CHAPTER-1

INTRODUCTION
AND
RESEARCH METHODOLOGY
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1.1. INTRODUCTION:

Electronics Chip Designing Industry has revolutionized the 21st century with sophisticated microelectronics devices and systems in a very short time span and is still running its course of development. There is no doubt that our daily life and profession is significantly governed by electronics engineering technology.

The pace of improvement of Semiconductor devices since the invention in 1959 of the IC’s has been astoundingly rapid. The revolutions in information and communication technologies (ICTs) are drastically altering the way things are done in nearly every field of human activity. The advent of ICTs has resulted in dramatic changes in employment patterns, skill-sets needed and the range of opportunities for employment and economic advancement over the whole world.

The key to exploiting the opportunity lies in creating the kind of Human Resources that are needed by the global information economy. Extremely rapid and continuous change in skills needed makes the task a complex and challenging one. A tidal wave of change is taking place in employment patterns and opportunities for Chip Designers. The Chip Design Engineer is
now clearly a global resource and increasingly, the white-collar worker is fast becoming one.

The emergence of this technologically intermediated global human resource offers breathtaking opportunities and challenges particularly, for the developing countries like India. The global gap between demand and supply of qualified human resources in the Chip Design sector is prevalent in India as well and arises on account of the below factors:

(a) Rising demand owing to rapid growth of Chip Designing usage in the domestic economy;
(b) Rising demand owing to increase in export of Chip Designing and services;

India is uniquely placed to bridge the global gap in human resources for Chip Designing. Yet we are encountering many critical problems in our efforts such as non-availability of a sufficient number of trained, knowledgeable and qualified chip designing engineers, trained teachers, lack of adequate infrastructure, and access to educational materials and libraries.

In a recent survey by Indian Semiconductor Association, it has been observed that there is an acute shortage of capable knowledgeable manpower for the VLSI industry in India. As such, there is an acute need for proper training and development of such manpower.
Human resources are a key to success in any high-technology sector such as Chip Designing. A country must not only provide necessary training to sufficient numbers of people, but it must create an environment in which those people can utilize their skills to make a decent living. Otherwise, they are likely to leave for other countries where the opportunities are greater. India has a large pool of human resources, which can be mobilized to achieve that goal. According to various sources, India has the third largest pool of engineering and scientific manpower in the world. The caliber of many of those people is world class.

Despite the large overall number of technically trained people, there appears to be an impending shortage of Chip Designing professionals. The shortage of people is due partly to the fact that the educational system has not adjusted to train more people with the necessary skills.

The Human Resource needs of the 21st century are dramatically different from that of the past. The demand for trained and knowledgeable human resource in the area of chip designing is enormous and catapulting many folds creating tremendous job opportunities. The human resource need of the Chip design industry falls into two categories.

(1) The number of skilled engineers (quantity).
(2) The educational background and skills of these engineers (quality).
India’s growth in this sector is very fast to become a hub of chip designing in due course.

But it may be affected due to the **Major Problem of Non Availability of Trained and Knowledgeable Human Resource.** The non-availability of trained / knowledgeable / skilled human resource to meet the **Requirements of the Chip Design Industry is dangerously very High.** The so-called skills gap defined as gap in skills between what industries would expect its engineering workforce to have and what they actually possess is highly on its increase. All studies indicate that the industry is facing an acute shortage of skilled human resource for chip designing. This study mainly aims at understanding the same phenomena.

### 1.2. OBJECTIVES OF THE STUDY:

The Study has the following objectives.

(3.1) To understand the training requirements for chip designing industry.

(3.2) To analyze and find out the employees Interest in undergoing needed training in chip designing.

(3.3) To evaluate the adequacy of the training undergone.

(3.4) To analyze the knowledge and competencies the personnel have
achieved through training.

(3.5) To suggest suitable training methods in the context of present scenario in chip design industry.

