



ASEAN

ICT Skills Standard 2018





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Introduction

With the fourth industrial revolution, according to a number of surveys conducted around the world, it is clear that ICT taskforces are needed around the world. Leaders of many large economic countries stated clearly in a number of occasions that they all welcome and encourage ICT taskforces to their countries. The same situation also occurs in ASEAN. In order to systematically deal with movement of ICT taskforce within the region, activities related to preparing taskforces and supporting them to move freer have been explicitly stated in both first and second ASEAN ICT Masterplan (AIM2015 and AIM2020). Especially the main objective of AIM202 states clearly that:

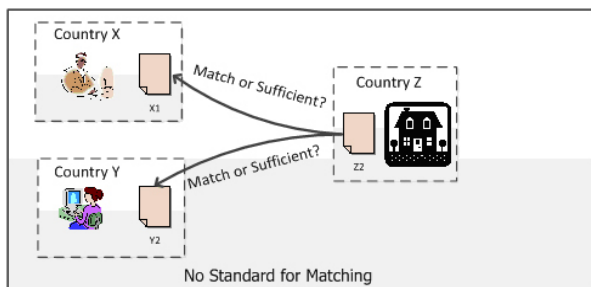
“The key objectives of the AIM 2020 have thus focused on enabling the transformation to the digital economy and developing the human capacity necessary for this transition, facilitating the emergence of a single integrated market that is attractive to investment, talent and participation, and building a digital environment that is safe and trusted.”¹

In order to achieve such objective, one of the mechanisms expected is to allow freer flow of ICT taskforces within the region is to develop a set of ICT skills definitions to be used for standard mapping between standards existed in all countries within the region. Imagine two countries with different languages, one way to understand each other is to map each of the country language to English language. Similar mapping mechanism can be used for comparing ICT skills from all countries within the region.

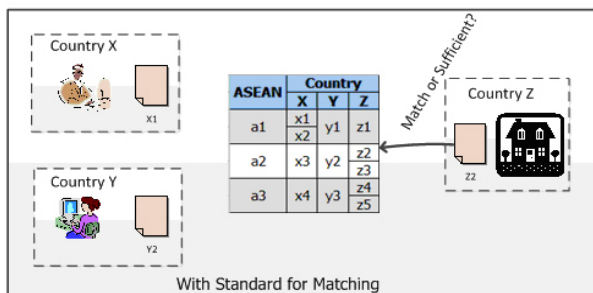
¹ The ASEAN ICT Masterplan 2020

There is nothing new with this kind of idea. Europe have already developed their ICT skills standard and used it for mapping ICT skills from different countries in Europe for many years. The ASEAN ICT skills standard developed in this project can be seen as something similar to European e-Competence Framework (e-CF) developed and maintained in Europe.

The following figures depicts a situation where a worker from one country move to another country without having the standard in place.



In this case, without a standard for matching ICT-related skills, a company recruiting new ICT workforces in country Z has to put unnecessarily great effort into comparing skills, namely X1, Y2 and a required skill, Z2.



With the standard in place, by using a skills comparative table (or mapping table), the three skills, X1, Y2 and Z2, can be compared at ease.

Activities Related to Development of ICT Skills Standard

As part of the continuing efforts that focus on supporting ICT taskforces to move freer in the region, a project to develop and maintain ICT Skills Standard has been initiated since AIM2015. There are already three phases of the project since then. The first phase was completed in 2013, while the second phase was concluded in 2015. This report is result of the current phase or third phase, which is finalized in 2018. The 3rd Phase of this project AIM 2020, which is explicitly considered in Action 5.2.1 Continue Efforts to Align ICT Skill Standards for ASEAN under Initiative 5.2 Develop Common ICT Workforce Skills, which belong to AIM Strategic Thrust 5: Human Capital Development.

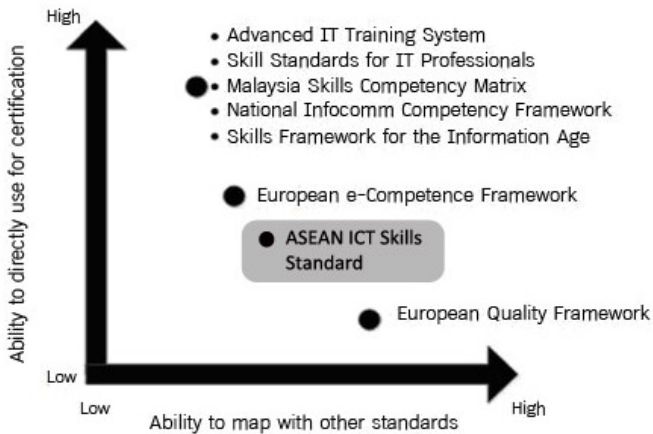
For each of the phases, in order to develop and maintain the ASEAN ICT Skills Standard, three main activities have been conducted, which include:

1. Survey existing ICT skills standard currently existing both within and outside ASEAN. For outside ASEAN, standards considered include standards developed by Japan, Canada, United Kingdom, Germany, and Europe.
2. Develop and maintain definitions of ICT skills used in the standard
3. Develop and update the mapping table

Note that from the three activities mentioned above, “**Definitions of ICT Skills**” and “**Mapping Table**” are two main output of every phase of the project.

Comparing this ASEAN Standard with Others

The following figure visualizes “Ability to directly use for certification” and “Ability to map with other standards” of most of the standards considered in this project



ASEAN ICT Skills Standard Project

This project is a continuing project. In the first phase of this project, 5 ICT skills were considered and 2 other ICT skills were included in the second phase of the project. In the current phase (Phase 3) of this project, Three new ICT skills have been added to ASEAN ICT skills standard. Therefore, a total number of ICT skills included in the standard is 10 as listed below.

1. Software Development
2. ICT Project Management
3. Enterprise Architecture Design
4. Network and System Administration
5. Information System and Network Security
6. Cloud Computing
7. Mobile Computing
8. Social business
9. Big data
10. Internet of Things

Toward the end of each phase of the project, a workshop enabling ASEAN representatives to review and endorse the proposed ICT skills is organized. Outcomes of the workshop include a definition of each individual ICT skill, skills mapping table and up-to-date information in the ASEAN ICT skills standard. Based on the outcomes and organized activities, a summary report is produced.

Photos taken at the workshop are shown below. The workshop was organized on 2 – 3 July 2018 at Library room, ATAS Hotel, Bangkok, Thailand. Six ASEAN representatives from Cambodia, Philippine, Lao People’s Democratic Republic, Thailand, Myanmar and Vietnam attended the seminar. It is a great honor to have Mrs. Vunnaporn Devahastin, Secretary – General, The National Digital Economy and Society Commission delivered an opening speech in the workshop.



Definitions for ICT Skills Standard

According to the fact that “Standard Definitions” and “Mapping Table” are the two main output of all 3 phases of the project, the following table shows “Definition” of all 10 skills that have been developed so far in the project.

