

The Impact of Future Computational Technologies on Global Alignment of IT Skills Needs

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Abstract: *Advancements in computational technologies within the last decade accelerated to enable complex Information Technology (IT) solutions transform practices within businesses and communities for efficiency gains and competitiveness. Organizations benefit from a wide range of computational technologies in order to modernize various products and service delivery initiatives. In fact, organizations rely heavily on various computational and information technology platforms for day to day operations. Intensive use of computational and information technology solutions has transformed the global demand for various skills sets. More specifically, increased use of technology has meant that organizations need skilled personnel to make effective use of technology solutions. It is believed that worldwide, demand for technology relevant skills (IT skilled in particular) is increasing. High demand for computational and IT skills has transformed the balance of skills needs globally. The increasing need for skilled IT skilled workforce has created challenges worldwide for governments and educational institutions to develop adequately skilled workforce for computational technology and IT sectors. Availability of standards and frameworks for more accurate understanding of skills needs plays a significant role in planning for developing adequately skilled IT personnel. Despite benefits offered via use of skills frameworks for IT, lack of clear understanding of frameworks and methodologies for use of frameworks can potentially be a barrier to effective use of frameworks.*

Keywords: *Computational Technology, Information Technology, Information Technology Skills, Global Demand for Technology Skills, Technology and IT Skills Frameworks.*

1. Introduction

Organizations and businesses rely heavily on computational and information technologies. Information Technology (IT) has become an effective tool for transforming business processes. Organizations make use of various computational technologies and IT to develop more effective approaches to design, development and delivery of products and services. Increasing dependence of organizations on computational technologies has in turn created a need for availability of skilled technology personnel for operational continuity.

Educational (universities) and industry training institutions (for instance Cisco Academy, Microsoft training organizations and other similar outlets) play a key role in developing skilled technology and IT personnel [1] and [4]. However, for a number of years there has been a debate on how effective educational and training programs are? More specifically, how would these organizations align their programs with real demand for skills within the computational technology sector?

Overall, there seems to be a consensus ([2], [4]) that both skills development approaches and educational programs must be aware of and consider realistic and relevant demand for IT skills ([2], [3] and [4]). Internationally recognized technology skills frameworks are one of the approaches for better recognition and alignment of education and training for computational technology skills alignment. One particular framework named Skills Framework for Information Age (SFIA – www.sfia.org.uk) has recently become widely recognized with computing and IT professional communities. What's more, numerous professional IT bodies in a number of

countries (UK, Australia and New Zealand) have adopted this framework as the basis for awarding computing technology and IT professional accreditations [1] and [3]. SFIA seems to be a platform that could potentially bring definition of IT industry roles to become consistent globally. A consistent global recognition of IT roles can assist educational and training organizations develop skilled computing professional personal in a strategic fashion [3].

This paper presents a review of skills frameworks as a potential global alignment tool. A preliminary study (based on assessment of SFIA categories and levels of authority) examined feasibility of aligning learning outcomes of a portfolio of courses with skills identified in SFIA. The outcome indicated that in general mapping of existing technology education programs to SFIA can be feasible. At the same time, the study highlighted a number of key challenges to be aware of if we are to ensure the mapping exercise is effective.

2. Broader Issues Concerning Computing Technology Skills

In previous section it was outlined that the global demand on IT skills has been increasing. The balance of organizational skills needs is changing and technology related skills seem to be replacing some of the traditional skills within organization [4]. What's more, there seems to be a growing emphasis on recruiting computing and IT professionals with recognized qualifications. This is evident in an overall reduction in number of IT personnel who do not have a formal qualification which adds to the demand for the qualified and skilled technology personnel [1] and [2].

Cappelli in his study in 2001 [6] outlined that only about half of IT professionals had bachelor's degrees, and only 10% of workers in programming positions had a bachelor's degree of any kind. The data from the Department of Communications, Information Technology and the Arts [7] Australia in 2004 show that only 9% of IT professionals did not obtain a formal IT qualification. The shift in culture of employment market places added pressure on higher education sector for delivering IT qualifications to bigger number of students and to ensure that programs are current and relevant.

Concern over increasing global demand on technology skilled personnel and employability of graduates in computing and IT has continued to grow over the past decade. Both industry and education sectors argue about "a divorce between the formal existing educational institutions and the needs of ICT professionals by the industry" [5]. Such inconsistency has been seen as the key contributor in the scarcity of IT and computing professionals world-wide ([1], [2], [6], [8], [9], [12] and [14]).

An investigation on graduate unemployment conducted by United Nations Educational Scientific and Cultural Organization (UNESCO Bangkok, 2006 [13]) also identified mismatch of ICT qualifications with employers' needs as a factor contributing to IT graduate unemployment in Thailand. Findings suggest that technical skills that graduates learned were "outdated and do not match the state-of-art technologies in use at the workplace" [11]. In addition, a research conducted by Queensland government in 2006 found that industry has expressed concerns over the applicability of course material to workplace situations (particularly in tertiary courses). This could have been caused by slow process of seeking approval and adopting changes in course material - as needed by the changing nature of technology and the requirements of IT job market. In more recent times, as outlined by evidence from reports by New Zealand government, the issue of disconnect does not seem to have been fully attended to.

Lack of effective alignment of skills development programs and real IT industry needs generally stem from lack of access to accurate assessment of needs. What's more lack of standards in recognition of technology skills impact consistency of assessments of skills needs (Asgarkhani, M. & Shankararaman 2014). Studies in skills needs can be more consistent if there are standards to follow in not only understanding skills but also assessing skills in a consistent manner. Similarly, if the view of the IT sector of roles in the sector and the views of the education sectors of the skills needed are better aligned (based on standards), there is a better chance of making alignment strategies more effective. IT skills frameworks can set standards which in facilitate better understanding of skills needed and more effective alignment of IT sector and academics.