1.3. HYPOTHESIS:
1. There is no association between personal profiles and attributes of training.
2. There is adequacy of training in organizations.
3. There is significant relationship among the attributes of training.
4. Training reduces the human resource problem prevailing in electronics chip designing industry.

1.4. METHODOLOGY:

Research Methodology is a way to systematically solve the research problem scientifically. Other than applying particular research techniques it helps in finding out the applicable research methods and techniques that are relevant for the research. It helps in understanding the assumptions underlying various techniques and the criteria to decide that certain techniques and procedures will be applicable to certain problems.
1.4.1. Research Design:

A comprehensive Descriptive Study, Normative Survey has been undertaken. Fact finding research of different kinds like the samples attitude towards getting the needed training, his opinion towards chip designing technology, his behavior and motives about getting good job opportunities after getting needed training and knowledge, have been studied, which is a more Descriptive and Qualitative approach of research – which has been Done.

1.4.2. Population:

Graduate engineers related to the discipline of electronics engineering and those working in the design and development of chips in the chip designing industry in India constitute the population.

1.4.3. Sampling Method:

Simple Random Sampling technique was followed. Care was taken to the maximum to maintain that each and every item of the population had the chance or opportunity of getting included as the needed sample in our study.
1.4.4. Sample Size:

A total of 70 companies are present in the industry of chip designing, with each company employing about an average of 40 chip design engineers, which means that there are 2800 design engineers in total working within these companies. A sample size of namely 10% of the population (i.e.) 280 design engineers are taken as the recommended size but we have gone for a sample size of 290 design engineers for more accuracy from the total samples which has been taken as the sample size for our research.

1.4.4.1. Reliability Test:

This test is used to find out the reliability of the data collected for proceeding with further statistical analysis.

Cronbach’s alpha is the most common form of internal consistency reliability coefficient. It should be at least 0.70 or higher to retain an item in an adequate scale. It proves in the research that Cronbach’s alpha is 0.791, which retains that the item is in a “good scale” and reliable for further research.
1.4.5. Pilot Study:

A pilot study was undertaken with the use of a questionnaire. The questionnaire was pre-tested with experts and the schedule was prepared. About 300 respondents were contacted in person. Mainly electronics engineers in work and study process in universities / colleges and those working in various companies were contacted and information required for the study was collected to instill confidence and to proceed further with the main study.

1.4.6. Collection of Samples and Sources:

The Samples were collected from both Primary sources and Secondary sources as follows.

(1) **Collection of Primary Data:** - Based on the information collected from the pilot study, a restructured questionnaire schedule employing “Ordinal Scale” of measurement was prepared. The samples were the design engineers working in electronics chip designing industry. The purpose of the study was explained to the respondents and their co-operation in getting the data was requested. Information was also collected by having interaction with experts in the industry of chip designing. They were assured that the information from them would be kept confidential.
(2) **Collection of Secondary Data**: - The fact file of data with reference to the acute shortage of needed trained and knowledgeable human resource was collected from journals, newspapers and electronic media.

**1.4.7. Statistical Tools Employed:**

The collected primary data were analyzed with the help of the following statistical tools to fulfill the objectives of the study. The statistical tools employed are Econometric Analysis- Percentage analysis, Multiple Regression analysis, Chi-Square Test, Correlation analysis, ANOVA test, Factor Analysis, Path analysis using Structural Equation Modeling, Charts and Graphs with the help of statistical package tool SPSS-16 and AMOS (Advanced moments of structural equation)

**1.4.7.1. Percentage Analysis:**

Percentage refers to a simple ratio. Percentage analysis is used in making comparison between two or more series of data. Percentage is used to describe the relationship. Since the percentage reduces everything to a common base, a meaningful comparison can be made. In our research percentage analysis has been employed for

(1) Distribution of respondents, company wise.
1. 4.7.2. **Multiple Regression Analysis:**

Multiple Regression Analysis uses two or more independent variables to estimate the values of a dependent variable. Causal analysis or Regression analysis is concerned with the study of how one or more variables affect changes in another variable.

