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# An Analysis of the Horizontal and Vertical Consistency of ICT Skill Standards in Selected Countries and Regions

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ICT-related occupations change rapidly. This leads to inquiries about the relevance of occupational standards amongst ever-changing industrial needs and individual career needs. This study utilises the Consistency Analysis Approach to identify horizontal consistency, which is similarities and differences in the components of six skills standards, and vertical consistency which includes implementation or applications. The analysis of horizontal consistency shows that the skills dimension in ICT skill standards are based on either occupational categories and career profiles, or skills. Japan ITSS, in particular, has two frameworks operating in parallel. Analysis of the vertical consistency shows that frameworks which have high applicability focus on using generic skills, and thus make it easier to adapt to other countries' occupational standards. South Korea and Germany exhibit a stronger linkage to training or industry, especially because South Korea ITSQF is linked to the National Competency Standards and hence the Korean Qualifications framework. This study suggests that continuous updates in the grouping of occupations in the ICT sectors is critical in this era, where ICT occupations are constantly being created and changed.

**Key words:** *ICT Skills, Occupations, Comparative analysis.*

## Introduction

The potential impact of the advancement of ICT and increasing digitalisation on the workforce is not new. It was mentioned by academics three decades ago. Reich (1992), in particular, is one of the earliest to predict the replacements of routine jobs by automation, as

well as the change in nature of ICT-related occupations. Globalisation, increasing economic integration and promotion of regionalism in many parts of the world, has brought about structural changes in the nature of employment. In the field of ICT, these trends have caused new rapid growth of ICT sectors and new jobs requiring new skills (Lopez-Bassols, 2002). ICT-related occupations changed from merely using ICT as an information exchange tool, but rather becomes service-oriented work (Levy and Murnane, 2005; Lopez-Bassols, 2002). Moreover, within the ICT field, terms such as skills, competences, job profiles or job descriptions are commonly used to describe the requirements needed for an individual to be capable of working in a specific ICT (European E competence framework, 2019).

Thus, there is an imperative to have a consistent point of reference. Such a point must be able to translate the different types of job descriptions, thus matching demands by employers, skills demanded in job candidates, and skills provided by training institutions. These standards could be used by education and training centres, employers and individuals alike, as an identification tool to identify the skills needed by graduates for ICT-related occupations as well as to inform ICT curriculum-making (von Konsky, Miller and Jones, 2016). ICT skill standards have been developed in various parts of the world. Although the specific purpose of each of these standards may differ, its major goal is to ease the understanding and match the qualification of skilled labour during the recruitment and training of ICT-related human resources. In vocational education and training, standards such as the e-Competence Framework are able to help vocational training centres identify and match vocational activity to educational modules (European E competence framework, 2019).
There exist a number of well-established and operational ICT skills standards globally. Further, many researchers have attempted to look into the best practices of ICT skills standards from various countries, as a benchmarking point to develop their national ICT skill standards. These researches are conducted either individually, such as those by Rodprayoon (2015), or conducted on a larger national scale such as regional working papers such as ASEAN ICT Skill Standards Definition and Certification reports (Ministry of Digital Economy and Society Thailand, 2013). However, past researches have focussed more on the background of the policy, its implementation and certification approach, while research on the dimensions and their basis was merely stated rather than analysed comparatively. There is still a need to understand the different dimensions of skills standards, and why it has been developed into those dimensions.

Further, more recently there have been some inquiries into whether occupational standards or competence standards could stay relevant to both industry needs and individual skilled worker's current career needs, as well as staying inclusive towards new occupations. The ICT sector in most developing or emerging economies consists of formal and informal sectors (Deen-Swarray, Moyo and Stork, 2013), whereby occupations in the informal economy depend on shared resources such as the cloud. Access to even the most basic form of

technology may provide a competitive edge to businesses in the informal sector even when faced with competition (Bhattacharya, 2019). Thus, investigating the best practices implemented by these skills standards is required, to identify ways of how skills standards can be developed while staying relevant and inclusive in this fourth industrial revolution.

The aim of this comparative study is to analyse and synthesise the different ICT skill standards, using the principles of consistency analysis approach, and identify the horizontal consistency which is the similarities and differences between the components and dimensions of skills standards and its vertical consistency, which includes its application or implementation differences.

