INSTITUTE FOR ADULT LEARNING SINGAPORE

Critical Core Skills Profiling and Development in the Singaporean Workforce

Xiao Fang BI
Simon FREEBODY
Bao Zhen TAN
Lena BOO
Johnny SUNG

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Address
11 Eunos Road 8
#07-04 Lifelong
Learning Institute
Singapore 408601
research@ial.edu.sg

For more information, see http://www.ial.edu.sg/

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Contents

Figures and Tables

Executive Summary

This Critical Core Skills (CCS) profiling and development project is commissioned by SkillsFuture Singapore (SSG) to seek an understanding of how CCS are distributed and developed in different occupations. This study adopts a mixed method approach, that is, it uses both quantitative and qualitative methods to achieve the research aims.

Drawing on the CCS framework (2019) developed by SSG, the research team adopted a task-based approach (Ashton, Felstead, Davies & Green, 2000) to develop the CCS survey instrument to measure the importance and self-efficacy of CCS in the general Singaporean workforce. Drawing on data from a representative survey of 2,500 Singaporean workers, Phase One of the study profiles Singaporean workers into seven occupation groups according to the different patterns of CCS importance. Each occupation group was labelled and described according to the most salient and required CCS. At the same time, the CCS in each occupation group which may need some further development were also identified.

From each of the profiled occupation groups, Phase Two of the study selected some participants for follow-up, where semi-structured interviews were adopted to understand how they used and developed their most required and least required CCS in various contextual settings. In total, 39 semi-structured interviews were conducted. The interview questions did not ask about the CCS directly, but focused on the tasks within each skill to get a sense of their use and development of these skills. Adopting situated learning theory (SLT) (Lave & Wenger, 1991), Phase Two of the study managed to draw out the development pathway of CCS of these selected participants. The pathway further informed us of some practical recommendations on how training in various settings could further facilitate the development of CCS for the Singaporean workforce.

Background

1. Introduction

In 2019, SkillsFuture Singapore (SSG) reviewed the generic skills and competencies framework (GSC) which was first introduced in 2016, before developing the Critical Core Skills (CCS) comprising 16 soft skills classified within three clusters. The stated purpose of the CCS skills framework is to "create a common skills language for individuals, employers, and training providers. This further helps to facilitate skills recognition and support the design of training programmes for skills and career development. The Skills Framework is also developed with the objectives to build deep skills for a lean workforce, enhance business competitiveness and support employment and employability" (SSG https://www.skillsfuture.sg/skills-framework). A better understanding of how these Critical Core Skills are distributed across the economy, and the potential best practices regarding their development among adults, will significantly enhance SSG's training and career guidance services to graduates and workers. In addition, this study makes important contributions to our knowledge and understanding of Critical Core Skills from an adult learner perspective. Last but not least, the instrument developed in this study will provide needs analysis for our practitioners to gauge the CCS development needs of employees or individuals. To fulfil these needs, the project first developed a tool to profile the CCS use and their importance to different occupation groups and also identify the CCS gaps in different occupation groups. Drawing on the profiling results, the project then investigated how the required CCS in different occupation groups were typically used and developed.

The next chapter provides a literature review of what Critical Core Skills are, and how these skills are measured, used and developed.

Literature Review

This section will discuss the importance of studying the CCS in the Singapore context. In addition, the theoretical and empirical literature on CCS measurement and development is discussed to set the context for the present study.

2.1 What are CCS and Why are They Important?

CCS are generally understood as valuable in many work contexts and transferable between those contexts. They are, therefore, to be contrasted with technical skills and firm specific skills. In this study, CCS are defined as:

> *"common, transferable skills that enable individuals to be employable and employed, facilitate their career mobility, and enable the acquisition of Technical Skills and Competencies relevant for specific job roles in the sector"*
> *(Retrieved from https://www.skillsfuture.gov.sg/skills-framework)*

Early discussion of CCS could be located in some literature (González & Wagenaar 2003; OECD, 2003; P21, 2007) on soft or generic skills relevant to CCS adopted in the study. CCS adopted in this study evolved from the Generic Skills Competencies Framework (GSCs) that was introduced as part of the Singapore Skills Framework (SFw) in 2016. They are common, transferable skills that enable individuals to be employable and employed, aim at facilitating career mobility, and enable the acquisition of Technical Skills and Competencies (TSCs) relevant for specific job roles in the sector. Prior to this skills framework in 2016, Singapore also established the Employability Skills System (ESS) through the Workforce Development of Singapore (WDA) in 2005. ESS is part of the Workforce Skills Qualification (WSQ). ESS comprises a subset of generic employability skills to complement (not replace) specific industry and occupational skills. They are intended to be portable skills that enable workers to better adapt to new job demands, work challenges and changing work environment. Both ESS and CCS are intended to (1) complement technical skills, (2) upskill workers at three levels: Managerial, Supervisory and Operational (ESS), Advanced, Intermediate and Basic level in CCS, and (3) be transferable to meet diverse job designs and demands. A speech by the Minister for Education and Manpower in 2006 included the following statement:

> *"The ESS [Employability Skills System] is a rigorous and developed platform to help our workers upgrade their skills to stay employable or get better paying jobs…The ESS comprises ten employability skills, ranging from numeracy, literacy and infocomm technologies, to teamwork and personal effectiveness. These are generic skills applicable across all industries. Our workers would have developed some of these skills during their formal schooling, but we need to make a conscious effort to teach, reinforce and enhance these skills amongst adult workers too. (Gan Kim Yong, 2006)*
> (Retrieved from http://www.skillsfuture.gov.sg/skills-framework/criticalcoreskills)

With the rapid transformation of Singapore economy and business environment and increasing digitalisation and adoption of technology at the workplace, there is a need to redefine the key skills to keep up with the future economy, including an increased emphasis on soft skills as part of the future work in the digital era. SSG constantly scans the horizon to keep skills updated to ensure continued relevance and currency of Generic Skills Competencies (GSCs) for different groups of stakeholders.

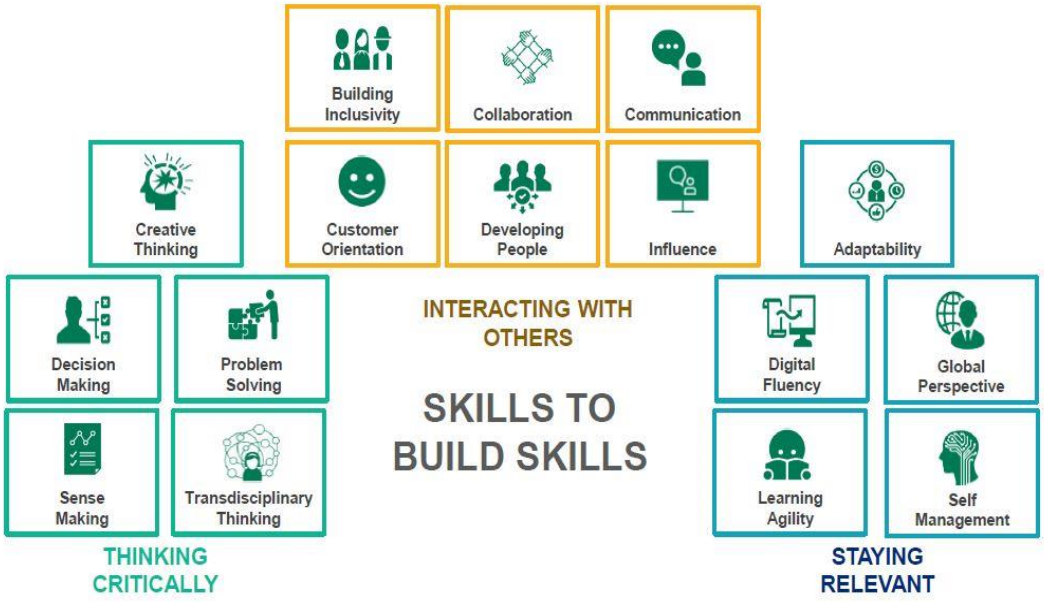
To fulfil the above needs, CCS framework was developed with inputs from more than 120 attendees from 78 organisations (e.g., Google, IBM, Shall, Watsons, etc.) across 28 industry sectors (e.g., professional services, manufacturing, lifestyle, public sector). Specifically, the development of CCS is expected to benefit the following stakeholders in Singapore (Retrieved from http://www.skillsfuture.gov.sg/skills-framework/criticalcoreskills):

Individuals in the Workforce
Individuals can equip themselves with CCS to be employable and employed as well as to empower themselves to acquire technical skills which they need to perform in the job roles that they serve in, to adapt to changes and expand career development opportunities.

Employers
Employers will be able to build not just technical skills amongst their employees but also CCS, so that their organisations can be nimble and agile by reskilling and upskilling their employees when corporate strategies change and business needs transform.

Training Providers
Training providers will be able to reference the CCS to design core skills curriculum and integrate them as part of technical skills training, so as to ensure the relevancy and currency of their course offerings in meeting the average employee's skills development needs and industries' skills demand.

Figure 1. What are CCS in Singapore context? (https://www.skillsfuture.gov.sg/skills-framework/criticalcoreskills)



Governing educational bodies in many countries have adopted the development of CCS as a central pillar of their higher education systems (Higher Education Council, 1992; European Commission, 2019). In 2013, a UNESCO working paper estimated that almost 90 countries referred to "generic competencies" in their education curricula (Tedesco, Opertti & Amdio, 2014). The motivation for this movement revolves around a growing consensus regarding the rapidly changing needs of the workforce (Hayward & Fernandez, 2004), and the inability of traditional education systems to produce graduates with skills that employers desire.

The staggering proliferation of labels, taxonomies, and theories of core skills provides an insight into the haphazard and unscientific nature of development in this area of study (National Research Council, 2013). In order to understand how this study approaches the measurement and analysis of CCS, an appreciation of how Critical Core Skills have been theorised and measured historically is

necessary. The following section discusses these issues, leading into a summary of the approach taken to measure CCS in this study.

2.2 Theorising CCS

Any attempt to discuss or analyse core skills (or any skills) requires, at the outset, an explanation and clarification of what constitutes a skill. A cursory review of the literature on skills in general will provide numerous theoretical positions and perspectives on what skills are and how they are defined.

Key contributions documenting this diversity have pointed to different perspectives of skills and their disciplinary and theoretical correlates. Attewell (1990) made a landmark contribution regarding the theorisation of skills wherein he posited several distinctive and mutually exclusive understandings of 'skill'.

The dominant perspective was described as "positivistic". Positivists view skill as "an attribute that is amenable to quantitative measure" and "believe that this attribute or quality has an objective character independent of the observer" (Attewell,1990). As such, the crux of this perspective is a focus on the objectivity, measurability, and attributive nature of skill. Echoing much of the debate around core skills today, Attewell (1990) succinctly pointed out that the positivist understanding of skills is thwarted by the need to apply rigorous validation and reliability testing to qualitatively varied tasks "found in the world of work". He also emphasised on the tension between skills that are narrow and specific enough to be measured and skills that are abstract and meaningful enough to be useful. He also criticised the notion that skills are situated within specific context, and thus the "typical laboratory study" is rendered questionable.

In a similar but broader review, Ashton, Felstead, Davies and Green (2000) discussed the main disciplinary traditions in the understanding of skills. They described human resource professionals as providing the basis for 'job analysis' which is the workhorse for much of the public discourse seen today on skills. Job analysis breaks down a specific job into required tasks. Here, skills refer to the ability to perform these tasks and the level at which they are performed. In job analysis, we find a key distinction between work activity, which produces tasks and defines skills, and worker traits or attributes, which influence the level at which the worker can develop those skills (Ashton *et al*., 2000).

The focus on work activity as the defining feature of skills marks an important departure from traditional notions of skill and thus has important implications for the fields of education and learning. The benefits of this departure were expressed well by the prominent psychologist David McClelland. In lamenting that intelligence testing seems to provide little predictive content regarding job success, McClelland pointed out that the superiority of "criterion testing" is so obvious that it had remained elusive only because of the confusion created by psychologists in their pursuit of a general intelligence factor (McClelland, 1973).

The principal distinction between a "work activity" notion of skills and a "personal traits" notion of skills is made clear in how it relates to our understanding of Core Skills by James Pellegrino and his colleagues in an important report for the National Research Council in the United States (National Research Council, 2013). Employing the methodological distinction between formative and reflective latent traits, two principal perspectives on the nature of any latent trait, and more specifically, skills, can be understood.

Pellegrino and Hilton (2012) went on to review a multitude of taxonomies of 21st century skills and established that due to their construction (through expert opinion and consultation with employers etc.), they were necessarily formative (National Research Council, 2013). More importantly, for the purpose of this report, the Singapore SkillsFuture Critical Core Skills Framework employs a formative theoretical perspective regarding critical core skills. This is evident from the method of its construction, which relied on consultation with job experts, employers, and incumbents. In addition, the definitions of skills contained in the framework are clearly task-based.

2.3. Measuring Core Skills

One of the most prominent and well-used examples of measuring skills from the formative perspective is the U.S. Department of Labour's O*NET database (https://www.onetonline.org). This extensive database provides scores of the importance of a large taxonomy of skills to each job listed in the Standard Occupation Classification. The list of "Basic Skills" includes broad categories such as active learning and science. These constructs are defined clearly using task statements, such as "using scientific rules and methods to solve problems". In this sense, O*NET clearly employs the formative job analysis approach to skills. The O*NET method provides an example of an extremely large scale, ongoing study which has taken years to complete.