The three main objectives of Multiple Regression analysis is

(1) To derive an equation which provides estimates of the dependent variables of two or more independent variables, its purpose is accomplished by deriving an appropriate regression equation by the method of Least Squares.

(2) To obtain a measure of the Error involved in using the regression equation as a basis for estimation. Its purpose is achieved through the calculation of a Standard Error of estimates.

(3) To obtain a measure of the proportion of variance in the dependent variable accounted for an “explained by” the independent variable. Its purpose is accomplished by computing the multiple coefficient of discrimination.
Here the objective of our analysis is to make a prediction or estimation or forecast about the explained or dependent variable “Y”, based on the known value of the explanatory or independent variables like $x_1, x_2, \ldots$

Here through Regression analysis we determine the functional or statistical relationship between two or more variables. Since there are more than two independent variables, we use Multiple Regression analysis. The basic relationship between $x$ and $y$ is given by

$$Y = a + b_1 x_1 + b_2 x_2 + \ldots$$

Where $a$, $b_1$, $b_2$ are constants and $b_1$, $b_2$ are known as regression coefficients.

Thus we get the regression equation of $Y$ on $x$ (regression line of $y$ on $x$ when drawn on a graph), where we get each unit change in $x$ produces a change of $b$ in $Y$, which is positive for direct and negative for inverse relationships. We use Least-square method to find the ‘best fit’ that a straight line of this kind can give.

Here we select independent variables to estimate the dependent variable in such a way that multicollinearity is reduced to the minimum
1.4.7.3. **Chi-square test** ($\chi^2$):

Chi-square test is an important non-parametric test and as such no rigid assumptions are necessary in respect of the type of population. Degree of freedom and also the size of the sample is required for using this test. This test can be used

1. As a test of Goodness of Fit.

2. As a test of Independence.

3. As to test the Homogeneity.

The Chi-square test is used to find out the significance of population variance (i.e.) which all variables are significant and relevant by using the test statistics

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

Test statistics:

Where

$\chi^2$ = the test statistic that asymptotically approaches a $\chi^2$ distribution.

$O_i$ = an observed frequency;

$E_i$ = an expected (theoretical) frequency, asserted by the null hypothesis;

$n$ = the number of possible outcomes of each event.
1. Chi-square as a test of Goodness of Fit:

It is popularly known as test of Goodness of Fit for the reason that it enables to ascertain how appropriately the theoretical distributions such as Binomial, Poisson, normal and others fit the empirical distributions (i.e.) those obtained from sample data.

Here the Null and Alternate Hypothesis are established and significance level is selected for rejection of Null hypothesis. A set of expected or theoretical frequencies is derived under the assumption that the Null hypothesis is true. The observed frequencies are compared with the expected frequencies.

If the calculated value of $\chi^2$ is less than the table value at a certain level of significance – generally it is 5% level – and for certain degrees of freedom the fit is considered to be good else if it is greater than the table value then the fit is considered to be poor.

2. Chi-square as a test of Independence:

This test is done to find out whether two or more attributes are associated or not. If the calculated value of $\chi^2$ is less than the table value at a certain level of significance – generally it is 5% level – it is said the hypothesis that the attributes are not associated holds good and if it is greater
than the table value then the result of the experiment do not support the hypothesis or the attributes are associated.

3. Chi-square to test the Homogeneity:

The $\chi^2$ test of Homogeneity is an extension of the Chi-square test of Independence. Tests of Homogeneity are designed to determine whether two or more independent random samples are drawn from the same population or from different population. Instead of one sample taken from one population, as with Independence problem here there are 2 or more independent samples one from each of the possible populations in question by using the test statistics.

Degree of freedom – df – for more than two or more independent variables is obtained from – \((r-1)(c-1)\), where ‘c’ means the number of column and ‘r’ means the number of rows.

