Distributed Development of Software Engineering Professionals

Kenneth L. Modesitt, Ph.D.

Professor, Department of Computer Science
Associate Dean for External Partnerships and Research
School of Engineering, Technology and Computer Science
Indiana University- Purdue University Fort Wayne
2101 E. Coliseum Blvd.
Fort Wayne, IN 46805
USA
modesitk@ipfw.edu
http://users.ipfw.edu/modesitk/

Abstract

In the November, 2001 issue of Crosstalk, the emphasis was on "distributed software development" with several provocative articles. Elizabeth Starrett, in the editorial column, wisely asked which distributed development concept the reader would prefer: distributed development of software, development of distributed software, or distributed development of distributed software[1]. Reading the entire article ignited a spark – what about the "distributed development of software professionals?" This is exactly the focus of this paper – the distributed development of software professionals around the world with the assistance of international universities recognized for their software engineering expertise, combined with the use of hybrid learning technologies, for providing high-quality credit and non-credit courses at all levels.

Providing software engineering (SE) training and education on a global basis is a priority of several organizations. The primary markets are corporations wanting to develop reliable, robust, and useful software products in a timely and efficient fashion, but whose professionals do not currently have state-of-the-art knowledge or skills. As a response, the author instigated the International Software Engineering University Consortium ISEUC in 2000. Other "players" include individual universities, university consortia, ACM, IEEE, U.S. Department of Defense and book publishers. ISEUC is a worldwide consortium of universities designed to provide SE courses via distributed learning, primarily using the Internet. ISEUC, a group of 35 universities, was selected from the 100+ responders to a SE survey funded in 1999 by ACM and IEEE-CS. ISEUC was slated to begin initial operations in September 2003, based on the results of visits to Australia, Canada, the U.K., and the U.S.A. This paper gives a description of ISEUC,

comparing it with other entities. Also discussed is whether the concepts embodied in ISEUC may be premature. Comprehensive information on ISEUC appears at www.ipfw.edu/sesurvey.

1. Introduction

There is a lack of qualified software engineers to address the dramatic worldwide growth in Information Technology, and the supply of Software Engineering (SE) programs is not keeping up with the increasing demand for qualified SE professionals[2,3]. Data to support these beliefs includes results from a survey conducted since 1999, under the auspices of the IEEE-Computer Society and ACM.[4,5,6,7].

Because of the high demand for SE professionals, institutions of higher learning (hereafter just called "universities") have an opportunity to contribute to the well-being of society worldwide, as well as increase enrollment and revenues, while continuing to develop SE-specific curricula and courses for students. The scarce resources can be efficiently leveraged using Distributed Learning (DL) technologies and processes to expand the reach of universities to a global student body as well as local students.

ISEUC (pronounced "I see, you see") was developed to provide access for software-intensive organizations and their global sites, using renowned international universities[8,9]. Such organizations include business, industry, government, etc. (hereafter just called "industry"). ISEUC is based on international best SE education practices, accreditation standards, credit and non-credit programs. ISEUC is designed to serve as a broker to provide additional students for existing and future Web-enabled courses, and is not intended to be a degree-granting organization.

ISEUC differs in several ways from the major example of a university consortium: degrees, members, and accreditation. The National Technological University (NTU)[10] has a primary focus on M.S. degrees in 19 disciplines, one of which is software engineering. NTU currently has 18 universities participating in SE, all from the U.S.A. ISEUC extends its mission to international universities, and also offers undergraduate courses via its members. NTU grants degrees under the auspices of the North Central Association. ISEUC is not designed to offer degrees. Both NTU and ISEUC include professional, non-credit, courses in their catalog of offerings. The author was the first industry member (from Texas Instruments) on the board of NTU in 1980, and has a long-standing relationship with the founder, as well as former vice-president of NTU. So, it was natural that this was the very first place he visited in October, 2000, during his sabbatical to develop ISEUC.

Recently, other entities, including individual universities, ACM, IEEE, the Department of Defense, and even book publishers have developed a presence in this market. Most of their offerings can be distinguished by their targeting the market for training courses, as compared to credit-bearing courses.

The University of Phoenix Online[11], while being a very large presence in the distributed learning arena, does not offer any degree in Software Engineering (the closest is "Computer Information

Systems"). They do have considerable "clout" in providing credit-bearing courses and degrees for working professionals.

