Assessing the work readiness skills of ICT Graduates

Brian R. von Konsky
Learning and Teaching
Curtin University
Perth, Western Australia

Charlynn Miller
Faculty of Science
Federation University
Ballarat, Victoria

Asheley Jones
Head of Education &
Workforce Development
Australian Computer Society

The Skills Framework for the Information Age (SFIA) from the SFIA Foundation is a standardised framework that is used to classify the skills of ICT professionals working at levels of autonomy and responsibility appropriate to their level of experience and professional role (SFIA Foundation, 2011). To ensure that ICT students are adequately prepared for professional practice, the Australian Computer Society (ACS) recommends that ICT higher education programs be designed from the top down using SFIA as a guiding framework. Despite this recommendation, there are few resources or examples of best practice to assist institutions in this exercise.

This report describes the outcomes of a research project funded by the Australian Council of Deans of ICT (ACDICT) Learning and Teaching Academy (ALTA). The project team investigated the role of SFIA in the curriculum design and management of programs leading to professional practice in ICT. In particular, the study examined the effectiveness of SFIA as a vehicle to develop a shared understanding of the skills required by early career ICT professionals amongst a range of stakeholders involved in course design and delivery, including academic institutions and their industry advisory boards.

Focus groups were conducted in multiple Australian locations to: investigate the extent to which SFIA had been adopted by industry and the higher education sector; examine the benefits of SFIA's common nomenclature and framework for defining career roles, learning outcomes, and assessments; and analyse the extent to which SFIA provided a structured framework and common language for engaging with industry advisory boards. A facilitated discussion examined the extent to which SFIA was used at the home institutions of focus group participants. Focus group activities included two SFIA-based exercises that required interaction between academics and industry professionals. In Activity 1, participants were given a set of SFIA skills for a hypothetical masters-level unit and asked to use SFIA skill descriptors to identify the level at which a typical masters student could reasonably demonstrate each skill. The participants were then asked to design appropriate assessments. In Activity 2, participants were given an entry-level ICT position description and tasked with identifying the corresponding SFIA skill sets. Audio recordings of focus group activities were transcribed and thematically analysed to provide insights regarding the role of SFIA in curriculum design and management.

- **Defining ICT career roles –** The participants were able to provide many good examples that demonstrated how ICT industry professionals use SFIA. These included a change management consultant, who uses SFIA to ensure an appropriate mix of ICT skills is identified for client organisations; a Chief Information Officer who utilises SFIA to manage the identification of ICT roles in his organisation; and representatives from the Queensland Government who use SFIA to formally define ICT position descriptions. There were also several examples of academic institutions that had used SFIA. However, these examples were generally in conjunction with mapping exercises for accreditation purposes, rather than as components of a holistic approach to curriculum design and management. Use of SFIA for the latter purpose was largely found to be aspirational.
- **Cognition, experience, and authentic learning –**It was observed that SFIA skill descriptors informed discussions as focus group participants identified SFIA skills for an entry-level ICT role as part of Activity 2. This not only enabled focus group breakout sessions to agree on skills associated with the activity, but also on the levels of autonomy and responsibility with which these skills are practiced by emerging ICT professionals. This suggests that SFIA is well positioned as a tool to assist academic institutions in defining the ICT roles intended for the graduates of academic programs. However, the need for further SFIA-based curriculum resources and examples was indicated. Observations from Activity 2 showed that whilst using SFIA to define entry-level skills for specific graduate ICT roles was distinctly beneficial, the use of SFIA levels in identifying masters-level programs was more problematic. This generally required assumptions to be made regarding prior experience, qualifications, and personal aptitude that impact an individual's ability to lead, mobilise and inspire others.
- **Soft skills in the ICT curriculum –** Industry participants experienced in the use of SFIA were

generally able to articulate how soft skills are captured in situ in the context of technical skills. Amongst academic participants, particularly those less familiar with SFIA, there was a common view that a limitation of SFIA was its focus on technical skills at the expense of soft skills like communication. Given the range of experience and skill associated with using SFIA and understanding its nuances, the need for additional SFIA professional development is warranted.

