Chapter One – Introduction

1.1 Introduction

The development of software is a complex process. Managing the process is a challenge to software developers. It not only requires that software developers have much experience in software design, but also requires them to master some tools to improve the quality of software. In order to be able to achieve a better quality of software and higher productivity, Computer Aided Software Engineering tools (CASE tools) should be used by software developers to help them in software development.

This chapter gives an overview of the research on the use of CASE tools carried out by the researcher. Firstly, the definition and history of CASE tools are discussed. This is followed by a discussion on the advantages and disadvantages of using CASE tools as well as the use of these tools in Malaysia. The researcher then discusses the research objectives, scope of the research, methodologies employed, the expected outcomes, and the research limitations. Lastly, the organization of the thesis is listed.

1.2 Definition of Computer Aided Software Engineering

Computer Aided Software Engineering (CASE) was introduced in the 70’s. Some experts have defined Computer Aided Software Engineering as the automation of systems development. CASE gives software developers help in building software system by using tools, techniques and methodologies in system development. Traditionally, researchers have classified CASE tools into four categories (David, 1997). These are:
1) Upper CASE

Upper CASE tools are used to handle high-level designs such as object and database modeling and also check limited repository information. Upper CASE tools are used in the methodology level.

2) Lower CASE

Lower CASE tools can be used in application development such as code generation and interface design.

3) Integrated CASE

Integrated CASE tools are a combination of the capabilities of Upper and Lower CASE tools and also have additional features such as database design.

4) Meta CASE

Meta CASE tools allow the system developers to innovate customized methodologies into particular CASE tools. For example, if a developer finds that there are no suitable methodologies for his or her project, he or she could develop a new methodology using Meta CASE tools.

1.3 History of CASE Tools

Initially, in the 70’s, the growing size and the complexity of software systems created the need for a tool to help developers break large and complex software into smaller and simpler modules and convert the software from an abstract level into a design level. During that time, many of the graphical notations available were used to help software developers model problems and solutions (Alfred, 1991). The CASE tools available at that time provided some basic functions such as diagram editions and system checking.
In the 80’s, CASE tools became more powerful as many researchers added more functions such as documentation generation, diagram, consistency checking, and code generation to them.

In the last ten years, due to significant changes in information technology, the CASE tools had additional new features added to them. These included Object-Oriented Techniques, Component-Based design, 4th generation language support and Reverse-Engineering.

At present, many CASE tools are available in the market. Examples are: RationalRose, SystemArchitect, Erwin and DOORS. These tools provide many functions such as: diagramming, repositories, interface design, schema object generation and reverse engineering.

1.4 Advantages and Disadvantages of Utilizing CASE Tools

Many software companies use CASE tools today. The CASE tools are playing an essential role in system development, especially in today’s analysis and design stages of system development. Generally, CASE tools help developers make their jobs easier, faster and better. Some benefits of using CASE tools are:

1) Faster coding (Joan, 2003)

CASE tools can generate source code automatically, and programmers do not have to write the code manually. Therefore the schedule of software development would become shorter.
2) More flexible ways for modification and maintenance

CASE tools have the ability to allow developers to maintain and modify the code. For example, if a developer wants to change an attribute of a class, he or she needs to only make the change once and the system automatically changes other factors related to this change.

3) Better communication between users and developers

CASE tools provide many notations to present different meanings, which are standardized and easy for users and developers to understand. Some standards such as IEEE are used to keep diagrams and the styles of naming are consistent. This benefit of CASE tools can reduce miscommunication between users and developers.

4) Better quality of software using reuse components

CASE tools also support re-usability in software design. In software design, some modules and components (e.g. some class diagrams and entities) can be used again for other projects. If later, developers want to design a new system that makes use of similar classes in the previous project, the developers can use these components without any changes. Developers need not worry about problems in this component as these components have been tested in the previous project.

5) Automatic documentation

Documentation is very helpful to both end users and developers. CASE tools can automatically generate documentations for end users and developers.
6) Powerful features for consistency checking

The consistency-checking features can ensure that developers are able to make changes to parts of the software without causing any conflict with other parts. Thus, these consistency-checking features reduce the risk of change.

7) Teamwork support

Nowadays, most software is developed by teams instead of individuals. CASE tools provide the capability of supporting software development by teams. CASE tools allow members of a development team to share designs and documentations in a software development project.

