Software development organizations are operating into diverse & dynamic market with lot of competition among their products, which is subjected to tight constraint of schedule & cost. The intangible & complex nature of software development make planning & controlling, difficult and challenging. [REE1999] wrote this situation as, "Software System is exceptionally complex. In fact, many agree that basic problem of the computing is mastery of complexity. Because software developer must deal with complex problems, they are generally very intelligent & complex individuals, which also complicate the management formula." While there is a worldwide concern about the strengthening of software development, at the same time there is a lot of uncertainty about the best scheme of carrying out this task.

This chapter deals with the nature & scope of our research and gives as overview of the research processes & various methodologies. K-Model has been a problematic assignment to carry out effectively & fruitfully. Software engineering has features that cannot be planned or controlled similarly to some other fields of engineering. By nature, software development is entirely human based and diverse. It is, at the same time, intellectual and sociological design activities are carried out in an environment of learning [OUL1996].

3.1 Introduction

The research is a systematic application containing several methods that are employed to provide trustworthy information about problems, lead to generalizations about problems and the development of theories. The way in which research is carried out may be part of the research philosophy subscribed to, the research’s techniques & methods employed, so the research gadgets develop in the hunt of a goal. It has often been observed that not even a single research methodology is fundamentally or inherently
superior than any other methodology, many researchers recommended for a combination of various research methodologies to enhance the worth & quality of research. Likewise, some research institutions are intended to implement a specific "house made style" methodology, which seems to explore the fact of audacity; a methodology should be best suited to the dilemma under consideration; as well as the objectives of the researcher, should be chosen always. In this study we have tried our best to avoid the facts of characterization as methodological monism, i.e. the perseverance on using a particular or single research methodology. As an alternative, we consider that all methods are valuable if they are used appropriately. Research can include elements of both the positivist and interpretive approaches, if carefully managed. Keeping the same strategy in developing the K-Model, our first endeavor is to design an unblemished & subject oriented research methodology, and for same we analyzed various methods, facts & factors [KOT2004].

Further, our research methodology also focused that each phase should be documented properly. Some documentation remains unchanged throughout the research while others continuously changes during the research. Revisions of other’s documents are also required to compare the result analysis performed in later phases. Documents produced from each phase shall be collected and patched in a task file. Though processes are automated, still it’s obligatory of extra care about this. Components are eager to incorporate a long-term bonding always. Also, everyone should be aware of legal concerns that can imply effectiveness or induce limitations on digital data or records. There are various ways by which information is collected & stored by the researcher. Research methodology is a structured way to explain a problem statement and to find root cause, and solve it through a logical formula. Various SDLC models are defined to describe traditional software life cycle methods & techniques which reflect the principles outline in the subsequent sections. Following are the fundamentals of software life cycle management:

- Software life cycle should be used to assure a controlled approach for systems development, its maintenance, and various operations.
• A comprehensive plan is always required for each system development.
• Expert/dedicated persons must be assigned to perform main tasks throughout the system life cycle i.e. roles and responsibilities will be structurally assigned & distributed.
• Documentation of result of every activity and conclusion for each phase are highly important.
• Management of data is highly recommended throughout the life cycle.

Research may also be defined as a technical or logical understanding which expresses the following:

• Innovation of new theories, concepts and scientific tools which would facilitate reliable and valid study of human behavior.
• Evaluation of their formation, sequence, logical relation, and explanation which are derived within a proper theoretical frame of reference.
• Discover new facts & essentials, verify and test old facts.
• Foster realistic expectations of what system will and will not deliver or provide.

Research methodology varies from problem to problem. In our scenario, we use mixed research methodology i.e. qualitative and quantitative both. Qualitative research methodology is significant in the behavioral sciences where the aim is to discover the purposeful intention of human behavior. Common type of qualitative research methodologies are literature survey, experiment etc. Quantitative methodology is based on the dimensions of quantity or amount. It is applicable to the phenomena that can be expressed in terms of quantity. Common quantitative techniques are survey, and case studies.

At present, every work is accomplishing by few clicks of a computer program, doesn’t matter what size of it is. The power of computer is increasing day by day, which leads the human’s propensity to use a
computer (system) more and more. Very soon, humans will be 100% dependent on computers to solve their problems by using application software. After every second we will require a latest software package to solve our problems, which will require software repository, otherwise everyone has to develop a fresh application software from his/her own to fulfill his/her requirements. If we have one global software component repository in place or eagerness to design an individual software component repository then with the help of various software reusability techniques from there we can accommodate frequent software changes, save manpower and its redevelopment cost & time. Also, we can engage more and more software engineers into software reengineering process for existing software applications. These techniques i.e. software reusability, customized tools, reengineering and various model(s) will give us an assurance of efficient, process oriented, economical, reliable, and cost effective development.