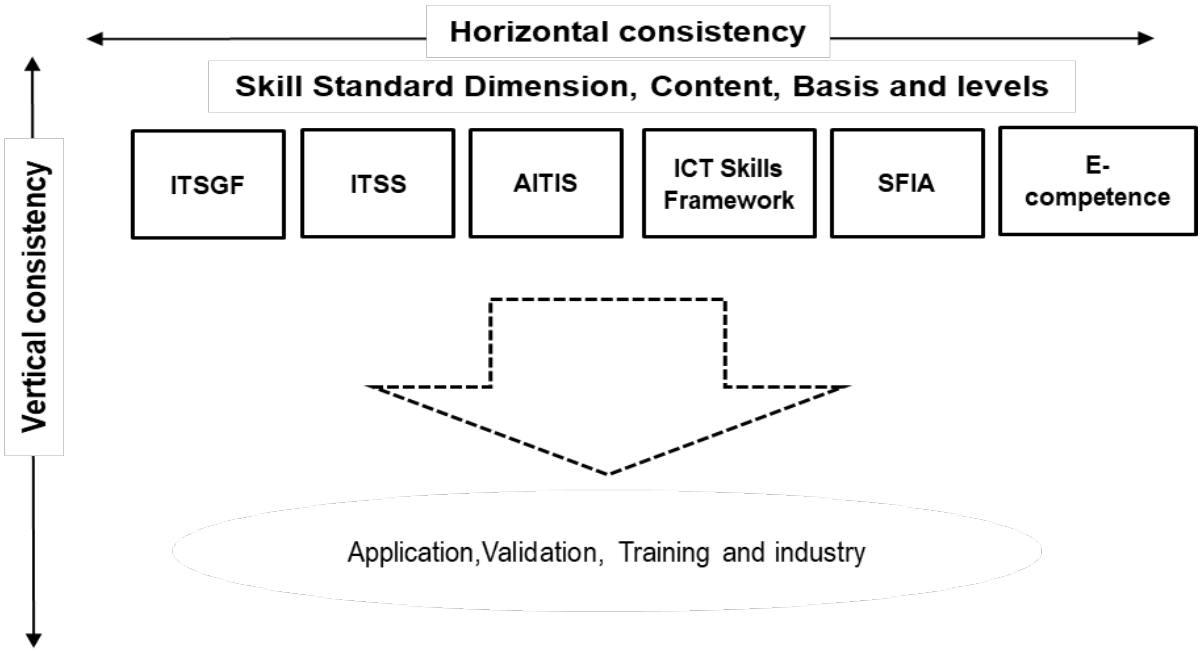
## Methodology

### *Understanding ICT Skill Standards through the Consistency Analysis Approach*

The consistency approach to study frameworks is generally used in European policy systems (Nuttall, 2001) analysis and software systems analysis (Nistala and Kumari, 2013; Engels, Küster, Heckel, & Groenewegen, 2001). The main idea behind these consistency analyses is to give a direction to analyse a particular systems and these directions are usually categorized into horizontal and vertical consistency (Pal, 1997). For policy-making, horizontal consistency refers to the similarities or differences between different policies within one region, while vertical consistency refers to the similarities and differences between regional and national policies (Nuttall, 2001). Similarly in software systems analysis, the main goal of consistency analysis is to identify the different viewpoints from which the system is modelled, and hence gain a better understanding of the model (Engels, Küster, Heckel, & Groenewegen, 2001; Hussain et al., 2019).

According to the International Standard Organization, the general definition of a standard is "a document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context (International Standard Organization, 2004)". In other words, it is a document that can be used consistently by various organisations. By taking this definition into account, while taking the principle of consistency analysis of systems approach and viewing the concept of "system" as "standards", this analysis will study the horizontal consistency (Refer to Figure 1) which is the similarities and differences in the different skills standards description and dimension, and the vertical consistency which is the differences in its approach to certification or implementation (Pal, 1997).

**Figure 1.** Consistency Analysis of ICT skills standards




***Horizontal Consistency and Vertical Consistency***

The units of comparison in this comparative analysis were derived from prior studies (refer to Table 1) including Voogt & Roblin (2012), Vance (2010) and the Ministry of Digital Economy and Society Thailand, (2013). According to a report by ASEAN ICT skills standards (Ministry of Digital Economy and Society Thailand, 2013), the major elements of a skill standards consist of its description, including the definition of skill, sub area of skills, the competency level, ability to map onto other standards, and the certification approach. Voogt and Roblin (2012) compared the rationales and goals for the competency framework, and the definitions and strategies for implementation and assessment. While Vance's (2010) analyses of competency framework includes identifying the overlap in the competency descriptions and goals, content areas, assessment indicators, and mastery levels of these frameworks.