The longest-standing entry in the field of distributed learning is PLATO ®[12]. However, their offerings at a post-secondary level for SE only include courses in calculus, physics, and chemistry. The history of PLATO over the last 40 years has had a significant impact on the author, as he has been actively involved since 1972 as a user, developer, product line manager, and site administrator. Many of the features available on the Internet today have their roots in PLATO. Or as is often heard, "The Internet is PLATO writ large."

This paper begins with an overview of ISEUC, including objectives, proposed schedule, curriculum, benefits, components, characteristics, and current status. Then a summary of other potential suppliers for international software engineering education is given, including individual universities, ACM, IEEE, the Department of Defense, and book publishers. The paper presents a summary of the status of ISEUC vis-à-vis distributed learning for international software engineering education: too late (dubious), too early (probably), or just-in-time (hopefully). The conclusion gives a rationale for the current status and an outlook to future developments.

2. MISSION STATEMENT OF ISEUC

- *To provide academic software engineering expertise globally to those with the need to know now, from those in the know*: This is a one-liner to indicate the "just-in-time" approach vs. the "just-in-case" one.
- *Lifelong learning*: This is required on the part of people performing quality software development -- ISEUC provides easy access to them for such learning, via a combination of distributed and face-to-face learning.
- *Expand the scope of SE courses*: Software Engineering educators should expand the scope of their courses beyond their campuses to reach these developers -- ISEUC provides the infrastructure to do this.

3. BROAD OBJECTIVES FOR ISEUC

The objectives include:
- Increase the number of Software Engineering professionals.
- Enhance the software skills of existing professionals from many disciplines.
- Facilitate cross-discipline software training and awareness for management.

Distributed Learning courses originating from "primary" universities will be coupled with traditional face-to-face aid from "associate" universities that are closer to the student. Thus, an effective hybrid program of web-based asynchronous and synchronous interactive learning modes can be fashioned to benefit the consortium participants, the students, and the industries that rely upon SE. These objectives were developed as a Request For Proposal (RFP) with the assistance of the Professional Advisory Board (PAB), a partner of the Computer and Information Science department at the University of Michigan- Dearborn[13]. The PAB is a group of 36 chief technology officers, chief information officers, presidents, and chief engineers of large, medium,

and small corporations, many of which are multi-nationals, founded by the author in 1995. In line with the RFP, ISEUC is to have both faculty and professional advisory boards.
The plan for ISEUC called for a small number of courses, universities, and students from industry to be used in a pilot test the fall of 2003, with consequent ramp-ups occurring in later years. Granting agencies, such as U.S. Foundation for the Improvement of Post Secondary Education (FIPSE) were particularly interested in the out-years to ensure that the seed funds provided would not be required then, and that ISEUC would be self-sufficient within 3-4 years[14]. However, they had no mechanism for dealing with international universities. There is a dearth of such funding agencies for international efforts in this arena.

The following broad curricular categories represent an adaptation of the ones used by Carnegie Mellon University and the ACM/IEEE-CS Computing Curricula Software Engineering (CCSE) joint effort[15], and are based on many effective and world-class Software Engineering curricula: Modeling and Analysis, Design, Verification and Validation, Evolution, Process, Management, and Quality

4. Benefits of ISEUC

There are several different beneficiaries. These include companies who desire high-quality (useful, reliable, robust) software products to be developed efficiently, employees who do not have time to commute to a university, students who cannot find a SE course at a local university, and universities with SE/CS departments.
- *Benefits for Industry/Business/Government*: The primary benefit is to have a much larger supply of qualified SE professionals who can develop the desired products.
- *Benefits for Students*: Students would primarily be drawn from corporations and government. However, a vital secondary market is composed of those students who wish to enroll in SE courses that are not available through their local university.
- *Benefits for Consortium Participants*: If the organization were a "primary" university, additional students would enroll in existing SE DL courses. Also *new* SE DL courses may be developed for additional university revenue from a worldwide population of students. Participation as an "associate" university would also increase revenues.

