

Response Measures to Software Engineering Education in the Internet Era

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Abstract. Training objectives of software engineer education locates in the high-qualified personnel, who meet the social needs of the software industry and combinate the basic theory with practical skill. The paper has elaborated the challenge of software engineer in internet era, for the wide spread of internet technology and development. The necessary reforms must be carried out on software engineer education with the development of technology in software engineer. In this paper, response measures have been proposed from the aspect of training objective, teaching content, teaching method, and teaching mode, to the software engineer education in internet era.

Introduction

In order to response to the challenges of “software crisis”, and solve the problem of declining in software quality with the size and needs, term of “software engineering” has been proposed in the NATO Software Engineering Conference held in Germany in 1968 [1]. For 40 years, with the development of software industry and the process of computer science, software engineering has developed into a new interdisciplinary from the initial single-discipline. One main goal of software engineering curriculum is to teach students how to develop and manage large-scale, long-lived software systems in a cost- effective manner [2]. As well as the deepening of practice in software engineering, technique, method, and principle has been proposed continually, which enrich the theoretical foundation, embarking a rapid development of software production.

For the role of software engineering in the software industry, software engineering is listed as a basis professional discipline for Computer Science and Technical in some colleges. It is shown from the statistic by the Ministry of Education in 2007, among the 678 colleges in the country, 526 of them has set the Computer Science and Technical profession, which become the most popular profession after English [3]. The goal of software engineering education is to train high-quality software engineering personnel with a combination of basic theory and practical skills, who can meet the social needs of the software industry. The teaching effectiveness has a direct impact on ability to qualify the software development job after graduation, and to create value for the enterprise quickly. Therefore, the research on software engineering education plays an essential role in the training of software professional.

General objectives for academic education are job qualification and the ability of scientific work. For the software engineering class emphasis is laid on job qualification. Having passed this course, students shall be able to develop software according to the state-of-the-art. And software engineering education should reflect the characteristic of the times and the needs of technology development. Software engineering has entered into the internet era with the wide spread and development of internet. In the context of rapid development of internet, the size of the software become complex and large increasingly, which proposed higher requirements to software engineering personnel.

Against the problem how to adapt to the technological development for software engineering education and to train qualified software engineering talent, this paper has elaborated from three aspects of target, content, method and mode of software engineering education, expecting to provide useful suggestions and ideas on the software engineering education in the internet era.

Challenges for Software Engineering Education in Internet Era

Software engineering has entered into the internet era with the expansion of the size and complexity of the application software, as well as the wide range applications of network and computer in the recent ten years. It has characteristic that individual software is combined into an application system according to user needs based on net, which tend to be a wide range of social needs. As the application of grid computing, computing service, and internet become common, software engineering is in a new phase of network-centric. Carnemie Mellon University Software Engineering Institute has studied the ultra-large-scale software systems and gave a report in June 2006, entitled “ultra-large-scale: challenge for software in future”, which defines the software system in future as ultra-large-scale systems with 10 million lines of code approximately and web-based [4]. The ultra-large-scale system depend on the increasingly complex support system, which consists of a large number of platforms, sensors, decision-making terminal, execution system, and execution unit through the wired or wireless network, far beyond the current system in any dimension, such as the amount of code, number of employee, data storage, read content, operating amount, soft component number, and complexity. The sharp increase in the scale of the system make things change from quantitative to qualitative, presenting a huge challenge to traditional software engineering principles, assumptions, methodologies, and software project management. In this respect the current education in software engineering has been criticized for neglecting most of the above mentioned aspects, and widening the gap between industrial practice and scientific education. Therefore necessary reform on Software Engineering Education will be in need for the advance of software engineering technology.

Response Measures for Engineering Education

A. Training Objective

The training objective of traditional software engineering is oriented towards community need and international frontier in software engineering field, introducing advanced software talent education model abroad, to train practical senior software talent with high level, project type, and linking up directly to social needs. Students mostly study the basic theoretical knowledge in computer hardware and software, the internationally advanced and mainstream software development techniques, and modern software engineering specifications. They also take high strength software engineering project training, full-time professional practice in large or medium-sized enterprises both at home and abroad, with strong operative ability and processes in software engineering [5].

The training objective of software engineer in internet era is to develop system software and application software R&D talents for ultra-large-scale system, to establish knowledge system and R&D capability framework compatible with its basic characteristic. Based on this, the reform of teaching content, teaching methods, and practical aspects will be conducted. The ability of engineering processes and professional practice, of problem solving and project management, of self-learning adapt to scientific and technological development and discipline change, should be attached. We should also place great importance on education of profession ethics and that related to law, written and oral presentation skills, exchange and communication skills, international intercourse ability, organization and management capacity, discipline, teamwork, initiative, creativity, aesthetic cultivation, etc, which will enrich the connotation of software engineering, promote the development of software engineering education.

B. Teaching Content

In the last ten years, web-based software engineering has gradually entered into teaching activities of software engineering. To a certain extent, some software engineering textbook, such as L. Sommervill, R.S. Pressman, S.L. Pfleeger, have a wide impact at home and abroad. Compare the new version of these three textbooks with previous editions, dynamic development and reform can be found in internet era. L. Sommervill’s “Software Engineering”, the eighth edition, published in

2007, enriching content about Safety Engineering, Service-oriented Software Engineering, Object-oriented Software Development, and Agile Software Development. R.S. Pressman's "Software Engineering", the sixth edition, published in 2005, enriching the content about the Web Software Engineering and Agile Software Development. S.L. Pfleeger's "Software Engineering", the third edition in 2006, fills in the content about Abstraction, Modeling, Agile Software Development. Although all above expands traditional software development method, and reflects some of new feature of software engineering in internet era, there is still a long way to solve the development, operation, and management problem of ultra-large-scale software in the internet context.