3.2 Literature Review Methodology

Literature review on reusability of software applications has been designed in order to analyze the problem against the background of sound theoretical framework. While searching the literature, it is found that literature review is very significant technique for any research process. It is fast, less expensive for a researcher to expand his understanding for a problem statement in a better way with less efforts & experience. In K-Model, entire reusability process consists of main three components:

- Domain engineering
- Reengineering
- Design of Component Repositories

We have studied various software models to combine their characteristics, efficiency and boundaries. The output of developed projects is used as lesson learning. For any kind of research, there are many methods, models, tools and techniques that are required on
various stages. Same obsession has been followed by us in our reusability process. Benefits of reusability and re-engineering are reviewed for new software development in the same domain. There are mainly two types of sources from where we gather information for literature review, these are, primary and secondary. In primary sources, data is gathered from the empirical study of the event or situation. The secondary sources are books and articles in which other researchers have reported their results. Data is being available in print or electronic media. Following are the resources which have been used for our literature study:

**Primary Resources:**
- Observation
- Participant
- Non-Participant
- Interviewing
- Structured
- Unstructured

**Secondary Resources**
- Documents
- Books / Magazines
- Journals / Conference papers / Conferences & Workshops
- Proceedings of the periodicals, Academic thesis
- Newspapers / Archives
- Reports and databases
- Statements

All these sources are available in hard copies or in digital form. The invention of computer was a big boost in research, and further innovation of internet revolutionized the research activities in all aspects. Every software developer or researcher can share their knowledge through a common platform with no difficulty.
3.3 Empirical Research

It relies on experience or observation alone, without the use of software and available theory. It is a data based research, coming up with conclusions which are capable of being verified by inspection or by experiments. It is also called experimental research; empirical research is considered as most powerful technique. Optimizations of search results are experimentally proved by using available tools and techniques. Component storage and retrieval mechanism are also evaluated on basis of experimental data.

3.4 Descriptive Research

It focuses towards the description of the state of affairs exists at present which means that gathering information and describing the current situation. Surveys, co-relational studies, case studies and observations are called descriptive research. Most common type of descriptive research involves questioning techniques for data collection. Survey methodology consists of asking questions from the respondent from the desired population at once. The people responding the questionnaire are the respondents.

In our study, we have surveyed various software developers for real evaluation of various processes’ parameters. When software is reused, the values of different parameters of a software component vary in comparison to new developed software. Let’s take an example, if we compare the performance of existing developed processes (developed manually) with the performance of software process which is developed by using domain reuse & reengineering; the performance increases in the second case.

3.4.1 Sample Area

A sample is small collection of units from a population used to determine truths. Every successful case study is always focused on sample area. Many methods can be used for sampling as discussed below:


**Chapter 3**

**Probability Sampling**

- Simple random sampling
- Systematic sampling
- Stratified sampling
- Multi Stage sampling
- Multiphase sampling
- Cluster sampling
- Deliberate sampling

**Non probability sampling**

- Convenience sampling
- Purposive sampling
- Quota sampling

In K-Model, we have used deliberate sampling. It is a sampling with a purpose which is also known as purposive sampling. We have preferred deliberate sampling method as it is easy, quick, and cost-effective. Our data samples are mainly collected from small and medium size software development companies. The inhabitants of our study comprise of software engineers, developers, managers, team leaders, professionals in the respective companies through the questionnaire filled by them.

### 3.4.2 Questionnaire

A questionnaire is a self-report instrument that is generally mailed or handed to the respondent to complete it without the help of researcher. For every case study the most difficult part is framing a questionnaire, due to this reason we were very much careful about three important attributes i.e. focus, brevity, and simplicity while designing questions for questionnaires. In our study, closed end questionnaire are designed on the basis of review of literature and many follow-ups with respondents. Finally, the questionnaires were sent to software development companies for their feedbacks. As the questionnaire was very simple and focused, it
helps us a lot. Most of respondents provided all significant information, except few who have refused to provide information because of their companies’ policies or some other reasons.

### 3.4.3 Data Collection

There are various methods for data collection that can be used, including questionnaires, interviews, observations, and telephone calls. In our case study we have mainly used questionnaire for data collection and requested the software engineers, developers, managers in the respective organizations to fill & send back the questionnaires.

### 3.4.4 Data Analysis and Interpretations

Data analysis and interpretation are the methods for providing means to conclude the significance, and implication of the research outcomes from the collected information. For numerical analysis of data we can use mean, percentage & frequency distribution techniques and for narrative data, interviews, group discussions and observation techniques can be used.

For analysis & interpretation of data we have consolidated the data values of all twelve attributes for the projects developed with or without using K Model separately. Then we calculated the mean values of all these attributes to compute their differences. On the basis of differences in mean values we interpret that whether any particular attribute's value is increasing or decreasing. In our next step feedbacks from experts are collected on twelve different statements related to study in the form of numeric values ranging between 1 to 5. Again mean values for all collected statements are computed. On the basis of mean values the interpretation is done for stability of our statements. Graphs are drawn to make the interpretations more easy and meaningful. Columns left blank in the questionnaires filled by the respondent are not considered in the analysis of the result. The results are based on the primary data. Simple statistics tools like percentage, mean, sorting and summarization are computed using MS-Excel. Graphs for analyzing the results are also drawn by using MS-Excel.