However, CASE tools are not perfect. Many IT companies have encountered problems in using CASE tools. Some problems resulted from the cost of installing CASE tools while others appeared because of the complexity of CASE tools. When using CASE tools, some issues to be considered are:

1) Education and training cost of using CASE tools

In order to ensure that the users know how to use CASE tools properly, companies have to spend much money in training and education. In many cases, this is a big cost to the companies.

2) Complexity of CASE tools

Some CASE tools are very complex. Users cannot master them easily.

3) Ongoing usage fees

Once companies have installed CASE tools, they likely continue to upgrade the version of CASE tools, and hence the extra money will be spent.
4) Simplistic code

CASE tools can generate code for programmers. But the codes are very simple. It normally cannot be used without any modifications. Programmers have to add more code to make sure the program runs correctly. Therefore when CASE tools are used, programmers sometimes spend a lot of time modifying the code.

5) Inadequate integration with other tools (Alan, 2002)

Integration of CASE tools is very important to ensure that they can be used in other projects. Unfortunately, some CASE tools cannot integrate with others.

6) Personal skills

Using CASE tools requires users to have strong skills and knowledge in methodologies and notations. If the users are new to such things, they will find it quite difficult to use CASE tools.

1.5 Usage of CASE Tools in Industrial and Educational Sectors in Malaysia

CASE tools are very powerful tools to help system developers in analysis, design and code and so on. According to a report done by Mohd (1989), in Malaysia, there has also been a significant advance in the development of software using CASE tools. The researcher believes that there will be an increasing trend in the use of CASE tools in both the industrial and educational fields.

1) Usage of CASE tools in the industrial sector

In order to speed up software development, companies in Malaysia are using CASE tools to improve software development. Selamat (1994) said that “Malaysia, a member of ASEAN, is experiencing a dramatic growth in the IT industry. Many enterprises are investing substantial resources into CASE technology to fulfill the growing demand of IT applications”. Some other companies use complex CASE
tools in analysis, design, code generation and documentation generation. Companies use the CASE tools based on different requirements such as business reasons and staff skills.

2) Usage of CASE tools in the educational sector

Software companies benefit from educators because the colleges and universities provide qualified new staff for them. Basically, before entering the companies, most IT students have learned some fundamental knowledge about software development. In order to ensure that IT students know about CASE tools, colleges and universities must teach and deliver new knowledge to IT students accordingly. These universities use CASE tools in their teaching areas that include System Development, Software Engineering and Principles of Database.

1.6 Problem Statement

More and more technologies are becoming available to support software development. To remain competitive, Software companies must be able to use these new technologies. Barbara (2004) pointed out that choosing a CASE tool for learning and teaching systems is an issue within an academic institution. CASE tools are becoming more important for software designers. In implementing CASE tools, both companies and educators face the following problems:

1) Companies that use CASE tools in software development sometimes do not have staff with the required skills (Duska, 1994).

2) CASE tools are becoming so powerful and complex that it is increasingly becoming difficult for developers and student to use (Paul, 1999).

3) Cost of using CASE tools is very expensive (Premkumar, 1995). Therefore, universities and colleges cannot afford to use CASE tools to teach their students.
4) There is limited time for teaching the use of CASE tools (Barbee, 1990). Therefore, students can only learn basic features of CASE tools.

To what extent are the above factors affecting universities and colleges in Malaysia and what can be done to alleviate the problems?

1.7 Research Objectives

Most of us agree that sometimes, what employees actually use in companies is different from what they learn in universities. A similar relationship can be made between software companies and IT students. The usage of CASE tools is a good example to be studied by the researcher. The research attempts to clarify whether there is any mismatch between required skills of software companies and knowledge produced by educators attempt to.

The researcher will explore three objectives in this study. The research objectives are:

1) To investigate what CASE tools are taught in colleges and universities and compare with that required from IT organizations.

2) To identify the factors and obstacles in implementing CASE tools in educational and industrial sectors.

3) To provide a collaborative CASE tools system that can help to promote the usage of CASE tools.

To cover the three objectives, the researcher developed some research questions, which were used to help the researcher to meet the objectives accordingly.