1.4.7.4. Correlation:

In case of bivariate population we go for studying the Correlation using various tests. It’s used for measure of relationship for bivariate population. It studies the joint variation of two or more variables for determining the amount of correlation between two or more variable. There
are different tests to do this analysis. In our study we use Karl Pearson's Coefficient of Correlation. Here it is assumed that

(1) There is linear relationship between two variables.

(2) The two variables are causally related (i.e.) one is independent and the other is a dependent variable.

(3) Large number of independent causes is operating in both variables so as to produce a normal distribution.

\[ R = \frac{(X_i - \bar{X})(Y_i - \bar{Y})}{n\sigma X \sigma Y} \]

It is also known as Product Moment Coefficient. The value of ‘r’ lies between +/- 1. Positive values of ‘r’ indicates positive correlation between the variables (i.e.) changes in both the variables taking place in the statement direction, where as negative values of ‘r’ indicate negative correlation (i.e.) changes in the two variables taking place in the opposite directions. A ‘zero value of r’ indicates that there is no association between the two variables when \( r = +1 \) it indicates perfect positive correlation and if \( r = -1 \) it indicates perfect negative correlation.
1.4.7.5. **Analysis of Variance - ANOVA Test:**

According to Prof. Ronald A. Fisher, ANOVA is essentially a procedure for testing the difference among different group of data for homogeneity (i.e.) segregation of variability due to one group of causes from variances due to another group of causes. The object of the variance ratio test or the F-test is to find out whether the two independent estimates of population variance differ significantly or whether the two samples may be regarded as drawn from the normal populations having the same variance.

Through ANOVA one can investigate any number of factors which are said to influence the dependent variable. The interrelation between two dependent variable or factors if any, affecting a dependent variable can as well be studied for better decisions. This technique is used when multiple sample cases are involved to examine the significance of difference amongst more than two sample means at the same time - to draw inferences whether the samples have been drawn from populations having the same mean.

\[ F = \frac{\text{variance of the group means}}{\text{mean of the within-group variances}} \]

The higher the calculated value of ‘F’ is above the table value, the more definite its sure one can be about the conclusions. The value of ‘F’ is
compared to the F- limit for given degrees of freedom. If calculated ‘F’ value is equal or exceeds the F-limit table value, it is said that there are significant differences between the sample means.

The calculated value of ‘F’ is compared with the table value at 5% or 1% level of significance. If the calculated value of F is greater than the table value then the F ratio is considered significant and the Null hypothesis is rejected, if it is less than the table value then the Null hypothesis is accepted ant it is inferred that both the samples have come from the population having same variance.

Since F test is based on the ratio of two variances it is also known as the Variance ratio test.

1.4.7.6. Factor Analysis:

It is a Multivariate technique applied to reduce the number of variables or factors under study and to find out the important factor which influences the sample. It is applicable when there is a systematic interdependence among a set of observed or independent variables and to find out something more fundamental or latest, which creates this commonality.
Thus it seeks to resolve a large set of measured variables in terms of relatively few categories, known as factors. Thus it allows to group variables into factors based on correlation between variables and the factors so derived may be treated as new variable, often termed as latent variable.

There are different methods used for factor analysis. In our study we use ‘Principle Components Method of factor Analysis’ or simply called as P.C. Method, developed by H.Hotelling. It seeks to maximize the sum of squared loadings of each Factor extracted in turn.

(1) Factor Loadings: They are those values, which explain how closely the variables are related to each one of the factors discovered. They are also known as factor-variable correlations. It is the absolute size and not ‘+ or −’ sign’s of the loadings that is important in the interpretation of a factor.

(2) Eigen Value or Latent root: The sum of squared values of factor loadings related to a factor is referred to as Eigen value or latent root. It indicates the relative importance of each factor in accounting for the particular set of variables being analyzed.

(3) Total Sum of Squares: When Eigen values of all factors are totaled the resulting value is termed as the total sum of squares.