Area	Definition	Source/ Reference
Software Development	<i>An engineering discipline that is concerned with all aspects of software production from the early stages of specification to maintaining the system after it has gone into use.</i>	Ian Sommerville, Software Engineering, Addison-Wesley, 2010
ICT Project Management	<i>Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements.</i>	https://www.pmi.org/about/learn-about-pmi/what-is-project-management

Area	Definition	Source/ Reference
Enterprise Architecture Design	<p><i>The software architecture of a program or computing system is the structure or structures of the system, which comprise software elements, the externally visible properties of those elements, and the relationships among them. "Externally visible" properties refers to those assumptions other elements can make of an element, such as its provided services, performance characteristics, fault handling, shared resource usage, and so on.</i></p>	<p>Software Architecture in Practice (2nd edition), Bass, Clements, Kazman; Addison-Wesley 2003:</p>
Network and System Administration	<p><i>An ontology for network and system administration is a particular type of ontology whose subject domain is constrained to the administration of networks and systems. Administration is defined as the set of management functions required to create, set up, monitor, adjust, tear down, and keep the network or system operational. One and more ontologies must be defined for each device in the network or system that has a different programming model.</i></p>	<p>Handbook of Network and System Administration edited by Jan Bergstra, Mark Burgess</p>

Area	Definition	Source/ Reference
Information System and Network Security	<i>An approach and framework to implementing, maintaining, monitoring, and improving information security that is consistent with organisational culture.</i>	ISO/IEC 17799, 2005
Cloud Computing	<i>A model for enabling service users to have ubiquitous, convenient and on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services), that can be rapidly provisioned and released with minimal management effort or service-provider interaction. Cloud computing enables cloud services</i>	Telecommunication Standardization Sector of ITU
Mobile Computing	<i>The act of using a computer while travelling from place to place or without being connected to electricity or other computers by wires.</i>	Cambridge Business English Dictionary

Area	Definition	Source/ Reference
Big Data	<i>Big data is high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation.</i>	Doug Laney of Gartner
Social Business	<i>New forms of collaboration and communication that companies are developing with social media</i>	David Kiron, MIT Sloan Management Review
Internet of Things (IoT)	<i>An IoT is a network that connects uniquely identifiable “Things” to the Internet. The “Things” have sensing/actuation and potential programmability capabilities. Through the exploitation of unique identification and sensing, information about the “Thing” can be collected and the state of the ‘Thing’ can be changed from anywhere, anytime, by anything.</i>	IEEE

Competency Levels in ASEAN ICT Skills Standard

According to studies conducted in this project, there is no standard approach in coming up with “Competency Level” in any standard existed around the world. In general, ICT Skills Standards existed to-date have their levels of competency ranged from 3 levels for country like Germany to 7 or 8 levels for countries like Japan and some countries in Europe. Note that most of the level 4 and higher are rarely used could be because of the fact that people with that level of competency do not need any certification because their experiences can already lead them to good positions in their workplaces. This could be the reason why country such as Germany only uses 3 levels of competency in their standard. Similar to what happen in ASEAN ICT Skills Standard, 3 levels of competency has been used and developed. These 3 levels of competency are:

- Level 1: Basic level

Basic level of this standard referred to “Has basic knowledge and skills which is adequate to perform a given task(s) under supervision of management”.

- Level 2: Intermediate level

Intermediate level of this standard referred to “Has professional knowledge and skills to perform a given task(s) independently, and, if required, can supervise others; understand a number of comparative approaches to problems in their fields; and be able to apply them efficiently”.

- Level 3: Advanced level

Advanced level of this standard referred to “Has professional knowledge and skills in both technical and management to lead a team in inexperienced environment”

In addition to the 3 levels of competency discussed above, based on the levels of competency used in this standard, a “Mapping Table” has been developed. The table can be used to compare or map levels of competency in different countries in ASEAN. The mapping is done by using the defined ASEAN standard as a baseline for comparison. This is the same mechanism used by e-CF standard of Europe.

For example, according to the mapping table shown below, assume that a company in Malaysia has a position which requires a person with “Level 3: Senior” of Malaysia’s competency level (which is equivalent to level 2: Intermediate Level, in the mapping table of ASEAN ICT Skills Standard). Anyone from Indonesia who are interested in doing this job, he/she has to have a level of competency between 4 to 6 of Indonesia’s competency level. However, if someone from Vietnam would like to apply for the job, he/she must have at least a competency level 2 of Vietnam’s competency level.

Mapping Table of ASEAN ICT Skills Standard

Competency Level	Level 1: Basic Level	Level 2: Intermediate Level	Level 3: Advanced Level
 ASEAN	Has basic knowledge and skills which is adequate to perform a given task(s) under supervision of management.	Has professional knowledge and skills to perform a given task(s) independently, and, if required, can supervise others; understand a number of comparative approaches to problems in their fields; and be able to apply them efficiently	Has professional knowledge and skills in both technical and management to lead a team in inexperienced environment
 Indonesia	Level 1-3	Level 4-6	Level 7-9
 Malaysia	Level 2: Intermediate	Level 3: Senior	Level 4: Advanced
 Myanmar	Level 2: Perform assigned duties under the supervision	Level 3: Perform all assigned duties independently	Level 4: IT professionals
 Philippines	Level 1: Basic	Level 2: Advance	Level 3: Specialist
 Singapore	Level 1: Entrant	Level 2: Specialist	Level 3: Expert /Management
 Thailand	Level 3	Level 4	Level 5
 Vietnam	Level 3-4	Level 2	Level 1

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Mutually Accepted Skills Standard

Mutually Accepted Skills Standard or MASS was developed after the first phase of this project due to the fact that ASEAN countries have their own way of ICT skills accreditation. It becomes very difficult to follow the Europe way of doing. Therefore, ASEAN member countries agreed upon a certain mutually accepted standard, which can be used by each member country for ICT skills mapping and comparison. The development of 10 skills' definition and outcomes of this project (all 3 phases) are referred to as ASEAN MASS (ASEAN Mutually Agreed Skill Standards) which comprises a definition of skills and their associated sub-skills and competency levels as described in the following section.

1. **Skill: Software Development** comprises the following sub-skills:
 - 1.1 Business Analyst
 - 1.2 System Analyst
 - 1.3 Software Designer
 - 1.4 Software Developer
 - 1.5 Software Tester
 - 1.6 Quality Assurance
 - 1.7 UX Strategist
 - 1.8 Interaction Designer
 - 1.9 Visual Designer

Skill	
Software Development	
Sub-Area	
Business Analysis	
Competency Level	Definition
3	Has ability to manage one or more team in communicating with clients and domain experts when gathering their requirements, resolving clients issues, creating and maintaining documentation related to requirements, performing functional reviews of system, and supporting users during their system validations. Responsible for a group of analysts with 10-50 members in total.
2	Has ability to supervise a team in communicating with clients and domain experts when gathering their requirements, resolving clients issues, creating and maintaining documentation related to requirements, performing functional reviews of system, and supporting users during their system validations. Responsible for a group of analysts with no more than 10 members in the team.

Competency Level	Definition
1	Under supervision of senior analysts, has ability to directly communicate efficiently with clients and domain experts in gathering their requirements, resolving clients issues, creating and maintaining documentation related to requirements, performing functional reviews of system, and supporting users during their system validations.

