

# **Information and Communications Technology (ICT) Sector Taxonomy Principles and Categories (ICT Sector Classification)**

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## 1. Executive Summary

The Information and Communications Technology (ICT) Sector Taxonomy Principles and Categories (“**ICT Classification**”) seeks, (i) to establish Qatar’s national ICT sector taxonomy principles and categories to help better understand the ICT sector’s business maturity in Qatar, (ii) to establish a national framework that supports further development of relevant policies, (iii) to provide guidance for companies in the ICT sector on mapping their ICT products and services against an established sector classification including where on the value chain their business stands, and (iv) to enable all stakeholders to better assess the overall sector and conduct outcome-driven analyses.

The domains considered under the so called “technology umbrella” of the ICT Classification include:

1. Information Technology (IT), inclusive of:
  - a. Traditional information technology - refers to the use of any computers, storage, networking and other physical devices, infrastructure, and processes to create, process, store, secure and exchange all forms of electronic data.
  - b. Emerging technologies (ET) – refer to innovative technologies that have been recently developed, are underdeveloped, or will be developed within the next few years, and that are creating, or are expected to create, significant social or economic effects.
2. Communications Technology (CT)
  - a. Technologies related to offering services which provide access to voice, internet, and data services through telecommunications networks and inclusive of all telecommunications standards.
  - b. CT is considered as a separate category due to following reasons: (1) The size and relevance of the telecommunications sector are still significant; (2) Including a telecommunications category is aligned with leading benchmarks; (3) It allows visibility to track the shift of telecommunication-based businesses towards provision of IT products and services; (4) It falls into CRA’s mandate to regulate Qatar’s telecommunications sector.

Currently, Operating Technologies (OT) are not considered in the ICT Classification. OT refers to technologies which are used in industrial setups and environments. as per the CRA Strategy 2020-2024 ICT sector definition used as a baseline to build this ICT Classification, OT falls outside the scope of this definition. It shall be note that in future review cycles of the Classification, OT may be considered to be potentially added as an additional layer based on market evidence or strategy revision.

The developed ICT Classification has three levels of granularity: Category 1, Category 2, and Category 3. Adjacent to these three categories, a horizontal layer of value chain activities (e.g., R&D, sales) is added to map the business profiles of local market players across all categories.

Throughout the document, “Classification” refers to the total of taxonomy principles and structure, including the classification of ICT activities and the categories across the *value chain*.

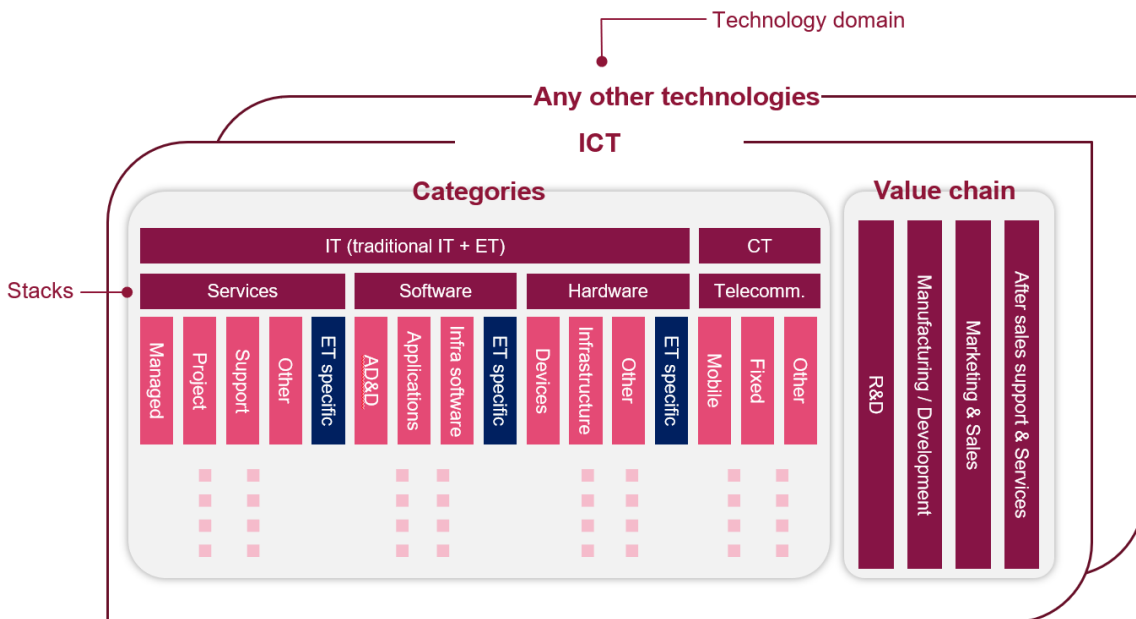


Figure 1: Overview of the ICT Classification Structure

The ICT Classification is designed to be inclusive and activity-based, as businesses could be (and typically are) active across several aspects of the classification (multiple categories and sub-categories of business activities, as well as value chain aspects). It is assumed that underlying

technologies might change, but the activities will remain. Companies expand and develop across the activities defined in the classification, as the spectrum of activities covered by one player may change. For example, trends show telco companies are increasingly developing into multiple IT-related activities and into the IT sector in general.