5. ESSENTIAL COMPONENTS OF SUCCESSFUL ISEUC MEMBERS

There are three primary factors, at least, required to be successful in providing SE courses in DL mode. These are the major findings from the visits to the 35 universities in four countries during the sabbatical of the author in 2000-01.
- *Excellent SE faculty and Program*: This almost always meant that most of the faculty had substantial industry experience, as well as academic credentials.
- *Industrial Advisory Board*: Virtually every department had a very active board. In one instance (Murdoch University in Perth, Western Australia), the host arranged to meet with board members off-campus. This also drew participants from other local universities.
- *Infrastructure*: This was the most likely gap of any university department. Such components include a development incentive, e.g., release time or money, development support, such as staff, tools, and processes, and course resources. The operations side also has requirements:

an operations incentive such as money/DL student, and operations support, such as staff, tools, and logistics. The infrastructure gap is the one for which ISEUC sought seed funding (unsuccessfully) from a variety of sources.

6. CURRENT STATUS OF ISEUC

"The best laid plans gang aft agley …." Several factors have had an impact on the reality for ISEUC in 2003 and why the specific goals were not met. To date, there have been several individuals (prospective students) around the world who have inquired about using ISEUC to take SE courses. They may have enrolled in such courses, but not via ISEUC. Until students actually use ISEUC to enroll in the course of a university member, ISEUC cannot "exist" in an operational sense. Here we look at some underlying reasons for this lack. The author has had several issues that have arisen in the last year.

- *Author took another position***:** A seemingly major one is that the author took a new position at another university in early 2002. However, the structure of ISEUC was developed to account for such a contingency – there is <u>no</u> requirement for the developer to reside at a specific location. To be sure, the files had to be ported to a new server, but that was a minor issue. The learning curve required in the new position did take time away from developing ISEUC – this <u>was</u> a major "distracter" from the viewpoint of ISEUC development. Substantial time is required for any start-up effort, and time is also required to nurture the fledgling organization. This time was simply not available when starting a new position.

- *New entries:* More interesting from a prospective client basis is the rapidly expanding presence of other entities with a related mission. Such presence could easily be viewed from a *competitive* viewpoint (zero-sum). The author prefers to view such new presence from a *collaborative* viewpoint (win-win). After all, a founding principle of ISEUC is that of collaboration, instead of competition. With few exceptions, however, the other entities do not share such a belief, or are unable to respond. The author has contacted ALL of them during the past year, several of them multiple times. The most likely organization with which ISEUC would work is NTU. However, NTU has changed ownership, and the only other "nibbles" have occurred at trade shows with book publishers.

7. CURRENT STATUS OF OTHER SUPPLIERS

Since ISEUC was first conceived, the author has been pleased to see an increasing number of other organizations who have also recognized the need to provide "just-in-time" educational opportunities to working SE professionals via distributed learning venues. Clearly, there has long been a substantial presence of individual universities interested in providing distriibuted learning materials for professional engineering training and education courses, first articulated by the Association for Media Based Continuing Education for Engineers (AMCEE) that was the predecessor of the National Technological University. AMCEE used video-tapes as the primary mode of DL.

The other current suppliers include individual universities, university consortia, ACM, IEEE-CS, book publishers, and the Department of Defense. There are certainly other providers as well.

- **Individual Universities**: Carnegie-Mellon, Southern Methodist University, Stanford, MIT, Colorado State University and Purdue come to mind immediately. They have long been in the business of providing distributed learning to engineers (and others) in the U.S.A. and in some cases, across the world via video tape, microwave, TV, satellite, and more recently with CD-ROM and DVD, and of course the Internet. The Open University in the UK has been a paradigm for many of us, and there are undoubtedly others throughout the world. Please contact the author if your favorite was left out. The former institution of the author has just initiated an on-line interdisciplinary M.S. SE program in which 18 students are enrolled, as of January 2004. This is part of a concentrated effort to offer several M.S. degrees on-line by the College of Engineering and Computer Science at the University of Michigan-Dearborn[13]. There are undoubtedly many others in formation or already online.

- **University Consortia:** National Technological University has the longest history, to the author's knowledge, in providing DL courses to working engineers. The author was the first industry board member for NTU in 1980, when he was the initial Corporate Education Director for Texas Instruments. NTU offers 19 M.S. degrees via distributed learning from top-flight U.S. engineering departments. They have already graduated over 1500 students who take about five years to complete the 33-hour program, as the students are all full-time employees. NTU does not offer any undergraduate degrees, although the author had coordinated an effort of five SE programs in the U.S. to do just that in 2001. Nor does NTU have any non-U.S. universities as members. In discussions with the founder and former vice-president for academic affairs of NTU, they were certainly willing to consider such an option. In February 2002, Sylvan Ventures assumed control of NTU. Contact with the new owner of NTU has not been fruitful in any collaboration. NTU also has a wide variety of professional development offerings from a large selection of sources, including universities.