Another extension of the formative, task-based approach towards research into skills, which is the methodology employed in this study, is found in the work of Ashton et al (2000). The measurement technique involved surveying workers on the importance of different activities and tasks to their work. The tasks were selected to represent common task related skills within broad, pre-defined generic skills categories. This technique has been used heavily in skills research. Other examples are found in the Skills and Learning Survey (SLS) conducted at the Institute for Adult Learning in Singapore (in press) and the OECD's Programme for the Assessment of Adult Competencies (PIAAC) (OECD, 2013).

Ashton's method of skills measurement is well established and appropriate from a theoretical perspective, due to its use of the formative approach in understanding skills, and from a measurement perspective, as a survey-based approach. As such, phase one of this study draws heavily from this method.

2.4 Core Skills Development

In the previous sections, we delineated what core skills are, theorised core skills, and outlined how to measure them. The review now focuses on the theoretical underpinnings of how core skills are developed. Before discussing the usage and development of skills, it is important to understand the metaphors of learning. Different metaphors of learning can help set the direction for the theoretical underpinnings for core skills development discussed in the following sections.

2.4.1 Developing Skills through Learning

Sfard (1998) has argued that there are two basic metaphors - learning as acquisition and as participation. The Oxford dictionary defines learning as acquiring knowledge of a (subject) or (skill) as a result of study, experience or teaching. Learning is portrayed as a product. This definition separates knowing and doing or theory and practice. Here, learning is (a) centred around the individual, (b) focused mainly on the rational, cognitive aspects of work performance, (c) built on the concept of work performance which tends to be conceived as thinking or reflection followed by application of the thinking or reflection (Argyris & Schoen, 1974,1978), and (d) taken for granted and not theorised or problematised. In practice, it tends to assume 'learning' to be formal learning, thereby favouring the acquisition metaphor, contributing to influential works driven by cognitive psychology that sought to explain the development of technical expertise of an individual (Tennant, 1991; Yates & Chandler, 1991). The alternative metaphor, learning as participation, views learning as a process (Sfard, 1998).

Hagar (2005) then expanded on the works of Sfard's perspective that understands learning as a process of construction and reconstruction. Learning is the construction and reconstruction of the self, and of the environment (world) which includes the self. Of great importance is the idea that learning is reconstruction, which hence posits that learning is a process that changes the self and the environment. This reconstruction element was previously lacking in Sfard. This view of learning underlines the relational character of learning, including its contextuality, and the pervasive influence of cultural and social factors. Schoenfeld (1999, p.6) offers a definition that captures the more holistic notion of learning as a process, "coming to understand things and developing increased capacities to do what one needs to do – contrast with the one defined as product". Such understanding highlights that the learning of an individual affects that of a community. Billet (2001), for example, offers an account of expertise located in dynamic activities of social practices:

> *"It proposes how individuals come to know an act by drawing on cognitive, social, cultural and anthropological conceptions, and through an appraisal of the ontological premises of domains of knowledge. The inter-psychological process for developing expertise is held to be constituted reciprocally between affordance of the social practice and how individuals act and come to know in the social practice (Billet, 2001, pp. 432*).

Therefore, in cultural, social, and cognitive terms, learning pathway is viewed as occurring across contexts in the midst of connected constellations of situated circumstances. Such learning is collated across developmental timelines, typically in a variety of locations that have reflective and enduring qualities. Learning is viewed as constellations of multimodal and discursive actions made in the midst of situational settings. Through their actions, persons express stances that relate to their developing commitments, concerns, and identities in the midst of unfolding events to the degree afforded by the context. In order to account for the social practices of diverse cultural and contextual settings, Situated Learning Theory (Lave & Wenger, 1991) was adopted in the study to account for the development process of CCS. Many researchers believe that SLT is the most relevant theoretical framework to understand how core skills are developed at the workplace (Matterson *et al*., 2016). Literature has expressed that learning and work are inseparable in the workplace. Situated learning theory encourages a focus not just upon cultural and organisational artefacts, but upon the embeddedness of practices (task statements in CCS instrument) of CCS in their contextual settings, rather than just the cognitive contents of an individuals' minds.

2.4.2 Situated Learning Theory

Situated learning theory (SLT) indicates that learning is a pervasive and embodied activity which involves the acquisition, maintenance and transformation of the knowledge of practices through the processes of social interaction (Lave & Wenger, 1991). Knowledge of practices is an epistemological difference between "entities located in the head" and reconstructed learning from processes of social interaction. From a more relational social perspective, knowledge of practices is "distributed over both individuals and their environments, and learning is situated in these relations and networks of distributed activities of participation" (Hemetsberger & Reinhardt, 2006, p. 189). The theory argues that acquisition of objective knowledge is best achieved as the accomplishment of knowing in action through everyday practice in organisational and other social settings (Handley, Clark, Fincham & Sturdy, 2007). These social cultural practices are built upon the concept of peripheral participation, members gaining skills by working and progressing from basic tasks to full participation (advance tasks). Novices can progress in a linear and sequential manner as they inculcate themselves in the practice of more experienced 'old-timers'. Peripheral participation acts as a bridge to develop skills, experience and approbation by interacting and learning from peers and mentors, and learning occurs via "centripetal participation in the learning curriculum of the ambient community" (Lave and Wenger, 1991, 100). Accordingly, this linear and sequential manner of novice to experienced "old timers" aligns with the design of CCS the instrument (basic, intermediate, and advanced levels of task statements). In other words, for example, a novice practicing basic level of creative thinking skills can progress to be an experienced "old timer" who will develop an advanced level of creative thinking skills through observations, interactions and practices in the different situated contexts.

In addition, SLT allows us to better understand how employees could (a) apply cognitive and conceptual knowledge acquired from conventional settings in an organisational and social environment, and (b) achieve integrated knowledge of practices and more realistic experiences through daily tasks and interactions that are organised within workplaces. Learning is conceived to occur as individuals become members of the "Communities of Practice" (CoP) in which they are acculturated as they participate actively in the diffusion, reproduction and transformation of knowledge in-practice about agents, activities and artefacts. "To know," it is argued, "is to be capable of participating with the requisite competence in the complex web of relationships among people and activities" (Boland & Tenkasi 1995; Fox, 2000; Gherardi, Nicolini, & Odella, 1998).

However, there are possible drawbacks to CoP that can limit conflictual and disruptive power relations within CoP and between their members and a wider institutional context can limit the learning that takes place in CoPs (Contu & Willmott, 2003; Fox, 2000). In particular, extremely unbalanced relationships between "old timers" and newcomers can restrict the learning of all parties. This weakness gives rise to the inception of the relational approach of situated learning theory, where a more reflexive understanding is adopted by exploring contexts where situated learning involves conflict, difference and change. The conceptual framework recognised habitualised practices within an understanding that also provides the means to explain how actors confront conflicting demands and changing social expectations (Kakavelakis & Edwards, 2012). Thus, it is noteworthy that we may be able to identify and understand some power relationships within and between contextual settings that may act as potential barriers to the development of core skills through the lens of SLT.

Vaughan (2017) conducted a longitudinal study of 41 apprentices in general practice medicine, carpentry and engineering technician work, and their workplace mentors and teachers, in New Zealand. The study theorised that the participants experienced "vocational threshold" in the journey of personal and professional challenges. This vocational threshold serves as a way to understand the socio-cultural dimensions of apprenticeship and enhance development of core skills. Core skills are the most meaningful in a context. The study found that in all three occupational practices: their work involved some forms of uncertainty which would require a learning-to-learn or agility. It is notable that this learning stance is common to both identities – apprentice and experienced practitioner. This finding of learning agility is congruent to Eraut (2007) who steered a longitudinal study of trainee accountants, engineers and newly qualified nurses gaining skills. This learning agility is likened to the intra-personal dimensions in core skills. Likewise, we extrapolate that this learning agility can be continuously developed across various occupations, and thus match the transferable nature of CCS.

2.5 Aims and Objectives

There has been a growing awareness of the importance of core skills to influence individual and organisation performance outcome positively (Heckman & Kautz, 2012). Studies have indicated that the growing importance has contributed to the rapidly changing demands for skills requirement in the workforce. Studies have found that there are significant skills mismatch in the existing workforce globally and in Singapore leading to difficulties filling up vacancies and lack of efficiency in the workforce. Studies have also found that core skills benefitted the employees as well as the employers because the skills can be continuously reconstructed throughout their professional careers and into their personal lives.

Meanwhile, managers and executives of many companies globally are yet to fully recognise the importance of core skills and impact of its development on employee performance. In fact, some managers have misconceptions about core skills themselves. The Singapore Talent Shortage Survey (2018) revealed that 65% of employers invest in technical training whilst 54% invest in core skills training, despite studies describing consistent skills gap between Singapore graduates and employers' requirements (Low, Gao, & Ng, 2021; Majid, Zhang, Shen & Raihana, 2012). Many complained about the huge amounts of money spent on such trainings; as they cannot really account for its return due to the inability of the trainees to translate what they have learnt to their jobs (Manpower group, 2015). And until recently, individuals view CCS as "must have" skills across occupations. As a result, CCS may continue to remain as an awareness campaign exercise that relies on metaphoric assumptions and expectations. Thus, the present study aims to address the following research questions to understand more about the CCS use and development in the Singapore context:

RQ1: How important is each CCS to the work to be performed in each occupation group?

RQ2: What proficiency level of each CCS is required by each occupation group?

RQ3: What is the CCS self-efficacy of Singaporean workers in each occupation group?

RQ 4: How do participants typically develop CCS in their different working contexts?

RQ 5: How do the participants typically develop CCS in their different working contexts?

Methodology

The CCS Measurement and Development project employed a two-phase mixed method approach. There were three broad stages to the quantitative phase, which consisted of instrument development, survey design and administration, cluster analysis and skills profiling, and skills gap identification.

Drawing on the profiling results of quantitative phase one in terms of the CCS use across different occupations, the qualitative phase two of the study employed semi-structured interviews to understand the actual use and development of the most demanded CCS in respective occupation groups.

3.1 Phase One of the Study

Phase one of the study required the development of a survey instrument, the administration of the survey instrument, and the analysis of the survey data. The methodology for each of these components is described below.

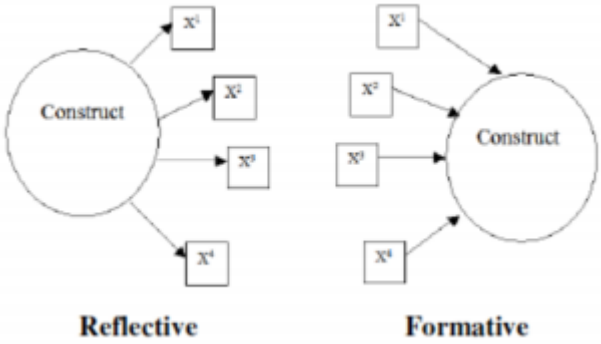
3.1.1 Instrument Development

The measurement of core skills and profiling of Singaporean workers on core skills importance required the development of a measurement instrument. An important element of the effective development and validation of the instrument is the positioning of critical core skills as formative, as opposed to reflective latent traits.

A reflective latent trait is positioned as a characteristic of the individual that is relatively stable, has some material bases in the brain, and causes the individual to exhibit consistent and predictable behaviour. These predictable behaviours are indicators of the reflective trait and are caused and determined by the presence of that trait. Well established examples would include intelligence, extroversion or conscientiousness.

A formative trait, on the contrary, is positioned as a trait having no substantive material basis but nonetheless provides a useful and meaningful subject of analysis. A good example would be the market price of a car. The market price of a car never exists outside of the understanding and assertions made regarding its nature. The visible indicators of the market value of a car (year, make, mileage) determine the market value of the car, not vice versa. Figure 1 below taken from the work of Pellegrino and Hilton (2012), illustrates the distinction.

Figure 2. Causal structures



Unlike reflective latent variables, the indicators of formative latent variables are not required to exhibit evidence of correlation. In this way, clarity regarding this specific, and often overlooked, feature of the skills being measured has important implications for measurement and analysis.

As covered in the literature review, the most appropriate method given the nature of the SSG CCS framework for such an instrument is the task-based method developed by Ashton *et al*. (2000). This method required that each of the 16 Critical Core Skills outlined in the SSG framework be converted into a bundle of understandable and relevant task statements. These task statements form the causal indicators of the formative latent trait that is the given critical core skill.

The strategy employed in achieving this followed several stages: coding the SSG CCS framework into dimensions, task generation from the dimensions identified, and instrument validation.

Coding the CCS framework into dimensions

Each SSG CCS has a framework consisting of a set of 20 to 30 task statements that have been generated by SSG in consultation with employers and occupation experts. Each of these task statements is assigned to a skill level (basic, intermediate and advanced). The initial stage of instrument development consisted of coding these statements into their groups or dimensions. The combination of these dimensions is intended to capture the essence of the skill as formulated in the framework. Care was taken to ensure that the dimensions were mutually exclusive, relatively specific to the core skill (not highly relevant to other core skills in the framework), and preferably cover more than one proficiency level. In addition, the full set of dimensions should capture the entirety of the skill. This coding was conducted for all 16 CCS frameworks. An example of this coding is provided in Annex A.

Task generation

For each dimension, a task – or small set of tasks – was then identified that provided instances of the use of the skills dimension in the context of work, and each task was assigned a skill level by referencing the original framework. Here, the ideal task aimed for was understandable by most intended survey respondents, relevant to the dimension that it addresses, and free of standard sources of survey bias. Care was taken to avoid double barrelled statements, acronyms or industry specific jargon.

As per Ashton *et al* (2000), the task-based approach to measurement used the question stem: “in your job, how important is…” followed by the task statement. A five-point Likert from “Not at all important” to “Essential” was then provided for the response code. According to the methodology used by Ashton et al. (2000), an aggregate score for all tasks under the skill provides the importance of that skill to the respondent’s job.

