CASE TOOLS: FULFILLING THE INDUSTRIAL REQUIREMENTS

ZAITUN A. B. and ZHU LIZHONG.
Faculty of Computer Science and Information Technology,
University of Malaya,
50603 Kuala Lumpur,
MALAYSIA

Tel: 603-79676363
Fax: 603-79579249

zab@um.edu.my

ABSTRACT:

As computer users become more and more sophisticated, CASE tools have emerged and evolved to meet the growing demands of software development. CASE tools have been developed to assist software developer in their daily functions. Universities and colleges have introduced CASE tools in some of their Computer Science courses, in an effort to give students an early exposure to CASE tools. This will ultimately help the students to equip themselves with specific skills that employers require. Furthermore, graduates with the latest computing skills stand a better chance to get employment. Their exposure and experience in using CASE tools is one of the computing skills that is very much being sought after. This paper presents the findings of our study based on a survey conducted amongst lecturers and interviews with organizations in the IT industry in Malaysia. The objective of the study is to find out whether there is a match between the CASE tools taught in Universities and colleges and the CASE tools that are required and used by the local IT community. Finally, we conclude that there is no real mismatch but the variety of CASE tools available in the market poses a big problem. This paper is written with the hope that by sharing the Malaysian experience of CASE tools utilization in higher education, other developing countries could conceive new ideas of how similar efforts can be carried out with the objective of providing the job market with graduates that have the right computing skills.

Keywords: CASE tools utilization, IT Skills, Computer Science curriculum.

1.0   INTRODUCTION

Computer Aided Software Engineering (CASE) tools encompass a collection of automated tools and method that assist software engineering in the phases of software development lifecycle [1]. The Software Engineering Institute at Carnegie Mellon University [2] refers to CASE tool as a computer-based product aimed at supporting one or more software engineering activities within a software development process. Software houses have experienced that by using CASE tools in their work they encounter an improvement in productivity, obtain better quality software, reduce cost in software development, enable software reuse and ability to support object oriented software development [3]. CASE tools have evolved from the period that it was first introduced in the 70s to support the ever increasing sophistication of software requirement of the IT industry. In the early 80s, CASE tools were only able to assist in documentation preparation and diagramming during the design phase of software development. In the mid-1980s CASE tools are able to perform automatic design analysis and check automated system information reposting. Then in the late 1980s, CASE tools are able to perform automatic code generation from design specifications, thus linking design automation and program automation [4]. In the early 1990s, CASE tools offer intelligent methodology drivers, habitable user interface and promote reusability. Programmers claim that when they use CASE tools in their work, they can; do coding faster, find more flexible ways of modifying and maintaining software, communicate better with end users and development team members, produce better quality and trusted software, remain undaunted by the tedious documentation phase as it can be generated automatically, they enjoy the powerful features that CASE tools can offer in consistency checking and CASE tools facilitate them to work in teams [5]. However, there are also some problems that tend to discourage software developers from using CASE tools. To begin with, CASE tools themselves are expensive and require an ongoing usage fees in terms of licensing. Using CASE tools require costly education and training. Some CASE tools are complex and will require a longer learning curve. Some of these CASE tools require the developers to have strong programming skills and knowledge of methodologies and notations. New programmers often find this a barrier to adopting a CASE tool [4]. CASE tools can also be categorized according to their functionalities. Some CASE tools can even support more than one phase of the system development life cycle. Categories of CASE tools include; editing tools, Programming tools, Verification

and Validation tools, Configuration Management tools, Metrics and measurement tools, Project Management tools, Reengineering tools, Change Management tools, Documentation tools, Testing tools and even Planning tools [6,7].

With the availability of powerful CASE tools in the market and the increase in the sophistication of computing requirements demanded by the present day lifestyle, how extensively are CASE tools utilized by the IT community? We often hear complaints from IT graduates that it is no longer easy for them to find employments. On the other hand, employers are also complaining that they find it difficult to get employees with the right IT skills. They are interested in candidates that have experiences or are exposed to utilizing specific CASE tools. Is there a mismatch between the CASE tools introduced by universities and colleges to their students and the knowledge of CASE tools utilization needed by the IT industry? If there is, then why are the universities and colleges not teaching students these new CASE tools?

