

## FAST ABSTRACT: An Effective Software Reliability Analysis Framework for Weapon System Development in Defense Domain

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### Abstract

*Software reliability has been regarded as one of the most important quality attributes for software intensive systems, especially in defense domain. As most of weapon systems complicated functionalities and controls are implemented by software which is embedded in hardware systems, it became more critical to assure high reliability for software itself. However, many software development organizations in Korea defense domain have had problems in performing reliability engineered processes for developing mission-critical and/or safety-critical weapon systems. In this paper, we propose an effective framework with which software organizations can identify and select metrics associated software reliability, analyze the collected data, appraise software reliability, and develop software reliability prediction/estimation model based on the result of data analyses.*

### 1. Introduction

Especially in defense domain, most of weapon systems' software are embedded into hardware systems to achieve the given mission goals. In order to support more complex functionalities required from the users, some of mission-critical parts of systems are controlled by only software. Therefore, it has become very important to implement and/or acquire high reliable software systems. However, software is different from hardware in that it is not independent from other factors such as developers, process, and developing environment for a system. In other words, it is hard to explain the software reliability by analyzing software product itself (source code, defects, and failure).

Many researches [1][2] addresses that reliability goal setting and operational profile development should be performed at early phase in the Software Development Life Cycle (SDLC) for reliable software

development. Especially for weapon systems, it is very difficult to correct the faults once it is already in mass-production phase or operation phase. For this reason, it is required to consider not only test activities but also the whole life cycle in order to guarantee high reliable software systems. Nevertheless, there is only limited information available about software reliability approaches in current defense because most of the information is highly proprietary.

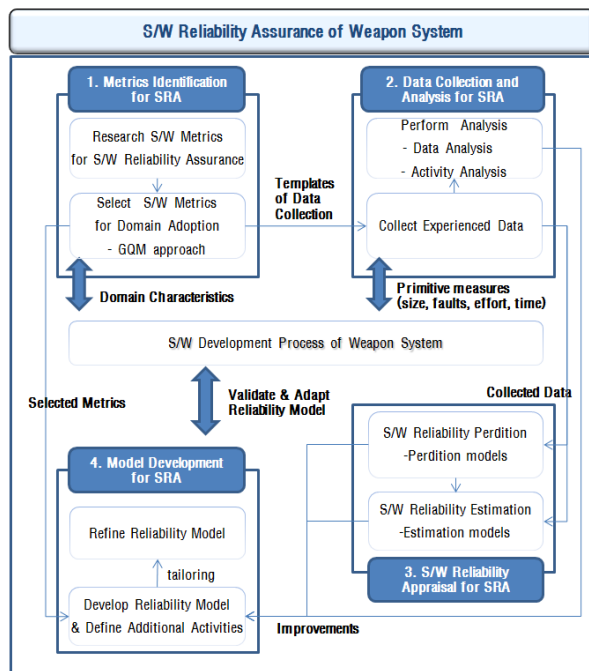
The primary purpose of our research is to propose a framework to assure the software reliability of weapons system in Korea defense domain.

### 2. Framework for Software Reliability Assurance of Weapon Systems

In this section, we describe the framework developed for assuring the software reliability of weapon systems. The framework consists of four parts which are *Metrics Identification for SRA (Software Reliability Assurance)*, *Data Collection and Analysis for SRA*, *S/W Reliability Appraisal for SRA*, and *Model Development for SRA*. Figure 1 illustrates the framework; the four parts in the framework and detailed stages in each part are explained as:

#### 1. Metrics Identification for SRA

This part has the two stages which are research of software metrics for SRA and selection of software metrics for domain adaption. Software metrics is defined to measure applicable quality attributes at each development phase and they are various; for that reason, research of associated metrics for SRA should be preceded than selection of domain specific metrics. In addition, appropriate metrics is identified for reflection of domain specific characteristics. To determine of adaptable metrics, we formulated GQM approach [3] that is one well-known approach to identify an appropriate set of metrics.



**Figure 1. A Framework for SRA**

## 2. Data Collection and Analysis for SRA

The main objectives of data analysis for SRA are to recognize the state of current software development process and to identify improvement opportunities. Moreover, experience data is collected by templates for metrics; template's elements are primitive measures, such as size, faults, effort, and time data.

## 3. S/W Reliability Appraisal for SRA

The S/W reliability appraisal performed with two different approaches which are reliability prediction and reliability estimation. Reliability appraisal based on the collected data set is performed for reliability prediction in early phase and reliability estimation in latter phase. The evaluation of an existing reliability prediction models and/or estimation models confirms the approval whether the result of model is fitted or not. Prediction result is compared with actual data, such as defect density. Estimation result is confirmed by statistical verification.

## 4. Model Development for SRA

In order to develop a well-fitted reliability model for SRA, it is necessary to obtain the outcomes of previous three parts that are selected metrics, the result of data analysis, and the result of reliability appraisal. Because of the results are used to establish specific reliability model in domain and additional activities at the process for reliable software development.

This part has the two stages which are activities

definition including baselines and reliability model development, and reliability model refinement. The baselines for quantitative monitoring of process are defined at each stage in the process. In addition to these, reliability model is developed based on the process. The developed reliability model must be validated by application in software development process, and then it is tailored.

The framework provides an approach for reliability model development for SRA of weapon system. It can help practitioners to effectively and efficiently collect experience data and analyze reliability associated with software reliability assurance in defense domain. It also can help to quantitatively manage and monitor activities in the software development process.

## 3. Conclusion

This paper introduced the framework for SRA in the defense domain. The framework consists of the stages to develop more suitable software reliability models in defense domain.

The software organizations can benefit by applying the proposed framework to their own software development process. The software reliability for the whole system can be improved through the framework. Since the software controls many parts of critical hardware entirely to achieve mission goals, the reliability of entire system can be also improved.

As a future work, we will practice the empirical application of the proposed framework to a MND (Ministry of National Defense) contract company. Furthermore, we will develop a software reliability model which reflects the characteristics of weapon system development in defense domain based on the collected information from the each stage.

## 4. References

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