CHAPTER – 3

RESEARCH DESIGN

3.1 Introduction

The chapter focuses on describing the research objectives and research methodology adopted to achieve objectives of the study. Firstly, objective-wise methodology is listed and thereafter, research techniques are discussed. It also highlights the research design which refers to the blueprint of how the research has progressed.

3.2 Objectives of research

Objectives of the present study are based on the gaps in the available literature and present demands. The overall objective of the proposed research is to develop an employability model for management graduates that will improve the quality of hiring decisions and can help in enhancing the overall employability level. The overall objective of the study is broken down into certain sub-objectives as follows:

1. To identify attributes of employability of management graduates
2. To evaluate available employability models; and examine the current status of employability of management graduates in India
3. To develop relative priority among various sub-attributes of employability using ISM-FMICMAC and AHP techniques
4. To develop a model of employability integrating Attitude, Skill, Knowledge and manager’s intuitive judgment – using Bowman’s Management Coefficient Model and prescribe employability index
5. To develop an employability evaluation tool to enable HR managers in improving quality of hiring decisions
6. To use QFD to translate industry’s needs for employability into a right management curriculum
7. To develop a framework for ranking business schools using gain in employability as a criterion

3.3 Tools and Techniques used

There are various methodological tools available in research, each with specific advantages and disadvantages. However, the choice of the tools and techniques depends on the objectives of the study, nature of the phenomenon and researcher’s discretion towards the ways in which the data will be used. Therefore, considering the complexity of the phenomenon under study and multiplicity of objectives, a combination of different tools and techniques have been used in different phases of developing the model, its validation and its potential applications. Table 3.1 summarizes objective-wise description of tools and techniques used whereas Figure 3.1 shows the research design of the study.
Table 3.1: Objective-wise description of research methodology used

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Objectives</th>
<th>Tools and Techniques used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To identify attributes of employability of management graduates</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>To evaluate available employability models; and examine the current status of employability of management graduates in India</td>
<td>Descriptive statistics</td>
</tr>
<tr>
<td>3</td>
<td>To develop relative priority among various sub-attributes of employability using ISM-FMICMAC and AHP</td>
<td>ISM-FMICMAC, AHP</td>
</tr>
<tr>
<td>4</td>
<td>To develop a model of employability integrating Attitude, Skill, Knowledge and manager’s intuitive judgment – using Bowman’s Management Coefficient Model and prescribe employability index</td>
<td>Bowman Management Coefficient Model, Regression, Sensitivity Analysis, Cluster Analysis, Simulation</td>
</tr>
<tr>
<td>5</td>
<td>To develop an employability evaluation tool to enable HR managers in improving quality of hiring decisions</td>
<td>PHP, MySQL, HTML</td>
</tr>
<tr>
<td>6</td>
<td>To use QFD to translate industry’s needs for employability into a right curriculum</td>
<td>QFD</td>
</tr>
<tr>
<td>7</td>
<td>To develop a framework for ranking business schools using gain in employability as a criterion</td>
<td>Descriptive statistics</td>
</tr>
</tbody>
</table>
Brief overview of various tools and techniques used to execute the research design is as follows:

### 3.3.1 Interpretive Structural Modeling (ISM) and FMICMAC Analysis

ISM is an established technique for identifying relationships among specific items which define a problem or an issue (Warfield, 2005). A group of experts are consulted and their opinions are used in developing the relationship matrix, which is used to develop the ISM model. ISM could be applied using the step-by-step procedure as follows:
I. Structural Self-Interaction Matrix (SSIM)

Using experts’ opinions, pair-wise comparison is done among the variables to know the direction of their relationship. Following symbols are used to denote the direction of relationship between the variables (i and j):

V: variable i will help to achieve variable j;
A: variable i will be achieved by variable j;
X: Variable i and j will help to achieve each other
O: Variable i and j are unrelated.

II. Initial Reachability Matrix

The SSIM is converted into a binary matrix, called the reachability matrix by substituting the symbols V, A, X and O by ‘0’ and ‘1’ as per the following rules:

• if the entry in the SSIM is V, then (i, j) entry in the reachability matrix becomes ‘1’ and the (j, i) entry becomes ‘0’
• if the entry in the SSIM is A, then (i, j) entry in the reachability matrix becomes ‘0’ and the (j, i) entry becomes ‘1’
• if the entry in the SSIM is X, then (i, j) entry in the reachability matrix becomes ‘1’ and the (j, i) entry becomes ‘1’
• if the entry in the SSIM is O, then (i, j) entry in the reachability matrix becomes ‘0’ and the (j, i) entry becomes ‘0’.
III. Final Reachability Matrix

