A Nation-Wide Evaluation of Software Components Reusability

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Abstract

Much discipline is needed in order to enable software engineers to develop versatile reusable components. There is need for a set of criteria which enable software builders to evaluate software component reusability both quantitatively and qualitatively across domains. This position paper describes the evaluation criteria, proposed methods, and related considerations, surveyed in a study circle with participation from experts in both industry and academia. However, since reuse disciplines defined through this time survey have not been properly verified, followup studies are needed.

Keywords: Reusability evaluation criteria, Software quality characteristics, Reuse discipline.

Workshop Goals: Learn and exchange information on recent reuse research results.

Working Groups: Standard guidelines for reuse, Quantitative evaluation

1 Background

As a member of NEC's Software Engineering Central Group, M.J. Matsumoto has facilitated the development and exploitation of software reuse libraries in the management information systems domain. He has undertaken the role of architect in the development of a software engineering environment which integrates reuse supports for office server systems during 1980's. As chair of numerous software quality research circles at the Japan Union of Scientists and Engineers, he has promoted several research thrust programs (including software reuse), attended by delegates from many leading industries and academia. Ms. A. Ishida from Hitachi Ltd. has headed the software reuse-related study teams. These joint study activities provide not only an opportunity for members to have insight on reuse issues, but also a chance to explore possibilities for forming a nation-wide consensus on the discipline of reuse engineering.

2 Position

Not all reusable components are reused at the same frequency. Some are very frequently reused, while the others somewhat less. What does this mean? For a given component, no reuse for a certain time period means perhaps that the component does not have enough versatility, with the more frequently reused component having more versatility. The reuse frequency is an index that can be used for evaluating the value of a reusable component, though the frequency itself does not mean the amount of money savings which the reuser can obtain at each reuse time.

If it is true that each component has its own reuse frequency, where does this frequency come from? Is it inherent to the component itself or to the characteristics of the reusers? Not enough surveys have been made for making judgements on what the major factors are that affect this frequency distribution.

There seem to be several factors which prevent software engineers from reusing software components, some of a managerial and some of a technical nature. The technical factors must be at least three-fold: factors pertaining to the component itself, factors pertaining to the reusers of the component, and factors pertaining to the environment in which the component is reused. This time survey focused on the component factor, while the other factors need further preliminary investigation before surveys can be started. The primary aim of this time survey was to find relationships between characteristics and reusability (reuse frequency) for a given component.

3 Comparison

3.1 Evaluation Criteria

There are few well-defined sets of criteria for evaluating software component reusability that have been commonly agreed upon in the reuse community. One possible set could be the 21 characteristics defined in ISO/IEC 9126 Annex A [1]. This set was originaly defined for evaluating software quality from viewpoints such as functionality, reliability, usability, efficiency, maintainability and portability. Since the ISO 9126 is a criteria which is used for evaluating software quality, it should be helpful for finding relationships between the reusability of given components when reviewed from the viewpoint of quality. This is the hypothesis we have taken as our position.

HO: The ISO 9126 could be used as a criterion for evaluating the reusability of software components.

The REBOOT criteria for software reusability might be another candidate which could be used for this evaluation purpose [2]. Metrics defined in the REBOOT might be of help in measuring each criterion quantitatively. The REBOOT criteria, however, have not yet widely been recognized as standards at the international level.

3.2 Proposed Method to Quantify Reusability

A set of reusable components was carefully examined, each component of which was reused frequently and with considerably high reputation. 21 components were sampled from this set. Another set of seldomly reused "reusable" components was examined, and five components were sampled from this set. Several member companies offered sample reusable components under these two distinctively defined categories: frequently reused and seldomly reused [3].

For each of these two distinctive sets, we gave scores to each of the components using five ranking methods, one for each of the ISO 9126 sub-characteristics. Comparing the component scores for these two sets, we have tried to find properties or quality characteristics which each category of components commonly holds.

3.3 Considerations

We found that the characteristics we must pay attention to in terms of factors which affect component reusability may vary depending on the software size, execution environment, development methods, and machine type. Consequently, guidelines for better reuse design should be established for each of these circumstances. We are however able to point out some disciplines, for example, where there is a big gap between two frequency categories in terms of functionality, reliability, usability and efficiency.

Accuracy, connectivity and understandability are thought to be factors independent of reusable component circumstances. On the other hand, characteristics which are thought to be inmportant vary largely from one domain to another. For example, understandability is thought to be important in the downsizing systems domain, while it is not in the embedded or communication systems domain. This example shows that further studies must be undertaken for defining disciplines which can be commonly used across domains.

References

[1] "International Standard Information Technology - Software Product Evaluation - Quality Characteristics and Guidelines for Their Use, First Edition," Tech. Rep. ISO/IEC 9126, ISO/IEC, 1991.

[2] A. de Mora et al, "A Metrics Approach to the Software Reuse Problem," in *Proceedings of the Third European Conference on Software Quality*, 1992.

[3] *Interim Report: Software Reusability in The 8th Year-Round Workshops on Software Quality Studies*, pp. 133–141. Japan Union of Scientists and Engineers, 1992. (in Japanese).

4 Biography

Masao J. Matsumoto joined NEC, Tokyo, Japan, in 1963. His responsibilities on the NEC Software Engineering Laboratory included modeling, developing, and exploiting integrated software development environments for and with reusable components under the SEA/I project. He had helped formalize and simplify software reuse libraries under the post STEPS, SSPL and SPar projects. He currently works in the C&C Software Development Group, NEC, and participates in corporate software engineering programs. He is developing software engineering curricula encompassing reusability, quality and productivity for the NEC Institute of Technology Education. He also chairs the Software Quality Study Programs at the Japan Union of Scientists and Engineers. He gives lectures on software engineering at Yamanashi University, School of Engineering and Tsukuba University, Graduate School. Dr. Matsumoto earned his bachelor's degree in Mathematics Science at Waseda University, and his Ph.D.degree in Information Engineering from Kyushu University.

Ms. Atsuko Ishida joined Hitachi, Ltd. in 1972 after graduating from Tokyo University, Faculty of Sciencei, earning earning her bachelor's degree in Mathematics. She has led several successful projects in software development and engineering. Ms. Ishida has also headed software reusability study groups at the JUSE.