To gauge the self-efficacy of the respondent in using a skill, the instrument presents the same task items with the question stem: “How confident are you in your ability to…”. This is a well-established method to estimate an individual’s self-efficacy and is taken from Albert Bandura (2006). Note that the instrument only provides the self-efficacy question if the respondent has indicated that the task was important to their job (Likert >3), to avoid cases where the respondent is unlikely to know or be able to answer due to their not performing the task in their job.

The instrument did not include information regarding the overall skill label assigned to each task or the sub-dimension to avoid priming bias. See Annex B for an example of the final task statements developed along with their allocation to dimensions and skills levels.

Validation

The first step in ensuring the validity of the instrument was to elicit feedback from the skills framework experts to ensure that the coding and tasks generated for the instrument were faithful to the original framework.

After collection of pilot data (n=500), the recommendations from Diamantopoulos, Riefler & Roth were followed on validation of formative constructs (2008). Pilot validation consisted of checking for criterion validity using correlation with a global measure and checking for excessive correlation between task items within the skill constructs. For use as a global measure, specific occupations were selected from the Singapore Standard Occupation Classification (SSOC) prior to pilot data collection that the SSG skills framework experts indicated should be high in each of the CCSs. This allowed for correlation of the skill and task scores from the pilot with occupations expected to score highly in those skills and tasks. Other exercises conducted for the pilot validation included ensuring that the levels assigned to each task were associated with appropriate requirement and self-efficacy scores and checking inter-skill task correlations to ensure that there was no excessive overlap.

3.1.2 Survey Design and Administration

The survey covered a target population of all employed Singaporean Residents (i.e., Singapore Citizens and Permanent Residents) aged 20 to 70; this excluded workers living in construction worksites, dormitories and workers' quarters at the workplace and persons commuting from abroad to work in Singapore. A systematic random sample of private households was selected based on a stratified design by broad dwelling type, with proportional allocation. The sample selection was undertaken by Singapore Department of Statistics, Singapore Ministry of Trade and Industry, which maintains a sampling frame of residential dwellings in Singapore. The selection was done in accordance with the specified sampling criteria of having at least one resident aged 20 years and older.

Data collection for the pilot study was conducted from 24 June 2021 to 10 August 2021, while data collection for the main study was conducted from 23 September 2021 to 24 January 2022. A one-to-one substitution with another unit of the same housing type was allowed for households within gated communities and landed properties for both data waves, whereas substitution for public housing (Housing Development Board) households was only allowed for the main study. A screening process was administered to identify eligible members within a selected household, and only one individual per household was selected for the survey. In the case where there was more than one eligible household member, the "next birthday" method was employed to select a participant for the survey.

The survey questionnaire included questions on the personal characteristics of the individual and details about their job, in addition to the instrument developed on the importance and efficacy of SSG CCS. The survey was administered in English via computer assisted personal interview for the pilot study. For the main study, participants were given the option to complete the survey in either English, Mandarin, or Malay. Due to the ongoing pandemic during the data collection period, participants were given the option to either complete the survey with an interviewer face-to-face or via video conference, or to self-complete the survey via an online link.

Of the 5,000 households selected in the main study, 326 households were excluded from the survey as they were unoccupied or non-residential, or there were no eligible household members. A total of 2,007 households responded to the survey, achieving an overall response rate of 42.9%.

3.1.3 Survey Sample Description

The overall survey sample is described below to provide a background of the survey data collected. A total of 490 individuals participated in the pilot study, while a total of 2,007 individuals participated in the main study. The majority of the main study participants completed the survey face-to-face with an interviewer (76.6%). 7.6% faced a language barrier to complete the survey in English and opted to complete the survey in either Mandarin (7.4%) or Malay (0.2%).

Table 1. Breakdown by survey mode and survey language for main study

	Proportion (%)
Mode	
In-person interview	76.6%
Zoom	3.6%
Online self-completion	19.8%
Language	
English	92.4%
Mandarin	7.4%
Malay	0.2%

Table 2 provides a demographic breakdown of the main study participants, while

Table **3** provides the breakdown of the main study participants by their occupation.

Table 2. Demographic breakdown of main study participants

	Proportion (%)
Residency Status	
Singapore Citizen	86.6%
Permanent Resident	13.4%
Gender	
Male	49.1%
Female	50.9%
Ethnicity	
Chinese	73.0%
Malay	13.8%
Indian	10.8%
Others	2.4%
Age Group	
20 to 29	14.5%
30 to 39	27.4%
40 to 49	25.8%
50 to 59	19.4%
60 to 70	12.9%
Highest Qualification Attained	
Below Secondary	10.4%
Secondary	12.5%
Post-secondary, non-tertiary	8.1%
Diploma	21.8%
Degree and above	47.2%
Employment Status	
Full-time employee	81.2%
Part-time employee	8.8%
Self-employed / freelancer	10.0%

Table 3. Breakdown of main study participants by occupation

	Main Study Sample	2021 Labour Force Report
Legislators, senior officials and managers	10.5%	16.8%
Professionals	34.3%	25.8%
Associate professionals and technicians	24.7%	20.7%
Clerical support workers	8.1%	9.9%
Service and sales workers	9.8%	10.6%
Agricultural and fishery workers	0.2%	0.0%
Craftsmen and related trades workers	2.5%	2.6%
Plant and machine operators and assemblers	4.8%	6.1%
Cleaners, labourers and related workers	4.9%	6.7%
Workers not elsewhere classified	0.2%	0.8%

3.1.4 Data Analysis

Having collected the survey data, analysis was conducted first to answer research questions one and two. This required the identification of CCS based occupation groups within the labour force. The analysis tool employed to identify these groups was hierarchical cluster analysis using the CCS importance scores measured in the survey.

The initial cluster analysis was performed by calculating average CCS scores for each 4-digit Singapore Standard Occupation Classification (SSOC) group in the sample. Hierarchical cluster analysis was then performed on the sample of SSOCs using Ward's method with Euclidean distances (Ward's method is the most popular hierarchical clustering algorithm and tends to provide interpretable solutions). The decision to use SSOC group averages for the initial cluster solution, instead of the individual jobs sampled, was to reduce noise in the cluster modelling.

A seven-cluster solution accounted for approximately 60% of the variance in the initial SSOC group averages and provided for highly interpretable clusters based on examination of the average skills scores and the SSOC groups distributed across clusters.

The initial cluster solution was used to create a logistic regression classification model. This allowed the calculation of the final membership allocation of the full data set of jobs, regardless of their SSOC. The details of the cluster analysis method can be found in Annex C and the results are provided in the seven profiles described in the results section.

To address research question three on the levels of CCS self-efficacy across the occupation groups, dummy regression analysis was used to identify whether each occupation group has significantly low self-efficacy in any of the 16 CCSs. Dummy regression analysis allowed the model to control for skills importance (which is significantly correlated with self-efficacy) and other demographics. See Annex D for the specifications of the regression analyses used.

3.2 Phase Two of the Study

This section will elaborate on the design of Phase Two of the study, including data collection and analysis.

3.2.1 Design

Phase Two of this study aims to understand how CCS are used by employees in the local workforce and investigate how each has developed these skills in their contextual settings in different occupation groups as identified in Phase One of the study. Van Laaar, Deursen, Dijk, and Hann (2020) expressed that contextual factors such as job quality, complexity of job tasks, nature and degree of support, and the degree of motivation, level of autonomy and self-belief, and other value-based factors can be considered for the development of core skills. These contextual factors influence the way employees may interact meaningfully with other individuals in their communal settings, which in turn impacts the way they construct shared conceptualisation for the development of CCS in their lives and their social world. To unpack these contextual factors in the development of CCS, SLT was adopted to craft the interview questions with a focus on the understanding of how situated events trigger the development of CCS to reach the proficiency levels as required by different job roles. The support and challenges in the process of the development of CCS embedded in various situated events were also explored during the interview. For example, if creative thinking as shown in Table *4* is one of the most demanded CCS for an occupation group, we would ask the interviewees "How and why the 'task' was important in his/her daily work"?, "Could you cite an example?" and "how do you develop the confidence in performing the task", "what support/challenges do you face in developing your confidence?

Table 4. Three levels of creative thinking task statements

Levels of tasks	Task statements
Basic	Noticing areas for improving your own work
Basic	Finding areas for improving the work of others
Intermediate	Thinking of new ways to do things
Advanced	Using specific techniques to generate new ideas
Advanced	Testing or evaluating the effectiveness of new ways of doing work

3.2.2 Data Collection

The interviewees were selected based on the seven occupation groups as identified in Phase One of the study. The research team chose interviewees whose skills are representative of the skills profile arising from the findings of cluster analysis conducted in Phase One of this study. The research team aimed to select five interviewees from each occupation group. However, due to the uneven distribution of participants in different occupation groups and the high decline rate in certain groups, we did not manage to secure an even number across the groups. As a result, some groups have more interviewees than other groups. Recruitment of the interviewees for Phase Two of the study was carried out by invitation through email and WhatsApp messages. It included an information sheet describing the project, project aims, and data collection procedures. There are 39 participants recruited for this study. 26 participants are male while the remaining 13 participants are female. The interviewees and their respective job descriptions are listed below:

Table 5. Number of interviewees according to occupation groups

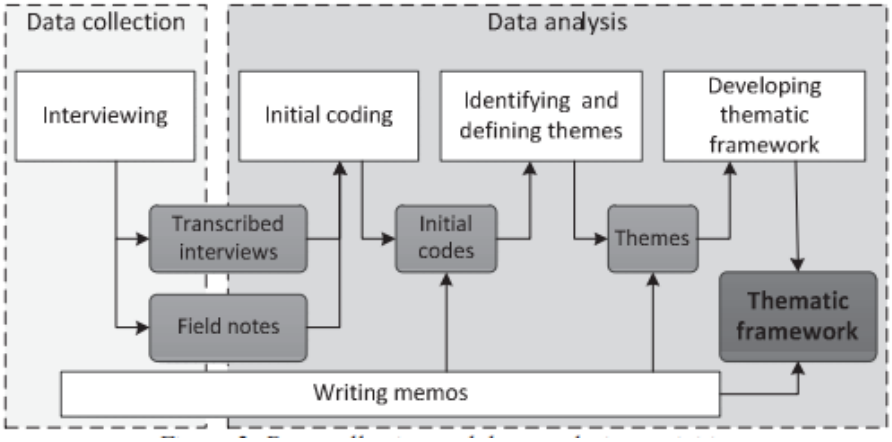
Occupation Groups	No of Interviewees	Jobs of the Interviewees
Servers	10	Taxi Driver, Admin Assistant, Shipping Agent Executive, Social Service Worker
Administrators	3	Business Development and Marketing, Financial Service Consultant
Traditional Practitioners	4	Technical Executive, Bakers, Account Executives
Developers	10	School Teachers, School Support Officer, Senior Executive in IHLs
Managers	3	Centre Supervisor, Social Media Manager, Assistant Admin Manager
Analysers	4	Electrician, Sales Executive for Machinery, Project Officer
Negotiators	5	Hair and Make-up Artist, Auditor, Legal Consultant and Trader

Interviews were carried out through zoom or in person meetings. Data was collected between December 2021 and April 2022 using semi-structured interviews. Each interview lasted approximately 60 minutes. During the interview, the interviewees were asked questions based on the top and bottom skills in each individual's skills profile within their respective occupation group. The semi-structured interviews were built around task statements of these skills in the CCS framework. From here, we can assess why this specific skill is highly demanded and determine how CCS is being used in their daily practice or other informal communal settings, if any. They also cited examples of how the specific task is used in their daily practice. Thereafter, semi-structured questions are targeted to understand how they developed their competency levels. The questions on their confidence levels of performing skill tasks explored the factors that may influence the development of these highly demanded skills in different occupation groups. This approach allowed the research team to draw out common themes in the discussion of the quantitative and qualitative data that the participants considered to be relevant and important to the development to CCS (Deely, 2014). Findings from the data analysis were used to generate a concept map (Hay & Kinchin, 2006).

3.2.3 Data Analysis

An inductive approach for thematic analysis proposed by Braun and Clarke (2006) is adopted. Data analysis procedures are represented in Figure *3*. The analysis activities are presented in the rectangles and products of each activity are presented in the rounded rectangles. The final product of data analysis is a thematic framework with identified themes and their relationships. Memos/notes were written throughout the research process. Methodological memos were used for discussing and clarifying methodological and organizational issues during the research, while theoretical memos were used in data analysis as the main tool for describing initial codes, themes, and the relationships between themes in the developed framework.

Figure 3. Data analysis procedures



This is a qualitative interpretative methodology that enables data analysis of unstructured text and identification of themes that reflect participants' experience about the investigated practice. The steps in data analysis are:

a) Familiarizing with the data. This step started immediately after conducting each interview by listening to the interview audio recording. After the interview transcription, reading and formatting the transcribed text helped in this step;

b) Initial coding. This stage included coding empirical data line by line in the Microsoft word document, which means assigning meaningful labels to the segments of the text. For each label, or initial code, a short theoretical memo was written to remark on the code and the text segment. The researcher performed initial coding independently, and after that, the next steps were performed through joint work with another researcher;

c) Searching for themes. This step involved collecting relevant text segments for each initial code and grouping the codes with the similar meaning into themes. Here, a list of initial and secondary codes will be discussed among researchers;

d) Reviewing themes. This stage included reviewing how collected text segments fit to the identified themes, and development of an initial thematic network with all identified themes and their relationships;

e) Defining themes. This step related to refining themes, which included defining their names and clear descriptions, and associating the text segment from interviews that will be used as verbatim quotations (Corden & Sainsbury, 2006). Verbatim quotations are a common tool for increasing evidential power in qualitative research; and

f) Writing the report. This stage related to writing documents about the research process and findings. It provided an additional opportunity to check the whole research process, and how research findings fit stated research objectives.