Initial reachability matrix is further iterated into a final reachability matrix. It is obtained by incorporating the transitivity, which is a basic assumption made in ISM. It states that if a variable A is related to B and B is related to C, then A is related to C. In order to incorporate transitivity, as per Malone (1975), add identity matrix to initial reachability matrix and then multiply the initial reachability matrix with itself (replace all values $\geq 1$ with 1) till following condition is fulfilled (eq. 3.1):

\[(A + I)^{n-1} < (A + I)^n = (A + I)^{n+1}\]  --- (3.1)

where, A is initial reachability matrix

IV. Level Partitioning

Various variables are aggregated into levels. A level is itself a set, composed of those variables that lie at the same relative position. From the final reachability matrix, the reachability set and antecedent set for each variable is determined. The reachability set consists of the variable itself and other variables, which it may help to achieve, whereas the antecedent set consists of the variable itself and the other variables, which may help in achieving it. Subsequently, the intersection of these sets is derived for all the variables. The variable for which the reachability and intersection sets are the same is the top-level variable in the ISM hierarchy. Once the top-level variable is identified, it is separated from the other variables. This process continues till the levels of all variables are identified. These identified levels help in building the digraph and hence the final model. The driving power and dependence power for each variable is calculated. Driving power is the total number of variables (including itself), which it may help achieve. On the other hand, dependence power is the total number of variables (including itself), which may help in achieving it. Finally, an ISM model is generated by putting the variables according to their levels in a directed graph.
V. ISM Fuzzy-MICMAC Analysis

While developing ISM model, the relationship between two variables is denoted by ‘0’ and ‘1’. Binary number ‘1’ denotes that there is a relationship between two variables and binary number ‘0’ denotes that there is no relationship between two variables. However, the extent of relationship between two variables is not considered i.e. some relations may be very strong, some may be strong and some may be weak. In order to overcome this drawback of ISM model, ISM Fuzzy MICMAC analysis is carried out as per following procedure:

VI. Binary Direct Relationship Matrix

A Binary Direct Reachability Matrix is obtained by converting the diagonal entries to zero in Initial Reachability Matrix.

VII. Fuzzy Direct Relationship Matrix (FDRM)

In FDRM, the possibility of reachability is considered instead of the mere consideration of reachability. To improve the sensitivity, in fuzzy MICMAC analysis, an additional input of possibility of interaction between the elements is introduced. This possibility of reachability is superimposed on the Binary Direct Relationship Matrix (BDRM) to obtain a Fuzzy Direct Relationship Matrix (FDRM).

VIII. Stabilization of Fuzzy Direct Relationship Matrix

For the stabilization of FDRM, the fuzzy direct relationship matrix is multiplied with itself until the hierarchy of driving power and dependence power is stabilized. According to Fuzzy Set Theory, when two fuzzy matrices are multiplied, the product matrix is also a fuzzy matrix. The multiplication follows the principle of fuzzy matrix multiplication (eq. 3.2, Kandasamy, 2007):
AB =\text{Max} \{\min (aij, bij)\} \quad ---\ (3.2)

Where, \(A = [aij]\) and \(B = [bijd]\) are two fuzzy matrices

The driving power of the variables in Fuzzy-MICMAC is determined by summing the entries of possibilities of interactions in the rows. The dependence power of variables is determined by summing the entries of possibilities of interactions in the columns.

3.3.2 Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process, multi criteria decision making (MCDM) technique, has been developed by Thomas L Saaty. It helps a decision maker to select the best alternative by giving prioritized ranking. This hierarchical model uses pair-wise comparisons of relative importance among a set of pre-specified alternatives. It evaluates the data mathematically by converting both qualitative and quantitative factors of decision into numbers. AHP can be summarized through following steps:

I. Problem identification
   The first step is to identify the decision making problem. Unless the problem is known, the process cannot be initiated.

II. Developing hierarchy
   The second step is to develop the hierarchy for the problem showing the overall goal, the criteria and the alternatives.

III. Establishing Priorities
   The third step is to establish the priorities for the criteria using pair-wise comparisons done by decision maker. It can further be explained step-by-step as follows:

   a. Pair-wise comparisons
The decision-maker gives relative weights to criteria while doing pair-wise comparisons. To measure how important is one criteria than other criteria, a comparison scale (Table 3.2) with values from 1 to 9 is used.

Table 3.2: Comparison Scale for the importance of Criteria

<table>
<thead>
<tr>
<th>Verbal Judgement</th>
<th>Numerical Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely more important</td>
<td>9</td>
</tr>
<tr>
<td>Very strongly more important</td>
<td>8</td>
</tr>
<tr>
<td>Strongly more important</td>
<td>7</td>
</tr>
<tr>
<td>Moderately more important</td>
<td>6</td>
</tr>
<tr>
<td>Equally important</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

b. Pair-wise comparison matrix

To construct a pair-wise comparison matrix, following steps to be followed:

i. Enter the numerical ratings given in step ‘a’ into the pair-wise comparison matrix.

ii. Make all the diagonal elements of the pair-wise comparison matrix as ‘1’. It is so because at this point, every criterion compares to itself.

iii. The remaining cells of the matrix are to be filled with the corresponding fractions. For example, if criteria ‘A’ is given relative importance of ‘n’ over criteria ‘B’, then criteria ‘B’ over criteria ‘A’ is to be rated ‘1/n’.
c. Synthesization