With those questions in mind, we have conducted a survey to investigate the CASE tools taught in universities and colleges and the CASE tools that IT organizations are interested in. The following sections will describe the survey that we have conducted, an analysis of the data gathered and conclude with some suggestions on how the situation can be improved so that universities and colleges are in synchronization with the demands of the IT industry. This will help universities to produce a workforce that meets the requirements of the IT industry.

2.0   ISSUES RELATED TO TEACHING AND LEARNING CASE TOOLS

To fully meet the industrial requirements, colleges and universities have offered software courses where CASE tools are used and made compulsory for students to use them in tutorials and course assignments. When using CASE tools as learning tools, the educators and students faced some problems as has been pointed out by [8]. These issues include:

- *Student's learning time* - The time allocated for lab practice to learn using CASE tools are simply not enough.
- *Cost of CASE tools* – The cost procuring the CASE tools are already high and on top of that educational institutions have to incur the cost of multi user licenses. This makes it difficult for them to install many types of CASE tools for many students.
- *CASE tools themselves* - Different CASE tools, provide different features. Most of the

CASE tools are initially commercial-oriented. These CASE tools are targeted for professional developers, and not for students. The vendors may assume that the users have experience in using these CASE tools. Usually, these CASE tools have many advance features. Therefore, students feel that it is quite difficult to learn and use the CASE tools. To give sufficient support to students, the vendors should provide a version of CASE tools that are suitable for learning purposes with simple features for the educational environment.

- *Lecturer's time and support* - Support from the lecturers is also very important in learning CASE tools. Lecturers who have to teach CASE tools will spend lot of time to learn the CASE tools themselves before they can teach students. The lecturer's knowledge will have an impact on the effectiveness of student's learning. If the lecturer does not guide the students well when teaching CASE tools, the students will not be able to get much knowledge in using CASE tools.
- *Computer labs* - There must be enough laboratories to practice using the CASE tools. Sometimes, there are too many students in one class and students have to take turns using the PCs. This is discouraging and in such a situation they may lose interests in learning CASE tools.
- *Materials and assignments* – There must be enough materials which falls somewhere between the short, step by step tutorial and tool-independent text books presentation of methodologies. There must be enough assignments given to students which are close to the real world to be attempted within reasonable amount of time. After finishing the assignments, these students can really experience the capabilities of CASE tools. If the assignments are too simple, the students will just use a few features of the CASE tools to do it. Then, the CASE tools will not give much benefit to them.
- *Vendor's support* - must offer educational version of CASE tools because students who gain experience using CASE tools will be potential customers in the future.

3.0   THE SURVEY AND INTERVIEWS

The objective of the survey is to investigate the utilization of CASE in universities and colleges. The questionnaire is made up of questions that will investigate on; *the background and experiences of lecturers, courses that include CASE tools, the awareness of the industrial needs, time spent on teaching CASE tools for each course, ease of teaching*

CASE tools, sufficient time and infrastructure for teaching CASE tools, problems faced in teaching CASE tools and suggestions to improve student's skills in CASE tools

121 questionnaires were distributed to lecturers and 53 (22%) completed questionnaires were returned. The target lecturers were those teaching courses that involve using CASE tools such as System Analysis and Design (SAD), Software Engineering and Object-Oriented Techniques. Before the administration of the survey, pilot tests were conducted with selected lecturers and students. We gave five sets of questions to lecturers and students, asked them to give comments on the survey. After correcting errors in the questionnaire, the survey was then carried out.

4.0 RESULTS AND ANALYSIS

We have used SPSS 12.0 for Windows to analyze the data collected. Findings of our survey showed that CASE tools are highly used in the Object Oriented Techniques (OOT) and Software Engineering and Database courses. Number of lecturers using CASE tools is highest for Software engineering and the maximum number of hours used is highest for OOT courses. Table 1 describes the situation further.

From Figure 1, we can see that the main CASE tools introduced to students are Rational Rose, followed by System Architect (SA) and Visio Professional. This is due to the fact that Rational Rose and SA supports the teaching of OOT courses. Besides the CASE tools and online help, the lecturers make use of supplementary materials such as text books, CASE tools websites and online materials to support their lectures. This is illustrated in Figure 2. When the lecturers were asked whether they are aware of what CASE tools utilization skills the industry wants, 27 (51%) said that they aware and only 10 (19%) are unaware or ignorant of the industries' need. Figure 3 describes the situation. It is encouraging to see from Figure 4 that 33 (62%) lecturers are satisfied with the supporting infrastructure. From Figure 5, we could see that 41 (77%) of the lecturers have prerequisite knowledge of SAD and OOT before they incorporate CASE tools in their teaching. This makes it easier for them to master the use of CASE tools before teaching the students.

