, they were depicted in dotted letters/numbers and were not taken into consideration for the rest of the investigation.

The various phases, viz. Federation, Plant, Unions and Supervisors (MSS and LSS) selected for the study were designated as Category-I, Category-II, Category-III and Category-IV, respectively.

3.4 VARIABLES, THEIR OPERATIONALIZATION AND MEASUREMENT

For any study undertaken in social sciences research, it is customary to precisely mention the variables used for the study along with their working concepts and scales used for measurement. In the present investigation, an attempt has been made to scan all the available literature for selecting the pertinent variables. However, the information secured from the pilot study and intensive discussions with the experts in the field were given due weightage before finalizing the identification of variables covering the entire gamut of the study. The list of selected variables and their measurement are presented in the Table 4 for a quick glance.

The variables selected for the study were categorized into two main groups, viz. independent traits and dependent traits. Independent traits further categorized into three sub groups i.e. personal traits, communication traits and behavioral traits. The variables under these groups along with their operationalization and measurement procedure are given below.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variables</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>INDEPENDENT</td>
<td></td>
</tr>
<tr>
<td>I.</td>
<td>Personal traits</td>
<td></td>
</tr>
<tr>
<td>01.</td>
<td>Age</td>
<td>Direct questioning</td>
</tr>
<tr>
<td>02.</td>
<td>Education</td>
<td>Direct questioning</td>
</tr>
<tr>
<td>03.</td>
<td>Experience</td>
<td>Direct questioning</td>
</tr>
<tr>
<td>04.</td>
<td>In service Training</td>
<td>Direct questioning</td>
</tr>
<tr>
<td>05.</td>
<td>Attitude Towards Superiors</td>
<td>Daly – Falcione (1976)</td>
</tr>
<tr>
<td>06.</td>
<td>Value Towards Superiors</td>
<td>Daly – Falcione (1976)</td>
</tr>
<tr>
<td>07.</td>
<td>Interpersonal Trust</td>
<td>Bhanja (1981)</td>
</tr>
<tr>
<td>08.</td>
<td>Communication Apprehension</td>
<td>Scott, Magroskey and Sheahan (1976)</td>
</tr>
<tr>
<td>II.</td>
<td>Communicational Traits</td>
<td></td>
</tr>
<tr>
<td>09.</td>
<td>Communication Contingency Structure</td>
<td>Wiio (1997) and Goldhaber (1977)</td>
</tr>
<tr>
<td>III.</td>
<td>Behavioral Traits</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Job Satisfaction</td>
<td>Brayfield and Rothe (1951)</td>
</tr>
<tr>
<td>13.</td>
<td>Organizational Commitment</td>
<td>Porter et al. (1974)</td>
</tr>
<tr>
<td>14.</td>
<td>Cohesiveness</td>
<td>Developed Multiple Choice Statements</td>
</tr>
<tr>
<td>15.</td>
<td>Recognition</td>
<td>Developed Multiple Choice Statements</td>
</tr>
<tr>
<td>16.</td>
<td>Decision Making</td>
<td>Developed Multiple Choice Statements</td>
</tr>
<tr>
<td>B.</td>
<td>DEPENDENT</td>
<td></td>
</tr>
<tr>
<td>01.</td>
<td>Communication Climate</td>
<td>Dennis (1974)</td>
</tr>
<tr>
<td>02.</td>
<td>Superior's Communication Effectiveness</td>
<td>Scale Developed</td>
</tr>
</tbody>
</table>
3.4.1 INDEPENDENT TRAITS

3.4.1.1 Personal Traits

01. Age: It was defined as the chronological age of the respondent rounded to nearest number at the time of investigation. The respondents were categorized into two groups viz. under 35 years and above 35 years (Appendix. II : 1).

02. Education: It was referred to the number of years of formal education acquired by the respondent. The respondents were categorized into-upto graduation and above graduation (Appendix. II : 2).

03. Experience: It was computed for the present study as total number of years an individual has acomplished in the service of the organization. The respondents were categorized into two groups i.e. under 5 years and over 5 years (Appendix. II : 3).

04. Inservice Training: It was described as the extent employees are encouraged by the organization to take up training or refreshal studies for their job enrichment. The inservice training was comprised of three parts, viz. type of training, name of the place/institution offering training and duration of the training. All these were quantified with the help of direct questioning (Appendix. II : 4).

05. Attitude Towards Superiors: It was conceptualized as the degree of positive or negative feeling towards a psychological object. This variable was measured with the help of Daly–Falcione (1976) Similarity-Dissimilarity test, which measures the degree to which the employees are similar or dissimilar in their attitude to
their superiors in the context of various matters related to organization (Appendix. II : 5).