Findings

In this chapter, the findings are presented in the sequence of the RQs. Firstly, the quantitative profiling of occupation groups in terms of CCS use and confidence is presented firstly to answer RQ1 to RQ3. Drawing on the three most demanded CCS as identified for each occupation group, qualitative findings are presented subsequently for each occupation group to answer RQ4 and RQ5 in terms of how these CCS have been used and developed in interviewees' respective contextual settings.

4.1 Cluster Analysis and Core Skills Profiles

The cluster analysis solution chosen provided seven groups of workers with relatively unique core skills use profiles. The final solution used accounts for approximately 60% of the variance in core skills importance reported. While there is no hard and fast rule, given the nature of the skills data obtained and the interoperability of the results, the researchers considered the result acceptable.

Table 6 provides the core skills profiles of the seven occupation groups that form the basis of the cluster analysis.

Table 6. Average CCS importance score by occupation groups

	Average Skills Importance Score by Occupation Groups							
Critical Core Skill	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
Collaboration	**3.380**	**3.125**	**3.539**	**3.444**	**3.638**	**3.500**	**3.522**	**3.459**
Building Inclusivity	3.076	2.124	3.406	3.424	3.529	2.815	2.617	3.182
Collaboration	3.251	3.188	3.587	3.555	3.909	3.556	3.473	3.494
Communication	3.348	3.220	3.592	3.621	3.758	3.754	3.888	3.574
Customer Orientation	3.742	3.428	3.467	3.165	3.678	3.590	3.989	3.523
Develop People	3.146	2.888	3.453	3.339	3.236	3.271	2.954	3.270
Influence	3.623	3.576	3.712	3.530	3.676	3.831	3.853	3.664
Critical Thinking	**2.971**	**3.498**	**3.690**	**3.463**	**3.484**	**3.746**	**3.408**	**3.464**
Creative Thinking	3.181	3.658	3.696	3.641	3.321	3.649	3.327	3.531
Decision Making	2.809	3.511	3.688	3.418	3.644	3.800	3.359	3.439
Problem Solving	3.016	3.619	3.729	3.549	3.624	3.803	3.548	3.533
Sense Making	2.891	3.417	3.695	3.480	3.503	3.883	3.669	3.487
Transdisciplinary Thinking	2.934	3.253	3.643	3.196	3.309	3.585	3.098	3.322
Staying Relevant	**3.303**	**3.292**	**3.560**	**3.415**	**3.534**	**3.545**	**3.330**	**3.440**
Adaptability	2.997	3.073	3.549	3.413	3.361	3.299	3.500	3.334
Digital Fluency	3.254	3.335	3.674	3.321	3.725	3.364	3.044	3.416
Global Perspective	2.603	1.714	3.386	2.828	3.258	3.590	2.940	3.026
Learning Agility	3.554	3.621	3.567	3.516	3.299	3.551	3.107	3.517
Self-management	3.871	4.033	3.610	3.854	3.949	3.875	3.898	3.820
Total	**3.234**	**3.301**	**3.594**	**3.441**	**3.558**	**3.595**	**3.427**	**3.455**

Table 7. Average CCS importance z-score by occupation groups

	Average Skills Importance Z-Score by Occupation Groups						
Critical Core Skill	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Collaboration	-0.482	-2.036	0.488	-0.091	1.091	0.250	0.384
Building Inclusivity	-0.207	-2.063	0.437	0.472	0.677	-0.716	-1.102
Collaboration	-1.019	-1.284	0.390	0.256	1.741	0.260	-0.088
Communication	-0.949	-1.487	0.076	0.197	0.773	0.756	1.319
Customer Orientation	0.836	-0.363	-0.214	-1.367	0.592	0.256	1.780
Develop People	-0.609	-1.877	0.899	0.339	-0.167	0.005	-1.552
Influence	-0.335	-0.718	0.392	-1.094	0.098	1.363	1.542
Critical Thinking	-1.963	0.135	0.900	-0.004	0.080	1.123	-0.223
Creative Thinking	-1.653	0.600	0.779	0.519	-0.992	0.557	-0.963
Decision Making	-1.929	0.220	0.763	-0.064	0.628	1.106	-0.245
Problem Solving	-2.025	0.337	0.768	0.063	0.356	1.057	0.059
Sense Making	-1.899	-0.223	0.663	-0.022	0.051	1.261	0.580
Transdisciplinary Thinking	-1.530	-0.272	1.266	-0.497	-0.051	1.037	-0.883
Staying Relevant	-1.143	-1.235	1.001	-0.209	0.784	0.876	-0.918
Adaptability	-1.617	-1.252	1.032	0.379	0.130	-0.168	0.796
Digital Fluency	-0.681	-0.341	1.085	-0.399	1.299	-0.219	-1.564
Global Perspective	-0.677	-2.100	0.576	-0.317	0.371	0.903	-0.138
Learning Agility	0.199	0.558	0.268	-0.005	-1.170	0.183	-2.201
Self-management	0.392	1.638	-1.615	0.261	0.992	0.423	0.600
Total	-1.544	-1.076	0.971	-0.098	0.720	0.978	-0.196

Supporting evidence and interpretation of the nature of the groups identified are provided in the following sections profiling each of the groups identified.

4.2 Summary of Group Descriptions

From the results presented above, the following summaries can be made of the seven occupation groups identified.

Group One – Service Frontliners

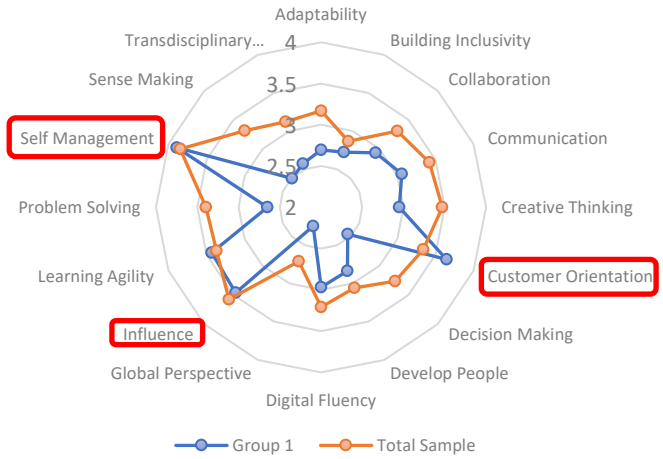
Interpretation: *Service frontliners' jobs have a high level of customer engagement, daily work involved in managing unusual requests from customers where communication is a critical part of work. Work demands constant negotiation with tight business processes and regulations. Increasingly, digital applications are part and parcel of work, hence, learning to work with digital tools and apps prompts a need for constant learning.*

The group is large but shrinking, representing an estimated 24% of the workforce and growing at an estimated annualised rate of only 0.5% in the last 10 years.[1] It has a relatively low number of university graduates (29% of the group in the sample) and is also the lowest paid group on average.

[1] Estimates made using MOM labour force reports 2010, 2020: *EMPLOYED RESIDENTS AGED FIFTEEN YEARS AND OVER BY DETAILED OCCUPATION tables*

The skills profile for Service frontliners, along with an explanation of the chart, is shown in Figure 4 and the common occupations contained in this group are listed in Table 9.

Figure 4. Core skills profile for server jobs



The radar chart on the left shows the average skills importance scores for the Servers Group in the blue line. To judge how important Servers' average scores are, the estimated average importance score for the whole workforce is provided with the orange line. ***For skills where the blue line is higher than the orange line, we would say this skill is relatively important to the group.***

We can see from the common tasks required in the jobs in the Servers group (Table 8) that maintaining mental and physical health, and managing stress are the most important. This is common to many of the groups identified. Responding to customer's requests and interacting with customers, on the other hand, represents the most common task that is relatively specific to this group.

Table 8. Common tasks for service frontliner jobs

Maintaining your own physical or mental health	Trying to find out what other people want or need
Managing your own stress or emotions	Employing time management techniques
Responding to a customer's request	Explaining to people how you can help them
Interacting with customers to determine their needs	Building a personal image or reputation
Prioritising tasks and goals effectively	Managing unusual requests or interactions

Table 9. Common occupations for service frontliner jobs

Common Occupations for Group One	
Administrative and Related Associate Professionals Not Elsewhere Classified	General Office Clerks
Car, Taxi, Van and Light Goods Vehicle Drivers	Cleaners in Offices, Commercial and Industrial Establishments
Receptionists, Customer Service and Information Clerks	Motorcycle (Including Motorised Personal Mobility Devices) Delivery Men
Food Preparation and Kitchen Assistants	Security Guards
Shop and Store Salespersons	Commercial and Marketing Sales Executives

Skills Deficiencies: *No skills deficiencies were identified for the Servers group, with no significantly negative average skills efficacy scores across any of the CCSs compared to the rest of the workforce. This is not unexpected, as the core skills requirements for jobs in the Servers group are relatively low.*

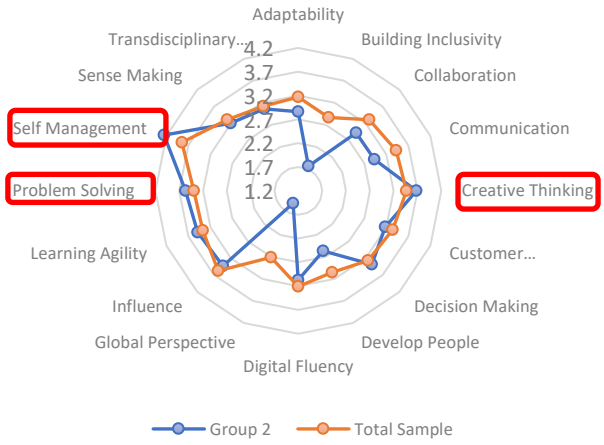
Group Two – Administrators

Interpretation: *For Group Two – Administrators - the value proposition that their work revolves around is creating better solutions, and improving and enhancing work processes and productivity. Jobs in this group demand orderliness, conscientiousness and time management. Systematic critical thinking skills and problem solving are essential core skills for this group, such as accountants and systems analysts.*

Administrators are estimated to be a relatively small proportion of the workforce, and the proportion is slowly shrinking. The group is 65% female with a medium to low average monthly salary.

The skills profile for Group Two is shown in Figure 5 and the common occupations contained in this group are listed in Table 11.

Figure 5. Core skills profile for administrator jobs



The radar chart on the left shows the average skills importance scores for Administrators in the blue line. To judge how important Administrators' average scores are, the estimated average importance score for the whole workforce is provided with the orange line. ***For skills where the blue line is higher than the orange line, we would say this skill is relatively important for the group.***

Table 10. Common tasks for administrator jobs

Managing your own stress or emotions	Building a personal image or reputation
Maintaining your own physical or mental health	Identifying or describing problems you encounter during work
Prioritising tasks and goals effectively	Thinking of new ways to do things
Employing time management techniques	Testing or evaluating the effectiveness of new ways of doing work
Noticing areas for improving your own work	Analysing the cause of work-related problems

Table 11. Common occupations for administrator jobs

Common Occupations for Group Two	
Administrative and Related Associate Professionals Not Elsewhere Classified	Systems Analysts
Accountants	Supervisors and General Foremen (Building and Related Trades)
Accounting Associate Professionals	Advertising and Marketing Professionals
Shop and Store Salespersons	Administration Professionals Not Elsewhere Classified
Software, Web and Multimedia Developers	Primary School Teachers

Skills Deficiencies: *The Administrators group, on average, reported relatively low levels of efficacy in performing* ***Self-Management*** *tasks, as compared to the rest of the workforce, while skills importance and demographics are controlled. This indicates that this group may face challenges in the areas of managing stress, emotions, mental health, and/or physical health.*

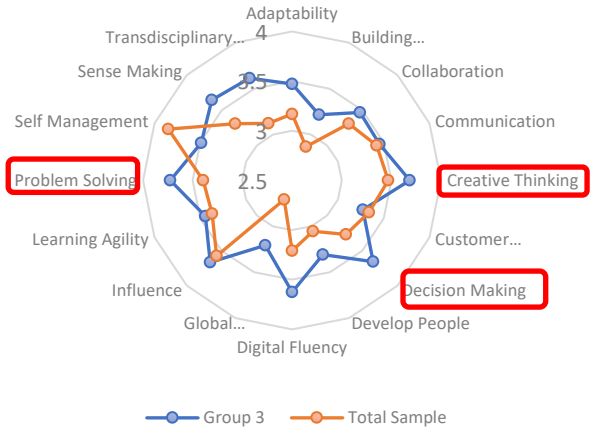
Group Three – Traditional Practitioners

Interpretation: *Traditional Practitioner job roles have high core skills requirements. These requirements extend to a wide spectrum of technical skills. There is a need to synthesise information and insights across a variety of sources and contexts. With the need to manage demands from employers and customers, decision-making and problem-solving ability has a significant impact on business outcomes and productivity.*

The Traditional Practitioner group is a large, growing proportion of the resident workforce in Singapore representing an estimated 25% of the workforce and growing at an estimated annualised rate of 2% per year since 2012. This profile is relatively young, more likely to be male, and 48% of them are graduates of IHLs.

The skills profile for Group Three is shown in Figure 6 and the common occupations contained in this group are listed in Table 13.

