CHAPTER 7
CONCLUSION AND FUTURE WORK

Testability is perceived to be expensive because the cost of adding testability at different phases is very easy to identify, but the losses incurred due to its ignorance are not easy to determine. This ignorance may result in low customer satisfaction and large amount of required maintenance. Traditionally, testability has not been on management's list of priorities when considering software development concerns. Their major concerns when thinking of a software system under development were usually functionality, cost, schedule and risk. What we should do is try to convince management that ignoring testability may have major ramifications in the guise of performance, availability and quality, and it has a direct influence on functionality and risk. Ignoring testability causes a very real threat to both schedule and cost of the system.

By now, it has become a well established fact that early measurement of testability assists software development team in many respects. Quantitative assessment of software testability may be used to improve software project under development. Object oriented design characteristics are used to estimate software testability at design phase. The study accounts for the development of a testability measurement framework by identification of factors, mapping with object oriented design properties and validation with the help of commercial software applications.

7.1 CONCLUSION

We have made mainly four contributions during the present course of study in addition to many macro level direct or indirect findings. The contributions are TMF^{OOD}, MMM^{OOD}, FMM^{OOD} and TMM^{OOD} that are explained below.

First Contribution: Testability Measurement Framework (TMF^{OOD})

An exhaustive review on testability measurement reveals the fact that there is an urgent need of deducing a mechanism to compute software testability at design phase of development life cycle. Therefore, we made an effort for the same and developed a Testability Measurement Framework (TMF^{OOD}) for object oriented design. This framework gives a layout of steps that can be followed for testability measurement. The framework comprises of seven steps namely Testability Factorization, Object Oriented Software Characterization, Recognition of Metric, Correlation Establishment, Testability measurement and finalization, along with an additional common step of Design Review. The order of execution of each step for testability measurement has been clearly mentioned in the developed framework.

Testability Factor Identification: We have used the proposed framework for testability factor identification and development of testability measurement model as explained below.

In fact, there are many factors affecting software testability. We identified two key factors viz. modifiability and flexibility having a significant contribution in measuring software testability at design phase.

Second Contribution: Modifiability Measurement Model (MMM^{OOD})

We have developed a Modifiability Measurement Model (MMM^{OOD}) for object oriented design and established the statistical correlation between Modifiability and design properties viz. encapsulation, inheritance and coupling with the help of multiple linear regression. Finally, empirical validation of the Modifiability measurement model was performed using commercial software applications.

Third Contribution: Flexibility Measurement Model (FMM^{OOD})

We have developed Flexibility Measurement Model (FMM^{OOD}) for object oriented design and established the statistical correlation between Flexibility and design properties viz. encapsulation, coupling, cohesion and inheritance with the help of multiple linear regression. An empirical validation of the Flexibility measurement model is also performed using commercial software applications.

Fourth Contribution: Testability Measurement Model (TMM^{OOD})

In order to strengthen the claim of correlation of Testability with Modifiability and Flexibility, statistical analysis was performed. Being highly correlated, Modifiability and Flexibility measures are used to develop Testability Measurement Model (TMM^{OOD}) as a fourth contribution of the thesis. Subsequently, an empirical validation of the testability measurement model was carried out using commercial software applications. The experimental result shows, the developed model (TMM^{OOD}) is highly significant and better than the existing model (MTMOOD).

7.2 FUTURE WORK

The model developed to measure software testability of object oriented design is highly significant and correlated with object oriented design properties. Subsequently, the model has been validated using commercial software applications. However, there is still some scope for future work that is listed below.

1. The model may be analyzed for larger set of data.
2. A generic guideline may be produced in the form of developer's manual for designing class hierarchy based on the results of the model.