06. Value Towards Superiors: It was viewed as a basic set of beliefs, an individual accrues with some sense of right/wrong judgement. This variable was also quantified with the help of Daly-Falcione (1976) Similarity-Dissimilarity test, which measures the degree to which the employees are similar or dissimilar in their values to their superiors in the context of various matters concerning organization (Appendix. II : 6).

07. Interpersonal Trust: It was related to the faith and confidence that the members of the organization possess among themselves. It was measured by asking the multiple choice statements developed by Bhanja (1980) (Appendix. II : 7).

08. Communication Apprehension: It was interpreted as the amount of apprehension (general feelings about communication) that an individual feels towards communicating in general and specifically at work. This variable was measured with the help of scale developed by Scott, McGroskey and Sheahan (1976). In this scale they indicated the agreement or disagreement to communication apprehension by using and not using asterisk (*) for individual item (Appendix. II : 8).

They also have given a formula to score the scale which is presented below:

Score = 60 – Total of items with asterisks (*)

+ Total of items without asterisk (*)
3.4.1.2 Communicational Traits

09. Communication Contingency Structure: It was described as patterns of dependency relationship within and among subsystems as well as between the system and its environment. This aids us to understand how the organizations operate under varying conditions and specific circumstances. The communication contingency structure has been operationalized into two categories viz. internal contingency structure (Type, outputs, demographic, spatiotemporal and traditions) and external contingency structure (economic, technological, legal, socio-cultural/political and environmental). The scale was quantified on a 6-point continuum ranging from non to a very great extent and was developed by Wiio and Goldhaber (1977) (Appendix. III : 9).

10. Communication Channel Use: It was characterized as the means, which the individual as a source using it to get his message across to the receiver. The frequency of use of various inter-organization communication channels was considered for this purpose. The variable consists of 15 channels, based on their common use in the organizations and was measured with the help of a 5-point scale developed by Singh (1974) ranging from almost never to almost always (Appendix. III : 10).

11. Communication Load: It was operationally defined as the amount of communication activities performed by an individual apropos to his daily routine in the organization. To quantify this variable a 5-point continuum scale developed by Mohan (1989) was adopted. Fifteen communication activities that are usually
carried out in the organization have been presented in the scale (Appendix. III : 11).

3.4.1.3 Behavioral Traits:

12. **Job Satisfaction**: It was referred to individual's feelings about the job as expressed in terms of interest, boredom, enjoyment and enthusiasm. The job satisfaction was measured with the help of an instrument developed by Brayfield and Rothe (1951). The instrument comprised of 18 items and was quantified on a 5-point continuum, ranging from strongly agree to strongly disagree (Appendix. IV : 12).

13. **Organizational Commitment**: It was attributed to the effective attachment to the goals and values of an organization to one's role in relation to goals and values. This variable was operationalised by using the scale developed by Porter et al. (1974). It consists of 15 items which were on a 5 point continuum, ranging from strongly agree to strongly disagree (Appendix. IV : 13).

14. **Cohesiveness**: It was operationalised as the extent and togetherness being felt by the members of the organization. The variable was measured by developing the multiple choice statements. The scores were given to various alternatives of each statement, which vary from 1 (almost never) to 5 (almost always) (Appendix. IV : 14).

15. **Recognition**: It was illustrated as the perception or acknowledgement of something as good and valid in terms of appreciation, rewards of achievements, marits, services etc. Operationally, this variable was measured with the help of
developing multiple choice statements for this purpose (Appendix IV: 15).

16. Decision Making: It was characterized as a coordinated sequence of actions and operationally, it referred to degree of involvement by the organizational members in making decisions or implementing decisions. It was quantified by giving scores to various alternatives of each statement, developed for this purpose. The scoring procedure is similar to that of cohesiveness (Appendix IV: 16).

3.4.2 DEPENDENT TRAITS

01. Communication Climate

Communication climate was operationally defined as the perceived evaluation of organization members apropos to how the communication flow takes place and how the people are acting and behaving at varying levels in the organization. Here this variable has been categorized into five dimensions, viz. superior - subordinate communication, quality of information, superior's openness/candor, upward communication opportunity and reliability of information. The instrument was developed by Dennis (1974) and it consists of 45 items, representing the above five dimensions. The dimensions have also been individually operationalized as below:

**Dimension – 1 Superior - Subordinate Communication**

It consists of twenty one items. This dimension particularly illustrates the supportiveness from the superiors as perceived by the subordinates in downward diffusion of information.
Dimension – II Quality of Information

It consists of twelve items and it ascribes to perceived quality and accuracy of downward communication with subordinates.

