CHAPTER 1

INTRODUCTION

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1.1 INTRODUCTION

In the era of software engineering, present day research community and software industry is facing big challenges due to increased maintenance cost and lack of intended software quality attributes viz. functionality, reliability, usability, efficiency, maintainability and probability. All the software quality attributes are hard to define and difficult to measure and recognize. These software quality attributes may be improved if the researchers and practitioners make use of relevant models and test process for software development. Researchers, practitioners and software engineers have been proposing and applying several models and methodologies for improving software development while focusing on software quality attributes in the field of Component-Based Software Engineering (CBSE). It is believed that facing some problems with traditional and object-oriented paradigms motivate shift towards CBSE. CBSE is a process for creating Component-Based System (CBS) and is an aid in answering a variety of questions associated with the difficulties of software development. It helps in project planning and allows us to determine the strengths and weaknesses of current processes and products. CBSE increases the prospects of software reusability, reliability and stability with shorter development time and reduced cost. In the last few years, CBSE has received much attention from both researchers and practitioners' point of view for developing high quality software with software components. Software components in CBSE seemed to be a silver bullet for software engineers for developing high quality software with less time and cost. Researchers have developed component-based models with the necessary technologies, which have been used to develop CBS with reusable components. No matter which model, process, tool, technique, and methodology is used for component development and testing, it remains an error-prone process.

In order to harvest all the potential benefits from the CBSE, major contribution of this study is to propose a model and test process. Moving in this direction this study is divided into two main sections - Component-Based Software Reuse (CBSR) and Component-Based Software Testing (CBST). In first section, the
study proposes a new component-based model and a modified development process of CBSE. In second section, the study proposes two component-based test processes.

1.2 PROBLEM OUTLINE

A wide range of development models and test processes can aid in increasing reusability, testability, correctness and maintainability in the code to evaluate the software. Component-Based Software Development (CBSD) paradigm requires an altogether different approach from functional development techniques. Component-based models and methodologies are different from object-oriented models and methodologies to evaluate the underlying attributes of efficiency, complexity, understandability, reusability, testability and maintainability. These attributes attempt to numerically extract relationships between given components in a software system and develop software with quality. CBSE is a step ahead in the same direction and is viewed differently in comparison to traditional software practices to decrease budget, time and cost. As a considerable portion of software development model and test process schedules face so many problems - excess budgets, deliver software with poor quality, testable component with not good interface and documentation, inadequacy of testing techniques and infrastructure, wrong functionality, poor testable and reusable component repository. Moving towards this direction, this study is a small step to analyze, design, and develop model and testing processes to solve all these problems with the research objectives discussed in next section. To cover the problem this study has a good thrust area to address and propose relevant model applicable to production of present day software systems. Few of the concerns related to the proposed study include the following:

- Component-Based Software Engineering
- Component-Based Software Development
- Component-Based Software Reusability
- Component-Based Software Testing.
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Research in many areas of CBSE has provided advances that hold promise for helping us to reach the goal of providing development model and test process that can help software engineers to develop high-quality software.

1.3 RESEARCH OBJECTIVES

The main objective of the study is to analyze, design and development of component-based reusable models and testing processes with the following research objectives:

Objective 1  *To find and analyze the various challenges in CBSR*

First objective can be considered to examine current Component-Based Development (CBD) models and testing processes in order to find and analyze various challenges viz. component functionality, programming languages, component generality, encoding scheme and data format, time and efforts, algorithm and data structure, software system evolution, compatibility and maintenance of CBSR and propose few directions, namely, documentation and specification, components libraries, and generative programming for software developer to make CBSR successful.

Objective 2  *To develop a new component-based model for CBSD*

Second objective is to propose a new X component-based model which help in development of software components and component-based software by using two main processes - development for reuse and development with reuse.

Objective 3  *To modify a development process of CBSE*

Third objective is to propose a modification in development process of CBSE for increasing reusability at different abstraction levels with the benefits of reusable component in programming.

Objective 4  *To find and analyze the various impacts and challenges of CBST*

Fourth objective introduces various impacts, issues and challenges of testability with testing infrastructure inadequacies to reduce time and cost in testing.
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Objective 5  To analyze CBST requirements and design a test case process documentation

Fifth objective is to analyze CBST requirements and design test case process documentation which is based on the belief that software is not only the code produced but also the documentation that supports the test case documentation. This study believes that creating components with proper documentation results in their successful and systematic reuse.