1) Utilization of CASE tools in some companies and some universities
   Do companies use CASE tools in software development?
   Do universities use CASE tools for teaching purposes?
   Why do the companies and universities use CASE tools?
   What are the CASE tools used in both universities and companies?
2) Factors and obstacles that affect the usage of CASE tools in companies and universities

Is there a business consideration to use CASE tools in companies and universities?

What resources are lacking in trying to learn how to use CASE tools by employees and students?

Are the CASE tools too difficult or too complicated to use?

Is the time for training and teaching enough to master the knowledge of using the CASE tools?

3) Comparison between students’ knowledge and a company’s usage of CASE tools

What are the necessary requirements for using CASE tools?

What do students know about using CASE tools?

Is there any mismatch between job requirements and student’s skills?

4) System development of Forum of CASE Tools (FOCT) System

Does FOCT provide a useful and helpful platform for promoting the usage of CASE tools?

1.8 Significance of the Research

The current problems in the educational and industrial sectors have been described in the previous section. After studying other similar and related research work, the researcher is claiming that this research work is significant for the following reasons:

1) Clarification of problems in educational and industrial sectors

The research problems have been described in the previous sections. The main problems have already existed for a few years. However, no
documented research work has been carried out to investigate the problem situation. Therefore such a study will benefit both the educators and IT community to understand the problems and the current scenario. To understand the problems better, the researcher will conduct surveys in the educational and industrial sectors. From the data gathered, an analysis can be conducted and recommendations formulated. This finding will contribute towards deriving at a solution to the problems.

2) More statistical findings

Although other researchers have conducted research in the usage of CASE tools in Malaysia, they have limited their studies to the industrial sector only. However, this study covers both educational and IT industrial sectors with different views. The data collected will be analyzed and presented in different formats. Therefore richer and more meaningful findings can be explored and generated.

3) Improvement of students skill

This research project is focused on investigating the usage of CASE tools in universities and colleges. The result of this research is more accurate and reliable for IT educators and IT professionals compared to other similar research. Therefore, the educators are able to identify the problems that exist in the colleges and universities and minimizing the gap between educational and industrial sector. Employers will be able to train new employees to improve the software skill with minimum cost.

These significant impacts encourage the researcher to carry out the study. This research will provide a firm basis for future and more detailed study on the usage of CASE
tools. The researcher hopes that the finding of the study will be beneficial to both educators and IT professionals to improve the productivity of employees in Malaysia.

1.9 The Scope of the Research

In order to closely focus on the research objectives, the researcher narrows the scope of this topic because of some factors including time, cost and researcher’s limitations. The scope of the research was defined as follows:

1) The research’s target area is Malaysia.

   The researcher will focus on the research area in Malaysia only because as a student, it is impossible to go overseas to conduct interviews and surveys.

2) Target educators are from some universities and colleges in Malaysia.

   The researcher will focus the study on colleges and universities in Malaysia, because these colleges and universities offer many IT and computer subjects that involve the use of CASE tools.

3) Target students are those students who are studying in colleges and universities.

   The researcher will select fifty IT students as a target group and administer questionnaires to them. From the completed questionnaires, the researcher will be able to collect data and information, which are the primary data for this research because these students can give some feedback on the usage of CASE tools in their study programs.

4) Target lecturers are in the universities and colleges. The researcher randomly selects fifty lecturers as respondents. The lecturers would be able to produce valuable feedback because they are using CASE tools in their teaching.
5) Target companies are IT organizations, which are using CASE tools to develop software in Malaysia. Twenty-five companies will be invited for this research. From interviewing the software companies, the researcher will be able to know what the real requirements are from IT companies and which areas are important for students.
1.10 Research Design

Figure 1.1: Research Design
To complete this research in an effective way, the researcher has come with a research design as shown in Figure 1.1. There are fourteen steps to complete this research.

1.11 Research Methodologies

To ensure that the researcher obtains the appropriate data from this research and achieves accurate results, the researcher must choose the right methodologies. The research instruments used in the collection of data are shown below:

1) Questionnaires

The researcher plans to distribute questionnaires to students and lecturers in some colleges and universities in Malaysia. Questionnaires are an effective way to collect data from a large number of people. The researcher plans to distribute at least two hundred questionnaires among the students. The researcher further needs to send out questionnaires to lecturers who are teaching some subjects that use CASE tools.