When the lecturers were asked, what were their expectations of students' ability in using CASE tools after graduating from the universities or colleges. They stated that they hoped the students would be able to have a basic understanding of CASE tools and use them to handle the tasks in their future work places. Lecturers were also asked whether they had any problems when they were teaching CASE tools. Most of the respondents commented that time is the main problem.

The time that they had in a semester for a given course is insufficient for the students to learn using CASE tools and also explore the full capabilities of these CASE tools. Some of respondents agreed that the high cost of CASE tools is another limiting factor to the use of CASE tools in their teaching. When the respondents were asked on suggestions to improve students' skills in learning how to use CASE tools, some argued that the vendors should provide an educational version of CASE tools with low prices. This will enable the university/college to provide more CASE tools licenses for students to learn and practice on. Some respondents strongly urged that the universities/colleges provide adequate infrastructure to teach CASE tools. Another suggestion is to prepare more practical assignments and projects to students so that they can really explore the full capabilities of the CASE tools.

In the second part of the study, 25 organizations were interviewed on the status of CASE tools utilization. These organizations were from the Banking (4%), Education (4%), Insurance (8%), Software House (80%) and the Transportation (4%) sectors. These organizations are highly computerized whereby 90% of their daily operations used computer systems. These organizations used CASE Tools in software development and Figure 6 shows the type of CASE tools used.

The respondents were asked about the skills and ability in using CASE tools they expect a fresh IT graduate to have before joining their company. Most of them said that as professionals, they expect fresh graduates to have basic skills in software development such as:

- *Methodologies in software development*
  Most of the interviewees pointed out that it is very important to understand the system methodologies, for example, they must know SDLC in software development.
- *CASE utilization tools in real business*
  Graduates should know how to use CASE tools like Rational Rose. If the graduates know how to use CASE tools, the students would be competitive and could handle more work and tasks with minimum training for using CASE tools.
- *In-depth understanding of UML and software modeling*
  Graduates should know UML, and be able to design simple models because UML is becoming very important in communicating among team members. Having knowledge in Software modeling is necessary for IT graduates.

84% of the respondents reported that when purchasing CASE tools, the vendors provide enough training for the organization's employees. Most of the interviewees

agreed that one or two weeks are enough time to learn how to use CASE tools. The learning curve depends on a person's experience in using CASE tools. Respondents were asked whether they think universities and colleges are teaching students CASE tools that industry requires. Only 32% said yes and 68% of the interviewees disagreed. However, 32% of the respondents believe that the educators need to offer courses using CASE tools. They suggested that lecturers should give more projects and assignments, which are real life business problems, and not just theory-based projects. The lecturers should emphasize to students that the main objective of using the CASE tools, is not just to learn how to draw diagrams but to use it also in other phases of the system development lifecycle (SDLC). The respondents were asked whether they think that it is necessary to use CASE tools to develop software. 92% of companies agreed that using CASE tools is very necessary and pointed out that CASE tools could promote better communication amongst the development team and are able to enforce standardization in software development. Only 8% of interviewees said that it is not really necessary to use CASE tools in software development due to the fact that the cost of using CASE tools would be a burden for companies since CASE tools are very expensive.