**Table 1:** Units of comparison used in prior studies

| **Prior studies on comparative analysis** | **Type of framework analysed** | **Units of comparison** |
|---|---|---|
| Voogt & Roblin (2012), | 21st century competencies framework | ✓ the rationales and goals for the competency framework,<br>✓ the definition<br>✓ strategies for implementation and assessment. |
| Vance (2010) | Youth Worker Competency Framework | ✓ competency descriptions and goals<br>✓ content areas<br>✓ assessment indicators<br>✓ mastery levels |
| Ministry of Digital Economy and Society Thailand, (2013) report | ICT skills standard | ✓ Description of skill standards<br>✓ definition of skill,<br>✓ sub area of skills,<br>✓ the competency level,<br>✓ ability to map into other standards<br>✓ certification approach |

These prior studies have been taken into consideration in this paper. Here, the authors have categorised the horizontal consistency as similarities and differences in the nature of the standards. This includes the dimension of skill standards including its name, categories and subcategories, and the basis in which the dimensions are developed. Skill Standards Dimensions in this analysis refers to the main components or axes in the skill standard, including the major components and skill levels which is the degree of complexity in a given skill. Skill Standard contents includes the major categories, such as main categories and subcategories of skills or occupation or business processes. The basis of each dimension means how they derived their standards.

However, vertical consistency refers to the similarities and differences in implementation approaches, or more specifically how the standards are used by either the institute governing them or by other institutes, in certification.

***Skills Standards Analysed***

The skill standards included in this study are those already at the operational stage, as well as those being operated in countries other than where it was first developed. These include the

1) South Korea IT Sectoral Qualification Framework (ITSQF); 2) Japan skill standard for IT professionals (ITSS); 3) United Kingdom Skills Framework for the Information Age (SFIA); 4) Germany Advanced IT Training Systems (AITTS); 5) European e-competence framework; and in Australia the 6) Queensland IT Skills Framework.

## Results

### *Horizontal Consistency*

**Table 2:** Analysis of the horizontal consistency

| **Name of Standards** | **Dimensions of the standards** | | | | **Basis** |
|---|---|---|---|---|---|
| | **No. of dimension** | **Name of dimension** | **Main Categories** | **Sub Categories** | |
| ITSQF Korea | 2 | Occupational categories | 5 (Occupational Categories) | 15 (Job Categories) | Korea Employment Classification of Occupations (KECO) |
| | | Levels | 9 levels | NA | NTQ and NCS |
| ITSS Career Framework Japan | 3 | Career Framework | 11 job | 35 Specialty fields | International Standard Organisation and Japanese Industrial Standard |
| | | Skills Dictionary | 5 skill categories | NA | Business operation skills |
| | | Skill levels | 7 Levels based | NA | Key Performance Indicator and Skills Proficiency level |
| German AITTS | 2 | Career profiles | 35 career profiles | NA | - |
| | | Levels | 3 levels | NA | Based on work processes including operative, specialist and IT occupation |

| | | | | | |
|---|---|---|---|---|---|
| The Queensland Government ICT Skills Framework Australia | 2 | Career stream | 4 (Technology Application, Technology services, Enterprise implemention, Enterprise governance) | 56 careers | - |
| | | Level | 3 (Foundational Level, Practitioner level and higher level) | NA | Based on alignment to SFIA |
| Skills Framework for the Information Age, SFIA UK | 3 | Professional Skills | 97 professional skills | NA | - |
| | | Generic attributes, Behaviours | 4 Generic levels of responsibility | NA | Experience and Competence |
| | | Levels of responsibility | 7 levels | NA | Based on the depth of responsibility in each level |

The horizontal consistencies were analysed through two dimensions. They are firstly, the description of the dimensions of the standards including their number of dimensions, the labels in which each dimension were referred to and the categories; and secondly, the basis in which these skills standards were developed (Refer to Table 2).

The general analysis shows two characteristics that are common across the skills standards, whereby some of the ICT skills standards are based on career profiles or job categories. These include Japan's ITSS Career Framework, the German Advanced IT Training System (AITTS), and in Australia the Queensland Government ICT Skills Framework. Meanwhile some standards are based on generic skills such as the E-Competence from the EU which is based on skills in business processes, and the generic skills of UK Skills Framework for the Information Age (SFIA).