  The Oregon Master of Software Engineering program is a "mini-version" of ISEUC involving four universities (all within Oregon) and is a very viable organization[16]. Three of the 12 core courses had been available online, until the Fall of 2003. OMSE is now "re-evaluating the on-line program."

- **ACM:** The Professional Development Centre (PD) advertises "over 250 valuable online IT training courses absolutely FREE"[17]. The offerings include "Java, Web Development, Object-Oriented Programming, Project Management, Telecommunications, e-Business, Networking & Security". These training courses are "all from leading providers of Professional Development, including Sun Educational Services, Digital Think, Telecommunications Research Associates." None of the providers are university CS or SE departments

- **IEEE-CS:** The IEEE-Computer Society also provides a substantial number of training offerings in software[18]. Their literature indicates "100 interactive web-based courses at no additional charge to members..." Courses include "Java, project management, TCP/IP

protocols, Cisco, UNIX, CompTIA, HTML, PowerPoint, Windows network security, Visual C++, and much more." Again, none of these come from universities and are not part of any degree.

To the pleasant surprise of the author, when reviewing the most recent material on the IEEE website at http://computer.org/DistanceLearning, Stevens Institute of Technology just became the first university supplier on October 15, 2003[19]. The WebCampus Stevens students can choose on-line graduate degrees in computer science/cybersecurity, networked information systems, and other areas of relevance to software engineering. They do not offer any degrees in SE, but do offer certificates in quantitative software engineering, project management, and other related areas. So, perhaps this section should go under the section on "individual universities," but Stevens is unique in that it appears under the IEEE logo and students who enroll with IEEE or ACM membership receive discounts.

- **Book publishers**: An increasing number of textbook publishers have realized that coordinating text content with on-line delivery is a very profitable venture. McGraw-Hill, Prentice-Hall, Course Technology, Addison-Wesley, and Wiley are just a few who are pursuing this avenue actively.

  McGraw-Hill content can be delivered through WebCT, the leading Internet-based learning tool for higher education[20]. They just ask faculty to choose a McGraw-Hill textbook packaged with an Online Learning Center and they will pre-pay the WebCT site license for the students.

  Prentice-Hall also has a partnership with WebCT[21].

  Addison-Wesley, one of the leading publishers in computer science and software engineering, is quite aware of the importance of providing materials that be accessed by students via the WWW, having relationships with both WebCT and Blackboard[22].

  Course Technology specializes in the IT market, so it is no surprise that they have partnered with WebCT as well as BlackBoard[23]. They claim to provide faculty with all the tools needed to teach an "interactive, informative class on information technology concepts, applications, and more."

  Wiley, although a partner with both WebCT and BB, has no online offerings for either SE or Computer Science[24]. The closest is an "e-pak" for a text on systems analysis and design.

- **Department of Defense (DoD):** The Naval Postgraduate School (NPS) at Monterey, California is famous for offering the very first Ph.D in Software Engineering in the U.S., both on-site and via distributed learning[25]. Initially targeted only for DoD personnel, the program expanded to include very highly qualified civilian personnel in the last few years. The author had the good fortune to know the first graduate from the program, and to have worked for him during an Intergovernmental Personnel Agency (IPA) assignment in SE during 2001. In May, 2002, Dr. Mike Saboe, Associate Director of the Next Generation

Software Program of the U.S. Tank Automotive Command, died unexpectedly four months after earning his degree.

The Air Force Institute of Technology (AFIT) offers distance learning SE courses <u>free</u> to all DoD employees[26]. During 2002, AFIT revamped its Software Professional Development Program, in its largest ever restructuring. The result is the ability of the DoD employee to complete one or more certificates, such as SE Management or Advanced Software Development.

These are just two of the many opportunities offered by the DoD.