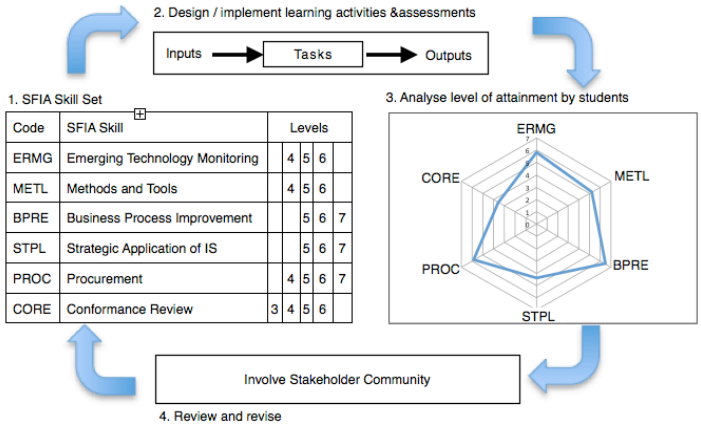
- **Processes and related frameworks –** The need for wider dissemination, peer review, and community discussion regarding mappings of SFIA to Bloom's Taxonomy and AQF requirements was indicated.
- **Closing the loop on curriculum design and management -** During debriefing sessions following activities, participants generally agreed on the importance of work experience, practicums and internships, particularly with respect to developing higher SFIA levels of autonomy and responsibility. The need for additional resources and examples to assist with this was indicated, particularly the use of e-Portfolios in which students could collect and reflect on their specific attainment of SFIA skills.

Detailed information about focus group activities, themes, findings, and the resulting recommendations have been documented for wider dissemination (Brian R. von Konsky, A. Jones, & Charlynn Miller, 2014). These recommendations include:

- "Use SFIA as a framework to engage Industry Advisory Boards when identifying the skills required by ICT graduates."
- "Consult established resources that specify ICT position descriptions in terms of SFIA descriptors and levels to inform discussions about career roles for graduates from a given program. In those cases where an appropriate set of position descriptions is not available, skills for the intended ICT role should still be mapped to SFIA."
- "Use SFIA as part of a holistic approach to ICT curriculum design and management."
- "Conduct professional development training for academic staff to ensure an adequate understanding of SFIA and its relationship to professional practice in ICT."
- "Use SFIA descriptors to inform the design of authentic learning activities and assessments, while taking into consideration the relationship of these to Bloom's Cognition Levels."

Focus group findings were used to inform the development of resources and examples that were dissemination at events and workshops held at multiple locations around the Australia and New Zealand. Examples of these resources include the following:

SFIA in Assessment Design – This project developed a process that uses SFIA skill and level descriptors to inform the design of authentic assessments. The process involves conducting a noun-verb analysis of SFIA skill and level descriptors to identify assessment artefacts and tasks. The process also describes the role of assessment artefacts in measuring the attainment of SFIA skills and levels to close the loop on curriculum design in a cyclic process of improvement that involves stakeholders, as shown in Figure 1. An overview of the process was presented at ascilite 2013 (Brian R. von Konsky, Jones, & Miller, 2013), and subsequently validated in conjunction with focus group activities.



Code	SFIA Skill	Levels			
ERMG	Emerging Technology Monitoring		4	5	6
METL	Methods and Tools		4	5	6
BPRE	Business Process Improvement			5	6	7
STPL	Strategic Application of IS			5	6	7
PROC	Procurement		4	5	6	7
CORE	Conformance Review	3	4	5	6	

Figure 1. SFIA-based assessment design process (Brian R. von Konsky et al., 2013).

SFIA Role Descriptions – The ACS recommends that SFIA be used to define the intended graduate career roles as part of a top-down approach to curriculum design. This project identified established collections of ICT roles that have been defined using SFIA. These are offered as a starting point to inform conversations between industry advisory boards and academics. This includes ICT position descriptions from the Queensland Government (Queensland Government Chief Information Office, 2013) and a survey of career mobility conducted by the Australian Computer Society in a recent white paper (ACS, 2013).

This project demonstrated how network analysis of such collections can be used to identify related ICT roles based on the skills they have in common (Figure 2), and the extent to which SFIA skills tend to be paired with other skills (Figure 3). As most higher education courses prepare students for a range of related roles, such an analysis further informs the discussion regarding graduate career roles and skills, based on industry needs (B.R. von Konsky, 2014).