It was discussed earlier that some of the previous work on assessment of IT skills needs used different categories of skills and resulted in inconsistency of outcomes. Furthermore, it was argued that using skills frameworks to standardize understanding of IT skills can play a significant role in more effective alignment of IT/IS education programs with industry needs.

3. Computing and IT Skills Frameworks: An Overview

In this section, some of the IT skills frameworks are introduced. Over the last decade, numerous classifications of IT skills and roles have been developed and introduced. Some were developed by academics for research purposes and others put together by the IT industry practitioners. For instance, ACM has developed curriculum guidelines for qualifications in information systems and computer Science. In 1972, Ashenurst [4] identified 37 Information Systems (IS) skills and abilities into 6 categories: people, models, systems, computers, organizations, and society. In their study of IS job advertisements from 1970 to 1990, Todd, McKeen and Gallupe reported in 1995 ([1], [4]) a classification of IS job skills into 7 categories: hardware, software, business, management, social, problem solving, and development methodology. Nelson in 1991 [10] categorized 30 IS knowledge/skills into 6 groups: organizational knowledge, organizational skills, organizational unit, general IS knowledge, technical skills and IS product.

Today, both technical and non-technical skills are required of IT workforce. In attempting to standardize roles and responsibilities within the sector (so as to making it easier to train, develop and drive recruitment selection processes) a number of industry supported standards for frameworks were developed.

SFIA (Skills Framework for the Information Age) is a framework grouping 86 skills into 5 categories: Strategy and Architecture, Business Change, Solution Development and Implementation, Service Management, Procurement and Management Support and Client Interface. With 7 levels of responsibility associated to each skill/knowledge, it matches the skills of the workforce to the needs of the business.

Another job roles/occupation framework that has been widely used within Australia and New Zealand is ANZSCO (Australia and New Zealand Standard Classification of Occupations). SFIA seems to be increasingly accepted as the global framework that could lead towards standardization of IT skills. The reasons for SFIA becoming widely accepted can include:

- SFIA seems to have considered a comprehensive range of skills and roles;
- SFIA has the advantage of recognizing the level of responsibility and authority associated with skills and roles;
- SFIA seems relevant to professional IC bodies' accreditation programs. This framework was recently adopted by the Institution of IT professionals NZ (IITP NZ) to be the basis for issuing first group of ICT Professional certificates. That is to say, SFIA will be playing a significant role in the future of the ICT sector within New Zealand. At the same time, this framework is used with UK by British Computer Society for standardizing IT skills.

SFIA is likely to be the basis of future accreditation of ICT qualifications within a number of countries – including the signatories of the Seoul Accord (http://www.abeek.or.kr/accord/contents.jsp?menu_l=85).

Skills-based programs have been part of the education systems. However, most of such programs have been implemented in the professional or vocational training sector. Thus, only in recent years skills-based teaching and learning has found its application in higher education – primarily due to the growing gap between the academic curricula of the higher education institutions and the actual demands from businesses and society. More and more higher education institutions are attempting to reshape their programs with a professional orientation. In order to do this, these programs have defined competency frameworks, which are essentially skills that are to be acquired by the students doing a particular course [3] and [4].

TABLE I: SFIA levels of authority

SFIA levels	
7	Set strategy/inspire/mobilise
6	Initiate/influence
5	Ensure/advise
4	Enable
3	Apply
2	Assist
1	Follow

Each level is characterised by four different attributes – table II.

TABLE II: Attributes determining level of SFIA authority

Attribute	Description
Autonomy	<ul style="list-style-type: none"> works under routine direction works under general direction
Influence	<ul style="list-style-type: none"> Interacts with and may influence immediate colleagues Interacts with and influences department/project team members.
Complexity	<ul style="list-style-type: none"> Performs a range of varied work activities in a variety of structured environments Performs a broad range of work, sometimes complex and non-routine, in a variety of environments.
Business skills	<ul style="list-style-type: none"> Understands and uses appropriate methods, tool and applications, demonstrates a rational and organized approach to work Understands and uses appropriate methods, tool and applications, demonstrates an analytical and systematic approach to problem solving.

4. Conclusions

Increasing spread of sophisticated computing technologies and IT solutions in organizations has resulted in high demand on technology and information management skills globally. The advances in computing technologies and projected future developments in IT have changed the balance for skills needs worldwide. We increasingly rely on IT solutions to deliver products and services. This has in turn created a need for skilled IT personnel to operate sophisticated computational infrastructures and solutions within organizations.

The high demand for skilled IT personnel is a worldwide phenomenon. Governments, the IT sector and the education sector need to coordinate projection of skills needs so as to effectively meet demand for skilled technology personnel globally. Global alignment of assessment for needs and skills development programs is a critical factor in strategic development of needed technology skills.

Both educational institutions and industry connected training organizations use various strategies for effective alignment of their education and training programs. However, some of the strategies deployed are highly dependent on common understanding of issues and problems. There is a need for standardizing

understanding of computational technology and IT roles so as to establish a common view of roles and skills that are in demand.

Developing a common view of IT roles can be achieved via IT skills frameworks. A number of skills models were discussed. It was suggested that SFIA (Skills Framework for Information Age) is likely to in advantageous position to be accepted as an international framework to be the basis of standardizing IT roles as well as IT Education. At the same time, there is a need for clear understanding of frameworks and common methodologies for alignment of both training and education programs to ensure effective alignment of skills development solutions and real needs.

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