ITSQF Korea, for instance, has two main dimensions. They are the occupational categories and its level. This is similar to the German AITTS and Queensland Government ICT skills framework which also have two dimensions including career profile and levels. Japan ITSS

on the other hand has three dimensions; career framework, skills dictionary and skill levels. SFIA UK has three dimensions include the professional skills, its generic attributes and behaviours and the level of responsibility (Brown, 2019).

Skills standards that are based on career profile or job categories varies in their levels. Korea IT Sectoral Qualification Framework (Industrial Skills Council Korea, 2018; Korea Software Industry Association, 2016), for example has 9 levels, which corresponds to the 8 levels of their National Competency Standards. While, Japan ITSS (Information-Technology Promotion Agency, 2010) has 7 levels, where by level 1 to 4 corresponds directly to the certification exam levels by the ITEE which is exam level 1 to 4. Meanwhile Germany has 3 levels depending on the work processes which is operative, specialist and IT occupation (Federal Institute for Vocational Education and Training BIBB, 2010). Although these standards are based on similar categorizations which is occupational or career categories, the levels are directly corresponding to their own national competency standards or national examinations standards.

Furthermore, among Korea ITSQF, Japan ITSS and Germany AITTS, the categorization of occupation and jobs differ greatly. For example, ITSQF has 5 main occupation category and 15 sub categories; while japan has 11 main job categories and 35 sub categories. These discrepancy in levels arise Japan developed the standards based on their national Japan Industrial Standards while Korea categorized the jobs based on the Korean Employment Classifications of Occupations (KECO). Similarly for the standards which are based on business processes, E-Competencies by European Union have five levels, which corresponds to EQF level 3 to 8; while SFIA has seven levels which correspond to the level of responsibility for each business skill (Brown, 2019; Sanz, Gómez-Pérez and Castillo-Martinez, 2017).

Japan ITSS shows quite an interesting characteristic whereby it is relatively simple to understand, and yet it is comprehensive enough to cater for both industrial needs and individual development. This is because the standard operates both the career framework and the skills dictionary in parallel, and could be mapped onto two different types of level which are the Key Performance Indicator (KPI) and the Skills proficiency levels.

***Vertical Consistency***

Analyses of the vertical consistency were viewed through three perspectives; its 1) application approaches; 2) concept of validation and 3) linkage to training or industry (Refer to Table 3). In terms of application approaches, most of these standards are either used as reference points to provide certification, alignment to other qualification framework or accreditation. German AITTS is the only framework that is used for accreditation (Federal

Institute for Vocational Education and Training BIBB, 2010). Among these standards, UK SFIA is identified to be of high applicability, as it is most widely used in other countries; about 200 institutions worldwide. The reason for this high applicability may be because the framework utilises generic skills as its main dimension, and this common language may be simpler to adapt in other countries despite their having their own national occupational categories.

In terms of validation, certifications are either provided or not provided depending on the purpose of the skills standards. Regional skills standards such as the EU E-competence were developed to ease the mapping of each European countries' own national framework to the European Qualification framework. Thus, this standard does not validate the skills and certification of how each country utilises the EU E-competences framework.

Meanwhile, for nationally developed skills standards, certification is provided based on certain assessment methods that may or may not be regulated by the law. Japan ITSS in particular offers validation, through the Information Technology Engineer Examination (ITEE) using two different levels which are key performance index (KPI) and skill proficiency (Level). The career framework is based on the seven levels of the Key Performance Index (KPI). The Key Performance Index represents the degrees of problem-solving experience and results demanded from IT professionals in a specialty field in a job category (Information-Technology Promotion Agency, 2010). The ITSS skills dictionary on the other hand has five categories including technology, methodology, business, project management and personal, and is divided according to skill proficiency levels (Information-Technology Promotion Agency, 2010). It is through the ITEE that Japan is able to sign Mutual Recognition Agreements (MRA) with twelve institutions from different countries (Information-Technology Promotion Agency, 2020).

Meanwhile, validation for the skills in the German AITTS depends on the level. For example, those in the specialist level are provided vocational qualification through individual certification which is not regulated by the law; while the certificates for professionals at the operative and strategic levels are provided a regulated certificate through AITTS or through chamber examinations. SFIA, on the other hand, provides certification through two pathways which are through the foundation's certification or awarding bodies, as it is not only utilised in the UK but also in other countries (Asgarkhani and Shankararaman, 2014; Brown, 2019).