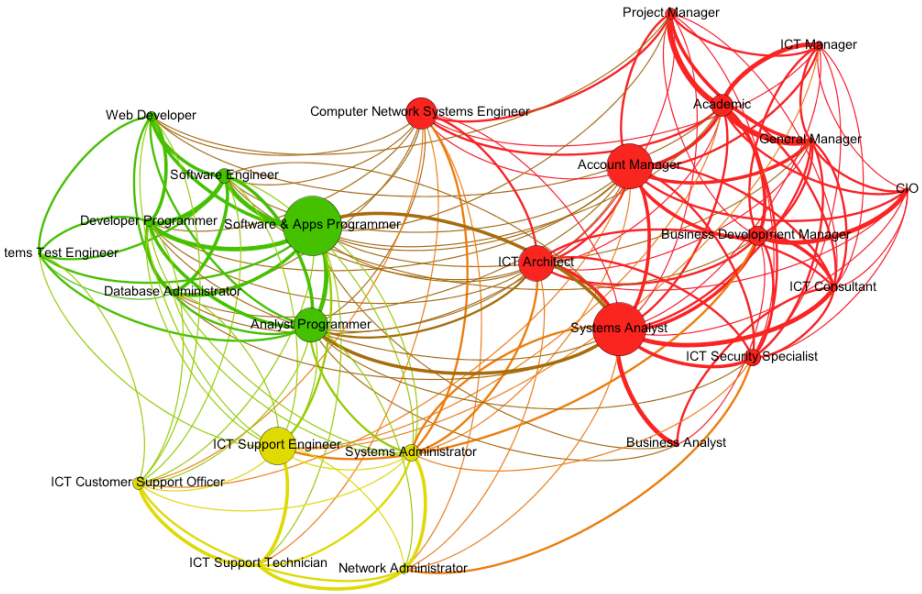


Figure 2. Network analysis of related positions based on common SFIA skills (B.R. von Konsky, 2014).

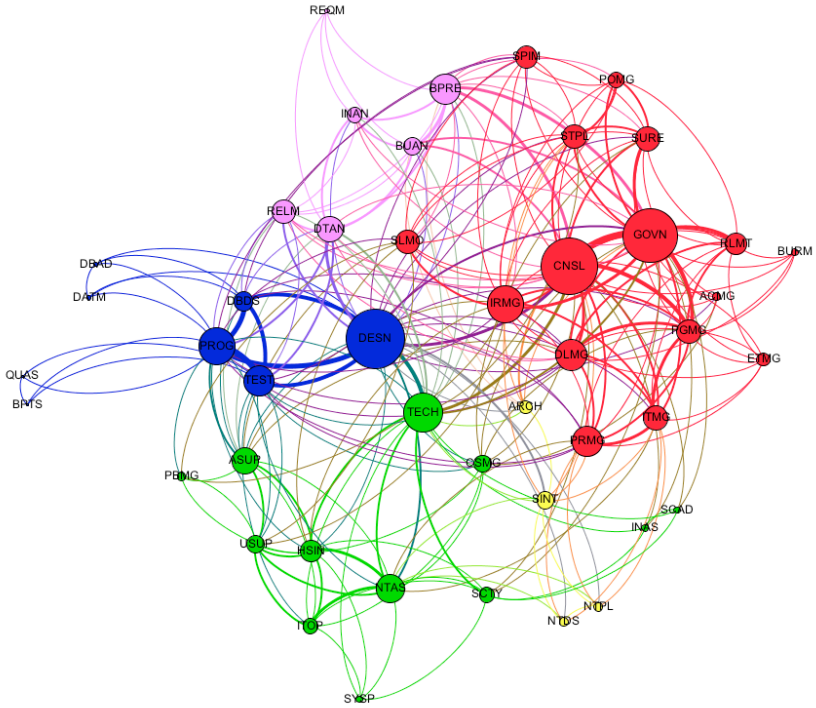


Figure 3. Related SFIA skills based on an analysis of position descriptions (B.R. von Konsky, 2014)

A specific example in which SFIA was used to define career roles for graduates of a hypothetical program in data science was developed for this project, and is shown in Table 1. The example was designed to provide an example in which SFIA skills are instantiated in the context of a specific ICT specialist discipline (B.R. von Konsky, 2014).

Table 1. – Data Science career role descriptions mapped to SFIA (Level 5)

Principal SFIA Skills	Relationship to the Data Science Consultant Career Role
Information Analysis (INAN)	Data scientists analyse data to discover and quantify patterns in information using statisti statistical inference, regression analysis, and machine learning.
Data Analysis (DTAN)	Data Scientists manage data requirements and establish and modify data structures leadi the retrieval, transformation, and analysis of data.
Methods and Tools (METL)	Data scientists ensure appropriate methods and tools are applied to retrieve, transform, c visualise, and analyse data and to build related data products.
Consultancy (CNSL)	Data scientists consult with clients to recommend and implement approaches to address business questions, leading to new insights and knowledge, informing decision making ar predicting outcomes.
Research (RSCH)	Data scientists form and test hypotheses based on a statistically rigorous and repeatable methodology involving the analysis of complex data sets.
Technical Specialism (TECH)	Data scientists require specialist knowledge in a range of topics including statistics, statist inference, high performance computing, and visualisation.
Project Management (PRMG)	Data scientists manage data science projects within agreed parameters of cost timescale quality.
Programming (PROG)	Data scientists write programs and integrate custom-off-the-shelf solutions to retrieve, cle transform, and visualise data, and build predictive data products that inform business decisions.

