8.1 Introduction

Modern society relies heavily on the correct operation of software in various forms. From the users’ point of view, software plays an important role in systems of both safety-critical and civil applications. High-quality software of such systems is desirable and even critical. From the developers’ point of view, the pressure of delivering high-quality software on time and within budget requires further research on software reliability assessment. Many software reliability models studied in the last three decades often excluded information on the software development process. In other words, the software reliability is assessed based on the software failure data without taking the software development environment into consideration. This chapter discusses the environmental factors involved in the whole software development process and the impacts of these factors on software reliability assessment. We also discuss several software reliability models that incorporate environmental factors.

8.2 Data Analysis

This section presents a recent survey on software environmental factors consisting of 32 factors based on the studies by Pham and Zhang (1998a) and Zhang and Pham (2000a), and Zhang et al. (2001a). The information about the background of survey participants are considered. The survey form with a brief definition of each of the 32 factors is included in Appendix 3. The basic question Pham and Xuemei (1998a) wanted to study was to determine the factors that profile the software development processes and have significant impact on software reliability?

Analyses of the survey information of the software development process are discussed. Also described is the identification of key factors for software development teams to consider in their software development practice as well as the
understanding of the elements in software development process that may affect software reliability.

8.2.1 Survey Analysis

The survey has two complementary sections (see Appendix 3). Section A data were collected using a formal survey questionnaire given directly by the software developers or managers in 13 organizations. The general information of the survey participants is shown in Table 8.1. The data were collected from March to May 1998. Demographic data on the participants is summarized in Table 8.2. Thirteen companies were chosen to maximize sample breadth for a mostly exploratory study, yet they have sufficient technical and managerial depth to provide reliable data. All organizations had software development projects either for safety-critical, commercial, or inside-user orientated applications. They had a relatively good mixture of software development experience, were diverse in size, program categories, and represented a good mixture of software development firms.

Section A of the survey used a Likert scale to identify the degree to which an increase of significance in each environmental factor (the independent variables) which typically makes software reliability assessment more accurate. In the survey form, 1 indicated “not significant” and 7 “most significant”. If these factors are irrelevant, scores of (or close to) 1 would be expected; if they do have a significant effect on software reliability assessment, mean scores would be statistically different from 1 (not significant). Similarly, factors with high scores could be deemed as having a greater impact than those with lower scores for comparative purposes. Finally, all the factors will be listed in order with the most significant at the top.

Section B in Appendix 3 sought personal and organizational professional data to explore possible relationships with the ranking of environmental factors. Some background data of the survey participants and the categories of the software application were collected. Information of software development effort allocation was also obtained. See Zhang and Pham (2000a) for detailed information.

Based on the survey information, the analysis, design, coding, and testing phases take, respectively, about 25, 18, 36, and 21% of the development efforts. Analysis and design testing phases together take about 64% of the total development time. People in different positions are found to have different opinions (Table 8.3). The significance of incorporating the factors into software reliability studies averages at 75%, ranging from 80% of the programmers, testers, and managers to 63% by other people. The distribution of the survey participants is also shown. For example, 9 out of 22 people are programmers, 4 are system engineers and so on.