Baseline Test Suite Construction of Smoke Test for Extreme Programming

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Abstract. This paper proposed an approach of construction of baseline test suite in smoke test for extreme programming. According to our investigation, the baseline test suite should firstly embody the thinking of “data-centerlization”, and the baseline test suite in smoke test should be conducted in terms of the true application scheme, so this baseline test suite should be the calibration marking for testing and verification of a baseline product version. As a typical example, in the procedure of construction in smoke test of Product Quality Monitoring Software, data accuracy, kinds of control chart, data range, typical application situation, and further requirement were taken into consideration. In order to improve the testing efficiency and to avoid mistakes, a loading kit was developed.

1. Introduction

Extreme programming is excellent programming strategy for varied requirement. We know, requirement is changing with the user, but the objective of the software product is relatively static in a survival period and the application scheme of the software product will keep stationary. So, we can construct test suite according to this true application scheme of the software product especially for extreme programming, in which, all kinds of test data will embrace these true application schemes, as shown in figure 1. Consequently, this kind of test suite will become a calibration marking in smoke test for testing the baseline product version of the software [1-3].

Additionally, in engineering and business activity, although business process will be distinguished for all kinds of factual object, basic features of business data will always keep relative invariant for the same subject. Not only taking the actual changed requirement into consideration but also giving and using an advantage of our experience, data-centerlization would be a good mode for software testing in extreme programming, especially in smoke test [4, 5].

1.1. Investigation of baseline test suite in smoke test

Extreme programming is kind of test-driven programming that test case and test suite is firstly designed in programming for the changed and specific requirement, and testing is taken as a core fact for software programming. For an update software product version, the smoke test is the primary step in testing activity [6]. So, the construction of baseline test suite in smoke test is very important for consequent software testing and programming. Of course, as we known, smoke test must firstly determine main function of the software product. As a result, following discussion is beginning with the analysis of software main function using IDEF0 diagram.
1.1.1. Analysis of software main function in smoke test for baseline version. The IDEF0 diagram for main function analysis of Product Quality Monitoring System Version 2.0 (abbreviation is PQMS2) is shown in figure 2 [7, 8]. And according to figure 2, we can know that main function of the software is inputting of inspection data, computing and drawing control chart, and we can give the basic disposing mode according to domain expert of quality control as following.

- **Mode1** - Manually inputting inspection data, computing and drawing control chart.
- **Mode2** - Inputting inspection data, computing and drawing control chart by digital gauge and measure tools.
- **Mode3** - Inputting inspection data, computing and drawing control chart using saving data.
- **Mode4** - Inputting inspection data, computing and drawing control chart using Notepad of Windows.

1.2. Affecting factors of baseline test suite based on true application scheme [9-14]

For true application scheme, a lot of test data must be generated in baseline test suite. These test data should not be disordered and disorganized [9, 10]. Therefore, the construction of baseline test suite should considerate various influence factors [11-14], and factors for true application scheme mainly include:

1.2.1. Data accuracy. For counting value data, data value is integer, and data accuracy is 1.
   a. For counting value data, data value is integer, and data accuracy is 1.
   b. For measuring value data, data accuracy usually access 0.1, 0.01, and 0.001 in manufacturing factory.

1.2.2. Kinds of control chart. Generally, control chart include two types — the control chart of measuring value data and the control chart of counting value data. Among control chart of measuring value data, there are three kinds — Median control chart, Average value control chart and Individuals control chart. And among the control chart of counting value data, there are four kinds — NP control chart, P control chart, C control chart, and U control chart.
   a. Median control chart/ Median and range control chart
      As a control chart of measuring value, the Median control chart is fitted to inspection data of little range value. And it is popularly used for mass and large batch production.
   b. Average value control chart/ Average and moving range control chart
      The average value control chart is a typical control chart of measuring value, and it is widely applied in quality control domain for mass and large batch production.
c. Individuals control chart/ Charlie control chart

Individuals control chart is generally used in the state which the inspection time is very long or the inspection data is difficultly gathered, for example, the specimen / work piece would be destroyed in test processing.

