Strengthening Curriculum Sructure of Software Engineering Programme

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ABSTRACT

The rapid development of technology has changed the world with various computer-based inventions and innovations. Education from primary to tertiary level is no exception in facing this change. With the curriculum changes that have begun to introduce courses related to programming at the primary and secondary level, the tertiary level curriculum should also change for quality education. This paper presents a new curriculum structure for the Software Engineering Undergraduate Program at University Malaysia Sarawak (UNIMAS). The current structure of Software Engineering programme does not follow the Malaysian Qualifications Agency (MQA) Programme Standards. The objective of this paper is to develop a new curriculum structure of Bachelor of Software Engineering based on MQA. The processes involved data collection, document analysis, and meeting with industries to restructure the curriculum. As a result, four new courses have been added to the new curriculum structure the Bachelor of Software Engineering programme for improvements. It is hoped that the graduates from this programme will fulfil the job skills and knowledge as required by the current industries.

Keywords: Software Engineering, curriculum, industry, students, quality education.

I INTRODUCTION

Bachelor of Computer Science with Honours (Software Engineering) is one of the five programmes offered by Faculty of Computer Science and Information Technology, UNIMAS. In the first year, students will take the same fundamental courses for all programmes. The majoring for each program starts during the second year. The total number of credits for Software Engineering graduates is 132 credits, and the duration of study is four years. However, the programme has to change the degree name as advised by MQA.

II BACKGROUND OF STUDY

A. Requirement to Change

In the current MQA Programme Standards, Computing (2014) the computing field has four major disciplines, namely Computer Science, Software Engineering, Information Technology and Information Systems. The current name of Degree is Bachelor of Computer Science (Software Engineering) is not compliance with these as it seems has two major disciplines; computer science and software engineering. As a software engineer, graduates from this discipline should be able to perform and manage activities at every stage of the life cycle of large-scale Software systems; they become specialist in designing and implementing software in the large (MQA, 2014)

The current name of the degree is not allowed according to Programme Standards. Thus the programme needs to be changed as required. Once the name agreed at the Programme level, programme member needs to revamp the currents structure. For this purpose, the programme members held a few meetings and discussions on these.

B. The Proposed Changes

The proposed new program of Bachelor of Software Engineering (BSE) from the existing program of Bachelor of Computer Science (Software Engineering) is following the standard programme of MQA and SWEBOK (Software Engineering Body of Knowledge).

The percentage of newly revised curriculum review for Bachelor of Software Engineering is 21.43%. There are 25 core courses, and programme core has been offered in this programme. One core course (Mathematic for computing) and One programme core (Advanced Topic in Software Engineering) has been removed since both courses are not in the SWEBOK. The courses such as Intelligent System, Expert Systems, Data Mining and Computer Security has been replaced with Automata Theory and Formal Language, Software Economics,

Software Maintenance, Configuration Management and Software Security Engineering respectively in aligning with SWEBOK. One of the strengths of the programme is that the syllabus of the courses Software Requirement dan Software Testing are from MSTB (Malaysian Software Testing Board) and teach by Certified Trainer besides UNIMAS is chosen as a pilot university from MSTB. The programme has been designed in response to industry demand for innovative software engineers who can design and develop complex software systems for the modern world

III LITERATURE REVIEW

A. Compliance with SWEBOK

The Software Engineering Body of Knowledge (SWEBOK) is published by The IEEE Computer Society (Bourque & Fairley, 2014) to serve as a guide for the advancement of both theory and practice in the field of software engineering. It includes curriculum development for undergraduate, such as the BSE. The SWEBOK has become an international standard; ISO/IEC TR 19759:2015 (www.iso.org) that defines the acceptable body of knowledge for software engineering discipline.

Although the SWEBOK and curriculum are not the same (www.computer.org), it is important for BSE to be compliant with the body of knowledge set in the SWEBOK for software engineering related courses. Just like any other standards, compliance with the SWEBOK will give BSE the recognition and accreditation from other institutions especially the Malaysia Qualifications Agency (MQA) that accredited programmes offered by the Higher Education Provider (HEP) in Malaysia (MQA, 2014).