8. ISEUC: TOO LATE? TOO EARLY? JUST-IN-TIME?

- **Too Late?:** Dubious. It does not appear that ISEUC is too late. NTU is the closest to ISEUC in terms of goals and structure, and has an enviable track record for nearly two decades (for SE, this is only since 2000 via the WWW and 1991 via satellite). It has continued to focus only on the M.S. level in SE, and uses only U.S. universities. This is an excellent strategy which has served NTU well since they became the first "virtual" U.S. university in 1984. However, it ignores the extremely wide presence of highly-qualified institutions outside the U.S. Many of these universities have been offering SE courses (often called "subjects") for much longer than U.S. counterparts. For example, the University of Melbourne in Australia has had a B.S in Software Engineering since 1990 and <u>accredited</u> undergraduate degrees in SE since 1996[27].
- **Too Early?:** Probably. [The author has a four-decade long period of being early on the adoption curve – how many people do you know who took computing courses in 1961, little knowing what the future would hold?] There were many responses early on questioning why anyone (meaning faculty) would want to do this. Institutional inertia is also considerable in terms of providing the necessary infrastructure to offer DL courses. Now it appears that several universities, and not just the one where the author was employed, have begun to "jump on the bandwagon." In the opinion of the author, it will not be long before either ACM or IEEE-CS determines that collaboration with universities is a worthwhile (and profitable) avenue to pursue, somewhat along the lines of ISEUC.
- **Just-in-Time?:** Hopefully! It is better to be a little ahead of the curve than behind it. The author is keenly aware that being on the "bleeding edge" and being on the "leading edge" may not be too far apart. The author has had employers whose philosophy was "We want to be second." Presumably, they did not want to take the risks associated with being the first to suggest/develop a "different" way of solving a problem.

Why has ISEUC not been able to meet its objectives in a timely manner? A major factor is a well-known adage – spend high-quality time on task! The author has been "distracted" by other issues since the inception of ISEUC: relocating professional position and home, new course preparation, additional responsibilities related to preparing his new department for ABET accreditation, and inviting his father into our home, admitting him to Hospice, and caring for him until his death at age 94 ½.

Now those issues have passed, and more time is available to make ISEUC successful. Next year this time, the reader can expect an update to include case studies of the involved institutions, critical evalutions, enrollments, and lessons learned.

9. CONCLUSION

As professionals in a technical discipline, it is quite natural for us to be concerned with current technical issues. One such issue is that of "distributed" XXX, where XXX is often software development, deployment, and maintenance. A recent issue in <u>Crosstalk</u> provided a starting point as the editor suggested multiple interpretations: distributed development of software, development of distributed software, and distributed development of distributed software. This paper has emphasized the distributed development of software engineering professionals, in the belief that considerable leverage can be gained. Providing software engineering training and education on a global basis has recently become a priority of several organizations. The primary markets are corporations that employ professionals trying to develop reliable, robust, and useful software products in a timely and efficient fashion, but who do not currently have state-of-the-art knowledge or skills. A secondary market includes students who wish to enroll in SE courses that are not available in their local university. In 2000, the author instigated the International Software Engineering University Consortium (ISEUC). Other entries include the National Technological University, ACM, IEEE-CS, U.S. Department of Defense and book publishers. ISEUC is a consortium of universities and colleges around the world that is intended to provide SE courses via distributed learning, primarily via the Internet. ISEUC members, currently numbering 35 from Australia, Canada, the U.K., and the U.S.A., already have established programs and/or degrees in software engineering, as determined from an ACM/IEEE-CS funded survey. The intention was to make some courses available on-line, with face-to-face mediators, by September, 2003. ISEUC is to serve as a broker to provide additional students for existing and future Web-enabled courses, and is not intended to be a degree-granting organization. ISEUC is to have both faculty and professional advisory boards. This paper gave a short description of ISEUC and a comparison with other related entities. The current status of ISEUC is covered, and reasons for not meeting its deadlines are given. A section discussed whether ISEUC is too early, too late, or "just-in-time." Current detailed information on ISEUC can be found at www.ipfw.edu/sesurvey.

BIBLIOGRAPHY

[1] Starrett, E., "Which Distributed Development Concept Did You Have in Mind?" *Crosstalk: The Journal of Defense Software Engineering*, Vol. 14, No. 11, 3.

[2] P. Freeman, W. Aspray, *The supply of information technology workers in the United States,* (Washington, D.C., Computing Research Association, 1999).