The third step of synthesization can be performed using following three-step procedure:

i. Calculate the sum of all the values in each column of the pair-wise comparison matrix.

ii. Divide each element by its column total in the pair-wise comparison matrix. The resulting matrix is called as normalized pair-wise comparison matrix.

iii. In normalized pair-wise comparison matrix, calculate the average of elements in each row. This average gives the priorities for the criteria.

d. Consistency

Consistency is the key step of AHP as it checks for the consistency in the pair-wise comparisons done by the decision-maker. ‘Consistency ratio’ is the measure of consistency and it can be calculated using following five-step procedure:

i. In pair-wise comparison matrix, multiply each element in the first column by the priority of the first item. Repeat the same process for all the columns and their respective priorities. Then, calculate the sum of all the values in a row and this is called “weighted sum”. After calculating “weighted sum” for all the rows, we get a weighted sum vector.

ii. Divide the elements of weighted sum vector by its corresponding priority.

iii. Calculate the average of all the values got in above step ‘ii’. This average is denoted by $\lambda_{\text{max}}$.

iv. Calculate the Consistency index as follows:

$$CI = \frac{\lambda_{\text{max}} - n}{n-1} \quad \text{--- (3.3)}$$
Where, \( n \) is the total number of criteria compared

v. Calculate the Consistency ratio as follows:

\[
CR = \frac{CI}{RI}
\]  --- (3.4)

Where, RI is the consistency index for randomly generated pair-wise comparison matrix and its value depend on the number of criteria compared and is as shown in Table 3.3:

<table>
<thead>
<tr>
<th>n</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.49</td>
</tr>
</tbody>
</table>

Consistency ratio of 0.10 or less is acceptable.

IV. Analyzing and Selecting best alternative

Based on the nature of problem and the priorities found, we select the best alternative.

The flow diagram of AHP is as depicted in Figure 3.2. In this research, AHP has been applied to find relative weights of ‘Specific’ attributes of employability for the domain of Human Resources, finance, Marketing, Operations and Analyst.
3.3.3 Quality Function Deployment (QFD)

Quality Function Deployment, multi-attribute measurement method, was developed in 1972 and was used first time by Ford and Xerox in United States in 1986. QFD is a structured approach to capture the voice of the customer and effectively relating “customer needs” and “technical requirements” of product design. The key matrix of QFD is House of Quality (HOQ) which shows the extent of relationships between “whats” and “hows” of product design. The basic structure of House of Quality is shown in Figure 3.3.
Designing HOQ includes defining and prioritizing customer’s needs, defining design requirements, designing relationship matrix and correlation matrix etc. (Figure 3.4). In this research, QFD has been used to suggest model curriculum for MBA program in a select ongoing business school.
3.3.4 Simulation

Simulation imitates the complex real-world systems. This technique is a quantitative approach for decision-making. It uses model rather than real system and hence, saves time, efforts and money. The simulation model represents the contents mathematically such as the input, output and the logical relationship between these two. Technology plays an important role in simulation as it makes easy to generate random numbers, doing analysis for large data. Simulation has been used in multiple contexts such as training, games, education and so on. The steps taken to simulate real-life situation are as depicted in Figure 3.5. In this research, simulation has been used for the purpose of model validation.
Employability profiles have been generated for 100 candidates appearing for interview and the same has been replicated three times.

![Flow diagram for Simulation](image)

**Figure 3.5: Flow diagram for Simulation**

### 3.3.5 Bowman Management Coefficient Model

Bowman (1963) suggested that the basic difference in intuitive decision making and the model based scientific decision making is the manner in which decision variables and situational parameters are linked with the objective function. While in a scientific model of decision making; the objective function is linked with the decision variables (controllable variables) and constraints (non-controllable parameters) in a mathematically consistent cause-effect model form; in intuitive decision making all these are linked in the mental model of the decision maker. In the process of this linking; the decision maker is more
erratic or inconsistent; rather than biased. Bowman also opined that most total system cost covers as a function of decision variable are ‘dish-shaped’ due to relative robustness of optimality. As a result; marginal biases in decision making are not that serious provided we are consistent around our own biases on either side of optimality. Thus, it is erratic or inconsistent nature of intuitive decision making which is the real problem and not the biases. Thus if a manager can be consistent about his/her own biases; then the intuitive decisions will be almost as good as optimal.

### 3.3.6 Miscellaneous Statistical Techniques

Other statistical techniques like descriptive statistics, regression, cluster analysis, sensitivity analysis have been used at multiple levels in order to achieve objectives of the study. Questionnaire and survey based empirical research have also been used in finalizing the employability attributes, developing and validating an employability model.

### 3.4 Conclusions

The aim of this chapter was to list down the various objectives of the study and choosing the appropriate methodology for each research objective. The application of the chosen techniques is shown in the subsequent chapters. It is hoped that these techniques would facilitate achievement of objectives and produce the results in desirable manner.