Skill	
Software Development	
Sub-Area	
System analysis	
Competency Level	Definition
3	Has ability to manage one or more team in performing feasibility analysis, cost benefit analysis and return-on-investment, suggest alternative solutions, create and maintain data and process models. Also, able to assist project management in scoping of the project, recommending deliverable priorities of all sub-systems, and planning. Responsible for a group of analysts with no more than 10-50 members in total.
2	Has ability to supervise a team in performing feasibility analysis, cost benefit analysis and return-on-investment, suggest alternative solutions, create and maintain data and process models. Also, able to assist project management in scoping of the project, recommending deliverable priorities of all sub-systems, and planning. Responsible for a group of analysts with no more than 10 members in the team.

Competency Level	Definition
1	Under supervision of senior system analyst, has ability to perform feasibility analysis, cost benefit analysis and return-on-investment, suggest alternative solutions, create and maintain data and process models. Also, able to assist project management in scoping of the project, recommending deliverable priorities of all sub-systems, and planning.

Skill	
Software Development	
Sub-Area	
Software design	
Competency Level	Definition
3	Has ability to lead design aspect of all responsible projects manage one or more team in designing software by using a set of modeling tools and techniques widely recognized and suitable to a problem at hand. Responsible for a group of designers with no more than 10-50 members in total.
2	Has ability to lead design aspect of a project and supervise a team in designing software by using a set of modeling tools and techniques widely recognized and suitable to a problem at hand. Responsible for a group of designers with no more than 10 members in the team.
1	Under supervision of senior software designer, has ability to design software by using a set of modeling tools and techniques widely recognized and suitable to a problem at hand.

Skill	
Software Development	
Sub-Area	
Software development	
Competency Level	Definition
3	Given a set of requirements of a software project, regardless of whether the requirements are for a new or existing software, has ability to lead technical aspect of all responsible projects and manage one or more team in working closely with analysts, designers, and related staff in proposing ideas for system improvements, producing detailed specifications, writing the program codes, conducting unit-test of the software. Responsible for a group of developers with no more than 10-50 members in total.
2	Given a set of requirements of a software project, regardless of whether the requirements are for a new or existing software, has ability to lead technical aspect of a responsible project and supervise a team in working closely with analysts, designers, and related staff in proposing ideas for system improvements, producing detailed specifications, writing the program codes, conducting unit-test of the software. Responsible for a group of developers with no more than 10 members in the team.

Competency Level	Definition
1	Given a set of requirements of a software project, regardless of whether the requirements are for a new or existing software, under supervision of senior software developer, has ability to work closely with analysts, designers, and related staff in proposing ideas for system improvements, producing detailed specifications, writing the program codes, conducting unit-test of the software.

Skill	
Software Development	
Sub-Area	
Software testing	
Competency Level	Definition
3	Given a set of requirements of a software project, regardless of whether the requirements are for a new or existing software, has ability to manage one more team of testers in developing and maintaining test plan, test strategy, test cases, and systematically design test values to be used for integration tests, system test, load test, and stress test, if required. Responsible for a group of testers with no more than 10-50 members in total.
2	Given a set of requirements of a software project, regardless of whether the requirements are for a new or existing software, has ability to supervise development and maintenance of test plan, test strategy, test cases, and systematically design test values to be used for integration tests, system test, load test, and stress test, if required. Responsible for a group of testers with no more than 10 members in the team.

Competency Level	Definition
1	Given a set of requirements of a software project, regardless of whether the requirements are for a new or existing software, under supervision of senior software tester, has ability to develop and maintain test plan, test strategy, test cases, and systematically design test values to be used for integration tests, system test, load test, and stress test, if required.

Skill	
Software Development	
Sub-Area	
Quality Assurer	
Competency Level	Definition
3	Under supervision of senior software quality assurance engineer, given an agreed standard, has ability to manage one or more team in performing quality engineering, inspecting/reviewing of all documentation used in a software project according to the agreed standard, communicating issues identified during quality assurance activities, and proposing solution(s) to process improvements to management. Responsible for a group of Quality Assurer with no more than 10-50 members in total.
2	Under supervision of senior software quality assurance engineer, given an agreed standard, has ability to supervise a team in performing quality engineering, inspecting/reviewing of all documentation used in a software project according to the agreed standard, communicating issues identified during quality assurance activities, and proposing solution(s) to process improvements to management. Responsible for a group of Quality Assurer with no more than 10 members in the team.

Competency Level	Definition
1	Under supervision of senior Quality Assurer, given an agreed standard, has ability to perform quality engineering, inspect/review of all documentation used in a software project according to the agreed standard, communicate issues identified during quality assurance activities, and propose solution(s) to process improvements to management.

Skill	
Software Development	
Sub-Area	
UX Strategist	
Competency	Definition
Level	
3	Given a set of business requirements, has ability to lead both technical and non-technical aspects of all responsible projects and manage one or more team in helping business to understand who customers are and what to build to serve their needs. This includes tasks in areas of creating survey and conducting analysis on results of the survey, conducting focus group interviews and report on findings, developing scenarios and criteria for usability testing from the findings. Responsible for a group of UX strategists with no more than 10-50 members in total.
2	Given a set of business requirements, has ability to manage a team in both technical and non-technical aspects of helping business to understand who customers are and what to build to serve their needs. This includes tasks in areas of creating survey and conducting analysis on results of the survey, conducting focus group interviews and report on findings, developing scenarios and criteria for usability testing from the findings. Responsible for a group of UX strategists with no more than 10 members in the team.

Competency Level	Definition
1	<p>Given a set of business requirements, under supervision of senior UX strategists, has ability to help business to understand who customers are and what to build to serve their needs. The responsibility includes creating survey and conducting analysis on results of the survey, conducting focus group interviews and report on findings, developing scenarios and criteria for usability testing from the findings.</p>

Skill	
Software Development	
Sub-Area	
Interaction Designer	
Competency Level	Definition
3	Given a set of business and user requirements, has ability to lead both technical and non-technical aspects of all responsible projects and manage one or more team in defining structure and flow of the user experience. This includes tasks in areas of creating and delivering workflows, wireframes, site maps, journey maps, and taxonomies. Responsible for a group of interaction designer with no more than 10-50 members in total.
2	Given a set of business and user requirements, has ability to manage a team in both technical and non-technical aspects of defining structure and flow of the user experience. This includes tasks in areas of creating and delivering workflows, wireframes, site maps, journey maps, and taxonomies. Responsible for a group of interaction designer with no more than 10 members in the team.

Competency Level	Definition
1	Given a set of business and user requirements, under supervision of senior interaction designer, has ability to define structure and flow of the user experience. This includes be able to create and deliver workflows, wireframes, site maps, journey maps, and taxonomies.

Skill	
Software Development	
Sub-Area	
Visual Designer	
Competency Level	Definition
3	Given a set of business and user requirements, has ability to lead both technical and non-technical aspects of all responsible projects and manage one or more team in creating prototypes, pattern libraries (for items like navigation elements, links, calendars, etc.), and selecting appropriate fonts for be used. Responsible for a group of visual designer with no more than 10-50 members in total.
2	Given a set of business and user requirements, has ability to manage a team in both technical and non-technical aspects of creating prototypes, pattern libraries (for items like navigation elements, links, calendars, etc.), and selecting appropriate fonts for be used. Responsible for a group of visual designer with no more than 10 members in the team.
1	Given a set of business and user requirements, under supervision of senior visual designer, has ability to create prototypes, pattern libraries (for items like navigation elements, links, calendars, etc.), and select appropriate fonts for be used.