Table 1: COURSES AND CASE TOOLS UTILIZATION

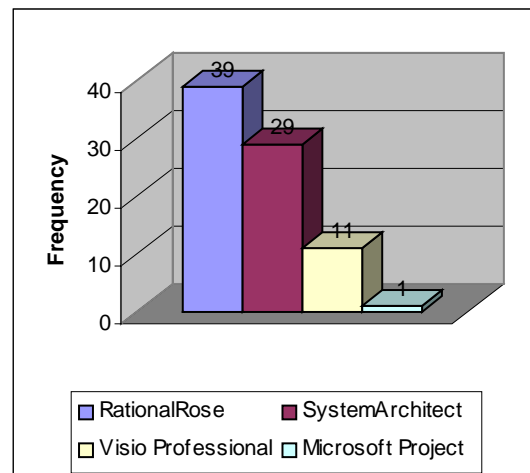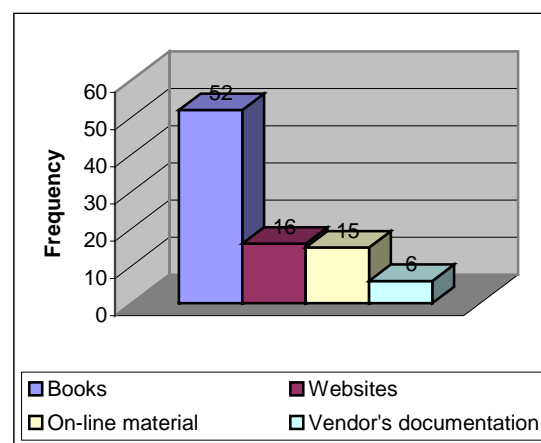| Courses that utilizes CASE tools	No. of lecturers using CASE tools in these courses	Max. no. of hours spent using CASE tools	Mean
OOT	21	42	**16.00**
Database	6	40	10.16
User Requirements Engineering	3	14	8.33
Project Development	3	14	6.5
SAD	20	28	9.8
Software Engineering	27	28	**11.63**
Project Management	4	18	7.62

Figure 1: Main CASE Tools

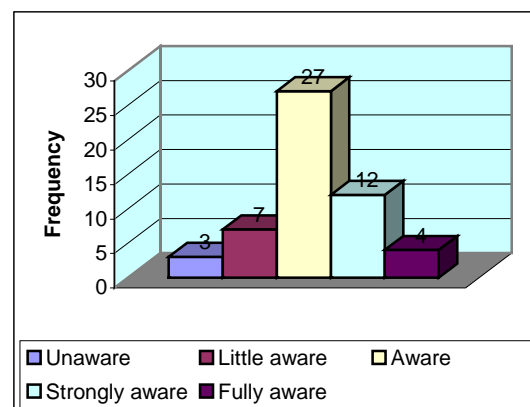**Figure 2:** Supplementary Resources Used

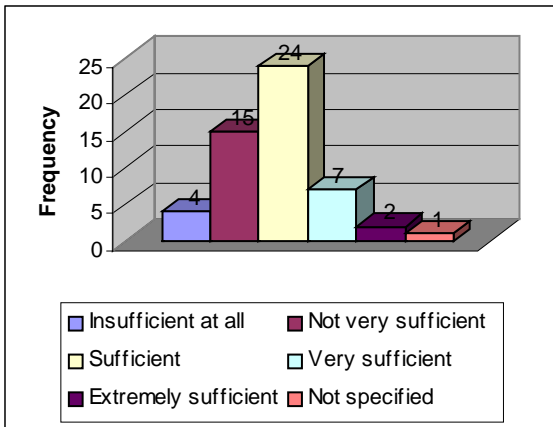**Figure 3:** Awareness of Industry's Requirements
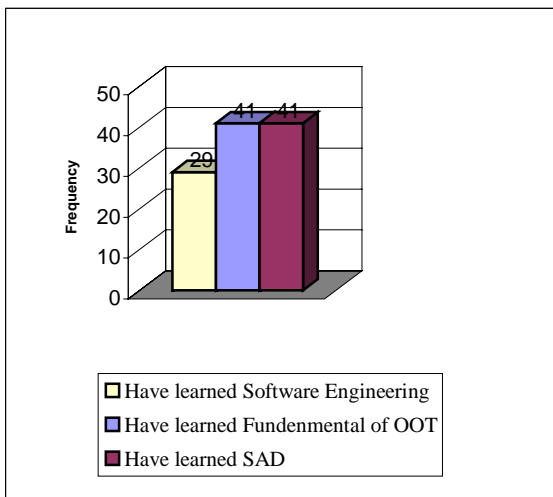
Figure 4: Supporting Infrastructure

