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ABSRACT

In the last decade, software has grown in complexity and size, while development timelines have diminished. As a result, component based software engineering is becoming a routine by advocated process. An increased use of Component Based Software Engineering (CBSE) to build safety–critical applications has made the reliability estimation for these applications an issue of great importance. Reliability estimation of component based software application combines the architecture of the application with the reliabilities of the components to obtain the application reliability. Where, the over reliability of the final application greatly depends on the reliabilities of the selected components. This makes the reliability estimation of software components of key importance, since the value of the reliability models for component based software applications is heavily depend on the accuracy of the components' reliabilities estimation.

Software reliability is one of the major software quality attributes, quantitatively expresses the continuity of correct service delivery. The problems of estimating the reliability before testing is indicated as a challenging research. Thus new methods need to be found for performing early reliability estimations. Moreover, early software reliability estimation models are often insufficiently formal to be analyzable and not usually connected to the target application. We postulate it is possible to overcome these issues by proper reliability estimation of its components, supporting reliability estimation by scenarios of application and rich use of UML as an architecture description language.

The main purpose of this research has been to come up with techniques to support reliability estimation in CBSE process. In this research, we introduced two formal techniques related to

estimation of the reliability of software component and to the early reliability estimation of component based software application.

Apart from gradually answering research questions, we identified the factors affecting software component reliability and proposed a classification model for these factors according to nature of their effects. The foremost main contribution is a framework for component reliability estimation i.e. CRE^F that based on sound theoretical basis and takes into account the reliabilities of component services and their relative frequencies and usage ratios. Secondly, an early reliability estimation approach for component based software application is developed based on sound theoretical basis, which takes into account the scenarios of application and their reliabilities, relative frequencies and usage ratios. Factually, scenarios of an application are capable to describe the application traces as the behavior models and also to depict very clearly the application components designed to provide the intended application behavior, as well as to outline a high level architecture view of the application being described. The independent scenarios identify application execution paths at the analysis and design phases of component based application development. The reliability of scenario is estimated from the components' reliabilities and connector's reliabilities.

Finally, we validate our reliability estimation framework / approach with several tryouts and case studies to demonstrate that the CRE^F and the early reliability estimation approach to estimate the reliability of component based software application are feasible, effective and meaningful. Further, we use in validation process the analytical studies at component level and application level to show importance of service for component reliability and importance of component and scenario for application reliability.