There have been many accounts of adaptation of SWEBOK in the academic curriculum, for example in (Thompson & Hardy, 2002) as well as in the industry (Samarthyam et al., 2012 and Narayanan & Neethi, 2001). Adaptation of SWEBOK based curriculum in the industry has been mainly described to have fulfilled organisational goals (Samarthyam et al., 2012). SWEBOK based curriculum has also been used in universities as a means to support and improve the quality of Software Engineering programmes, for example in, (Alarifi et al., 2016).

Due to the comprehensive SWEBOK Knowledge Areas, it can be used to evaluate the academic curriculum at different levels of detail (Frailey & Mason, 2002 and Alafiri et al., 2016). Software engineering is a dynamic field, and new topics emerge regularly. SWEBOK is also intended to be revised from time to time; hence it is suitable to accommodate the dynamic nature of the software engineering field (Frailey & Mason, 2002).

B. Towards IR4.0

Industry 4.0 was first publicly introduced as "Industrie 4.0" by Germany in 2011 (Schwab, 2016). Industry 4.0 combines physical, digital and biological worlds has brought a new fundamental paradigm shift in the ways we work, communicate and live. These fusion technologies impact our society across all disciplines, which includes the field of education.

Industry 4.0 revolution led to changes in professions and employment trends. The workforce is expected to be problem solvers, critical thinkers, possessed soft skills and other essential skills to thrive in the fourth industrial as depicted in the report The Future of Jobs (2016) published by World Economic Forum. World Economic Forum highlighted the changing job market where many jobs will be replaced by technologies and robots in the future in The Future Job 2020 report (2020), for instance, artificial intelligence and data science automation graduates might be unable to find a job due to misalignment of qualifications current market demands or lack of future-ready skills and competencies required for the future of work. In short, we need to prepare our students for the future.

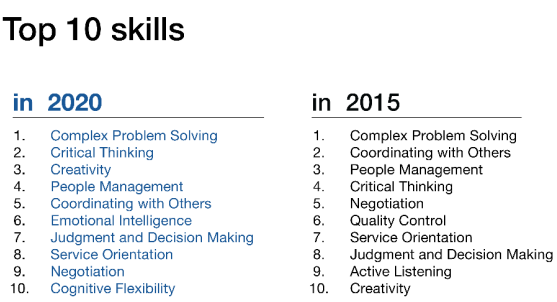

Figure 1. Top 10 skills in 2015 and 2020 (Gray, 2016) and (The Future of Jobs Report 2020, 2020)

Similar to other disciplines, the emerging technologies like Internet of Things (IoT), big data and artificial intelligence (AI) have transformed the way in teaching and learning in education and led to the rise of Education 4.0 in response to the fourth Industry revolution (Maria et al., 2018). There are needs to redesign the education system mainly on transforming the learning and teaching strategies around the world (Lawrence et al. 2019).

IV METHODOLOGY

Few processes have been conducted to restructure the curriculum to fulfil MQA requirements. The process involved data collection, such as survey, meetings and document analysis from SWEBOK.

A. The Survey

A survey from industries was conducted to get their feedback on the new curriculum structure of software engineering courses. A market survey was conducted

to get a response from industries on the new programme. An online questionnaire has been shared online with industries. Out of 100 respondents, 92% from locally owned and 8 % from foreign-owned organisation/ industry.

Students survey is also conducted to identify the current problems of the Software Engineering curriculum structure. The total no of respondents is 102 students consist of 47.1% third-year students, 28.4% second-year students, 20.6% fourth-year students and 3.9% fifth-year student.

B. Meeting

Software engineering programme held a few meetings and online discussion to discuss the changes needed for a new programme. Other than programme and faculty level meeting; industry meeting also held by the faculty to get feedback from the industries on a new programme of Bachelor of Software Engineering.

Industry Meeting

"Board of Studies" refer to the committee responsible for offering professional recommendations on academic programmes to be set up or checked by each Centre of Studies. The Faculty of Computer Science and Information Technology (FCSIT) Board of Studies (BoS) has ultimate responsibility for student teaching and learning and quality improvement in all faculty programmes.