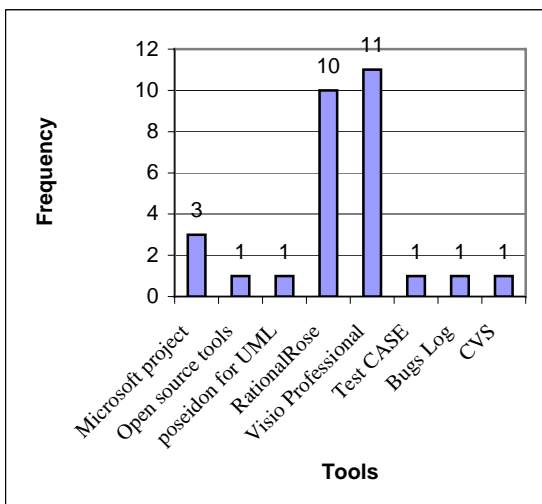**Figure 5**: Prior Knowledge Requirements

Figure 6: CASE Tools used in the IT Organizations

Respondents were asked about the main purpose of using CASE tools in software development in their organizations. They revealed that the main reasons for using CASE tools are: visualization of applications, analysis of risks, cost estimation of projects and documentation. Some companies used CASE tools in the design stage and to draw diagrams only and did not use the full features of CASE tools. Respondents were asked whether they think that there will be a growing trend of CASE tools utilization in IT organizations in future. Over 90% of the interviewees believed that there would be a growing trend of using CASE tools in IT organizations, but it would take time to fit into their work culture. The majority of the interviewees agreed that obstacles of using CASE tools are the cost and complexity of the CASE tools. Some big companies experienced the benefits of using the CASE tools, so they do believe that there will be a growing trend of using CASE tools. Finally, the respondents were asked about suggestions on promoting the usage of CASE tools. They believed that to promote the usage of CASE tools, Open-Source tools should be introduced in the workplaces. Open-source tools help developers with customized features and they are lower in cost. Developers can modify the tools based on specific needs. They stressed that management should understand the benefits of using the tools in the long-term, and not on a short-term basis because implementing CASE tools take a longer time.

5.0   DISCUSSION AND CONCLUSION

From the data gathered in the survey amongst lecturers, can see that universities and colleges are helping students to learn how to use CASE tools and the type of CASE tools matches the CASE tools that are mostly used in the Industry. However, the types or range of CASE tools used in the industry is very varied, it is impossible for universities and colleges to teach students to learn every one of them. This is supported by the data reflected in Figure 1 and 6. There is no strong mismatch of the industry's requirement and the Univesities/colleges effort, the problem is mainly caused by the variety of CASE tools available and the diverse software development requirements of the industry. Cost and time seems to be the main obstacles to a wider use of CASE tools both in the learning institutions and the industry. The introduction of open source CASE tools in both sector is a viable solution and should be taken up more seriously in order to promote CASE tools utilization. Industry can contribute towards a more effective CASE tools lab sessions by providing real life case studies for students to practice on. This will make learning CASE tools a challenging and realistic experience. In order for universities and colleges to provide the right training to students, regular reviews of the curriculum should be made with the participation of representatives from the IT industry. Feedback from the industry can help universities and colleges to update their outdated course contents particularly with respect to CASE tools utilization.

REFERENCES:

[1] Thayer R. H. and Dorfamn M., Software Requirements Engineering 2nd Edition, USA, IEEE Computer Society Press, 1997. p515

[2] Software Engineering Institute at Carnegie Mellon University http://www.sei.cmu.edu/ Last access date 29/12/2004

[3] *Stephen* Haag, Maeve Cummings and Jim Dawkins,
Management Information System for the Information Age, Irwin/McGraw-Hill, 1998. pp 20-25.

[4] Wanda J. Orlikowski, *CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development*, Management Information Systems Quarterly Vol 17, No. 3, September, 1993

[5] Tony Pittarese, *CASE TOOLs Overview*, Auburn University,
http://www.pittarese.com/Auburn/cse625/case.htm
Last access date 29/12/2004

[6] David A. Lamb, *CASE Tools by Category*, Queens University, http://www.qucis.queensu.ca/Software-Engineering/toolcat.html Last updated 01/02/1003

[7] itmWEB (2004), itmWEB CASE Tools site, http://www.itmweb.com/case.htm Last access date 29/12/2004

[8] Barbee T. Mynatt, Laura Marie Leventhal, An Evaluation of a CASE-Based Approach to Teaching Undergraduate Software Engineering, *ACM*, Vol2, p.122-p.125