Looking into the linkage of standards to training and industry, compared to other standards, German AITSS and Korean ITSQF exhibit a strong linkage. German AITSS, in particular, is unique because it does not just act as a point of reference but it is also an alternative pathway to higher education and is directly linked to the credit system. In German, the IT sector is the only sector where both a qualification and credit framework is implemented in Germany, and

this AITSS is based on work-flow embedded qualification concept whereby learning occurs while performing work and doing projects (Federal Institute for Vocational Education and Training BIBB, 2010). Korea ITSQF is linked to the Korean Standard Classification of Occupation, National Competency Standards and hence the KQF, and thus, through this, education and training, qualification system and industry needs are connected (Industrial Skills Council Korea, 2018). Japan ITSS, on the other hand, although it is not directly linked to any national qualification system but an "Education and Training roadmap" which could be used by institutions, is developed and disseminated (Information-Technology Promotion Agency, 2006). This roadmap includes a list and description of training courses which is requisite for graduates according to career, as well as being the knowledge that needs to be delivered in each training course.

**Table 3:** Analysis of the Vertical Consistency

| **Name of Standards** | **Implementation** | | |
|---|---|---|---|
| | **Application approaches** | **Concept of validation** | **Linkage to training/industry** |
| ITSQF Korea | • Alignment to other qualification framework<br>• Certification using ITSQF (still in development) | (still in development) | Aligned to NCS and hence KQF |
| ITSS Career Framework Japan | ▪ Certification | Certification through Information Technology Engineer Examination (ITEE)<br>Level 1-3 (validation based only on skill capability through pass-fail exam)<br>Level 4-7 (validation based pn noth KPI and Skill through experience and interview) | Not directly linked to a qualification system but the standards developer developed and disseminates a "Training roadmap" |

| | | | |
|---|---|---|---|
| Advanced IT Training System (AITTS) Germany | ▪ Accreditation<br>▪ Certification<br>▪ Alignment to other qualification framework | ▪ workflow-embedded qualification<br>▪ Vocational certification of specialist through individual certification of ISCO/IEC and not regulated by law<br>▪ Certificates for operative professionals and strategic professionals through AITTS or chamber examinations and regulated by law | Directly link to a qualification framework |
| The Queensland Government ICT Skills Framework Australia | ▪ Certification | | |
| Skills Framework for the Information Age, SFIA UK | 1) Certification<br>2) Alignment to other countries skill standards | Certification through 2 pathways:<br>1) SFIA provided certification<br>2) Awarding Bodies provided Certification (using SFIA) | Updated often through consultation with industrial leaders. (SFIA 7) |
| E-Competence EU | Solely for mapping to National Framework in Europe or to EQF | NA<br>(Depends on how each country uses EU Ecompetence) | NA<br>(Depends on how each country uses EU Ecompetence) |

**Conclusion and Implication**

In conclusion, it is evident through the results of this research, that although the skills standards selected for this study is from an emerging and advanced economy, where the ICT sector might be on a similar advancement level, there are still a big discrepancy in the contents and description of the ICT skills standards. However, these discrepancies are inevitable as each skills standard was developed on the basis of the country's industrial

needs, occupational categories or according to the initial purpose on which the standard was developed and how the skill standards is implemented and utilised.

The results of this study could provide implications for future research that attempts to develop a specific skills framework at regional, national, or individual institutional levels, through benchmarking of other ICT skills standards, by showing one of the ways in which skill standards could be analysed - the Horizontal and Vertical Consistency Analysis. In the process of benchmarking, it is important to not only delve into the similarities and differences of the frameworks, but more importantly to understand the rationale or basis of each framework. The analysis of horizontal consistency includes examining the general structure of the standards, its terminology and general description of standards, as well as the basis on which it was developed in such a way. The vertical consistency, however, was examined through its utility, validation and relevance or linkage to the training system.

Moreover, the understanding of vertical consistency, especially as to implementation, could shed light on the reason why some skill standards are more adaptable and user-friendly, while others are more complicated in its usage. For example, some ICT skill standards are structured such that their main categories are on a much larger unit and are more specific, such as career, occupation or job and therefore cannot be easily utilised in another country. Other, however, have an easier applicability, and are developed in a way that main categories are based on smaller units which are more generic, such as skills according to business processes. Moreover, although relevance to ever-changing industry is maintained through various means including alignment to the national qualification framework, or through continuous consultations, ensuring the relevance of the skills standards is of the utmost importance, as ICT-related occupations are constantly being created and changed. Best practices and an in-depth knowledge that can be derived from these analyses of skill standards could be applied to develop more applicable, adaptable standards which are relevant to the industry and inclusive of new occupations in either the formal or informal sectors of ICT.

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