Web-oriented Software Engineering will orient network social-ecological system with large-scale and software-intensive, including people, policy, science, technology, culture, economy, and safety. Software design philosophy of ultra-large-scale in internet context change from technology-centric to people-centric, organization-centric, and society-centric, and consider the factors of environmental perception, design rules, and management strategies systematically. Software engineering need support from cognitive science, nature language understanding, information security, microeconomics, biology, town planning, and sociology, which is necessary to be expanded on software engineering education.

C. Teaching Method

As ultra-large-scale software engineering is still immature in many fields, teaching method of software engineering in internet context must emphasize combination of teaching and research, and carry out exploratory learning. In the field of human-computer engineering, it is necessary to further emphasize key role in complex systems, to explore interactive collaboration mode between the human and system, modeling of user and its community, understanding of user wish, and environment sensor computation in complex system. While in the design field of ultra-large-scale, it is necessary to study multi-level space and design rules of complex system, and to explore software design technology oriented to conflict goal and interest, software design and analysis in complex system, adaptive design and evolution technology based on dynamic feedback, coordination and management methods of decentralized design activities, continuous evolution method based on dynamic feedback, user-centric quality measurement and control method, and software process modeling and improvement of complex system. We should also study support technology of collaborative development, configuration, and distributed release from software development platform, and of monitoring, dynamic configuration, online heat release, and dynamic evolution from software running platform. By simulating students' interest in learning and exploration passion, they will understand technology, method and management process of ultra-large-scale complex system in the process of exploring the unknown world. It is necessary to set experiment subject according to the essential characteristic of ultra-large-scale software system, to request student explore new problem, new technology, and new process management approach existed in the R&D process of ultra-large-scale software system in internship course. Making use of main features of simulation complex system in distributed software technology platform, to deepen students' recognition of the essential difference between complex and existing large-scale system, characteristic of complex system, and challenges to existing software technology. Utilizing software simulation theory, students try to design simulation software of complex system, with a socio-technical system, such as urban construction and operation management or the ecosystem, as simulation goals. In the search for the challenging experimental subject, students can explore the design and evolution technology, quality control, and improvement in software development process of complex system.

D. Teaching Mode

In the way of exploring constructing varied network teaching mode, which points to meet the study needs, we should, despite lectures mode and self-study mode, based on the actual needs of learners and the analysis of network teaching mode to actively explore the platform which can support multi-network teaching mode, such as special website mode, situational learning mode,

inquiry-based learning mode and diversified thematic learning mode. The premise and protection of network teaching mode is to focus on the construction and development of network teaching resources. Only the varied learning resources can be able to meet the needs of different learners. We should establish a new mechanism to update the shared learning resources, and actively carry out various types of distance-learning platform. In addition, we should arrange reasonable resource construction, based on the information's development such as multimedia lab and online reading room, to enable learners to obtain more knowledge and practice, improve teaching quality and effect and break the network teaching platform area restrictions. The feature of network teaching mode's development is free of regional restrictions and time limit, so this method should work in every district. Based on the existing network teaching platform we should pay attention to component technology and cloud computing. Component technology can not only adapt to different network teaching mode but also maintain and expand the network teaching platform, which brings great convenience. At the same time, we should also pay attention to the application of cloud computing in network teaching. Social software should be another important part. The goal of building network teaching mode is to make education to be network education. Essentially, network education is no longer transforming the traditional teaching method to network. Moreover, it has other characters as spatialization, diversification, open and individuation, which bring human's initiative and network interaction into play, making the teaching platform effectiveness to be maximized. One way to fully show the individuation of teaching is to build social software on the network teaching platform. With the help of the special technique of social software, we can build a software system which points to suit individual, both reflecting one's liberty and satisfying the needs of learners. And it will also make up for the inadequacies of the network teaching mode, making it more in line with the adult education needs. Network teaching method is a teaching method adapts to the social needs and development. We should construct a reasonable network teaching mode, giving full play to its advantages and effectively improving its application, to realize the actual network education.

Conclusion

With the popularity and wide application of internet, and the dramatic growth of scale and complexity of web-based software system, the ultra-large-scale system facing in the future must be based on the network as a platform, with 10 million lines of code. Appropriate reform has to be conducted on software engineering education to meet the challenge. In this paper, response measures has been proposed from the aspect of training objective, teaching content, teaching method, and teaching mode, to the software engineer education in internet era, for the sake of meeting the challenge facing software engineering in the network environment.

References

- [1] R. S. Pressman. Software Engineering--A Practitioner's Approach [M]. BeiJing: Machinery Industry Press, 1999.
- [2] S. H. Huang and D. Distant. On Practice-Oriented Software Engineering Education [C]. Proc. the 19th Conference on Software Engineering Education and Training Workshops (CSEETW'06), IEEE Press, 2006.
- [3] J. Liu. Combination of Research and Teaching in Software Engineering Education [C]. Proc. 2009 WASE International Conference on Information Engineering, IEEE Press, 2009: 437-440.
- [4] "Ultra-Large-Scale Systems: The Software Challenge of the Future," Available from: <http://www.smartulss.com>.
- [5] Computer Science and Technology Teaching Steering Committee in College of Education Ministry. Development Strategy Research Report of Computer Science and Technology in College [M]. BeiJing: Higher Education Press, 2006.