CHAPTER 7

CONCLUSIONS AND FUTURE WORK

7.1 INTRODUCTION

There is an increasing demand for high quality reusable components in the software industry today. This rapid expansion of the component market is motivated by the advantages of reduced lifecycles and lower development costs. The use of COTS components does have beneficial effects. For example, National Aeronautics and Space Administration (NASA) successfully employed COTS components in reengineering the Hubble Space Telescope Command and Control system (Pfarr and Reis 2002).

There is a need for the development of a quality standard for the COTS component market that will guarantee component purchasers, high quality reliable components. One way of providing a quality guarantee is by having the components evaluated and certified by some third party organization based on an agreed COTS component quality evaluation model which is the objective of this research, the results of which having been already discussed in previous chapters. A future step can be to design a COTS component quality maturity model that can be used to assess the components quality maturity levels and classify the components according to their quality maturity levels. The quality maturity levels of the component quality maturity model should be mapped to the Q’Facto12 COTS component quality evaluation model discussed in chapter 5.

This chapter provides the conclusion of the thesis, a brief discussion of the SEI Capability Maturity Model (CMM) and outlines a
COTS Component Quality Maturity Model which is based on the CMM model, which is a product maturity model with the aim of assessing a component’s quality maturity level in relation to the quality model Q’Facto 12. This is the future direction of the work discussed in this thesis.

7.2 CONCLUSIONS

The objective of this research is to develop a comprehensive quality model that is suitable for use by end users to assess the quality of commercial COTS components. As a first step, a seven dimensional vector (T,R,U,S,T,A,D) was proposed that can be used to clearly demarcate COTS and In-House components. A model Q’Facto 10 based on the ISO9126 quality standard was proposed which was later improved using reviewers suggestions to the upgraded model Q’Facto 12 that is based on the ISO 25000(SQuaRE) quality standard. A statistical analysis of the model of the proposed quality measures was carried out using feedback from software professionals.

It has been found that all the forty quality measures are sufficiently important to be included in the model and the quality measures have also been ranked according to their level of importance based on critical values obtained in the student t Test. It is also seen that all the forty quality measures pass the test of ease of measurability. Further using weights assigned by the users for the quality attributes and measures to the COTS component that is being used by them, the quality factors for ten components were computed. It is verified that the quality factors so computed correctly reflect the perception of the users regarding the quality of the component they have been using. To conclude we find that the proposed quality measures have been accepted by the sample group of professionals and therefore the basic model proposed is meaningful and can be used as a good starting point for future development.
7.3 CAPABILITY MATURITY MODEL (CMM)

The Component Maturity Model that is going to be discussed in the
next section as a future continuum of the current work is loosely based on the
SEI CMM model. The SEI CMM model was originally developed as a tool
for objectively assessing the ability of government contractors' processes to
perform a contracted software project. The CMM is based on the process
maturity framework first described by Watts Humphrey(1989).

The Capability Maturity Model involves the following aspects:

- **Maturity Levels:** a 5-Level process maturity continuum -
  where the uppermost (5th) level is a notional ideal state where
  processes would be systematically managed by a combination
  of process optimization and continuous process improvement.

- **Key Process Areas:** a Key Process Area (KPA) identifies a
  cluster of related activities that, when performed together,
  achieve a set of goals considered important.

- **Goals:** the goals of a key process area summarize the states
  that must exist for that key process area to have been
  implemented in an effective and lasting way. The extent to
  which the goals have been accomplished is an indicator of
  how much capability the organization has established at that
  maturity level. The goals signify the scope, boundaries, and
  intent of each key process area.

- **Common Features:** common features include practices that
  implement and institutionalize a key process area. There are
  five types of common features: commitment to Perform, Ability to Perform, Activities Performed, Measurement and Analysis, and Verifying Implementation.
- **Key Practices**: The key practices describe the elements of infrastructure and practice that contribute most effectively to the implementation and institutionalization of the KPAs.

There are five levels defined as follows:

1. Managed - the process is managed in accordance with agreed metrics.

2. Defined - the process is defined/confirmed as a standard business process, and decomposed to levels 0, 1 and 2 (the latter being Work Instructions).

3. Quantitatively managed

4. Optimizing - process management includes deliberate process optimization/improvement.

Within each of these maturity levels are Key Process Areas (KPAs) which characterise that level, and for each KPA there are five definitions identified:

1. Goals

2. Commitment

3. Ability

4. Measurement

5. Verification

The KPAs are not necessarily unique to CMM, representing — as they do — the stages that organizations must go through on the way to becoming mature.
The CMM provides a theoretical continuum along which process maturity can be developed incrementally from one level to the next. Skipping levels is not allowed/feasible.

7.4 THE COTS QUALITY Maturity MODEL

The COTS Quality Maturity Analysis Model is a product maturity model proposed with the aim of assessing a component’s quality maturity level in relation to the Q’Facto 12 quality model described in chapter 5 that can be used to evaluate the component’s quality.

The Quality Maturity Analysis Model involves the following facets:

1. **Quality Maturity Index Levels**: This is a 5 level quality maturity continuum where each maturity index level represents a quality state achieved by the component that can be directly mapped to the quality factors that are evaluated by the component quality evaluation model.

2. **Key Quality Focus Areas**: Key Quality Focus Areas identify a set of quality factors whose criteria have to be satisfied for a component to achieve a certain quality maturity index level.

3. **Key Quality Test Goals**: The quality test goals summarize the target quality state that a component must achieve for a Key quality Focus area to be implemented in an effective and lasting way.

**Key Quality Tests**: Quality Tests describe the different activities carried out in order to check if the quality goals of the key quality focus areas have been achieved
Figure 7.1 The Proposed COTS Maturity Model

Figure 7.1 gives an outline of the proposed maturity model. There are five quality maturity Index levels. Every index level will have key quality focus areas that can be mapped to the quality factors of the Q'Facto12 model.
Key quality focus area will have quality tests that have to be carried to check if the component has implemented the key quality focus areas properly. The quality tests will have test goals and checklists. A component should pass all the tests and clear a maturity level before it gets tested for the next quality maturity index level. This means that only a one star component can be checked for two star maturity levels. Similarly, only a three star component can be tested for a four star maturity level and so on. This also implies that if a component has been graded has five stars, it has crossed and passed all the previous maturity levels. So, a three star component is also a one star and two star components but cannot be a four star or five star components. A five star component is a matured high quality component and a one star component is a low maturity lower quality component.

7.3 CONCLUSION

One of the most critical processes in CBSD is the selection of appropriate COTS components that meet the user’s requirements. An important step in the component selection process is the evaluation of COTS components using quality models. For a quality evaluation model to be effective, it should be possible to match the model to a quality maturity model, so that the COTS component’s quality maturity level is also evaluated. A COTS quality model has already been proposed and validated in this thesis. As a future step, a COTS quality maturity model can be conceived which when combined with the quality model can form a COTS quality assurance framework. This chapter discusses the outline for a COTS component quality maturity model that can be used to evaluate the component’s quality maturity level. Each focus area has quality goals, checklists and quality tests. Work is in progress for a detailed design of the model.