Figure 6. Core skills profile for traditional practitioner jobs



The radar chart on the left shows the average skills importance scores for Traditional Practitioners in the blue line. To judge how important Traditional Practitioners' average scores are, the estimated average importance score for the whole workforce is provided with the orange line. ***For skills where the blue line is higher than the orange line, we would say this skill is relatively important for the group.***

Table 12. Common tasks for traditional practitioner jobs

Identifying or describing problems you encounter during work Noticing areas for improving your own work Analysing the cause of work-related problems Thinking of new ways to do things Generating (finding or creating) new solutions to work-related problems	Learning how to use new technologies Planning or managing a project or an operation Evaluating new solutions to work-related problems Collaborating with workers in different occupations or professions Finding useful sources of information

Table 13. Common occupations for traditional practitioner jobs

Common Occupations for Group Three	
Administrative and Related Associate Professionals Not Elsewhere Classified Commercial and Marketing Sales Executives Accountants Software, Web and Multimedia Developers General Office Clerks	Sales, and Business Development Managers Receptionists, Customer Service and Information Clerks Finance and Administration Managers Electrical Engineers Security Guards

Skills Deficiencies: *Traditional practitioners reported skills deficiencies in several areas, including:*

- ***Building Inclusivity***
- ***Digital Fluency***
- ***Influence, and***
- ***Problem solving***

Of particular concern are problem solving and digital fluency, as these are core skill areas that are heavily required of Traditional Practitioners.

Group Four – Nurturers

Interpretation: *The Nurturers group reflects job roles with a strong component of communication, building inclusivity, and creative thinking. Dominated by teachers, human resource*

practitioners, and the caring professions such as nurses, this group has a broad variety of core skills requirements including a strong component of interpersonal and emotional labour.

The Nurturers group is a large, growing proportion of the resident workforce in Singapore representing 23% of the workforce and growing at an annualised 1.9% per year since 2012. This group is relatively young and more likely to be female. Developers report a significant number of skills gaps.

The skills profile for Group Four is shown in Figure 7 and the common occupations contained in this group are listed in Table 15.

Figure 7. Core skills profile for nurturer jobs

The radar chart on the left shows the average skills importance scores for Nurturers Group in the blue line. To judge how important the Developers Group's average scores are, the estimated average importance score for the whole workforce is provided with the orange line. ***For skills where the blue line is higher than the orange line, we would say this skill is relatively important for the group.***

Table 14. Common tasks for nurturer jobs

Managing your own stress or emotions	Thinking of new ways to do things
Maintaining your own physical or mental health	Building a personal image or reputation
Prioritising tasks and goals effectively	Testing or evaluating the effectiveness of new ways of doing work
Noticing areas for improving your own work	Asking questions to clarify your understanding
Employing time management techniques	Finding areas for improving the work of others

Table 15. Common occupations for nurturer jobs

Common Occupations for Group Four	
Administrative and Related Associate Professionals	Private Tutors
Not Elsewhere Classified	Secondary Education Teachers
Software, Web and Multimedia Developers	General Office Clerks
Accountants	University, Polytechnic and Higher Education Teachers
Financial Analysts and Related Professionals	
Human Resource Professionals	Primary School Teachers

Skills Deficiencies: *Developers reported the largest number of skills deficiencies in the study. They included*

- ***Adaptability***
- ***Problem solving***
- ***Building Inclusivity***
- ***Sense making***
- ***Communication***
- ***Creative thinking***

- ***Develop People, and***
- ***Influence***

Of particular concern are Creative Thinking and Communication, as these are core skill areas that are heavily required of Nurturers.

Group Five – Managers

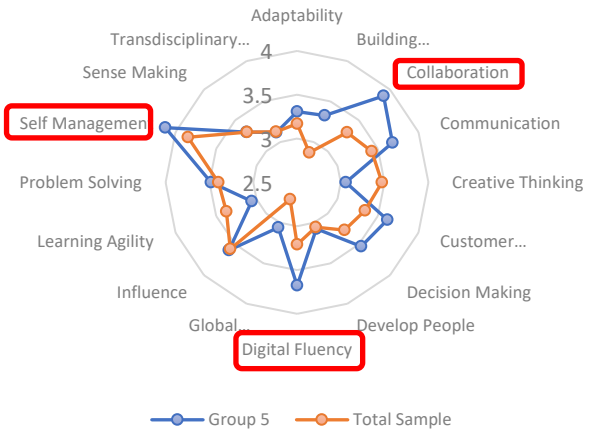
Interpretation: *The Managers group tends to work across multiple stakeholders to coordinate delivery of services and solutions. Information processing and collaboration across stakeholders are critical aspects of the work. Use of digital tools and platform is also an essential part of their work.*

Managers represent a small but growing proportion of the resident workforce in Singapore, representing only 5% of the workforce and growing at an annualised 1.9% per year since 2012. This profile is relatively young, more likely to be male, and graduates of IHLs.

The skills profile for Group Five is shown in Figure 8 and the common occupations contained in this group are listed in

Table 17.

Figure 8. Core skills profile for manager jobs



The radar chart on the left shows the average skills importance scores for the Managers Group in the blue line. To judge how important the Managers Group's average scores are, the estimated average importance score for the whole workforce is provided with the orange line. ***For skills where the blue line is higher than the orange line, we would say this skill is relatively important for the group.***

Table 16. Common tasks for manager jobs

Managing your own stress or emotions	Employing time management techniques
Maintaining your own physical or mental health	Sharing information and ideas with others
Prioritising tasks and goals effectively	Responding to a customer's request
Building a personal image or reputation	Managing conflicts between different people in a team
Collaborating with others to achieve a common objective	Asking questions to clarify your understanding

Table 17. Common occupations for manager jobs

Common Occupations for Group Five	
Sales, and Business Development Managers Supervisors and General Foremen (Building and Related Trades) Administrative and Related Associate Professionals Not Elsewhere Classified General Office Clerks Managing Directors, Chief Executives and General Managers	Management and Business Consultants Business Services and Administration Managers Not Elsewhere Classified Software, Web and Multimedia Developers Healthcare Assistants and Other Personal Care Workers Film, Stage and Related Directors and Producers

Skills Deficiencies: *Managers reported the following skills deficiencies in the study:*

- ***Adaptability***
- ***Customer Orientation, and***
- ***Self-management***

Like Administrators, Managers report low confidence in performing Self-management tasks. Self-management is a core skill that is relatively important to Managers also.

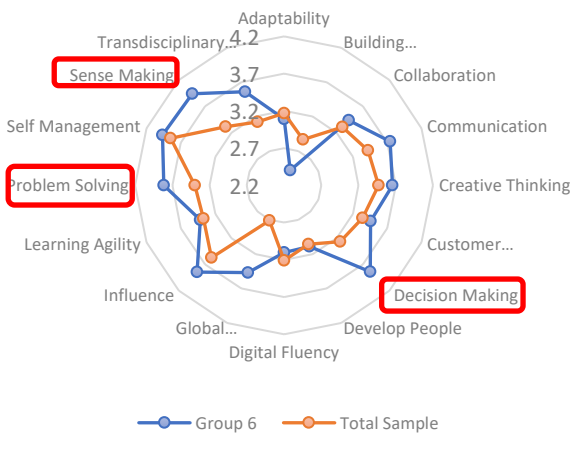
Group Six – Analysers

Interpretation: *Analyser jobs suit the typical knowledge worker in the digital economy. There is a strong requirement for cognitive skills to create value. Their decisions have major impacts on the organisations they work for.*

Analysers represent a moderate sized proportion of the resident workforce at 12%. This group, however, is rapidly growing. This profile is relatively young, dominated by graduates and is well paid.

The skills profile for Group Six is shown in Figure 9 and the common occupations contained in this group are listed in Table 19.

Figure 9. Core skills profile for analyser jobs



The radar chart on the left shows the average skills importance scores for Analysers Group in the blue line. To judge how important the Analysers Group's average scores are, the estimated average importance score for the whole workforce is provided with the orange line. ***For skills where the blue line is higher than the orange line, we would say this skill is relatively important for the group.***

Table 18. Common tasks for analyser jobs

Managing your own stress or emotions Prioritising tasks and goals effectively Finding useful sources of information Maintaining your own physical or mental health Making judgements about the quality of information sources	Asking questions to clarify your understanding Drawing on information analysis to make recommendations Identifying or describing problems you encounter during work Planning or managing a project or operation Employing time management techniques

Table 19. Common occupations for analyser jobs

Common Occupations for Group Six	
Financial Analysts and Related Professionals Commercial and Marketing Sales Executives Management and Business Consultants Systems Analysts Accounting Associate Professionals	Advertising and Marketing Professionals Accountants Buyers and Purchasing Agents Managing Directors, Chief Executives and General Managers Administrative and Related Associate Professionals Not Elsewhere Classified

Skills Deficiencies: *No skills deficiencies were identified for the Analysers group, with no significantly negative average skills efficacy scores across any of the CCSs compared to the rest of the workforce.*

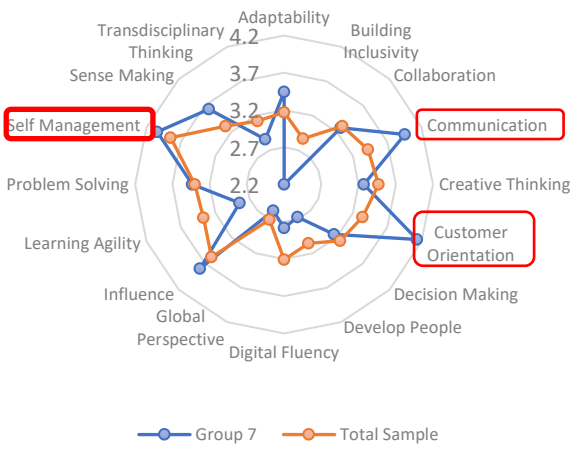
Group Seven – Negotiators

Interpretation: *Negotiator jobs tend to be in general management or sales. These jobs ensure smooth operation of businesses and organisations. Managing customers' and stakeholders' needs is the core of their work, including anticipating needs and issues.*

The Negotiator group is a small but rapidly growing proportion of the workforce. Representing 6% of the resident workforce, the profile has grown at an annualised rate of 2.6% compared to 1.6% for the entire resident workforce since 2012. The Negotiator group tends to be relatively senior, highly educated, and has the highest pay of all the CCS skill groups.

The skills profile for Negotiators is shown in Figure 10 and the common occupations contained in this group are listed in Table 21.

Figure 10. Core skills profile for negotiator jobs



The radar chart on the left shows the average skills importance scores for the Negotiator Group in the blue line. To judge how important the Negotiator Group's average scores are, the estimated average importance score for the whole workforce is provided with the orange line. ***For skills where the blue line is higher than the orange line, we would say this skill is relatively important for the group.***

Table 20. Common tasks for negotiator jobs

Responding to a customer's request Interacting with customers to determine their needs Asking questions to clarify your understanding Managing your own stress or emotions Prioritising tasks and goals effectively Managing unusual requests or interactions	Maintaining your own physical or mental health Presenting your ideas to one or more people Identifying improvements to the way you or others interact with customers Adapting your communication technique to meet the needs of a person or group of people

Table 21. Common occupations for negotiator jobs

Common Occupations for Group Seven	
Sales, and Business Development Managers Commercial and Marketing Sales Executives Financial and Investment Advisers Real Estate Agents Managing Directors, Chief Executives and General Managers	Accountants Financial Analysts and Related Professionals Management and Business Consultants Senior Government and Statutory Board Officials Specialised Goods Sales Professionals

Skills Deficiencies: *The Negotiators group, on average, reported relatively low levels of efficacy in performing* ***Creative Thinking*** *tasks, as compared to the rest of the workforce, while skills importance and demographics are controlled.*

4.3 Findings on CCS Use and Development in Occupation Groups

This section will present the CCS development pathway as identified from the selected participants from different occupation groups, with illustration using examples excerpted from the interview transcripts. Drawing on the findings, how different stakeholders could play a role in facilitating the CCS pathway will be discussed subsequently.

4.3.1 CCS Development Pathway

Based on the self-reported importance of the tasks and confidence in performing these tasks, Phase One of the study was able to profile the occupations into seven groups according to the different job natures associated with these groups. In each of the seven profiles, we noticed that there are three most demanded skills. This section will present the findings on how the selected participants develop their confidence in using these most demanded skills in their respective working contexts to answer RQ4 and RQ5 of the present study. Even though the most demanded skills for different occupation groups are not similar due to the different job natures, the development pathway of these different CCS is highly similar. SLT helped us shape the presentation of the development pathway for these selected participants as shown in Figure 11 below. After the visualisation of this pathway, we will use some transcript excerpts to illustrate the pathway.