Objective 6  To develop a new process to construct testable component

Sixth objective of this study is to propose a new process to construct a testable component with good interface which help in enhancing reusability and testability.

1.4 RESEARCH METHODOLOGY

Research involved in this study is aimed at developing a model and testing process in CBSE. Design and development of CBS is based upon a synthesis of outstanding features from current systems, leverages the costly and time-consuming efforts devoted to other software. Due to complex nature of software, prototyping and simulation are not possible within the scope of a study and without a vast research budget. Scholars have devised various dichotomies for describing research, including the following - basic compared with applied, scientific in contrast to engineering, evaluative versus developmental, research versus development, and formulating in comparison to verificational (Nunamaker et al., 1991). System research falls into the applied science, engineering, developmental and formulative categories. Software engineering research is that specialty of system research with a focus on the design, development, analysis, measurement, and improvement of software systems (Nunamaker et al., 1991). The fast growth of the Internet and World Wide Web (WWW) encourage the research and development of software. A literature review indicates that a significant amount of serious research in software engineering is devoted to the development and testing of CBS. Research methodology of the proposed research is devoted to the development of both a conceptual model and process for a
software development. Two main research methodologies are to be used in this study, first is development of CBS with reuse and development for reuse, and second is development of test processes for reusable and testable component for CBS. This study, like most software engineering research, belongs to the domain of research in reusability and testability of CBS.

1.5 SCOPE OF RESEARCH WORK
The study focuses on the analysis, design and development of models and testing processes of CBS. The scope of the work covers the following areas for researchers and practitioners to:

- Perform analysis on CBSD by using challenges in CBSR and CBST to build CBS with reusable component;
- Perform analysis and evaluate various traditional model with the a new X component-based model;
- Compare and evaluate the various phases of X model of CBSD with the traditional software development phases;
- Perform analysis and evaluate the CBST requirements and design test case process documentation;
- Perform analysis and evaluate the process to construct testable component.

1.6 ORGANISATION OF THESIS
This thesis is organized into nine chapters which are briefly discussed below. First three chapters deal respectively with the introduction, study and review of literature, and evolution of CBSE. Chapters four to six deal with the CBSR and chapters seven to eight deal with the CBST and last chapter is organized to present the conclusions of current research work and future directions.

Chapter 1 Introduction
This chapter is organized to discuss the problem outline, research objectives, research methodology, scope of the research and organization of thesis.
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Chapter 2 Study and Review of Literature
This chapter is organized to provide the study and review of literature according to the proposed research work. In this chapter study and review of literature is used to review the critical points of past and current knowledge on CBSE with software models, CBD, software reuse and testing, component-based software, component reuse and testing.

Chapter 3 Evolution of Component-Based Software Engineering
This chapter presents the evolution and background of CBSE with the motivation behind the CBSE. This chapter is also organized to present the researchers and practitioners’ point of views about Object-Oriented Programming (OOP) and Component-Oriented Programming (COP) with component-based software models and technologies.

Chapter 4 Challenges and New Directions for CBSR
This chapter introduces the major challenges and new directions for component reuse in the field of CBSR. This chapter also presents some of software engineering concepts with non-technical aspects which are very helpful in CBSR to develop CBS.

Chapter 5 X Model - A New Component-Based Model
This chapter deals with the analysis and introduction of software life cycle models and introduces a new X component-based model. This chapter presents a model-driven approach of CBD with the working of X model which cover the likely phases of large software development and enforces software reusability along its phases.

Chapter 6 Modified Development Process of CBSE
This chapter is organized to present CBSE and components properties with a modified development process of CBSE and presents the benefits of reusable components in programming which are developed with modified development process of CBSE.

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Chapter 7 Impacts and Challenges of CBST
This chapter provides the issues of component-based software testing and quality with the impacts of inadequate testing and testing infrastructure of CBS. This chapter also presents the main features of testable components with testability challenges.

Chapter 8 Component-Based Test Processes
This chapter is organized into two main sections. First section is organized to modify test case process documentation for improving CBST while considering two factors viz. CBST requirement and test case process documentation. Second section proposes a new process for building testable component with good interface.

Chapter 9 Conclusions and Future Directions
This chapter summarizes the research contribution by highlighting conclusions, significance, limitations of present study and future directions.

This study was intended to begin a foundation of the research and preliminary study in CBSE with the reusability and testability. In this manner, this study is carried out only to state an idea of analysis, design and development of software reusable model and test processes. This work is to act as a prototype for a lifetime of observation, development, testing and maintenance of CBS.