(4) Rotation: Different rotations reveal different structures in the data.
Though different rotations give different results, statistically all are to be treated as equal and none as superior or inferior and the right structure of the data are to be chosen. If factors are independent orthogonal rotation is done and if they are correlated an oblique rotation is made.

1.4.7.7. PATH ANALYSIS USING STRUCTURAL EQUATION MODELLING – SEM:

The term ‘Path Analysis was first introduced by the Biologist ‘Sewall wright’ in 1934 in connection with decomposing the total correlation between any two variables in a causal system. The technique of path analysis is based on a series of multiple regression analysis with the added assumption of causal relationship between independent and dependent variables. This technique lays relatively heavier emphasis on the heuristic use of visual diagram, technically described as path diagram.

Path analysis makes use of standardized partial regression coefficients known as beta weights as effective coefficients. In-linear additive effects are assumed, and then through path analysis a simple set of equation can be built up showing how each variable depends on preceding variables. The main principle of path analysis is that any correlation coefficient between two
variables can be decomposed into a series of parts: separate paths of influence leading through chronologically intermediate variables to which both the correlated variables have links.

This technique requires the assumption that there are linear additives, a symmetric relationship among a set of variables, which can be measured at least on a quasi-interval scale. Each dependent variable is regarded as determined by the variables preceding it in the path diagram and a residual variable, defined as uncorrelated with the other variables, is postulated to account for the unexplained portion of the variance in the dependent variable. The determining variables are assumed for the analysis to be given.

1.4.8. SIGNIFICANCE OF THE STUDY:

The results of the analysis are as follows.

1. The demand for talented and knowledgeable human resource in the area of chip designing is enormous and catapulting many folds, creating Tremendous job opportunity.

2. The industry’s requirements are the number of skilled engineers (Quantity) and the educational background and skills (quality).

3. There is a so called skills gap defined as the gap in skills between what Industries would like in its engineering work force and what the
Universities are currently producing.

4. There is an acute shortage of human resource for chip designing.

5. Engineers in the industry are not professionals required.

1.4.9. SCOPE OF THE STUDY:

The study covers the entire electronics chip designing industry in India and the design engineers working. The study is to enlighten reasons for the acute shortage of skilled human resource to work as design engineer, which is causing a severe problem to the growth of this industry in India. Study about the awareness about chip designing industry, getting needed training, gaining knowledge and competency, universities and companies attitude towards imparting the needed training, age factors role in getting the needed training – among electronics engineers are to be studied.

1.4.10. LIMITATION OF THE STUDY:

4.10.1. Coverage: “The study was conducted with only 6 companies out of almost the 70 companies present in the industry. Out of the 2800 engineers present, 290 engineers were selected in random.

4.10.2. Confidentiality: The respondents were not willing to reveal information on details of their knowledge level in chip designing, their
interest on training aspects, and their level of competencies, their personnel profiles due to reasons known only to them and on grounds of confidentiality.

4.10.3. The findings were limited with the initial technical needs of the industry such as variables related to training, knowledge, skills, interest and awareness only.

4.10.4. Direct access to the respondents was a difficult task to achieve as the respondents were working in different hierarchy and their work load and time constraint made it difficult.

4.10.5. The authorities in the companies did not show much interest in collecting data for the study.

1.5. CHAPTERISATION:

The chapters have been formulated meaningfully in simple terms and much legible form.

Chapter 1: It provides the introduction to the industry of study – the chip designing industry and the statement of the problem to be studied has been mentioned. Objectives of the study have been detailed in this chapter. The details of Research methodology having details of research design, population, sample size, sampling methods, pilot study, collection of
samples, statistical tools employed, significance of the study, scope of the
study, limitations of the study have been detailed.

Chapter 2: It provides details about the Review of literature.

Chapter 3: It deals with studying of the Chip designing industry and the
human resources problem in detail.

Chapter 4: The details of Analysis and Interpretation of the Data with the
Statistical tools employed have been detailed.

Chapter 5: It provides the details about the findings, suggestions,
implications of the study, future scope of the study and conclusions of the
research.