The Board ensures the successful execution of the University's teaching objectives and is solely responsible for content, structure, delivery, quality assurance and final results recommendations. The consistency of programme is maintained by measuring and reviewing the teaching programmes of the faculty by external and internal processes, including student feedback and individual student performance and progress. The Board of Studies meets once a term. Its committee includes staffs who contribute to the undergraduate programmes in the faculty, student representative, alumni, and industry stakeholders.

The programme has appointed an External Examiner from local university and Advisory Panel consists of five industries representative. The programme have received feedback and views on curriculum proposals.

For University Curriculum Benchmarking report, few local universities have been compared based on the duration of study, industrial training semester, final year project semester and total credits of the programme. From this report, duration of study is between 3.5 to 4 years, the earliest student do their industrial training is in semester 5 to semester 8. There is university allows the students to do their industrial training between FYP1 and FYP2. The benefits of students do their industrial training in final semester is the student can continue work after their industrial training at the same company. This is based on the offer by the company. For final year project the student starts their project as early as semester 6. The range of total credits for the programme is between 121 to 128 credits.

V ANALYSIS OF DATA

This section will reveal the analysis of the results from market and student survey. Other than that, feedback from Industrial Panel also presented in this section.

A. Market Survey

The market survey has three parts namely Part 1: Content of Programme and its relevance to the needs of the organisation and Part 2: Career Opportunities and Part 3: Others.

Part 1: Content of Programme and its relevance to the needs of the organisation

From Part 1, the programme fulfils the basic theories required in the related discipline according to the 73% respondents, whereas 26% of them partially agree and only 1% disagree. 94% agreed the theories used in this programme are relevant to the current situation. Then 95% of respondents agreed the subjects contribute to the strength of the programme. 79% of respondents agreed that the BSE programme covers all relevant subjects. From 6 given criterias stated in the market survey, the fundamental theory is the most fulfil (75%) criteria, followed by the use of ICT (62%), current concept (60%), use of quantitative methods (56%), market/industry relevancy (53%) and the least fulfils legal criteria (49%).

For programme implementation, 98% agreed that four years duration of study is sufficient for the students, and 94% agreed six months duration of practical training is adequate for the students.

Part 2: Career Opportunities

For career opportunities, respondents' organisation stated than between 1- 3 posts in their organisation can be filled by graduates of this programme (75%). Half of the respondents, 50% agreed that Appropriate income for the graduates of this programme is between RM2000 – RM2,500 per month (50%) and 88% agreed that this programme is suitable to be enhanced to a higher level which is Master's degree (92.1%).

Part 3: Others

The respondents' organisation have sponsored the student in this field/area (73%). 91% agreed that the

programme able to produce the right graduates for the labour market. The reasons are the fundamental concepts is there such as Java programming, which is part of the programme. Most of the subject enrolled under this programme suit for the IT engineering field.

Another reason is the coming years will need more software skilled employees. Hardware is already good enough, but a lot of software optimisations are required. Hence, people from software background are needed. The maintenance of technical aspects in the organisation is essential to keep the organisation runs smoothly in line with the national agenda or Sarawak itself, moving towards a digital economy. Thus, more systems need to develop and data to be kept. Most of the industries agreed on the new curriculum structure of the new Software Engineering programme.

B. Student Survey

The objective of this survey is to identify current problems with the existing curriculum structure. There are seven measured criteria, namely curriculum structure, course contents, academicians, teaching and learning facilities, assessment method, course delivery and academic advisory. The result showed that the three strengths of the programme are assessment methods, course contents and curriculum structure. The three weaknesses are course delivery, course contents and teaching and learning facilities. These weaknesses because the faculty has a problem with air-conditioning facilities for a few months. For the course contents, it appears as strength and weakness; thus, action is needed to tackle this problem. To improve the programme, the students need more exposure and examples, especially for programming related course. For example, have more lab session and guidance from senior. Course contents listed as the strength and weakness, and need to be improved based on SWEBOK and industry demand. The faculty also, in a process to provide a more conducive learning environment to the students.