Table 1 is also represented graphically in Figure 4. The figure demonstrates an approach for visualising SFIA skill sets and the progression from undergraduate study to professional practice that was developed in conjunction with this project and presented at the Australasian Computing Education (ACS) Conference during Australasian Computer Science Week (von Konsky, Jones, & Miller, 2014). The approach provides for the animation of SFIA skills and levels in visualising career progression and changing levels of autonomy and responsibility as an emerging professional enters professional practice. This methodology further serves, as a basis for comparing the ICT skills developed by an academic program, relative to those required in advertised position descriptions.

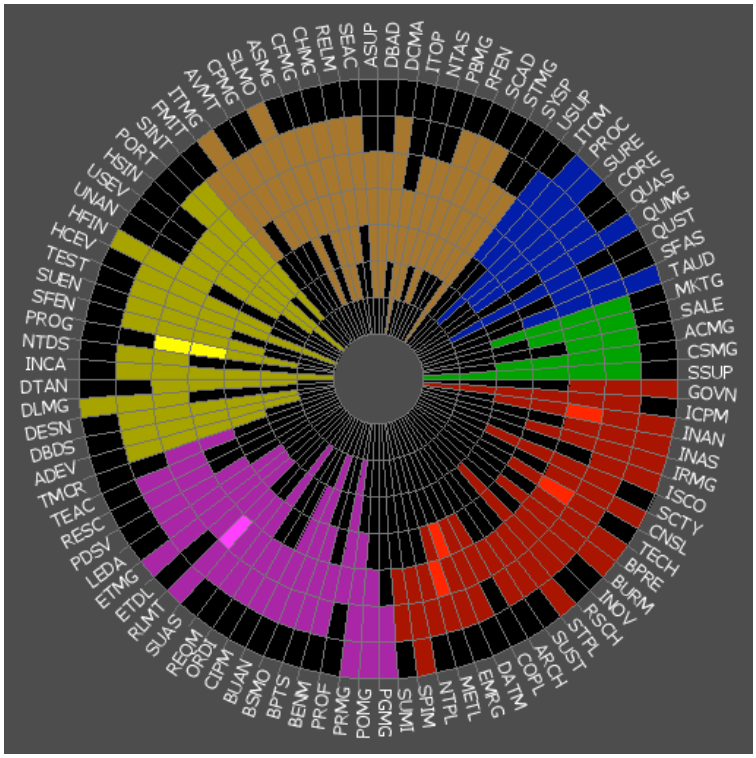


Figure 4. Visiaulisation of skills and levels for the Data Science career role.

SFIA Curriculum Design Case Studies – Three detailed case studies were developed in conjunction with the project that provide examples demonstrating how SFIA has been used in curriculum design and management (Jones et al., 2014). Cases are for the Computer Professional Education Program (CPeP) from the ACS; the Bachelor of Business Information Systems from RMIT; and the Bachelor of ICT from the University of Tasmania.

CPeP– This postgraduate level program offered by the ACS and has been mapped to SFIA. The program uses SFIA as a common framework to to communicate skills and levels of autonomy and responsibility amongst stakeholders. These include students, instructors, mentors, and an industry advisory board. The program has a strong focus on ICT business alignment and in assisting graduates to make more effective use of technology in the workplace. A key component is a Professional Practice year, in which students collect and reflect on artefacts that demonstrate attainment of SFIA skills, in consultation with a mentor.

RMIT University, Bachelor of Business Information Systems – This program is a mature course that was mapped to SFIA in conjunction with a prior accreditation exercise. It is now going through a subsequent curriculum design iteration. The program has been mapped to SFIA, Bloom's Taxonomy, and Australian Quality Framework (AQF) skills. The relationship between these frameworks is shown in Table 2, resulting from a mapping exercise conducted by RMIT staff.

Table 2. SFIA-Bloom's-AQF Mapping from RMIT.