![Diagram](image)

**Figure 2.** IDEF0 of software main function

d. NP control chart

NP control chart is a kind of control chart to monitor numbers of unqualified product. This control chart is fitted to acceptance testing.

e. P control chart

P control chart is a kind of control chart to monitor rates of unqualified product. This control chart is also fitted to acceptance testing.

f. C control chart

C control chart is a kind of control chart to monitor numbers of defect/fault, and it is used for testing of point counting value, especially for numbers of flaw.

g. U control chart

U control chart is a kind of control chart to monitor rates of defect/fault or defect/fault per unit, and it is also used for testing of point counting value, especially for the rate of flaws.

1.2.3. Data range. For data type of computer programming, there are its own definition and constraint according to programming language and hardware configuration. But for typical application scheme, we should pay attention to following specifications: (1) for measuring value data, general true value is among 0 and 1000, and most is not beyond 500; (2) for measuring value data, general deviation value is
among 0.000 and 10.000, and most is less than 1.000; (3) for counting value data, general number of specimen is among 0 and 10000, and most is not beyond 1000.

1.2.4. Typical application
   a. Purchase inspection
      Purchase inspection executes the testing for purchasing, including all testing of material, standard part, and special part or component, etc.
   b. Process test
      Process test includes mainly two aspects, that is, process testing of fabrication part for factory self, and testing of assembly process.
   c. Finish product test
      Finish product test is the end test of a product in a factory.

1.2.5. Further requirement. For extreme programming, the requirement of user for software product will be multi-layer and multi-dimension. Sometimes, there are some further special requirements for test-driven testing. For example, in PQMS2, distinguished amplification coefficient is required for R chart different from XAve chart in the chart when the range value is very tiny.

2. Construction of baseline test suite of smoke test for extreme programming

2.1. Criterion and procedure of construction of baseline test suite for smoke test
At first, in smoke test for baseline version, construction and arrangement of the test suite must be based on of main function to fulfill the aim of calibration marking. And then, details should be conducted in terms of affecting factors of application scheme to assure that baseline test suite is effective, completed, systematical and convenient to use.

Consequently, construction and arrangement of the test suite must be obliged to the standard and specification of software producing and testing. Disposing procedure of test suite in a survival period should be deferred to figure 3.

![Figure 3. Disposing procedure of test suite in a survival period](image-url)
2.2. Concrete contents of baseline test suite of PQMS2

2.2.1. Arrangement of typical application scheme. Typical application scheme mainly focus on quality control phrases with respect to all kinds of control chart [15]. The table1 has demonstrated the arrangement about this issue. In table 1, columns include Median (control chart of median and range value), XAve (control chart of average and range value), X (control chart of individuals and moving range), NP (control chart of numbers of unqualified product), P (control chart of rate of unqualified product), C (control chart of numbers of defect), and U (control chart of rate of defect), while rows include three typical application schemes.

Table 1. Arrangement of typical application scheme in baseline test suite.

|                      | Median | XAve | X | NP | P | C | U | Sum | Percent |
|----------------------|--------|------|---|----|---|---|---|-----|---------|
| Purchase inspection  | 1      | 2    | - | -  | - | - | - | 3   | 27.2%   |
| Process test         | 3      | -    | - | 1  | 1 | 1 | 6 | 12  | 54.6%   |
| Finish product test  | -      | 1    | 1 | -  | - | - | - | 2   | 18.2%   |

As the table 1 shows, the rate concerning process test achieves 54.6%, the rate of purchase inspection gains 27.2%, and the rate about finish product test is 18.2%. We can find that the arrangement of all kinds control chart is reasonable for various quality control phrases.

2.2.2. Composition of test data in baseline test suite for smoke test [16-18]. Test data plays a very important role in software testing, and it is generally taken as a part of test case in baseline test suite. Particularly, the quality of test data will play very important influence in smoke test while the composition and state of test data will directly determine the effectiveness of true application scheme or situation. Table 2 has illustrated the composition and data volume of baseline test suite for smoke test.

Table 2. Data volume of baseline test suite for smoke test.

| Kinds of control chart | Measuring value | Manually inputting | Inputting by digital gauge and measure tools | Inputting using saving data | Inputting using Notepad of Windows |
|------------------------|-----------------|-------------------|---------------------------------------------|-----------------------------|----------------------------------|
|                        | Median XAve X    | 60                | 70                                          | 60                          | 40                               |
|                        | NP P C U        | 20                | -                                           | -                           | -                                |
|                        | Sum             | 80                | 122                                         | 150                         | 60                               |

As above table exhibitis, for the former three modes of inputting data, data volume is relatively larger, because the first mode and the third mode can supply better safety of data with data verification of limitation and format, and the second mode would improve the efficiency of data acquisition. But the data volume of the fourth mode is relatively decreased because of safety of inputting data and lower efficiency. All these disposing will improve the effectiveness of baseline test suite far from virtual application scheme.