C. Industrial Panel Evaluation Feedback

The appointed Industry Advisory Panel (IAP) has held visits and meetings with programme members. The role of an IAP is reviewing the department's curriculum to maintain industrial relevance, offering advice and assistance on curriculum design, and ensuring that graduates have the necessary skills needed by industries as prospective employers. Based on the Industry Advisor Report, the emphasis is placed on soft skills (communication, interpersonal, leadership, professionalism, teamwork and so on.) As well as expertise in new technologies among students. Curriculum review is required to ensure that the latest soft skills and technology components are incorporated into the courses offered to suit industry needs, for example, Scrum, Project Management Professional (PMP), The 6-Thinking Hats principles, Python programming and IoT Development. The following are examples of new components and technologies incorporated into the courses offered.

Table 1: Latest Components / Technologies and related courses

No	Latest Components / Technologies	Courses Related
1.	Scrum - Project Management/ Group Work	- Software Engineering Lab course
2.	Project Management Professional (PMP) - Project Management	- Project Management
3.	The 6 Thinking Hats Principles - Improve communication skills and be more effective in teamwork	- Softskill and Volunteerism - Introduction to Programming, - Project Management - Software Engineering - Lab Courses
4.	Python - One of the latest industry needs programming languages	- Object Oriented Software Engineering
5.	IoT Development - Students can choose to develop an IoT project under the guidance of their supervisor.	Final Year Project) - Students can choose to develop an IoT project under the guidance of a supervisor.

Scrum (Deemer et al., 2012; Schwaber, n.d.; Subramaniam et al., 2017), Project Management Professionals (PMP) (Project Management Professional (PMP)®, n.d.), and 6-Thinking Hats (The De Bono Group LLC, 2014) have been incorporated in the curriculum syllabus as suggested by the IAP. All the components essential for the students to manage projects efficiently, improve communication skills and be more effective in teamwork. Python is one of the latest industry needs programming languages has been taught in Object Oriented Software course. Meanwhile, for Internet of Things (IoT) development, students can choose to develop an IoT project under the guidance of their supervisor.

For University Curriculum Benchmarking report, Four local universities have been compared to the existing curriculum.From this report, duration of study is between 3.5 to 4 years, the earliest semester for industrial training is in semester 5 to semester 8. There is a university that allows the students to do their industrial training between FYP1 and FYP2. The benefits of students do their industrial training in final semester is the student can continue work after their industrial training at the same company. This is based on the offer by the company. For final year project, the student starts their project as early as semester 6. The range of total credits for the programme is between 121 to 128 credits.

VI RESULT

In order to improve the curriculum structure, the courses need to restructure and updates accordingly. There are four new courses have been introduced as the new curriculum structure of BSE, namely Software Economic, Automata Theory and Formal Language, Software Security Engineering and Software Maintenance and Configuration Management.

A. New Curriculum Structure

Software Economic

Software economic is one of the important course that covers the cost management consideration when working on any ICT projects. It has been reported that most of the projects fail due to financial limitation. As most of the ICT projects do not concern financial sustainability prior beforehand, this course is introduced to fill these gaps. This course introduces mechanism, practices and principals towards financial sustainability study of ICT projects. In the course, the students will cover with state of the art sustainability assessment theory and tool through value-based requirement engineering. The concept and tool that are used in this course is e3value. The benefits of e3value modelling are to view the business model on a value perspective corner. At the same time, e3value capable to visualise the business process model into process flow perspective. It can model an economically independent entity, example; enterprises and end consumers or profit and loss responsible business units. The e3value model consists of some technical terms, example actor, value transaction, value network, value object and others (Gordijn & Akkermans, 2003). The actor refers to the consumer, stakeholders, customers, partners, government and end-users. Each transaction between the actors refers to the value object. The value transactions are playing a role as economic value exchanges in the business model (Jamila Daoudi,2017). Then, value network able to show relation and transaction among the actors in this business model. The model has the capability to analyse how the network creates and delivers value (Jamila Daoudi, 2017). Furthermore, the model facilitates the users in checking numerical computation involved in the projects (Artur Caetano, 2014). When all the data or value enters into e3value model, the user can simulate the model. The data will produce in the spreadsheet. This model is helpful for the researchers to analyse the financial sustainability of the project (Wim, et al., 2010).

Automata Theory and Formal Language

This course introduces some fundamental concepts in automata theory and formal languages including grammar, finite automata, regular expression, formal language, pushdown automaton, and Turing machine. Finite automata are very useful in the creation of compiler and interpreter techniques, also used in text processing and hardware design. While formal language is very useful in producing a complete and precise model of software specification. Not only do they form basic models of computation, they are also the foundation of many branches of computer science, e.g. compilers, software engineering, concurrent systems, etc.