Dimension – III Superior’s Openness/Candor

It consists of five items and it relates to superiors perceptions of communication relationships with subordinates, especially the effective aspects of there relationship, i.e. openness and empathy, confining to downward flow of information.

Dimension – IV Upward Communication Opportunity

It also consists of five items and it pertains to subordinates perception of upward communication opportunity and degree of influence.

Dimension – V Reliability of Information

It consists of two items and it depicts the perceived reliability of information among peers in horizontal communication and from subordinates in upward communication.

The instrument designed by Dennis was administered of all the selected respondents who have been asked to indicate, for each item, the extent to which they agree with the statement. The five point continuum used each item was:

1- to a very little extent
2- to a little extent
3- to some extent
4- to a great extent
5- to a very great extent
Thus, the range of scores for 45 items varied from a minimum of 45 (indicating a very poor communication climate) to a maximum of 225 (indicating a very good communication climate) (Appendix V: 17).

02. **Superior's Communication Effectiveness**

For the present study, the superior's communication effectiveness was operationally defined as individual's performance of communication activities in relation to fulfillment of various characteristics of essential elements of communication process, viz. source, message, channel and receiver. The individual superior's communication effectiveness was assessed with the help of subordinates perceptions of their superior's communication abilities as expressed in terms of source, message, channel and receiver characteristics.

The instrument designed for the study was administered on all the 100 identified respondents (from the total sample), who were considered as superiors among different categories, at varying levels in the organization. The respondents were asked to choose the alternatives for each item from the response code as depicted here under:

1- to a very little extent
2- to a little extent
3- to some extent
4- to a great extent
5- to a very great extent

Thus, the range of score for 26 items varied from a minimum of 26 (indicating very poor superiors' communication effectiveness) to a
maximum of 130 (indicating very good superior's communication effectiveness) (Appendix, V : 18).

3.5 DEVELOPMENT OF INSTRUMENT

The instrument for the measurement of superior's communication effectiveness at varying levels in the organization was developed. The following described steps were followed to develop this instrument:

(i) **Collection and Administration of Items**
All the possible items regarding the superior's communication effectiveness were collected in consultation with experts, relevant literature and concerned research studies, while collecting items, care was taken to include most relevant items pertaining to different elements of communication process, which serve as the basis for assessing communication effectiveness of superior's. In all 40 items, apropos to different elements of communication (Source, Message, Channel and Receiver) were formulated. All these 40 items were administered to 50 judges (subjects) consisting of experts and academicians in the disciplines of extension, communication, management and allieds. The responses to all the items on the basis of frequency distribution were recorded on a 5-point rating scale "most important"; "much important"; "important"; "less important"; and "least important" with weights of 5, 4, 3, 2 and 1 respectively.

While analyzing the statements, the judges were asked to rate the items based on the perception of their superiors about the downward and upward communication, i.e. routinely taking place in the organization. They were also requested to bear two things in mind:
(a) how effectively the superior is fulfilling the qualities of Source, Message and Channel while sending the messages downward and 
(b) how effectively the superior is fulfilling the qualities of a receiver, while the messages are received upward.

For final selection of the items, item analysis has been done by following the summated rating method (Likert technique) as suggested by Edward (1957).

(ii) **Analysis of Items**

The responses from 30 subjects (judges) were received and were then arranged in descending order of scores from highest to lowest. The top 25 percent of subjects with the highest total scores and 25 percent with the lowest total scores were used to assess each item, for which 't' value was calculated with the help of the following formula given by Edward (1957):

\[
t_{cal} = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\Sigma (\bar{X}_H - \bar{X}_H)^2 + \Sigma (\bar{X}_L - \bar{X}_L)^2}{n(n-1)}}}
\]

where,

- \(X_H\) = the mean score on a given statement for the high group
- \(X_L\) = the mean score on a given statement for the low group

\[
\Sigma (\bar{X}_H - \bar{X}_H)^2 = \bar{X}_H^2 - \frac{(\Sigma \bar{X}_H)^2}{n}
\]
\[ \sum (X_L - \bar{X}_L)^2 = X_L^2 - \left( \frac{\sum X_L}{n} \right)^2 \]

\[ \sum X_H^2 \quad \text{sum of the squares of the individual score in the high group} \]
\[ \sum X_L^2 \quad \text{sum of the squares of the individual score in the low group} \]
\[ n(n-1) \quad \text{no. of subjects in the high group/low group (here, it is nH = nL = n as the same percentage of the total number of subjects were selected, both for the high and low groups).} \]
\[ t \quad \text{the extent to which a given statement differentiates between the high and low groups.} \]

(iii) **Selection of Items**

Finally, for this study, 26 items out of the original 40 items were selected on the basis of highest \( t \) – value, i.e. more than 1.75 was taken into account. The range \( t \) – value of selected items from the minimum of maximum was 1.75 to 5.71. The calculated \( t \) – value of various items are present in Appendix I.