2. **Skill: ICT Project Management** comprises the following sub-skills:

2.1 Project Manager

2.2 Agile Project Manager

2.3 QA for Project Management

Skill	
ICT Project Management	
Sub-Area	
Project Manager	
Competency Level	Definition
3	Has ability to carry out Scope Planning, Scope Definition, Create WBS, Scope Verification, and Scope Control, as a person responsible for the project with between 10-50 members in the team.
2	Has ability to carry out Scope Planning, Scope Definition, Create WBS, Scope Verification, and Scope Control, as a person responsible for the project with no more than 10 members in the team.
1	As a project member, has ability to carry out Scope Planning, Scope Definition, Create WBS, Scope Verification, and Scope Control under the direction of the project manager.

Skill	
ICT Project Management	
Sub-Area	
Agile Project Manager	
Competency Level	Definition
3	By using an agile-based method such as SCRUM as a basis for software development, has ability to manage requirements, development team members, product owners, and all related stakeholders in order to develop software, as a person responsible for one or more projects with no more than 10-50 members in total.
2	By using an agile-based method such as SCRUM as a basis for software development, has ability to manage requirements, development team members, product owners, and all related stakeholders in order to develop software, as a person responsible for the project with no more than 10 members in the team.
1	As a project member, by using an agile-based method such as SCRUM as a basis for software development, has ability to manage requirements, development team members, product owners, and all related stakeholders in order to develop software under the direction of the project manager.

Skill	
ICT Project Management	
Sub-Area	
QA for Project Management	
Competency Level	Definition
3	By using a well-known project management standard(s) as a framework for quality assurance, has ability to manage evaluating and ensuring that the project management discipline is set up to produce quality deliverables, communicating issues identified during quality assurance activities, and proposing solution(s) to process improvements to management. Responsible for the project with no more than 10-50 members in the team.
2	By using a well-known project management standard(s) as a framework for quality assurance, has ability to supervise evaluating and ensuring that the project management discipline is set up to produce quality deliverables, communicating issues identified during quality assurance activities, and proposing solution(s) to process improvements to management. Responsible for the project with no more than 10 members in the team.

Competency Level	Definition
1	As a project member, by using a well-known project management standard(s) as a framework for quality assurance, has ability to evaluate and ensure that the project management discipline is set up to produce quality deliverables, communicate issues identified during quality assurance activities, and propose solution(s) to process improvements to management.

3. **Skill: Enterprise Architecture Design** comprises the following sub-skills:

3.1 Enterprise Architect

3.2 Security Architect

3.3 Integration Architect

Skill	
Enterprise Architecture Design	
Sub-Area	
Enterprise architect	
Competency Level	Definition
3	By using a well-known enterprise architecture concept, modeling languages, and technique, has ability to oversee an entire architect of an organization, manage one or more team in gathering of required information, analyzing the required information, suggesting a solution(s) or strategy(ies) in making sure that: (1) the IT and company are in the same path; and (2) leads a company's business strategy and defines IT systems architecture to support that strategy, anticipating future needs to management, and maintaining all blueprints created. Responsible for a group of enterprise architect with no more than 10-50 in total.

Competency Level	Definition
2	By using a well-known enterprise architecture concept, modeling languages, and technique, has ability to supervise gathering of required information, analyzing the required information, suggesting a solution(s) or strategy(ies) in making sure that: (1) the IT and company are in the same path; and (2) leads a company's business strategy and defines IT systems architecture to support that strategy, anticipating future needs to management, and maintaining all blueprints created. Responsible for a group of enterprise architect with no more than 10 members in the team.
1	Working under supervision of a senior enterprise architect, by using a well-known enterprise architecture concept, modeling languages, and technique, has ability to gather required information, analysis, suggest a solution(s) or strategy(ies) in making sure that: (1) the IT and company are in the same path; and (2) leads a company's business strategy and defines IT systems architecture to support that strategy, anticipate future needs to management, and maintaining all blueprints created.

Skill	
Enterprise Architecture Design	
Sub-Area	
Security architect	
Competency	Definition
Level	
3	By using a well-known enterprise architecture concept, modeling languages, and technique, especially focused on “Security architecture”, has ability to oversee an entire security architect of an organization, manage one or more team in gathering of required information, analyzing the required information, suggesting a solution(s) or strategy(ies) in making sure that: (1) the IT security and company are in the same path; and (2) leads a company's business strategy and defines security systems architecture to support that strategy, anticipating future needs to management, and maintaining all blueprints created. Responsible for a group of enterprise architect with no more than 10-50 in total.

Competency Level	Definition
2	<p>By using a well-known enterprise architecture concept, modeling languages, and technique, especially focused on “Security architecture”, has ability to supervise a team in gathering required information, analyzing the gathered information, suggesting a solution(s) or strategy(ies) in making sure that: (1) the IT security and company are in the same path; and (2) leads a company's business strategy and defines security systems architecture to support that strategy, anticipating future needs to management, and maintaining all blueprints created. Responsible for a group of security architect with no more than 10 members in the team.</p>
1	<p>Working under supervision of a senior security architect, by using a well-known enterprise architecture concept, modeling languages, and technique, especially focused on “Security architecture”, has ability to gather required information, analysis, suggest a solution(s) or strategy(ies) in making sure that: (1) the IT security and company are in the same path; and (2) leads a company's business strategy and defines security systems architecture to support that strategy, anticipate future needs to management, and maintaining all blueprints created.</p>

Skill	
Enterprise Architecture Design	
Sub-Area	
Integration architect	
Competency	Definition
Level	
3	By using a well-known enterprise architecture concept, modeling languages, and technique, especially focused on “Integration architecture”, has ability to oversee an entire integration architect of an organization and manage one or more team in gathering required information, analyzing the information gathered, suggesting a solution(s) or strategy(ies) in making sure that: (1) the integration of all architects and company are in the same path; and (2) leads a company's business strategy and defines integration architecture to support that strategy, anticipate future needs to management, and maintaining the integrated blueprint created. Responsible for a group of security architect with no more than 10-50 members in total.

Competency Level	Definition
2	<p>By using a well-known enterprise architecture concept, modeling languages, and technique, especially focused on “Integration architecture”, has ability to supervise a team in gathering required information, analyzing the information gathered, suggesting a solution(s) or strategy(ies) in making sure that: (1) the integration of all architects and company are in the same path; and (2) leads a company's business strategy and defines integration architecture to support that strategy, anticipate future needs to management, and maintaining the integrated blueprint created. Responsible for a group of security architect with no more than 10 members in the team.</p>
1	<p>Working under supervision of a senior integration architect, by using a well-known enterprise architecture concept, modeling languages, and technique, especially focused on “Integration architecture”, has ability to gather required information, analysis, suggest a solution(s) or strategy(ies) in making sure that: (1) the integration of all architects and company are in the same path; and (2) leads a company's business strategy and defines integration architecture to support that strategy, anticipate future needs to management, and maintaining the integrated blueprint created.</p>

4. **Skill: Network and System Administration** comprises the following sub-skills:

4.1 Network Architect

4.2 Network Engineer

4.3 System Architect

4.4 System Engineer

Skill	
Network and System Administration	
Sub-Area	
Network architect	
Competency Level	Definition
3	Has ability to oversee an entire network architecture of an organization and manage one or more groups of network architects in using of network computer-aided design (CAD) software packages to create/optimize/maintain network designs, developing plans or budgets for network equipment replacement, and if required, estimating time and materials needed to complete network related projects. Responsible for a group of network architect with no more than 10-50 members in total.