The properties of these models will be studied, and various rigorous techniques for analysing and comparing them will be discussed by using formalism and examples. Automata Theory course is essential to be taught for undergraduate students because it is a basis for Computer Science foundation as it exposed on how the computer works (ACM, 2015). As for Software Engineering Programme, this course consists of three learning outcomes in which to expose the students on the computing models so that they can explain and justify the powerful computing models to capture general computer (Tecson et al., 2018), as well as based on time and complexity. Due to various acceptance in term of fast understanding of the topics, as well as a slow learner, there is an approach to assist the students in learning this course. One approach is by designing a tool to simulate the expression and algorithms (Ade-Ibijola, 2018). In addition, the latest research and improvement in the area of automata and formal languages will be studied

Software Security Engineering

Security affects every software component in different types of computing systems. Many vulnerabilities and attacks on those systems are due to security weaknesses in the software itself (Yang et al., 2018) Therefore, incorporating software security into an undergraduate software engineering course is needed in order to produce graduates that fulfil industry needs (Lexter & Jamerson, 2009).

Course Software Security Engineering has been introduced in order to fulfil the SWEBOK besides meet industry needs. This course provides a foundation of building secure software by applying security principles to the software development lifecycle. CLOs course is created for achieving PLO programme by mastering a range of essential and procedures, including developing and testing software system related practices and processes to solve a broad range of complex problems in software engineering and Relate ideas both in written and oral forms using appropriate and different forms of presentation with confident, accurate and coherent in an appropriate context.

Software Maintenance and Configuration Management

Software Maintenance and Configuration Management course covers two knowledge areas in software engineering practices. This course is designed to meet criteria of 21st-century learning and has deployed the HIEPs element of Collaborative Assignments and Projects (CAS) in teaching and learning in this course. Students are expected to acquire future-ready skills upon completion of this course.

Software maintenance and configuration management is a part of the software life cycle. Previously, software maintenance receives less attention compared to the other phases. However, it has changed recently as most software is developed for long term use. The organisation strive to keep software operating as long as possible (Bourque & Fairley, 2014). In order to maintain the life of the software, few changes need to be done according to the current requirement. Thus software maintenance and conguration required for this purpose. Software configuration management is to control changes of software products and guided by international standards such as IEEE and ISO (Fahmy et al., 2017). A formal definition is to identify and document the functional and physical characteristics of a configuration item, control changes to those characteristics, record and report change processing and implementation status, and verify compliance with specified requirements (ISO/IEC/IEEE 24765:2010). It benefits the project management, development and maintenance activities, quality assurance activities, as well as the customers and end-users (Bourque & Fairley, 2014).

The first learning outcome of this course provides knowledge on software maintenance and configuration tasks, tools and techniques used in the process. The second learning outcome of this course provides the student with problem-solving skill and critical thinking skill to perform impact analysis on the software maintenance and change control task for given scenarios. Whereas the third learning outcome of this course builds a team spirit in students through their collaborate in a team to solve the given project.

VII CONCLUSION

The proposed new curriculum structure for programme Bachelor of Software Engineering is developed based on MQA requirements and in compliance with SWEBOK. The improvements made based on feedback from industry, market survey and the student survey. As a result, four new courses have been introduced to improve the programme curriculum structure, which has been approved by MQA. The programme of Bachelor of Software Engineering will be offered to the new intake of student 2021/2022.

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REFERENCES

ACM/IEEE Joint Task Force On Computing Curricula, Software Engineering 2014 Curriculum Guidelines For Undergraduate Degree Programs In Software Engineering, February 2015.

Ade-Ibijola, Abejide. (2018). Synthesis of regular expression problems and solutions. International Journal of Computers and Applications. 10.1080/1206212X.2018.1482398.