(iv) **Reliability of the Scale**

The scale designed for the study was pre-tested for its reliability by using the split-half technique. It was administered to 20 respondents of non-sample area. The coefficient of correlation between odd and even scores was calculated with the help of Pearson’s product moment correlation coefficient \( (r) \). The \( r \) value thus calculated was 0.85 and was found significant at 1 percent level of probability, thereby, testifying the reliability of the scale.
(v) **Validity of the Scale**

The validity of this scale was established through content validity. All possible care was taken to include the items covering all aspects of superior's communication effectiveness by surveying the literature and taking experts' opinion. It was also checked for language comprehension during pre-testing and thus it was assumed that the scale was measuring what it intended to measure. Moreover, calculation of 't' value also showed high discriminatory values of the items. Therefore, the scale was taken as a valid measure of the desired dimension.

3.6 **PRE-TESTING**

Before introducing the questionnaire to the target sample, it was pre-tested on a similar population of 20 respondents in a non-sample area (Kanpur milk plant of PCDF). After getting the response, necessary modifications were made in the construction of questionnaire to improve the clarity and meaning of the statements in the final questionnaire.

3.7 **RELIABILITY AND VALIDITY**

The reliability and validity of various instruments taken for the study were tested through split – half method and content method, respectively. The schedule was administered to 20 non-sample respondents taken randomly from the managerial cadre population of Kanpur milk plant of PCDF. The coefficient of reliabilities were computed by using Pearson's Product movement correlation coefficient (r). The reliability values, thus, calculated for various instruments are presented below:
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variables</th>
<th>'r' – values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Communication apprehension</td>
<td>0.88</td>
</tr>
<tr>
<td>2.</td>
<td>Communication contingency</td>
<td>0.76</td>
</tr>
<tr>
<td>3.</td>
<td>Communication load</td>
<td>0.68</td>
</tr>
<tr>
<td>4.</td>
<td>Communication climate</td>
<td>0.87</td>
</tr>
<tr>
<td>5.</td>
<td>Superiors communication effectiveness</td>
<td>0.85</td>
</tr>
<tr>
<td>6.</td>
<td>Job satisfaction</td>
<td>0.78</td>
</tr>
<tr>
<td>7.</td>
<td>Organizational commitment</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Significant at 1% level of probability.

These values show the suitability of the various tools used to measure the selected variables.

The validity of various instruments was tested with the help of content validity. Content validity is the representativeness or sample adequacy of the contents i.e. the substance. Validity of the scale is borne out by the method of collecting the items within the universe. The universe of the concept was covered widely and selected through scanning available literature and consulting experts concerned.

### 3.8 DATA COLLECTION

The final data collection was undertaken by administering the final format of organization communication assessment questionnaire. The data collection was carried out at three levels, viz. Federation at the state level, milk plants and milk unions at the district level and milk producers cooperative societies at the grass root level. Before the initiation of data collection, all the relevant secondary information in terms of number of existing milk plants, milk unions, village cooperative societies, list of employees in managerial/officer cadre at all levels, functions of various units and other related information were obtained. Considerable rapport was also developed with the officials of the selected units by visiting
them prior to data collection. Hence, there was not much difficulty in recording the data. Care was taken to get the accurate response from the respondents by personally explaining them. The questionnaires were distributed and collected personally.

The collected responses were scored and tabulated into a master sheet. The raw scores were converted into percentages and then advanced for statistical analysis.

3.9 STATISTICAL ANALYSIS OF THE DATA

The data collected and tabulated was statistically analyzed in the light of the objectives set forth for the study. The statistical methods used in the present study includes mean, frequency, percentage, coefficient of correlation and multiple regression analysis. Most of the analysis was carried out through computer. However, the techniques used were depicted with their formulae as under:

Mean

Mean was calculated by adding the total scores obtained from the respondents and then dividing by the total number of respondents.