Competency Level	Definition
2	Has ability to supervise using of network computer-aided design (CAD) software packages to create/optimize/maintain network designs, developing plans or budgets for network equipment replacement, and if required, estimating time and materials needed to complete network related projects. Responsible for a group of network architect with no more than 10 members in the team.
1	Working under supervision of a senior network architect, has ability to use network computer-aided design (CAD) software packages to create/optimize/maintain network designs, develop plans or budgets for network equipment replacement, and if required, estimate time and materials needed to complete network related projects.

Skill	
Network and System Administration	
Sub-Area	
Network engineer	
Competency	Definition
Level	
3	Has ability to oversee an entire network operation of an organization and manage one or more team to operational monitoring of the voice and network infrastructures, installs network hardware, conduct day to day operation of the networks and carrying out scheduled maintenance activities, resolution of network faults, carry out approved changes to the voice and network infrastructures, and maintain documentation of the environment and operational procedures. Responsible for a group of network engineer with no more than 10-50 members in total.
2	Has ability to supervise a team to operational monitoring of the voice and network infrastructures, installs network hardware, conduct day to day operation of the networks and carrying out scheduled maintenance activities, resolution of network faults, carry out approved changes to the voice and network infrastructures, and maintain documentation of the environment and operational procedures. Responsible for a group of network engineer with no more than 10 members in the team.

Competency Level	Definition
1	Work under supervision of senior network engineer, has ability to operational monitoring of the voice and network infrastructures, installs network hardware, conduct day to day operation of the networks and carrying out scheduled maintenance activities, resolution of network faults, carry out approved changes to the voice and network infrastructures, and maintain documentation of the environment and operational procedures.

Skill	
Network and System Administration	
Sub-Area	
System architect	
Competency	Definition
Level	
3	Has ability to oversee overall system architect of an organization and manage a team in developing high level design choices for the software, hardware, infrastructure, and interfaces used between them, determine development tools and techniques to be used, including validation requirements, communicating with various parties in an organization to evaluate feasibility of requirements and determine priorities for development with regard to business's goal(s) set by the organization. Responsible for a group of system architects with no more than 10-50 members in total.
2	Has ability to supervise a team in developing high level design choices for the software, hardware, infrastructure, and interfaces used between them, determine development tools and techniques to be used, including validation requirements, communicating with various parties in an organization to evaluate feasibility of requirements and determine priorities for development with regard to business's goal(s) set by the organization. Responsible for a group of system architects with no more than 10 members in the team.

Competency Level	Definition
1	Work under supervision of senior network engineer, has ability to develop high level design choices for the software, hardware, infrastructure, and interfaces used between them, determine development tools and techniques to be used, including validation requirements, communicate with various parties in an organization to evaluate feasibility of requirements and determine priorities for development with regard to business's goal(s) set by the organization.

Skill	
Network and System Administration	
Sub-Area	
System engineer	
Competency Level	Definition
3	Has ability to manage one or more them of system engineer in designing, implementing, and maintaining computer systems, software and networks include understanding complex system requirements, determining system specifications, and processes. Responsible for a group of system engineer with no more than 10 members in the team. Responsible for a group of system engineer with no more than 10-50 members in total.
2	Has ability to supervise design, implement, and maintain computer systems, software and networks include understanding complex system requirements, determining system specifications, and processes. Responsible for a group of system engineer with no more than 10 members in the team.
1	Work under supervision of senior network engineer, has ability to design, implement, and maintain computer systems, software and networks includes understanding complex system requirements, determining system specifications, and processes.

5. **Skill: Information System and Network Security** comprises the following sub-skills:

5.1 Network Security Analyst

5.2 Network Security Engineer

5.3 System Security Analyst

5.4 System Security Engineer

5.5 Data Security Analyst

5.6 Data Security Engineer

5.7 Information Security Management System Engineer

5.8 Data Privacy Engineer

Skill	
Information System and Network Security	
Sub-Area	
Network security analyst	
Competency Level	Definition
3	Has ability to manage one or more teams of network security analyst in planning and introducing appropriate procedures together with security measure that can be used to within an organization in order to protect its infrastructure from security breaches and computer viruses, when incident with regard to security occurred, investigating the issue and identify root of the problem, and promoting a proactive approach to the protect the organization's networking system. Responsible for a group of network security engineers with no more than 10-50 members in total.

Competency Level	Definition
2	Has ability to supervise a network security analysis team in planning and introducing appropriate procedures together with security measure that can be used to within an organization in order to protect its infrastructure from security breaches and computer viruses, when incident with regard to security occurred, investigating the issue and identify root of the problem, and promoting a proactive approach to the protect the organization's networking system. Responsible for a group of network security engineers with no more than 10 members in the team.
1	Work under supervision of senior network engineer, has ability to plan and introduce appropriate procedures together with security measure that can be used to within an organization in order to protect its infrastructure from security breaches and computer viruses, when incident with regard to security occurred, investigate the issue and identify root of the problem, and promote a proactive approach to the protect the organization's networking system.

Skill	
Information System and Network Security	
Sub-Area	
Network security engineer	
Competency Level	Definition
3	Has ability to manage one or more teams of network security engineers to gather and analyze network security needs, design, integrate, and installation of hardware and software, analyze and correct network problems, maintain and monitor security systems such as firewalls and intrusion detection systems. Responsible for a group of network security engineers with no more than 10-50 members in total.
2	Has ability to supervise a team to gather and analyze network security needs, design, integrate, and installation of hardware and software, analyze and correct network problems, maintain and monitor security systems such as firewalls and intrusion detection systems. Responsible for a group of network security engineers with no more than 10 members in the team.
1	Work under supervision of senior network engineer, has ability to gather and analyze network security needs, design, integrate, and installation of hardware and software, analyze and correct network problems, maintain and monitor security systems such as firewalls and intrusion detection systems.

Skill	
Information System and Network Security	
Sub-Area	
System security analyst	
Competency Level	Definition
3	Has ability to manage one or more team of system security analysts in developing a framework(s) for controls and levels of access, including develop standards, policies, and procedures, coordinate with facilities security, and recommending improvements for computer and terminal physical security. Responsible for a group of system security analysts with no more than 10-50 members in total.
2	Has ability to supervise a team in developing a framework for controls and levels of access, including develop standards, policies, and procedures, coordinate with facilities security, and recommending improvements for computer and terminal physical security. Responsible for a group of system security analysts with no more than 10 members in the team.
1	Work under supervision of senior network engineer, has ability to develop a framework for controls and levels of access, including develop standards, policies, and procedures, coordinate with facilities security, and recommend improvements for computer and terminal physical security.

Skill	
Information System and Network Security	
Sub-Area	
System security engineer	
Competency	Definition
Level	
3	Has ability to manage one or more team of system security engineers in developing and implementing security solutions, including the ongoing assessment and tracking of activities within organization according to required security guidelines across the enterprise computing environment, ensuring authorized access, monitoring information requests by new programming, and recommending improvements. Responsible for a group of system security engineers with no more than 10-50 members in total.
2	Has ability to supervise a team in developing and implementing security solutions, including the ongoing assessment and tracking of activities within organization according to required security guidelines across the enterprise computing environment, ensuring authorized access, monitoring information requests by new programming, and recommending improvements. Responsible for a group of system security engineers with no more than 10 members in the team.