## 2. Context

The Government of Qatar delineated its overall development goals in the “Qatar National Vision 2030” and cascaded these goals in its National Development Strategies, highlighting the transformative role the ICT sector needs to play in the future of the country. The CRA is one of the key stakeholders driving the sector’s development guided by the country’s vision. It regulates the ICT sector and supports its competitiveness, with the aim of enabling access to advanced, innovative, and reliable services and balancing the rights of consumers with the objectives of service providers.

Within this context, the CRA Strategy 2020-2024 (CRA Strategy) was designed to fulfil CRA’s mandate and to support the vision and underlying strategies by building the foundations for a knowledge-based economy through the ICT sector.

The CRA Strategy highlights the need to develop comprehensive sector performance measurements and includes, in its list of initiatives, the launch of an ICT sector survey dedicated to fill the data and information gap related to the industry, with a focus on the Information Technology sub-sector where such gap is most substantial.

This document aims to provide a comprehensive and relevant taxonomy principles and categories for Qatar’s ICT sector by analyzing various international methodologies and tailoring a best-of-breed approach to the local Qatari context and CRA purposes. The ICT Classification will serve as a foundation for conducting further regular cycles of the ICT Survey and for prospective sector assessment and analysis.

The Classification will also support and enable further CRA initiatives, including building a comprehensive data base of Qatar’s ICT businesses and making available a published list of the active market players with their business activities categorized as per this sector classification.

### 3. Objectives

The ICT Classification serves the following main objectives:

- 1) Create sector specific categorization for Qatar's ICT sector to comprehensively cover locally provided ICT products and services and serve as a base to rank and assess the level of business maturity of the overall sector and individual industry players and registered enterprises.
- 2) Establish a national framework to better understand Qatar's ICT market that is open, structured and informative for all industry stakeholders, and to support further development of relevant and state-of-art sector governance models, policies, and regulations.
- 3) Provide guidance for companies in the ICT sector on mapping their ICT products and services against an established sector classification including where on the value chain their business stands.
- 4) Enable all stakeholders to better assess the overall sector and conduct outcome-driven analyses (including market maturity assessments, value chain analyses, demand/supply gap analyses across categories, investment gap analyses) and provide a base for further market segmentation and policy development.

In the subsequent chapters, this ICT Classification has been detailed to discuss the following:

- a. Background on the ICT sector definition as per the CRA Strategy
- b. Approach and methodology, including references and best practice, guiding principles and applied criteria.
- c. Detailed description of the classification structure and definitions.
- d. Linkage to other classifications, e.g., ISIC codes, illustrative use cases.

## 4. Scope

OECD defines the ICT sector as combining manufacturing and services industries whose products primarily fulfil or enable the function of information processing and communication by electronic means, including transmission and display. The ICT sector contributes to technological progress, output and productivity growth. As per OECD, its impact can be examined in several ways: directly, through its contribution to output, employment or productivity growth, or indirectly, as a source of technological change affecting other parts of the economy<sup>1</sup>.

For building this ICT-specific taxonomy, the domains considered under the so-called “technology umbrella” are described below:

### 1) Information Technology (IT)

IT comprises of both traditional Information Technology and Emerging Technologies (ET)<sup>2</sup>. The term “Emerging Technologies” has been widely adapted and shall be understood as a reference to technology that has a development and/or application that is figuratively emerging into prominence; the term helps to differentiate between relatively new and established technologies. Therefore, traditional IT and ET are considered as follows:

- a. Traditional Information Technology refers to the use of any computers, storage, networking and other physical devices, infrastructure, and processes to create, process, store, secure and exchange all forms of electronic data.
- b. Emerging technologies (ET) are innovative technologies that have been recently developed, are under development, or will be developed within the next few years, and that are creating, or are expected to create, significant social or economic effects.