Figure 11. CCS development pathway in the present study

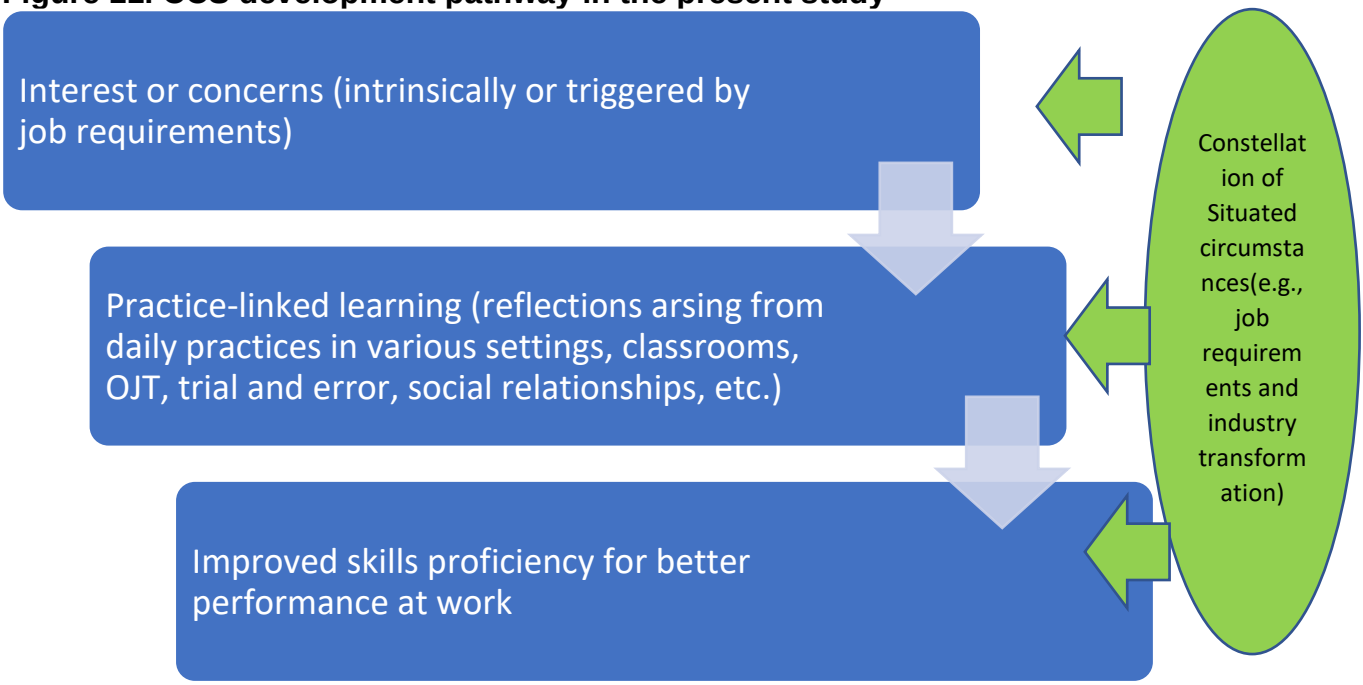


Figure 11 above depicts the pathway of CCS development as observed in the selected interviewees' sharing. Next we will select one of the most demanded CCS from each occupation group to illustrate how they experience such a pathway in their development of different CCS.

Group 1: Service Frontliners - Customer Orientation (Use and Development)

In this occupation group, one of the top demanded CCS is Customer Orientation. During one of the interviews, we noticed that the interviewee needs to deal with and manage unusual requests from passengers; as well as understand the needs of the shipping company to coordinate shipments for customers in her daily work. Her busy schedule resulting from having to deal with different types of customers has been described in the excerpt below,

> *Basically because our customers are overseas based, so we don't see them face to face. because everybody's busy in the shipping world, so they don't usually do Zoom. So, it's more of emails still because emails are black and white, you know, we get to know what exactly they want. Because sometimes through phone, you might misinterpret what they are talking, because they are Russians, some of them, or those ang moh, sometimes you just cannot get what they talk about. So, basically it's all emails, and ah…and after a while it's like I can somehow see their pattern of doing things.*
>
> *So, like for one customer they prefer to do everything, you know. They give us a list, then we just need to know this is done, this is done, this is taken care of, blah blah blah. But another customer, they might be those like, "Ok, this is my company, my vessel is coming. Doesn't matter what you do, but as long as the main points are there." The main points, that means whatever they come to Singapore for is already done, that's it. Then another customer, they want every single step to be jotted down.* (Frosty, Shipping Executive)

Frosty subsequently shared with us how she developed this customer orientation as below,

> "*How do I learn to determine the needs? Uh, basically like I say, it's… it's, for me it's experience, ok. Experience because I don't know anything at all, my boss is the one who… of course initially I will ask my boss. Or even until now, sometimes if we can't or if we don't*

know, or we're not sure of what to do, I will ask my boss. Then my boss will say, "Ok, maybe you try calling this person, try calling that person." And then we do the research and then you know, it's all a lot of communication ah. We don't decide on our own. So, like I say, because we are the middle man, we research, we research, and then whatever answer we have, we go back to the vessel master or the owner, to say that" (Frosty, Shipping Executive)

When she started as a shipping executive with little experience in the shipping industry, she had a **concern** to provide timely information of ship details to customers that pushed her to pursue the development of customer orientation skills. Working closely with her bosses who are identified as members with whom she has a **social relationship** and also a member of the community of practice where she practises (**coordinated participation**) in, she starts to develop her skills by coordinating in a social manner - the more clients she handles, the more experience (**constellation of situated circumstances**) she gains, and further develops a workflow (**practice-linked learning**) to determine their needs. More on the job training will help her perfect her practice as she matures to an advanced level of customer orientation skills (**practice linked social identity**) in a peripheral manner.

Group 2: Administrators – Self- Management (Use and Development)

In this occupation group, one of the top demanded CCS is self-management. Dale, a business development manager, shared with us how he needs to manage his stress and emotions well, in order to expand business opportunities and manage different stakeholders' expectations, e.g., achieving sales target within the specified timeline, as shown in the transcript excerpt below,

"Pace of work is quite fast, looking at volume and targets of sales. My team are the primary drivers of sales targets, we cannot give cookie cutter solutions to secure sales of enterprise. Need lots of practice, to address business to business and business to customers, so very stressful and can be emotionally draining" (Dale, Business Development Manager).

When checking with him on how he learnt to manage such stress and emotions under such pressure in order to achieve the sale targets, he shared,

"Lots of practice over time. Encounter different projects. Learn to separate my emotional and cognitive state of being to self-manage to ensure I achieve my sales goals or targets". (Dale, Business Development Manager)

From the above excerpt, we noticed that for Dale, achieving sales targets is identified as a **concern** that triggered his development pathway for self-management skills. The more projects he handles, and the more customised solutions (**practice linked learning**) he proposes, there will be less uncertainty in pitching sales. He works closely with his directors (**social relationships**) to propose customised solutions, he starts to practise in a socially coordinated manner and gradually builds his confidence to manage sales over various projects (**constellation of situated circumstances**) and continues to perfect this skill from basic to advanced level to perform better at work.

Group 3: Traditional Practitioners – Decision Making (Use and Development)

In this occupation group, one of the most demanded CCS is decision making. Tuk, a technical executive working in a government agency, shared with us that in making decisions at work, he has to refer closely to the 'cardinal rules' and manage projects according to company targets of costs and profits, or municipal regulations, as shown in the excerpt below,

"We go for many site meetings, need to make many decision on the spot specifically at the construction site, our job involves many municipal issues and cardinal rules, very important to keep a calm mind to make decision that is beneficial to the project like issuing licence to

contractors, when issuing licence, notice if there is any residential or commercial property for the licence, we cannot promise the licensee that we can process their application, need to consider all the rules (like noise, dust or other factors) for processing the licence application, timing for the licensee and the residents moving into the construction" (Tuk, Technical Executive).

In terms of how to develop this CCS, Tuk shared with us as below,

"As a technical executive, I need to issue licences for contractors to use vacant land of HDB. Use for marriage, use for storage or for other uses. We need to consider municipal issues and regulations on the site and decisions need to be made on site, on the spot. We need to consider, e.g., issue a licence to use vacant land for a contractor. If the land is very near to residential properties, will there be noise pollution, also to take note of residential moving in… so need to gauge the timing of licensee and the surrounding environment…takes lots of practice, usually on the job training ". (Tuk, Technical Executive)

As a technical executive, his daily job involves managing the usage of vacant land. The **concern** to issue licences for contractors initiated the development pathway for his decision-making skill. He needs to refer to municipal regulations to issue licences for contractors. He works closely with his boss and contractors **(members of community of practice)** to approve licences. He aims to be well-versed in the regulations as decisions are made usually at the site for recommendation. If he encounters a new situation that he cannot decide, he executes the assignment in a socially coordinated manner **(coordinated participation)** with his boss. The more situations he encounters **(constellation of situated circumstances)**, the more well versed he gets when referring to procedures to make decisions. Gradually, he builds his confidence by practising decision-making tasks from basic to advanced level to complete the work well.

Group 4: Nurturers – Communication (Use and Development)

In this occupation group, one of the most demanded CCS is communication. Wario, a director in real estate sales, needs to manage stakeholders' expectations through lots of asking and clarifying of information to achieve the desired outcome, e.g., managing pricing expectation in negotiation. Wario has over 20 years of experience. The **concern** to negotiate a business deal created his learning pathway for communication skill. He works closely with developers and investors **(social relationships)** with whom he established a long-standing relationship. Over the years of experience **(constellation of situated circumstances)**, he learns to manage expectation **(practice-linked learning)** of clients to close deals successfully. He has developed his communication skill from basic to advanced levels to better cater to the needs and requirements of his work.

"Communication skills usually used for managing negotiation. So negotiation wise, there comes in many forms, right? Some are like, you mean the technique that we taught? Okay, in our mind we look at the documents first, and then process in our mind and see what is fair and what is not fair, and what is market practice and then basically, gauge, try to get more for the owners, okay. If we can't, at least we meet the middle ground, and if we can't meet the middle ground, there are clauses whereby those they can accept, we try to trade off those conditions, so as to make the deal go through. Is that what you're expecting? As in, we try to give and take within those conditions. I think not all conditions will be acceptable by all parties, at least certain conditions will be acceptable, some are not acceptable, so we tend to trade these conditions with the other side, to see which is more acceptable to try to make the deal go through" (Wario, Director)

Group 5: Managers – Collaboration (Use and Development)

In this occupation Group, collaboration is one of the most demanded CCS. Kermit, a student care centre manager, shared with us that working together with the team to achieve the common objectives, for example, resolving conflicts of team members, is very important in his daily work as shown below.

> *"Common objectives are very important because you see, I have eight staff. Okay? At times I will swap staff okay, maybe arrange this staff along the way, along the way to take other classes or to manage these classes. Okay, if we do not have a common objective, we do not have a common understanding of this or common objective, okay, then I will not, my staff will not be able to be mobilised, okay, around, to meet the objectives of my company. (Kermit, Student Care Centre Manager)*

As a student care centre manager, Kermit has an **interest** to ensure that the students come and go back from the centre happily, fuelling his development pathway to collaborate with others. He works closely in a socially coordinated manner with the student mentors **(community of practice)** to make sure everybody achieves common objectives. He regularly observes and tests how his mentors solve problems **(practice-linked learning).** Over the years of experience **(constellation of situated events),** he grows his confidence to execute basic to advanced level of collaboration tasks to better achieve the goals at work as shown in the excerpt below,

> *"Okay, I will test them, I will evaluate them. How do I test them? When they encounter problems, they give feedback to me, I will guide them along. Okay? What should be done, okay, and what should not be done. How to improve in the way that my staff is doing. Of course, I will understand how, I will not straight away share my idea. I will ask my staff how they handle a problem or situation. From there we share, discuss about me letting them know the approach which I will take, so we come to a common understanding lah". (Kermit, Student Care Centre Manager).*

Group 6: Analysers – Sense Making (Use and Development)

In this occupation group, Sunny, an electrical supervisor at renovation site, is really concerned with information for potential projects and the successful completion of existing projects, e.g., referrals for feasible projects, timeline and manpower cost to maximise profits in his daily work.

> *"I need to find out how reliable some information is, so usually I mix around a lot, I have an extensive network of vendors and clients that can refer me projects, but not everybody's information is reliable, so need to check, check and counter check to secure a project, whether the project can do or cannot do. Then from the information I sourced, can help me to identify who to contact, what type of resource I need, e.g., wiring works, get a reliable wiring contractor, welder and also draw up a timeline for the project. All the information must make sense and make sure the project doesn't lose money". (Sunny, Electrical Supervisor).*

As an electrical supervisor, Sunny's **concern** to pitch new projects fuels his development pathway for sense-making skill. He works closely with his vendors and customers (**social relationships**) in a socially coordinated manner. Information of referral is used to measure the feasibility **(practice-linked learning)** of new projects. The more people he interacts with **(constellation of situated events)**, the more competent he will be to assess the quality of information. Over the years of experience, he grows his confidence from basic to advanced level of making sense from a variety of information to become a professional supervisor who is able to secure projects for the team, as shown below,

"I have a very wide base of networks to help me refer jobs. This network includes supplier and customer from long standing relationships. They help me to check information" (Sunny, Electrical Supervisor)

Group 7: Negotiators – Problem Solving (Use and Development)

In this occupation group, problem solving is one of the most demanded CCS. Daisy, a hair and make-up artist, has to meet customers' needs and foresee specific problems which may arise for the purpose of completing her projects, e.g., settings in a shoot scene, at the spot of her different workplace settings, in order to progress with the work smoothly.

"Identifying problems in my job. For sure, because if there is any problem, it will be raised. And it will be my fault, so I cannot let that be? Like I have to identify it first before it becomes a problem, and it delays the entire production. Say for example, if the wardrobe for a particular scene was dictated by the director. Say for example, just a collared shirt. But that scene that they are going to shoot is a scene where he's going to be beaten in the back, and I'm doing a special effects thing. So I have to raise it up to them, say "Maybe you want to choose another wardrobe because the collar will hinder the shooting". (Daisy, Hair and Make-up Artist).

Daisy has the **concern** to complete the project, which helps her establish her development route for problem solving skill. She works closely with the scene directors and others at the same place **(community of practice)** in a socially coordinated manner. The more projects she completes **(constellation of situated events)** with trial and error **(practice- linked learning)**, the more competent she is to identify and resolve problems at scene. As she works through the levels of problem-solving skills, she grows to become a more **professional make-up artist** who can foresee and solve any problems that arise before or at the scene.