Competency Level	Definition
1	Work under supervision of senior network engineer, has ability to develop and implement security solutions, including the ongoing assessment and tracking of activities within organization according to required security guidelines across the enterprise computing environment, ensure authorized access, monitoring information requests by new programming, and recommend improvements.

Skill	
Information System and Network Security	
Sub-Area	
Data security analyst	
Competency	Definition
Level	
3	Has ability to manage one or more team in communicating with users to discuss issues such as computer data access needs and security violations, developing and maintaining documents related to data security and emergency measures policies, procedures, and tests, monitoring use of data files and regulate access to safeguard information in computer files. Responsible for a group of data security analysts with no more than 10 members in the team. Responsible for a group of data security analysts with no more than 10-50 members in total.
2	Has ability to supervise a team in communicating with users to discuss issues such as computer data access needs and security violations, developing and maintaining documents related to data security and emergency measures policies, procedures, and tests, monitoring use of data files and regulate access to safeguard information in computer files. Responsible for a group of data security analysts with no more than 10 members in the team.

Competency Level	Definition
1	Work under supervision of senior data security analyst, has ability to communicate with users to discuss issues such as computer data access needs and security violations, develop and maintain documents related to data security and emergency measures policies, procedures, and tests, monitor use of data files and regulate access to safeguard information in computer files.

Skill	
Information System and Network Security	
Sub-Area	
Data security engineer	
Competency	Definition
Level	
3	Given a set of data security controls, procedures and assessments identified, has ability to manage one or more team of data security engineers in overseeing for any results or weaknesses identified, communicate security procedures to program management and the end customer, review and evaluate progress and results, and recommend major changes in procedures, if necessary. Responsible for a group of data security engineers with no more than 10-50 members in total.
2	Given a set of data security controls, procedures and assessments identified, has ability to supervise a team of data security engineers in overseeing for any results or weaknesses identified, communicate security procedures to program management and the end customer, review and evaluate progress and results, and recommend major changes in procedures, if necessary. Responsible for a group of data security analysts with no more than 10 members in the team.

Competency Level	Definition
1	Given a set of data security controls, procedures and assessments identified, by working under supervision of senior data security engineer, has ability to oversee for any results or weaknesses identified, communicate security procedures to program management and the end customer, review and evaluate progress and results, and recommend major changes in procedures, if necessary.

Skill	
Information System and Network Security	
Sub-Area	
Information Security Management System engineer	
Competency Level	Definition
3	Has ability to manage one or more teams in developing and continuously improving organization's information security management system according to an industrial standard(s) and best practices, designing, implementing and documenting information security concepts and controls for the organization, and performing information security audits and vulnerability assessments. Responsible for a group of ISMS engineers with no more than 10-50 members in total.
2	Has ability to supervise a team in developing and continuously improving organization's information security management system according to an industrial standard(s) and best practices, designing, implementing and documenting information security concepts and controls for the organization, and performing information security audits and vulnerability assessments. Responsible for a group of ISMS engineers with no more than 10 members in the team.

Competency Level	Definition
1	Work under supervision of senior network engineer, has ability to develop and continuously improve organization's information security management system according to an industrial standard(s) and best practices, design, implement and document information security concepts and controls in the organization, and perform information security audits and vulnerability assessments.

Skill	
Information System and Network Security	
Sub-Area	
Data Privacy Engineer	
Competency	Definition
Level	
3	Has knowledge in up-to-date cyber and computer crime law, and be able to manage one or more teams in analyzing and designing systems' architectures and all related technologies for privacy impact in order to ensure that organization compliant with their concerned privacy and data protection policies while maximizing digital outreach of the organization. Responsible for a group of data privacy engineers with no more than 10-50 members in the team.
2	Has knowledge in up-to-date cyber and computer crime law, and be able to supervise a team in analyzing and designing systems' architectures and all related technologies for privacy impact in order to ensure that organization compliant with their concerned privacy and data protection policies while maximizing digital outreach of the organization. Responsible for a group of data privacy engineers with no more than 10 members in the team.

Competency Level	Definition
1	Work under supervision of senior data privacy engineer, has knowledge in up-to-date cyber and computer crime law, and be able to analyze and design systems' architectures and all related technologies for privacy impact in order to ensure that organization compliant with their concerned privacy and data protection policies while maximizing digital outreach of the organization.

6. Skill: Cloud Computing comprises the following sub-skills:

6.1 Cloud Architect

6.2 Cloud Developer

6.3 Cloud Security Specialist

Skill Cloud Computing	
Sub-Area Cloud Architect	
Competency Level	Definition
3	Given a set of requirements of a cloud-based application, regardless of whether the requirements are for a new or existing software, has ability to lead technical aspect of all responsible projects and manage one or more team in, depending constraints in each cloud environment, designing, documenting, maintaining architecture for the application, and communicating the architecture to all stakeholders including end-users and management. Responsible for a group of developers with no more than 10-50 members in total.

Competency Level	Definition
2	Given a set of requirements of a cloud-based application, regardless of whether the requirements are for a new or existing software, has ability to lead technical aspect of a responsible project and supervise a team in, depending constraints in each cloud environment, designing, documenting, and maintaining architecture for the application. Responsible for a group of developers with no more than 10 members in the team.
1	Given a set of requirements of a cloud-based application, regardless of whether the requirements are for a new or existing software, under supervision of senior cloud architect, has ability to, depending constraints in each cloud environment, design, document, and maintain architecture for the application.

Skill	
Cloud Computing	
Sub-Area	
Cloud Developer	
Competency Level	Definition
3	Given a set of requirements of a cloud-based application, regardless of whether the requirements are for a new or existing software, has ability to lead technical aspect of all responsible projects and manage one or more team in working closely with analysts, designers, and related staff in proposing ideas for system development or configuration, depending constraints in each cloud environment, producing detailed specifications, writing the program codes or configuring system, and conducting unit-test of the software. Responsible for a group of developers with no more than 10-50 members in total.
2	Given a set of requirements of a cloud-based application, regardless of whether the requirements are for a new or existing software, has ability to lead technical aspect of a responsible project and supervise a team in working closely with analysts, designers, and related staff in proposing ideas for system development or configuration, depending constraints in each cloud environment, producing detailed specifications, writing the program codes or configuring system, and conducting unit-test of the software. Responsible for a group of developers with no more than 10 members in the team.

Competency Level	Definition
1	Given a set of requirements of a cloud-based application, regardless of whether the requirements are for a new or existing software, under supervision of senior cloud developer, has ability to work closely with analysts, designers, and related staff in proposing ideas for system development or configuration, depending constraints in each cloud environment, producing detailed specifications, writing the program codes or configuring system, and conducting unit-test of the software.