<table>
<tr><th>SFIA Level</th><th>SFIA Autonomy</th><th>Bloom's Level</th><th>Bloom's Cognition</th><th>Australian Quality Framework (AQF) Skills</th></tr>
<tr><td>1</td><td>Follow</td><td>1</td><td>Remembering</td><td>Remember</td></tr>
<tr><td>2</td><td>Assist</td><td>2</td><td>Understanding</td><td>Understand</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Apply</td><td>3</td><td>Applying</td><td>Apply</td></tr>
<tr><td>4</td><td>Analysing</td><td>Investigate, analyse</td></tr>
<tr><td>4</td><td>Enable</td><td>5</td><td>Evaluating</td><td>Critical reflection, evaluate</td></tr>
<tr><td>5</td><td>Ensure, Advise</td><td>6</td><td>Creating</td><td>Create</td></tr>
<tr><td>6</td><td>Initiate, influence</td><td colspan="3" rowspan="2">These SFIA skills are generally achievable through experience in the ICT industry</td></tr>
<tr><td>7</td><td>Set strategy, inspire, mobilise</td></tr>
</table>

A key component of the Bachelor of Business Information Systems is a professional practice year. Several touch-points during that year require students to reflect on the connection between their formal learning and their Industry Based Learning experience. Although these reflections were not originally SFIA-based, they will be in the next version of the program.

University of Tasmania, Bachelor of ICT – This is a new program was redesigned from the top down using SFIA-based resources to inform discussions in a structured process, aimed at identifying the ICT roles required by local industry. This case study focuses on that process and its outcomes, with particular attention placed on the role of SFIA as a common reference model to identify ICT skills required by local industry. Early indicators suggest a positive impact on enrolment and retention, with local industry actively promoting a program they helped to shape, and students having a greater appreciation of the industry relevance of the programs in which they are enrolled.

Focus Group Events

- 4 November 2013, Sydney, New South Wales, (Hosted at ACS National Office, Sydney)
- 5 November 2013, Brisbane, Queensland, (Hosted at ACS Queensland)
- 6 November 2013, Victoria (Hosted at ACS Melbourne Office)
- 17 November 2013, Perth, Western Australia (Hosted at Curtin University)

SFIA Workshops

- 12 November 2013, ICT Work Readiness Skills and SFIA, Tenth Melbourne Computer Education Conventicle
- 20 January 2014, Ensuring ICT Graduate Work readiness: Using the SFIA Framework for Course Development in University Programs, http://elena.aut.ac.nz/homepages/ace2014/WS2.pdf

Dissemination Events

- 10 April 2014, Melbourne Dissemination Event (Hosted at ACS Melbourne Office)
- 11 April 2014, Sydney Dissemination Event (Held at Vibe Hotel, Sydney)
- 15 April 2014, Perth Dissemination Event (ACS WA Branch Forum)
- 9 May 2014, ACDICT ALTA Learning Forum

CPeP Student Interviews

This project planned to complement data arising from focus groups involving academics and industry representatives with data from interviews with ACS Computer Professional education Program (CPeP) students. These students had used SFIA in ePortfolio assessments in conjunction with a unit on professional practice. Few students elected to participate in this study. Interview results have not been reported due to limited student participation.

ACDICT ALTA Project Publications

Jones, A., von Konsky, B. R., Miller, C., Herbert, N., Henschke, K., & Richardson, J. (2014). Critical Conversations: Using SFIA to inform stakeholder communication in curriculum design and management. *in preparation*.

von Konsky, B. R. (2014). A network analysis of ICT career pathways and the implications for curriculum development. *in preparation*.

von Konsky, B. R., Jones, A., & Miller, C. (2013). *Embedding professional skills in the ICT curriculum*. Paper presented at the ascilite 2012, Auckland, New Zealand.

von Konsky, B. R., Miller, C., & Jones, A. (2014). SFIA: Engaging stakeholders in ICT curriculum design and management. *in peer review*.

von Konsky, B. R., Jones, A., & Miller, C. (2014). *Visualising Career Progression for ICT Professionals and the implications for ICT Curriculum Design in Higher Education*. Paper presented at the Sixteenth Australasian Computing Education Conference (ACE2014), Auckland, New Zealand.

Related References

ACS (2013). "Common ICT job profiles & indicators of skills mobility: ICT skills white paper." Retrieved 13 June 2014, from http://www.acs.org.au/information-resources/ict-skills-white-paper.

Queensland Government Chief Information Office (2013). "ICT Career Streams." Retrieved 24 August 2013, from http://www.qgcio.qld.gov.au/products/ict-workforce-capability/careers-and-programs/ict-career-streams.

SFIA Foundation (2011). SFIA 5 framework reference: Skills defined in categories and subcategories.