"Performance ah. It's a lot of trial and error, so it may work, it may not work. And we have to work with it. My performance at work, I guess like I said, production is a teamwork, so everyone has a part to play lah. And I try to be, I think I am quite a teamwork person, so yeah. We'll work together and like, if they need help, I readily offer to help, even if it is not my department". (Daisy, Make-up Artist).

4.3.2 Discussion on the CCS Development Pathway

From the findings in Section 4.4.1, we observed that most participants have a similar skills development pattern across the diverse contextual settings. The pattern of the three overarching themes (as shown in Figure 10) appears to imply that there is a "must have time" space to practise the "executing them in a coordinated manner". Our observation lends evidence to a study by Noe (1986) and Russ-Eft (2002) who expressed that the extent to which trainees have sufficient time and resources available to practise and internalise what they have learnt determines the extent to which the training content will be used or constrained on the job.

In addition, we observed that the social relationships that are peripheral to the job design for the purpose of successful execution of the tasks, influence the degree of motivation to develop core skills. When healthy relationships are fostered within an organization, they fuel the informal sharing amongst the community of practice. These storylines then act as an enabler for the development of core skills. When conflictual and unhealthy relationships exist, they pose as a potential barrier for development of core skills. Similar studies have concluded similar findings as well (Contu & Willmott, 2003; Fox, 2000)

Conclusion

This chapter will firstly discuss the conclusions of the study and then propose some possible recommendations based on the results from the two phases of the study. Secondly, the limitations of the present study and the remedial measures are discussed.

5.1 Conclusions and Recommendations

The study concludes that measuring CCS from a formative perspective **(**Ashton, Felstead, Davies & Green, 2000**)**, e.g., job task-based, is an effective way to profile the occupations in terms of importance and self-efficacy in the use of CCS at workplace settings. The profiling results of seven occupation groups from Phase One of the study show clearly that certain occupations share some commonalities in their job requirements for CCS use as discussed in Section 4.2 and 4.3. The development pathway as identified from Phase Two of the study reinforces that concern or interest arising from the job requirements is the main drive for CCS development. The practice-linked learning, e.g., OJT, trial and error, observation of and support from peers or mentors at workplaces, are the main route for their development of CCS. The participants from across the seven profiling occupation groups shared such commonalities in their development pathway as illustrated in Section 4.4.

Therefore, it would be appropriate to recommend that training of core skills be conducted through in-person (but not lecture style) contexts or e-learning portals to allow the individuals the time and space to practise the tasks peripheral to their job design so that they can stay on task or continue to be on-the-job. Such a strategy is advised because of the emerging evidence that core skills are work-based concepts (Sung, Ng, Loke & Ramos, 2013). The in-person training could be informal sessions at workplaces to avoid unhealthy competition but be a safe environment to share storylines of development of core skills. Such informal sharing sessions can be spaced over a longer but targeted period to suit the needs of the training objectives. Another approach would be to leverage on e-learning portals that are used by companies for staff's professional development. The core skills learning program could be designed for these e-learning portals through working with training providers, e.g., IAL, to design customised training programmes to suit the operating environment of each organisation. The employees could then work with their respective department heads to pace their learning pathways in a targeted manner to coincide with "must have time" space to practise. For example, Deep, Salleh & Othman (2016) carried out an empirical research using a 3-day module of e-learning adopting the PBL approach found that PBL strategy on e-learning platform significantly generated conflict resolving skills and communication skills.

Specifically, the results of CCS profiling and development would be applied in the following ways,

- Skills needs analysis and evaluation for core skills development interventions. For example, using the instrument (See Annex E for the full instrument), employers may better recognize the skills needs of their employees to help develop their existing staff with the appropriate set of CCS required by the job roles;

- Job-worker matching for career counsellors and employment agencies. For example, using the instrument, career counsellor and employment agencies may identify the important CCS in different job roles to better match the prospective employees to the suitable job roles;

- The Skills Deficiencies analysis results can provide important evidence for the direction of skills development policy through the identification of areas requiring

directed effort. For example, with the profiling results using the instrument, employers may foresee the CCS deficiency in the job role to further plan the development for prospective and existing staff;

- The CCS development pathway can provide some guidance for training providers and employers in the development of CCS for employees. For example, employers could also consciously design the job tasks by referring to the CCS instrument to better facilitate the development of the required CCS for their own staff more efficiently, together with appropriate practices and support at workplaces;

- Future research employing the data generated in this project will focus on the wage returns to various core skills and the pay penalty associated with lack of confidence in various core skills.

5.2 Limitations and Remedial Measures

Despite the survey ultimately obtaining a reasonably acceptable response rate (50%), due to the untimely Covid-19 pandemic in Singapore during the period that this research was conducted, the research did encounter difficulties in recruiting participants for both phases. In particular, due to constraints in time and budget for the purchase of an additional sampling frame, substitution of non-responding unit with another unit of the same housing type was also implemented during the last two months of data collection, in order to achieve the target number of at least 2000 responses. As the selection of the substitute unit was left to the interviewer's discretion, this may have some effect on the representativeness of our sample.

Several measures were also implemented to boost the responses during data collection for phase one. These included (i) providing participants with the option of completing the survey with an interviewer via Zoom, which was offered for both data waves, as well as (ii) offering the option of self-completion via an online link provided in the invitation letter, which was implemented during the latter part of the main study. About 20% of our participants went for this option. While multi-mode surveys may increase the coverage of the population of interest and minimize non-response bias, combining data that had been collected from multiple survey modes for our analysis may introduce mode-related measurement errors and reduce the quality of our data (Lavrakas, 2008).

To minimise the delay of the Phase One study caused by the untimely Covid-19 pandemic, Phase Two of the study was initiated before the main study of Phase one, that is, the Phase Two study selected 15 participants from the pilot study for the follow-up interviews to understand their use and development of CCS without the profiling result from Phase One yet. This step could have led to some difficulties to match the selected participants with the profiling results of Phase One later. However, after the profiling results were out, we manually matched these 15 participants with the occupation clusters. Fortunately, most of them could be perfectly matched with the seven occupation groups. We replaced the rest of the participants from the occupation clusters to ensure the consistency of the Phase One and Phase Two results.

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Annex A

An example of dimension coding from the “Creative Thinking” CCS framework developed by SSG.

SSG-CCS Task set for “Creative Thinking” Coding		
Adopt diverse perspectives in combining ideas or information and making connections between different fields to create different ideas, improvements, and solutions		
Basic	Intermediate	Advanced
Connect ideas or information to propose and test ideas, improvements and solutions which challenge current assumptions or ways of working	Integrate multiple ideas and information from across various fields to develop solutions and new ways of working which address specific issues and deliver impact	Cultivate a culture of innovation and creativity across the organization to push boundaries and reshape goals and possibilities
Dimension 1: Identify opportunities for improvement		
Employ process analysis techniques to review current work processes and identify potential improvement areas.	Identify the desired outcomes of creative thinking processes. Analyse improvement areas to prioritise work areas for action. Develop resource and information collection approaches and processes for identified improvement areas.	Synthesise research and information from various sources within the organisation to determine potential synergies or opportunities for organisation-wide innovation initiatives.
Dimension 2: Generate ideas for improvement		
Apply lateral thinking techniques to improve current ways of performing work activities. Share inputs during brainstorming sessions to support the generation of ideas.	Facilitate exercises with different stakeholders to enable the generation of ideas and imaginative solutions. Integrate convergent and divergent thinking techniques to develop new approaches, ideas, or solutions. Collaborate with internal and external stakeholders to consider how ideas, improvements or new solutions from other areas can be applied to different contexts.	
Dimension 3: Test and evaluate new idea		

Conduct experiments to test ideas, improvements, or new solutions in one's own work areas. Collect information to monitor implementation of ideas, improvements or new solutions against impact criteria.	Design experiments to trial the implementation of ideas, improvements, or solutions. Design criteria to measure impact of new ideas, improvements, or solutions. Analyse outcomes of experiments using an iterative process to continuously improve the implementation of ideas, improvements or new solutions.	Evaluate the implementation of lateral, convergent, and divergent thinking techniques to design "out-of-the-box" ideas, improvements or solutions which push the boundaries and solve problems. Evaluate outcomes of design experiments to recommend new ideas, improvements, or solutions to be implemented across the organisation. Evaluate emerging applications of innovations or solutions across industries to determine any relevant applications within own organisation.
Others		
Collect information related to potential new ideas, improvements or solutions using a variety of identified tools.	Deploy visualization techniques to communicate proposed new ideas, improvements, or solutions.	Establish strategies to analyse the effectiveness of creative processes across the organisation. Engage with internal and external stakeholders to communicate compelling narratives and rationale for implementing new ideas, improvements, or solutions.

Annex B

Final task statements developed for measuring the importance of the “Creative Thinking” CCS in a survey respondent’s job.

Description	Proficiency level		
	Basic	Int-m	Adv
Identify opportunities for improvements			
Noticing areas for improving your own work	√		
Finding areas for improving the work of others	√	√	√
Generate ideas for improvements			
Thinking of new ways to do things		√	√
Using specific techniques to generate new ideas			
Test and evaluate new ideas			
Testing or evaluating the effectiveness of new ways of doing work			√

Annex C

Cluster analysis

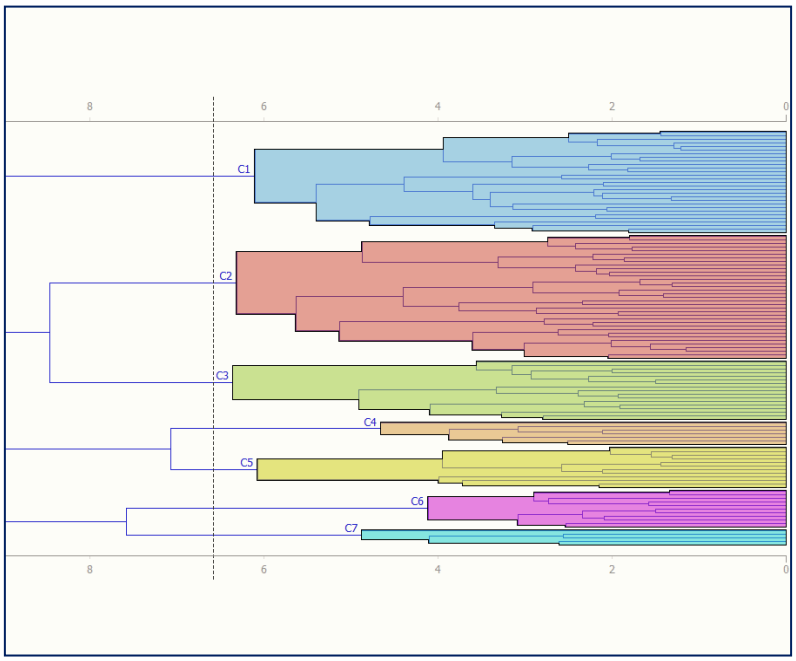
Stage One:

Average skills scores were generated for 4-digit SSOC occupations (providing 116 occupations with 16 CC Skills use scores).

Hierarchical cluster analysis was performed (Ward's method with Euclidian distances).

Seven clusters accounted for 60% of variance in CC skills use scores. Figure 11 shows the final dendrogram for the stage one cluster analysis.

Figure 12. Dendrogram of cluster analysis



Stage Two:

A logistic regression classifier was built employing the results of the cluster analysis. The classifier was then used to assign the entire sample to the seven clusters.

Skills profiles and occupation counts were used to interpret and validate the solution.

Annex D

Skills gaps identified using multiple regression. The regression identified any negative and significant relationship between each of the seven specific occupation clusters and reported CC skills efficacy. As skills efficacy is positively correlated with skills use, the regression controls for skills use, age, gender, and ethnicity were put in place.

The regression model was run for each CC Skill of the form:

Where:

Eff is the reported skills efficacy, *D* is a dummy indicating the occupation cluster being analysed, and *i* is the sampled worker. *Use* is the reported skills use at the job, *age* is the age, *fem* is female gender and *min* is the minority ethnicity.

Table 22 shows an example for skills gap among developers and carers in creative thinking skills.

Table 22. Example of skills deficiency regression

Eff = Creative Thinking	**Coefficient**	**t Stat**
Intercept	2.086	18.936***
Dummy (Developers & Carers)	-0.160	-4.401******
use	0.326	16.058***
fem	-0.097	-3.134***
age	0.005	3.553***
min	0.165	4.784***
Significance F	0.000	
R Square	0.144	
Adj. R Square	0.141	
N	1,880	

**Mildly significant **Significant ***Highly significant*

Annex E

You will now be asked about different activities which may or may not be part of your job.

We are interested in finding out what activities your **MAIN JOB or BUSINESS** involves and how important these are.