Skill	
Cloud Computing	
Sub-Area	
Cloud Security Specialist	
Competency Level	Definition
3	Has ability to lead technical aspect of all responsible projects and manage one or more team in defining security architecture for private cloud, designing, planning and implementing of risk mitigating security solutions. Work closely with development teams and product architecture team(s) to guide security direction and solutions alignment with industry best practices. Responsible for a group of developers with no more than 10-50 members in total.
2	Has ability to lead technical aspect of a responsible project and supervise a team in defining security architecture for private cloud, designing, planning and implementing of risk mitigating security solutions. Work closely with development teams and product architecture team(s) to guide security direction and solutions alignment with industry best practices. Responsible for a group of developers with no more than 10 members in the team.

Competency Level	Definition
1	Under supervision of senior cloud security specialist, has ability to define security architecture for private cloud, design, plan and implement of risk mitigating security solutions. Work closely with development teams and product architecture team(s) to guide security direction and solutions alignment with industry best practices

7. **Skill: Mobile Computing** comprises the following sub-skills:

7.1 Mobile Developer

7.2 Mobile Networking

7.3 Mobile Security

Skill Mobile Computing	
Sub-Area Mobile Developer	
Competency Level	Definition
3	Given a set of requirements of a mobile application, regardless of whether the requirements are for a new or existing software, has ability to lead technical aspect of all responsible projects and manage one or more team in working closely with analysts, designers, and related staff in proposing ideas for system improvements, producing detailed specifications, writing the program codes, conducting unit-test of the software. Responsible for a group of developers with no more than 10-50 members in total.

Competency Level	Definition
2	<p>Given a set of requirements of a mobile application, regardless of whether the requirements are for a new or existing software, has ability to lead technical aspect of a responsible project and supervise a team in working closely with analysts, designers, and related staff in proposing ideas for system improvements, producing detailed specifications, writing the program codes, conducting unit-test of the software. Responsible for a group of developers with no more than 10 members in the team.</p>
1	<p>Given a set of requirements of a mobile application, regardless of whether the requirements are for a new or existing software, under supervision of senior mobile developer, has ability to work closely with analysts, designers, and related staff in proposing ideas for system improvements, producing detailed specifications, writing the program codes, and conducting unit-test of the software.</p>

Skill	
Mobile Computing	
Sub-Area	
Mobile Networking	
Competency Level	Definition
3	Has ability to manage one or more team in implementing, managing and supporting mobile devices and environments, include integrating mobility with wired and wireless LANs. Responsible for a group of engineers with no more than 10-50 members in total.
2	Has ability to supervise a team in implementing, managing and supporting mobile devices and environments, include integrating mobility with wired and wireless LANs. Responsible for a group of engineers with no more than 10 members in the team.
1	Under supervision of senior mobile networking engineers, has ability to implement, manage and support mobile devices and environments, include integrating mobility with wired and wireless LANs.

Skill	
Mobile Computing	
Sub-Area	
Mobile Security	
Competency Level	Definition
3	Has ability to manage one or more team in either creating secure mobile application or implementing security in mobile networking environments, or both. Responsible for a group of engineers with no more than 10-50 members in total.
2	Has ability to supervise a team in either creating secure mobile application or implementing security in mobile networking environments, or both. Responsible for a group of engineers with no more than 10 members in the team.
1	Under supervision of senior mobile security engineers, has ability to either create secure mobile application or implement security in mobile networking environments, or both.

8. **Skill: Social Business** comprises the following sub-skills:

- 8.1 Content Creator
- 8.2 Community Manager
- 8.3 Advertiser
- 8.4 Analyst

Skill	
Social Business	
Sub-Area	
Content Creator	
Competency Level	Definition
3	Given a set of business requirements, has ability to lead both technical and non-technical aspects of all responsible projects and manage one or more team in content creation for social media posts, including blog posts, images, and videos. In addition, being able to communicate the creation to all stakeholders including end-users and management. Responsible for a group of content creators with no more than 10-50 members in total.

Competency Level	Definition
2	Given a set of business requirements, has ability to manage a team in both technical and non-technical aspects of content creation for social media posts, including blog posts, images, and videos. Responsible for a group of content creators with no more than 10 members in the team.
1	Given a set of business requirements, under supervision of senior content creator, has ability to create content for social media posts. This includes blog posts, images, and videos.

Skill	
Social Business	
Sub-Area	
Community Manager	
Competency Level	Definition
3	Given a set of business requirements, has ability to manage one or more team in engage and connect with customers on social media. This includes listening to conversations on social media, replying to comments, and organizing social media events. In addition, being able to communicate the overall picture of the community with stakeholders and management. Responsible for a group of developers with no more than 10-50 members in total.
2	Given a set of business requirements, has ability to manage a team in engaging and connecting with customers on social media. This includes listening to conversations on social media, replying to comments, and organizing social media events. Responsible for a group of Community Managers with no more than 10 members in the team.
1	Given a set of business requirements, under supervision of senior Community Manager, has ability to engage and connect with customers on social media. This includes listening to conversations on social media, replying to comments, and organizing social media events.

Skill	
Social Business	
Sub-Area	
Advertiser	
Competency Level	Definition
3	Given a set of business requirements, has ability to manage one or more team experimenting with different ad types, analyzing the results of the social media ads, and refining ad campaigns for maximum revenue for companies. In addition, being able to communicate the overall status of advertising to all stakeholders and management. Responsible for a group of advertisers with no more than 10-50 members in total.
2	Given a set of business requirements, has ability to manage a team in experimenting with different ad types, analyzing the results of the social media ads, and refining ad campaigns for maximum revenue for companies. Responsible for a group of advertisers with no more than 10 members in the team.
1	Given a set of business requirements, under supervision of senior advertiser, has ability to experiment with different ad types, analyze the results of the social media ads, and refine ad campaigns for maximum revenue for companies.

Skill	
Social Business	
Sub-Area	
Analyst	
Competency Level	Definition
3	Given a set of business requirements, has ability to manage one or more team in analyzing data such as engagement rates, traffic, click-through rates, conversions, and, in some cases, revenue. In addition, being able to communicate the overall picture of the analysis to all stakeholders and management. Responsible for a group of analysts with no more than 10-50 members in total.
2	Given a set of business requirements, has ability to manage a team in analyzing data such as engagement rates, traffic, click-through rates, conversions, and, in some cases, revenue. Responsible for a group of analysts with no more than 10 members in the team.
1	Given a set of business requirements, under supervision of senior analyst, has ability to analyze data such as engagement rates, traffic, click-through rates, conversions, and, in some cases, revenue.

9. **Skill: Big Data** comprises the following sub-skills:

9.1 Data Hygienist

9.2 Data Explorer

9.3 Business Solution Architect

9.4 Data Scientist

9.5 Campaign Expert

Skill	
Big Data	
Sub-Area	
Data Hygienist	
Competency Level	Definition
3	Given a set of business and domain requirements together with problem at hand, has ability to manage one or more team in cleansing and ensuring accuracy of the data. In addition, being able to communicate the overall picture of data quality to all stakeholders and management. Responsible for a group of data hygienists with no more than 10-50 members in total.
2	Given a set of business and domain requirements together with problem at hand, has ability to manage a team in cleansing and ensuring accuracy of the data. Responsible for a group of data hygienists with no more than 10 members in the team.
1	Given a set of business and domain requirements together with problem at hand, under supervision of senior, has ability to clean and ensure accuracy of the data.