2) Interviews

The researcher will conduct interviews with IT organizations. Interviewing some IT companies or IT departments is a main research approach to get the primary data about using CASE tools from IT organizations. By interviewing IT people, the researcher will be able to obtain details about how CASE tools are used in their companies. A similar approach applied in a CASE tools study has been used by Selamat (1996). This researcher made surveys and interviews in IT Malaysian companies.

3) Literature analysis which include the following sources:

   a) Job advertisements

   Job advertisements are an economical and effective way to collect secondary data. From the job advertisements, the researcher will be able to find out what
skills are needed by IT graduates. Generally, the employee will list out skills that the candidates must have, such as knowledge on Rational Rose and UML. Job advertisements are published in newspapers and some well-known websites such as www.JobStreet.com.my in Malaysia. The researcher will frequently check these resources as references.

*b) Journals and magazines*

Journals and magazines are very important sources to find helpful and reliable secondary information. University libraries subscribe many journals related to CASE tools, such as CAM and IEEE. The researcher will search Universiti Malaya (UM) library or other research centers to get these journals and magazines. The papers obtained from the journals and magazines give the researcher the latest information and issues about CASE tools. After reading and analyzing these papers, the researcher will be able to get accurate and very clear knowledge about the study of CASE tools.

*c) Academic reference books*

Reference books are a main resource to the researcher. Reference books give more complete and accurate definition about this study. The researcher will select some references as secondary information.

*d) Websites*

Some professional and well-known websites such as IBM’s website issue many white papers and provide forums for researchers to explore more knowledge. The researcher will access these websites to search for helpful information.
1.12 Expected Research Outcomes

The expected research outcomes are as follows:

1. From interviewing IT organizations, a status report on the utilization of CASE tools in the industrial sector will be obtained.
2. From surveying students and lecturers from colleges and universities, a report on the usage of CASE tools in the educational sector will be reported.
3. The main success factors and obstacles will be identified.
4. From the above findings, the Forum of CASE Tools (FOCT) system will be developed. This system will help in promoting the utilization of CASE tools.

1.13 Limitations of the Research

The main limitations are the sample size of companies, students in colleges and universities and language.

- Size of companies
  The researcher plans to interview about twenty-five companies in Malaysia because of reasons such as time frame and cost. The researcher would have liked to spend about three or four months to conduct interviews with many IT organizations.

- Size of survey groups
  The researcher plans to distribute about two hundred sets of questionnaires among some private and government universities in Kuala Lumpur and Selangor such as KDU, APPIT, UM, UTM and UPM. The researcher is not able to distribute the questionnaires to USM, due to distance and cost. Maybe, a web-based survey is an alternative way to collect data from USM. But the time and reliability of data are concerns.
Language is another limitation for the researcher. For example, the researcher wants to access some websites of universities to get information about IT subjects, but many websites are presented in Bahasa Malaysia, which is the Malaysian official language. It is difficult for the researcher to understand. Very often, the researcher has to ask friends to interpret the content, which is presented in Bahasa Malaysia.

1.14 Organization of the Thesis

According to the guide on dissertations and thesis in UM, the researcher will arrange the order of the research under the following headings:

1. Preface

   This chapter contains the title page, abstract, acknowledgements, table of contents, list of figures, and list of symbols and abbreviations.

2. Introduction

   This chapter contains the introduction to the issues of CASE tools, brief history, research objectives, research questions, methodology, scope of the research, research design, limitations of the research and organization of the thesis.

3. Literature Review

   This chapter will explore the relevant academic issues of using CASE tools done before. Some issues will be studied such as the support of CASE tools to software engineering and methodologies and problems in using CASE tools.

4. Survey and Data Analysis

   From findings, some figures and tables will be generated.

5. System Development of Forum of CASE Tools (FOCT) system
System development of FOCT is described in this chapter. All necessary information and documentation will be described in detail.

6. Conclusion

This chapter interprets the tables and figures derived from data analysis, and also compares data with previous expected output and literature review.

7. References

8. Appendix

1.15 Conclusion

Generally, from the brief introduction of CASE tools, the researcher has presented a basic understanding of utilization of CASE tools. The researcher discussed the history of CASE tools, advantages and disadvantages of CASE tools’ utilization, factors and obstacles in using CASE tools in both the industrial and educational environment. Furthermore, the researcher described the research methodologies applied in this research, the expected research outcomes, limitations of the research and lastly, the researcher set the organization of thesis according to the thesis format.