CREATIVE THINKING

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_CT1	noticing areas for improving your own work?	1	2	3	4	5
Imp_CT2	finding areas for improving the work of others?	1	2	3	4	5
Imp_CT3	thinking of new ways to do things?	1	2	3	4	5
Imp_CT4	using specific techniques to generate new ideas?	1	2	3	4	5
Imp_CT5	testing or evaluating the effectiveness of new ways of doing work?	1	2	3	4	5

[If your response to Imp_CT1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_CT1	notice areas for improving your own work?	1	2	3	4	5
Eff_CT2	find areas for improving the work of others?	1	2	3	4	5
Eff_CT3	think of new ways to do things?	1	2	3	4	5
Eff_CT4	use specific techniques to generate new ideas?	1	2	3	4	5
Eff_CT5	test or evaluate the effectiveness of new ways of doing work?	1	2	3	4	5

DECISION MAKING

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_DS1	referring to well-established procedures to make decisions?	1	2	3	4	5
Imp_DS2	using well-established tools or techniques to make decisions?	1	2	3	4	5
Imp_DS3	planning or managing a project or operation?	1	2	3	4	5
Imp_DS4	determining criteria for appraising the success or failure of a project or operation?	1	2	3	4	5
Imp_DS5	contributing to the strategic direction of your business or organisation?	1	2	3	4	5

[If your response to Imp_DS1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_DS1	refer to well-established procedures to make decisions?	1	2	3	4	5
Eff_DS2	use well-established tools or techniques to make decisions?	1	2	3	4	5
Eff_DS3	plan or manage a project or operation?	1	2	3	4	5
Eff_DS4	determine criteria for appraising the success or failure of a project or operation?	1	2	3	4	5
Eff_DS5	contribute to the strategic direction of your business or organisation?	1	2	3	4	5

PROBLEM SOLVING

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_PS1	identifying or describing problems you encounter during work?	1	2	3	4	5
Imp_PS2	analysing the cause of work-related problems?	1	2	3	4	5
Imp_PS3	generating (finding or creating) new solutions to work-related problems?	1	2	3	4	5
Imp_PS4	evaluating new solutions to work-related problems?	1	2	3	4	5
Imp_PS5	considering the business implications of a specific solution or proposed solution?	1	2	3	4	5

[If your response to Imp_PS1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_PS1	identify or describe problems you encounter during work?	1	2	3	4	5
Eff_PS2	analyse the cause of work-related problems?	1	2	3	4	5
Eff_PS3	generate (find or create) new solutions to work-related problems?	1	2	3	4	5
Eff_PS4	evaluate new solutions to work-related problems?	1	2	3	4	5
Eff_PS5	consider the business implications of a specific solution or proposed solution?	1	2	3	4	5

SENSE MAKING

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_SM1	finding useful sources of information?	1	2	3	4	5
Imp_SM2	making judgements about the quality of information sources?	1	2	3	4	5
Imp_SM3	looking at multiple information resources to identify patterns or relationships?	1	2	3	4	5
Imp_SM4	analysing information to provide evidence for the reliability of patterns or relationships?	1	2	3	4	5
Imp_SM5	drawing on information analysis to make recommendations?	1	2	3	4	5

[If your response to Imp_SM1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_SM1	find useful sources of information?	1	2	3	4	5
Eff_SM2	make judgements about the quality of information sources?	1	2	3	4	5
Eff_SM3	look at multiple information resources to identify patterns or relationships?	1	2	3	4	5
Eff_SM4	analyse information to provide evidence for the reliability of patterns or relationships?	1	2	3	4	5
Eff_SM5	draw on information analysis to make recommendations?	1	2	3	4	5

TRANSDISCIPLINARY THINKING

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_TT1	exploring solutions or ideas from outside your normal area of work or expertise?	1	2	3	4	5
Imp_TT2	using tools or techniques that are not normally used in your occupation or profession?	1	2	3	4	5
Imp_TT3	combining ideas or solutions from other industries or professions to create a new way of doing things?	1	2	3	4	5
Imp_TT4	collaborating with workers in different occupations or professions?	1	2	3	4	5
Imp_TT5	helping or encouraging workers with different areas of expertise to communicate?	1	2	3	4	5

[If your response to Imp_TT1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_TT1	explore solutions or ideas from outside your normal area of work or expertise?	1	2	3	4	5
Eff_TT2	use tools or techniques that are not normally used in your occupation or profession?	1	2	3	4	5
Eff_TT3	combine ideas or solutions from other industries or professions to create a new way of doing things?	1	2	3	4	5
Eff_TT4	collaborate with workers in different occupations or professions?	1	2	3	4	5
Eff_TT5	help or encourage workers with different areas of expertise to communicate?	1	2	3	4	5

INFLUENCE

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_IF1	trying to find out what other people want or need?	1	2	3	4	5
Imp_IF2	explaining to people how you can help them?	1	2	3	4	5
Imp_IF3	justifying decisions that you or your team has made?	1	2	3	4	5
Imp_IF4	explaining to others the logic you use when you make decisions or present ideas?	1	2	3	4	5
Imp_IF5	building relationships with people outside of your immediate environment?	1	2	3	4	5

[If your response to Imp_IF1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_IF1	try to find out what other people want or need?	1	2	3	4	5
Eff_IF2	explain to people how you can help them?	1	2	3	4	5
Eff_IF3	justify decisions that you or your team has made?	1	2	3	4	5
Eff_IF4	explain to others the logic you use when you make decisions or present ideas?	1	2	3	4	5
Eff_IF5	build relationships with people outside of your immediate environment?	1	2	3	4	5

DEVELOP PEOPLE

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_DP1	understanding career planning methods?	1	2	3	4	5
Imp_DP2	identifying training or learning opportunities for others?	1	2	3	4	5
Imp_DP3	coaching or mentoring others to help them succeed in their work?	1	2	3	4	5
Imp_DP4	providing feedback in order to help others improve their work?	1	2	3	4	5
Imp_DP5	running training or learning events for your team/organisation?	1	2	3	4	5

[If your response to Imp_DP1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_DP1	understand career planning methods?	1	2	3	4	5
Eff_DP2	identify training or learning opportunities for others?	1	2	3	4	5
Eff_DP3	coach or mentor others to help them succeed in their work?	1	2	3	4	5
Eff_DP4	provide feedback in order to help others improve their work?	1	2	3	4	5
Eff_DP5	run training or learning events for your team/organisation?	1	2	3	4	5

CUSTOMER ORIENTATION

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_CO1	asking customers questions to determine their needs?	1	2	3	4	5
Imp_CO2	responding to a customer's request?	1	2	3	4	5
Imp_CO3	identifying improvements to the way you or others interact with customers?	1	2	3	4	5
Imp_CO4	managing unusual requests or interactions?	1	2	3	4	5
Imp_CO5	helping to develop guidelines for effective customer interaction?	1	2	3	4	5

[If your response to Imp_CO1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_CO1	ask customers questions to determine their needs?	1	2	3	4	5
Eff_CO2	respond to a customer's request?	1	2	3	4	5
Eff_CO3	identify improvements to the way you or others interact with customers?	1	2	3	4	5
Eff_CO4	manage unusual requests or interactions?	1	2	3	4	5
Eff_CO5	help to develop guidelines for effective customer interaction?	1	2	3	4	5

COMMUNICATION

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_CM1	presenting your ideas to one or more people?	1	2	3	4	5
Imp_CM2	asking questions to clarify your understanding?	1	2	3	4	5
Imp_CM3	identifying or clarifying the desired outcome of a meeting or discussion?	1	2	3	4	5
Imp_CM4	leading a meeting with a group of more than one other person?	1	2	3	4	5
Imp_CM5	adapting your communication technique to meet the needs of a person or group of people?	1	2	3	4	5

[If your response to Imp_CM1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_CM1	present your ideas to one or more people?	1	2	3	4	5
Eff_CM2	ask questions to clarify your understanding?	1	2	3	4	5
Eff_CM3	identify or clarify the desired outcome of a meeting or discussion?	1	2	3	4	5
Eff_CM4	lead a meeting with a group of more than one other person?	1	2	3	4	5
Eff_CM5	adapt your communication technique to meet the needs of a person or group of people?	1	2	3	4	5

COLLABORATION

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_CL1	collaborating with others to achieve a common objective?	1	2	3	4	5
Imp_CL2	sharing information and ideas with others?	1	2	3	4	5
Imp_CL3	managing conflicts between different people in a team?	1	2	3	4	5
Imp_CL4	managing a team of people?	1	2	3	4	5
Imp_CL5	evaluating the effectiveness of teams or teamwork?	1	2	3	4	5

[If your response to Imp_CL1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_CL1	collaborate with others to achieve a common objective?	1	2	3	4	5
Eff_CL2	share information and ideas with others?	1	2	3	4	5
Eff_CL3	manage conflicts between different people in a team?	1	2	3	4	5
Eff_CL4	manage a team of people?	1	2	3	4	5
Eff_CL5	evaluate the effectiveness of teams or teamwork?	1	2	3	4	5

BUILDING INCLUSIVITY

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_BI1	working with people from different cultural backgrounds to you?	1	2	3	4	5
Imp_BI2	learning about people with physical or mental disabilities?	1	2	3	4	5
Imp_BI3	managing teams with diverse members?	1	2	3	4	5
Imp_BI4	developing guidelines for managing people with different backgrounds?	1	2	3	4	5
Imp_BI5	working with people who have physical or mental disabilities?					

[If your response to Imp_BI1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_BI1	work with people from different cultural backgrounds to you?	1	2	3	4	5
Eff_BI2	learn about people with physical or mental disabilities?	1	2	3	4	5
Eff_BI3	manage teams with diverse members?	1	2	3	4	5
Eff_BI4	develop guidelines for managing people with different backgrounds?	1	2	3	4	5
Eff_BI5	work with people who have physical or mental disabilities?					

ADAPTABILITY

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_AD1	finding out about the changes in your industry or occupation?	1	2	3	4	5
Imp_AD2	considering how trends or changes in your industry will affect your work?	1	2	3	4	5
Imp_AD3	develop strategies to respond to changes in your industry?	1	2	3	4	5
Imp_AD4	implementing new ways of working to suit changes in your industry or work environment?	1	2	3	4	5
Imp_AD5	managing the development of new procedures or guidelines in response to changes in your industry or work environment?	1	2	3	4	5

[If your response to Imp_AD1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_AD1	find out about the changes in your industry or occupation?	1	2	3	4	5
Eff_AD2	consider how trends or changes in your industry will affect your work?	1	2	3	4	5
Eff_AD3	develop strategies to respond to changes in your industry?	1	2	3	4	5
Eff_AD4	implement new ways of working to suit changes in your industry or work environment?	1	2	3	4	5
Eff_AD5	manage the development of new procedures or guidelines in response to changes in your industry or work environment?	1	2	3	4	5

DIGITAL FLUENCY

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_DF1	learning how to use new technologies?	1	2	3	4	5
Imp_DF2	working with new technologies?	1	2	3	4	5
Imp_DF3	considering how new technologies could be used in your work?	1	2	3	4	5
Imp_DF4	deciding on whether new technologies should be employed at your workplace?	1	2	3	4	5
Imp_DF5	overseeing or managing the implementation of new technologies?	1	2	3	4	5

[If your response to Imp_DF1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_DF1	learn how to use new technologies?	1	2	3	4	5
Eff_DF2	work with new technologies?	1	2	3	4	5
Eff_DF3	consider how new technologies could be used in your work?	1	2	3	4	5
Eff_DF4	decide on whether new technologies should be employed at your workplace?	1	2	3	4	5
Eff_DF5	oversee or manage the implementation of new technologies?	1	2	3	4	5

GLOBAL PERSPECTIVE

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_GP1	finding out about global issues or trends?	1	2	3	4	5
Imp_GP2	conducting research regarding global issues or trends?	1	2	3	4	5
Imp_GP3	collaborating with people from overseas?	1	2	3	4	5
Imp_GP4	generating/establishing/building up relationships with people overseas?	1	2	3	4	5
Imp_GP5	informing people about how to respond to global issues or changes?	1	2	3	4	5

[If your response to Imp_GP1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_GP1	find out about global issues or trends?	1	2	3	4	5
Eff_GP2	conduct research regarding global issues or trends?	1	2	3	4	5
Eff_GP3	collaborate with people from overseas?	1	2	3	4	5
Eff_GP4	generate/establish/build up relationships with people overseas?	1	2	3	4	5
Eff_GP5	inform others about how to respond to global issues or changes?	1	2	3	4	5

LEARNING AGILITY

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_LA1	making plans for your own work-related learning?	1	2	3	4	5
Imp_LA2	identifying your own development needs?	1	2	3	4	5
Imp_LA3	recording what you have learned from your own work?	1	2	3	4	5
Imp_LA4	measuring the progress of your own learning or development?	1	2	3	4	5
Imp_LA5	making decisions about your own learning activities or training courses?	1	2	3	4	5

[If your response to Imp_LA1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_LA1	make plans for your own work-related learning?	1	2	3	4	5
Eff_LA2	identify your own development needs?	1	2	3	4	5
Eff_LA3	record what you have learned from your own work?	1	2	3	4	5
Eff_LA4	measure the progress of your own learning or development?	1	2	3	4	5
Eff_LA5	make decisions about your own learning activities or training courses?	1	2	3	4	5

SELF MANAGEMENT

In your job, how important is …?

(If the activity is NOT part of your job, please use number 1 – Not at all important)

		Not at all important	Not very important	Fairly important	Very important	Essential
Imp_SE1	managing your own stress or emotions?	1	2	3	4	5
Imp_SE2	maintaining your own physical or mental health?	1	2	3	4	5
Imp_SE3	prioritising tasks and goals effectively?	1	2	3	4	5
Imp_SE4	employing time management techniques?	1	2	3	4	5
Imp_SE5	building a professional image or reputation?	1	2	3	4	5

[If your response to Imp_SE1/2/3/4/5 > 2] How confident are you of your ability to…?

		Not at all confident	Slightly confident	Fairly confident	Confident	Very confident
Eff_SE1	manage your own stress or emotions?	1	2	3	4	5
Eff_SE2	maintain your own physical or mental health?	1	2	3	4	5
Eff_SE3	prioritise tasks and goals effectively?	1	2	3	4	5
Eff_SE4	employ time management techniques?	1	2	3	4	5
Eff_SE5	build a professional image or reputation?	1	2	3	4	5