Skill	
Big Data	
Sub-Area	
Data Explorer	
Competency Level	Definition
3	Given a set of business and domain requirements together with problem at hand and data that has been cleaned, has ability to manage one or more team in selecting relevant data to the question at hand. In addition, being able to communicate the overall picture of data availability to all stakeholders and management. Responsible for a group of data explorers with no more than 10-50 members in total.
2	Given a set of business and domain requirements together with problem at hand and data that has been cleaned, has ability to manage a team in selecting relevant data to the question at hand. Responsible for a group of data explorers with no more than 10 members in the team.
1	Given a set of business and domain requirements together with problem at hand and data that has been cleaned, under supervision of senior data explorer, has ability to select relevant data to the question at hand.

Skill	
Big Data	
Sub-Area	
Business Solution Architect	
Competency Level	Definition
3	Given a set of business and domain requirements together with problem at hand and selected set of cleaned data, has ability to manage one or more team in preparing the selected data, so they are ready for analysis. In addition, being able to communicate the overall picture of data preparation process to all stakeholders and management. Responsible for a group of business solution architects with no more than 10-50 members in total.
2	Given a set of business and domain requirements together with problem at hand and selected set of cleaned data, has ability to manage a team in preparing the selected data, so they are ready for analysis. Responsible for a group of business solution architects with no more than 10 members in the team.
1	Given a set of business and domain requirements together with problem at hand and selected set of cleaned data, under supervision of senior business solution architect, has ability to prepare the selected data, so they are ready for analysis.

Skill	
Big Data	
Sub-Area	
Data Scientist	
Competency Level	Definition
3	Given a set of business and domain requirements together with problem at hand and data that has been prepared, has ability to manage one or more team in based on the organized data, creating analytics models that answer the question. In addition, being able to communicate the overall picture of progress and issues on data modeling to all stakeholders and management. Responsible for a group of data scientists with no more than 10-50 members in total.
2	Given a set of business and domain requirements together with problem at hand and data that has been prepared, has ability to manage a team in, based on the organized data, creating analytics models that answer the question. Responsible for a group of data scientists with no more than 10 members in the team.
1	Given a set of business and domain requirements together with problem at hand and data that has been prepared, under supervision of senior data scientist, has ability to, based on the organized data, create analytics models that answer the question.

Skill	
Big Data	
Sub-Area	
Campaign Expert	
Competency Level	Definition
3	Given a set of business and domain requirements together with problem at hand and models that have been developed, has ability to manage one or more team in turning the models into results. For example, which customer should get what message and when. In addition, being able to communicate the overall picture of progress and issues in turning the models into results to all stakeholders and management. Responsible for a group of campaign experts with no more than 10-50 members in total.
2	Given a set of business and domain requirements together with problem at hand and models that have been developed, has ability to manage a team in turning the models into results. For example, which customer should get what message and when. Responsible for a group of campaign experts with no more than 10 members in the team.
1	Given a set of business and domain requirements together with problem at hand and models that have been developed, under supervision of senior campaign expert, has ability to turn the models into results. For example, which customer should get what message and when

10. Skill: Internet of Things (IoT) comprises the following sub-skills:

- 10.1 IoT System Analyst
- 10.2 IoT System Designer
- 10.3 IoT Prototyping Engineer
- 10.4 IoT System Tester
- 10.5 IoT System Engineer

Skill	
Internet of Things (IoT)	
Sub-Area	
IoT System Analyst	
Competency Level	Definition
3	Given a set of business requirements and details of target environment, has ability to manage one or more team in analyze and convert the given set of business requirements to system requirements. In addition, being able to communicate the overall picture of existing system to all stakeholders and management. Responsible for a group of system analysts with no more than 10-50 members in total.
2	Given a set of business requirements and details of target environment, has ability to manage a team in analyzing and converting the given set of business requirements to system requirements. Responsible for a group of system analysts with no more than 10 members in the team.

Competency Level	Definition
1	Given a set of business requirements and details of target environment, under supervision of senior system analyst, has ability to analyze and convert the given set of business requirements to system requirements.

Skill	
Internet of Things (IoT)	
Sub-Area	
IoT System Designer	
Competency Level	Definition
3	Given a set of business requirements, details of target environment and result from system analysis process, has ability to manage one or more team in designing an IoT-based system that answer business requirements. In addition, being able to communicate the overall picture of design of a system to all stakeholders and management. Responsible for a group of system designers with no more than 10-50 members in total.
2	Given a set of business requirements, details of target environment and result from system analysis process, has ability to manage a team in designing an IoT-based system that answer business requirements. Responsible for a group of system designers with no more than 10 members in the team.
1	Given a set of business requirements, details of target environment and result from system analysis process, under supervision of senior system designer, has ability to design an IoT-based system that answer business requirements.

Skill	
Internet of Things (IoT)	
Sub-Area	
IoT Prototyping Engineer	
Competency Level	Definition
3	Given a set of business requirements, details of target environment and design of a system, has ability to manage one or more team in using a prototyping tools to develop a set of rapid prototypes that can be used to effectively communicate with project owner(s). In addition, being able to communicate the overall picture of progress and issues in prototyping to all stakeholders and management. Responsible for a group of prototyping engineers with no more than 10-50 members in total.
2	Given a set of business requirements, details of target environment and design of a system, has ability to manage a team in using a prototyping tools to develop a set of rapid prototypes that can be used to effectively communicate with project owner(s). Responsible for a group of prototyping engineers with no more than 10 members in the team.
1	Given a set of business requirements, details of target environment and design of a system, under supervision of senior prototyping engineer, has ability to use a prototyping tools to develop a set of rapid prototypes that can be used to effectively communicate with project owner(s).

Skill	
Internet of Things (IoT)	
Sub-Area	
IoT System Tester	
Competency Level	Definition
3	Given a set of business requirements, details of target environment, has ability to manage one or more team in designing test cases, performing system integration test and load test of system, including be able to effectively communicate result of testing. In addition, being able to communicate the overall picture of test result to all stakeholders and management. Responsible for a group of IoT system testers with no more than 10-50 members in total.
2	Given a set of business requirements, details of target environment, has ability to manage a team in designing test cases, performing system integration test and load test of system, including be able to effectively communicate result of testing. Responsible for a group of IoT system testers with no more than 10 members in the team.
1	Given a set of business requirements, details of target environment, under supervision of senior IoT system tester, has ability to design test cases, perform system integration test and load test of system, including be able to effectively communicate result of testing.

Skill	
Internet of Things (IoT)	
Sub-Area	
IoT System Engineer	
Competency	Definition
Level	
3	Given a set of business requirements, details of target environment, design of a system and results from prototyping process, has ability to manage one or more team in developing embedded system software that enables access to the hardware such as flash memory, GPIOs, and serial interfaces. In addition, being able to communicate the overall picture of IoT system development to all stakeholders and management. Responsible for a group of IoT system engineers with no more than 10-50 members in total.
2	Given a set of business requirements, details of target environment, design of a system and results from prototyping process, has ability to manage a team in developing embedded system software that enables access to the hardware such as flash memory, GPIOs, and serial interfaces. Responsible for a group of IoT system engineers with no more than 10 members in the team.

Competency Level	Definition
1	Given a set of business requirements, details of target environment, design of a system and results from prototyping process, under supervision of senior IoT system engineer, has ability to develop embedded system software that enables access to the hardware such as flash memory, GPIOs, and serial interfaces.



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