Frequency

It was used to find out the number of respondents in a particular group. In the present study, the respondents were categorized in terms of independent and dependent variables with the help of mean and S.D. The grouping was done as below:

Low : < m - 2/3 SD

Medium : m - 2/3 SD to m + 2/3 SD

High : > m + 2/3 SD
**Percentage**

This was used for making simple comparisons. The percentage was worked out by dividing the frequency of a particular cell by total number of respondents in that particular category and multiplying by 100.

**Coefficient of Correlation**

In order to find out the association between selected independent variables and the dependent variables, Pearson's product movement correlation coefficient (r) was adopted. The Downie and Heath (1965)'s formula for this purpose is given below:

\[
  r = \frac{\Sigma XY - (\Sigma X)(\Sigma Y)/n}{\sqrt{\left[\left(\Sigma X^2 - (\Sigma X)^2\right) \left(\Sigma Y^2 - (\Sigma Y)^2\right)/n\right]}}
\]

Where,

\[
  r = \text{Correlation coefficient}
\]

\[
  x, y = \text{variables}
\]

\[
  n = \text{no. of observations}
\]

**Multiple Regression Analysis**

Multiple regression technique was done on the computer to determine the degree to which the dependent variable could be predicted with the independent variables and also to trace out the contributory influence of independent variables on dependent variables. For this purpose the independent variables were grouped as personal, communicational and behavioral variables and they were regressed in two phases, each with communication climate and superiors communication
effectiveness. In multiple regression analysis our aim usually is to find out the joint effect of several independent variables on dependent variables. The multiple regression equation model used in the study was:

\[ y = a + b_1x_1 + b_2x_2 + \cdots + b_kx_k \]

Where,

\[ Y = \text{predicted value of dependent variable on the basis of independent variables -} x_1x_2 \cdots \cdots x_k \]

\[ a = \text{constant term of equations of} x_1x_2 \cdots \cdots x_k \]

\[ b_1, b_2, \ldots, b_k = \text{partial regression coefficients of} y \text{ on} x_1x_2 \cdots \cdots x_k \]

However, The formula used for calculating the partial regression coefficient was:

\[ \sum x_1^2 \sum x_1x_2 \cdots \cdots \sum x_1x_k \]

Let \( A = \sum x_2x_1 \sum x_2^2 \cdots \cdots \sum x_2x_k \) and

\[ \sum x_kx_1 \sum x_kx_2 \cdots \cdots \sum x_k^2 \]

be the variance covariance matrix

\[
\begin{bmatrix}
  b_1 \\
  b_2 \\
  \vdots \\
  \vdots \\
  b_k \\
\end{bmatrix}
\]

\[ \sum x_1y \]

\[ \begin{bmatrix}
  \sum x_2y \\
  \vdots \\
  \sum x_ky \\
\end{bmatrix} \]

RHM

Then \( B = A^{-1} \quad \text{RHM} \)
Gives the estimates of regression coefficients.

\[ b_0 = y - b_1 X_1 - b_2 X_2 \ldots \ldots \ldots \ldots b_k X_k \]

Standard error of \( b_i = \sqrt{c_{ii}} \cdot s^2 \)

Where \( c_{ii} \) are the diagonal elements of the inverse of the matrix \( A \), i.e., elements of \( A^{-1} \).

\( s^2 = \text{Residual variance in the analysis of regression.} \)

The significance of individual partial regression coefficient \( (b) \) can be calculated with the help of \( t \)-value:

\[ t_{\text{cal}} = \frac{b - b_0}{\text{S.E.} (b)} \text{ with } (n - k - 1) \text{ d.f.} \]

Where,

\( b = \text{regression coefficient} \)

\( \text{SE} (b) = \text{standard error of the regression coefficient} \)

The multiple regression tool is also used to compute coefficients of multiple determination \( (R^2) \). This gives the percentage of variation explained by the independent variables \( (x_1, x_2, \ldots, x_k) \) independent variables \( (y) \). The \( R^2 \) can be calculated by using the following formula:

\[ R^2 = \frac{\Sigma b_i S_{Y|X}}{S_{YY}} \]

Where,

\( R^2 = \text{Coefficient of multiple determination} \)

\( b_i = \text{Partial regression coefficient of } Y \text{ on } X_i \)

\( S_{Y|X} = \Sigma X_i Y \text{ and} \)

\( S_{YY} = \Sigma Y^2 - \frac{(\Sigma Y)^2}{n} \)
Standard Regression Coefficient

This was calculated by using the following formula:

$$B_s = b_s \times S_2/S_1$$

Where,

- $B_s$ = Standard regression coefficient
- $b_s$ = Partial regression coefficient
- $S_2$ = Standard deviation of independent traits
- $S_1$ = Standard deviation of dependent traits