Alarifi, A., Zarour, M., Alomar, N., Alshaikh, Z., & Alsaleh, M. (2016, June). SECDEP: Software engineering curricula development and evaluation process using SWEBOK. Information and Software Technology, 114–126. https://doi.org/10.1016/j.infsof.2016.01.013

Cynthia Y Lexter, Frank Jamerson (2009). Incorporating Software Security into an Undergraduate Software Engineering Course. IEEE Volume: 1, Pages: 161-166

Deemer, P., Benefield, G., Larman, C., & Vodde, B. (2012). A Lightweight Guide to the Theory and Practice of Scrum Version 2.0. InfoQ.

Frailey, D. J. and Mason J., (2002). Using SWEBOK for education programs in industry and academia, Proceedings 15th Conference on Software Engineering Education and Training (CSEE&T 2002), Covington, KY, USA, 2002, pp. 6-10, doi: 10.1109/CSEE.2002.995193.

Fahmy, S., Deraman, A., Yahaya, J., Ngah, A., & Salman, F.A. (2017). A Model for People-Centric Software Configuration Management. Journal of Telecommunication, Electronic and Computer Engineering, 9, 7-13.

Gray, A. (2016). The 10 skills you need to thrive in the Fourth Industrial Revolution. Retrieved from The World Economic Forum website: https://www.weforum.org/agenda/2016/01/the-10-Skills-you-need-to-thrive-in-the-fourth-industrial-revolution/

Jeong Yang, Akhtar Lodgher, Young Lee (2018) Secure Modules for Undergraduate

ISO/IEC/IEEE 24765:2010 Systems and Software Engineering—Vocabulary, ISO/ IEC/IEEE, 2010.

Lawrence, R., Ching, L. F., & Abdullah, H. (2019). Strengths and Weaknesses of Education 4 . 0 in the Higher Education Institution. (2), 511–519. https://doi.org/10.35940/ijitee.B1122.1292S319

Malaysian Qualifications Agency Edition https. //www2.mqa.gov.my/mqr/

Maria, M., Shahbodin, F., & Pee, N. C. (2018). Malaysian higher education system towards industry 4.0 - Current trends overview. AIP Conference Proceedings, 2016 (September 2018), 0–7. Https://doi.org/10.1063/1.5055483

MQA, Programme Standards: Computing, (2014), 1st edition, The Standards Division.

Narayanan, R., & Neethi, S. (2001). Building software engineering professionals: TCS experience. Proceedings 14th Conference on Software Engineering Education and Training. "In Search of a Software Engineering Profession" (Cat. No.PR01059). https://doi.org/10.1109/csee.2001.913839

Bourque, P., & Fairley, R. E., (2014). Guide to the Software Engineering Body of Knowledge (SWEBOK(R)): Version 3.0 (3rd. ed.). IEEE Computer Society Press, Washington, DC, USA.

Project Management Professional (PMP)®. (n.d.). Retrieved January 15, 2021, from https://www.pmi.org/

Samarthyam, G., Suryanarayana, G., Gupta, A. K., & Nambiar, R. (2012, June). FOCUS: An adaptation of a SWEBOK-based curriculum for industry requirements. 2012 34th International Conference on Software Engineering (ICSE). https://doi.org/10.1109/icse.2012.6227021

Schwab, K. (2016). The Fourth Industrial Revolution. Retrieved from www.weforum.org

Schwaber, K. (n.d.). scrum.org: The home of scrum. Retrieved January 15, 2021, from https://www.scrum.org/

Subramaniam, S., Chua, F.-F., & Chan, G.-Y. (2017). Project-based Learning for Software Engineering–An Implementation Framework. Journal of Telecommunication, Electronic and Computer Engineering, 9(3-4 Special Issue), 81–85.

Tecson, Cesar & Rodrigo, Ma. (2018). Tutoring Environment for Automata and the Users' Achievement Goal Orientations. 2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE).526-533. 10.1109/TALE.2018.8615234.

The De Bono Group LLC. (2014). The de Bono Group - Six Thinking Hats. Www.Debonogroup.Com.

The Future of Jobs Report 2020. (2020). Retrieved from World Economic Forum website: https://www.weforum.org/reports/the-future-of-jobs-report-2020

The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution. (2016). Retrieved from World Economic Forum website: http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf

Thompson, J., & Hardy, C. (2002). Use and evaluation of SWEBOK by postgraduate students. Proceedings 15th Conference on Software Engineering Education and Training (CSEE&T 2002). https://doi.org/10.1109/csee.2002.995199