2.2.3. Constructing baseline test suite for smoke test considering affecting factors. According to analysis of the above section 2.2, we can do concrete and detail construction of baseline test suite for smoke test. The table 3 has demonstrated the concrete state in terms of data accuracy, kinds of control chart, and data range. In table 3, the symbol “★” imply that the factor at intersection position is turned into fact for conducting test case in baseline test suite for true application scheme. Still, the last column
lists the special requirement -add marking for tiny range value.

Table 3. Construction of baseline test suite for smoke test in PQMS2.

| Data range | According to main functions | According to affecting factors |
|------------|----------------------------|-------------------------------|
|            | Manually inputting | Inputting by digital gauge and measure tools | Inputting using saving data | Inputting using Notepad of Windows | Further requirement -add marking for tiny range value |
|            |                      |                               |                           |                                      |                                              |
|            | Manually inputting  | -                             | -                          | -                                    | -                                            |
| 0.001      | -                   | ★                             | -                          | -                                    | -                                            |
| 0.01       | -                   | ★                             | -                          | -                                    | ★                                            |
| 0.1        | -                   | ★                             | -                          | -                                    | -                                            |
| Median     | -                   | ★                             | ★                          | ★                                    | -                                            |
| XAve       | -                   | ★                             | ★                          | ★                                    | -                                            |
| X          | -                   | ★                             | -                          | -                                    | -                                            |
| NP         | -                   | -                             | -                          | -                                    | -                                            |
| P          | -                   | -                             | -                          | ★                                    | -                                            |
| C          | -                   | -                             | -                          | ★                                    | -                                            |
| U          | -                   | -                             | -                          | ★                                    | -                                            |
| 10-2 range | -                   | -                             | ★                          | -                                    | -                                            |
| 10-1 range | -                   | -                             | ★                          | -                                    | ★                                            |

In table 3, it implies that all factors must have its representative and should indicate the factual application scheme with fewer unmeaning repeat as possible.

2.3. Loading kit of basic test data for smoke test in PQMS2

The baseline test suite usually includes a lot of test data, and there are many basic test data for setting up of testing environment in smoke test, while some test data are remaindering or unmeaning. If these basic test data all are treatment manually, it will decrease the efficiency of testing. So, a loading kit is facilitated for initialization of testing environment. Basic test data organization of loading kit in smoke test is shown in figure 4. It mainly includes three sections that factory divisions embodies the general organization of factory, product and part mainly use factual and meaningful subjects, and inspection processes focus on key control point of product quality. Of course, these basic data also imply the true application scheme [15].

For programming of this loading kit, this technical task should performed by testing engineer because of the convenience of using and maintenance. In order to fulfill this situation, the testing engineer must be disciplined and drilled perfectly. On one hand, testing engineer must take part in the developing procedure and keep cooperation with the programmers. On the other hand, it is required that testing engineer should be familiar to the software programming and be knowledgeable of usual computer programming language [8].

Figure 4. Basic test data organization of loading kit in smoke test
Against the maintenance, because the test data will be changed with the update of true application scheme and baseline product version, the testing engineer must edit test data following this change.

3. Result and conclusion
For extreme programming, the software programming is driven by testing. As a result, the construction of baseline test suite becomes a very important working, in which, the test case must be updated according to the variety of all kinds of requirement. But, for a baseline version of a software product, the true application scheme of the software generally keeps stationary, so the baseline test suite in smoke test should be conducted in terms of this application scheme, and this baseline test suite will be the calibration marking for testing and verification of a baseline product version.

Based on the true application scheme, we have constructed a baseline test suite of smoke test for PQMS2, while following five aspects have been taken into consideration, that is, data accuracy, kinds of control chart, data range, typical application, and special requirement. Consequently, a test loading kit is facilitated for PQMS2. With the installation of loading kit of basic test data, the efficiency of testing will be promoted and the unnecessary mistakes will be avoided in smoke test.

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