[3] Office of Technology Policy, America's New Deficit: The Shortage of Information Technology Workers, U.S. Department of Commerce, 1998, available on-line at www.ta.doc.gov/OTPolicy/reports.htm

[4] K. Modesitt, D. Bagert, L. Werth, Where Are We Now? A Status Report on the First Annual Survey for International Academic Software Engineering Programs, *23rd International Conference on Software Engineering,* Toronto, CA, May, 2001, 643-652.

[5] K. Modesitt, D. Bagert, L. Werth, International Academic Software Engineering: Results of First Annual Survey, *IASTED International Conference on Applied Informatics*, Innsbruck, Austria, February 19-22, 2001, 555-560.

[6] K. Modesitt, Survey of Software Engineering Programs, ACM *Software Engineering Notes (SIGSOFT),* 25, 4, July, 2000, 5-7.

[7] K. Modesitt, Annual Survey of International Software Engineering Programs (Progress Reports), *Forum for Advancing Software Engineering (FASE)*, available on-line [www.cs.ttu.edu/fase], 10, 5, May, 2000, November, 2000.

[8] K. Modesitt, The Software Engineering Academy Joins Industry: Results of the first Annual International Survey and a Future Portrait, *32nd ASEE/IEEE Frontiers in Education Conference,* Boston, MA, 2002, Paper S3B-12 (on CD)

[9] K. Modesitt, International Software Engineering University Consortium (ISEUC): A Glimpse into the Future of University and Industry Collaboration, *Fifteenth Conference on Software Engineering and Training,* Cincinnati, OH, February, 2002, 32-41.

[10] National Technological University, 2003, available on-line at www.ntu.edu.

[11] The University of Phoenix, 2003, available on-line at www.universityofphoenix.com/online2.asp

[12] PLATO Learning, Inc., 2003, available on-line at www.plato.com.

[13] Department of Computer and Information Science, University of Michigan-Dearborn, 2003, available on-line at http://www.engin.umd.umich.edu/CIS/cispab.html

[14] K. Modesitt, Carnegie Mellon University, National Technological University, Oregon Master of Software Engineering, Texas Technological University. Florida State University, American Association of Higher Education, *An International Software Engineering University Consortium (ISEUC): A Virtual Community of Connected Professionals, Faculty and Students*, $1,392,383 for three years, Submitted to the Learning Anytime Anywhere Program (LAAP), Foundation for the Improvement of Post Secondary Education, February, 2001.

[15] Association for Computing Machinery and Institute for Electrical and Electronic Engineers, *Computing Curricula - Software Engineering*, 2004, available at http://sites.computer.org/ccse

[16] Oregon Master of Software Engineering, 2003, available on-line at www.omse.org.

[17] Association for Computing Machinery, 2003, available on-line at http://pd.acm.org

[18] Institute of Electrical and Electronic Engineers - Computer Science, 2003, available on-line at computer.org/DistanceLearning.

[19] Stevens Institute of Technology, available on-line at http://webcampus.stevens-tech.edu/

[20] McGraw-Hill Higher Education, Inc., 2003, available on-line at www.mhhe.com.

[21] Pearson Education, plc, 2003, available on-line at http://cms.prenhall.com/webct/index.html

[22] Addison-Wesley, Inc. 2003, available on-line at www.aw.com.

[23] Thomson Course Technology, 2003, available on-line at www.course.com.

[24] John Wiley & Sons, 2003, available on-line at http://he-cda.wiley.com

[25] Software Engineering Automation Center, Naval Postgraduate School, Monterey, CA, 2003, available on-line at http://seac.nps.navy.mil.

[26] B. Herman, The AFIT Offers Software Continuing Education at Your Location at No Cost, *Crosstalk: The Journal of Defense Software Engineering,* December, 2002, 15-16, also available on-line at www.stsc.hill.af.mil.

[27] Department of Computer Science and Software Engineering, The University of Melbourne, Melbourne, Australia, 2003, available on-line at www.cs.mu.oz.au.

BIOGRAPHY

MODESITT, KEN
The author was on sabbatical in 2000-01and consulted with the Next Generation Software Engineering Department of the U.S. Army Tank Automotive Command. He then began to develop the International Software Engineering University Consortium, an outgrowth of a survey funded by ACM and IEEE-CS; now numbering 30+ universities in five countries. As CS department chair in Michigan, he started M.S. and B.S. degrees in Software Engineering.