Seven key ET areas have been identified and shortlisted based on secondary research and expert guidance to identify technology areas that (a) have a potential strong future impact

<sup>1</sup> [https://www.oecd-ilibrary.org/science-and-technology/information-and-communication-technology-ict/indicator-group/english\\_04df17c2-en#:~:text=The%20ICT%20sector%20combines%20manufacturing,progress%2C%20output%20and%20productivity%20growth.](https://www.oecd-ilibrary.org/science-and-technology/information-and-communication-technology-ict/indicator-group/english_04df17c2-en#:~:text=The%20ICT%20sector%20combines%20manufacturing,progress%2C%20output%20and%20productivity%20growth.)

<sup>2</sup> In this document, Emerging Technologies are meant to include only fundamental technologies, no technology concepts, such as digital twins or metaverse.



on the sector, (b) have a current substantial growth of perceived relevance, (c) are balanced towards being distinct on the one hand and exhaustive on the other hand, (d) can be examined along the entire technology stack (hardware/infrastructure, software, services):

- Cybersecurity
- Big Data and Artificial Intelligence / Machine Learning
- Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality)
- Internet of Things (IoT) / Machine-to-Machine (M2M)
- Blockchain / Distributed Ledger
- Edge & Cloud computing
- Other Emerging Technologies, including but not limited to Next Gen Networks (e.g., laser and quantum communications), Next Gen Computing (e.g., quantum computing).

Each of the above mentioned ET areas refers to a theme that encompasses multiple underlying technologies for classification purposes. While Cybersecurity for instance is not a specific technology itself, the term refers to the underlying technologies, i.e., technologies linked to the protection of computer systems and networks.

This ICT Classification considers a wider scope of ET compared to what the CRA Strategy has considered, further detailing the ICT sector definition through incorporating additional relevant technologies and thus leading to a more holistic scope and approach to comprehending the sector (See Figure 2).

### CRA Strategy 2020-2024

CRA's strategy addresses emerging technologies (ET) in initiatives relating to the IT and telco sectors:

- ✓ • **Blockchain/DLT:** "Develop a national blueprint for blockchain/Distributed Ledger Technology" (IT-initiative)
- ✓ • **AI:** "Contribute to Artificial Intelligence Framework" (IT-initiative)
- ✓ • **IoT/M2M:** Establish Internet of Things/Machine-to-Machine regulatory framework (Telecommunications initiative)

Furthermore, the strategy touches upon other ETs, e.g., regulations on cybersecurity, however without these being reflected as initiatives

- ✓ Reflected in strategy and classification document
- + Added in classification document

### CRA ICT Classification

Seven key ET areas are identified and shortlisted, impacting the entire technology stack (hardware/infrastructure, software, services):

- + 1. Cybersecurity
- ✓ 2. Big Data and Artificial Intelligence (AI) / Machine Learning
- + 3. Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality)
- ✓ 4. Internet of Things (IoT) / Machine-to-Machine (M2M)
- ✓ 5. Distributed Ledger (DLT) / Blockchain
- + 6. Edge computing
- + 7. Other Emerging Technologies, including but not limited to Next Gen Networks (e.g., laser and quantum communications), Next Gen Computing (e.g., quantum computing)

**Figure 2: Comparison of Emerging Technologies list of CRA Strategy 2020-2024 and the current ICT Classification**

## 2) Communications Technology (CT)

CT is defined as technologies related to offering services which provide access to voice, internet, and data services through telecommunications networks and inclusive of all telecommunications standards (fixed, mobile, satellite, etc.). Communications technology and telecommunications are used interchangeably in this document.

CT as a category generally refers to a far less companies than IT, i.e., mainly large telecommunication companies and licensed telecommunications networks and service providers. However, CT is maintained as a separate category due to following reasons:

- a. The size and relevance of the telecommunications sector are still significant, both for the overall economy as well from the perspective of an enabler of the IT sector
- b. Including a telecommunications category is aligned with leading benchmarks, e.g., the ISIC classification.
- c. It allows visibility to track the shift of telecommunication-based businesses towards provision of IT products and services.

- d. It falls into CRA's mandate to regulate Qatar's telecommunications sector; thus, CT is included in the ICT classification.

### 3) Operating Technologies (OT)

OT refers to technologies which are used in industrial setups and environments (such as Scada). OT is outside the scope of CRA as per the CRA Strategy and therefore not considered for the ICT classification. However, if a future strategy revision or market evidence suggest encompassing OT, it may be added as an additional layer.

In summary, for the above-mentioned purposes and based on all relevant references and applicable definitions, the ICT sector has thus been defined to be comprised of Information Technology (IT), including both Traditional Information Technology and Emerging Technologies, and the Communications Technology sector (CT).

## 5. Background

CRA's mandate as a regulator of the ICT sector and the sector definition as provided by the CRA Strategy have been the starting point for defining and shortlisting the business activities to be included in the ICT sector classification.

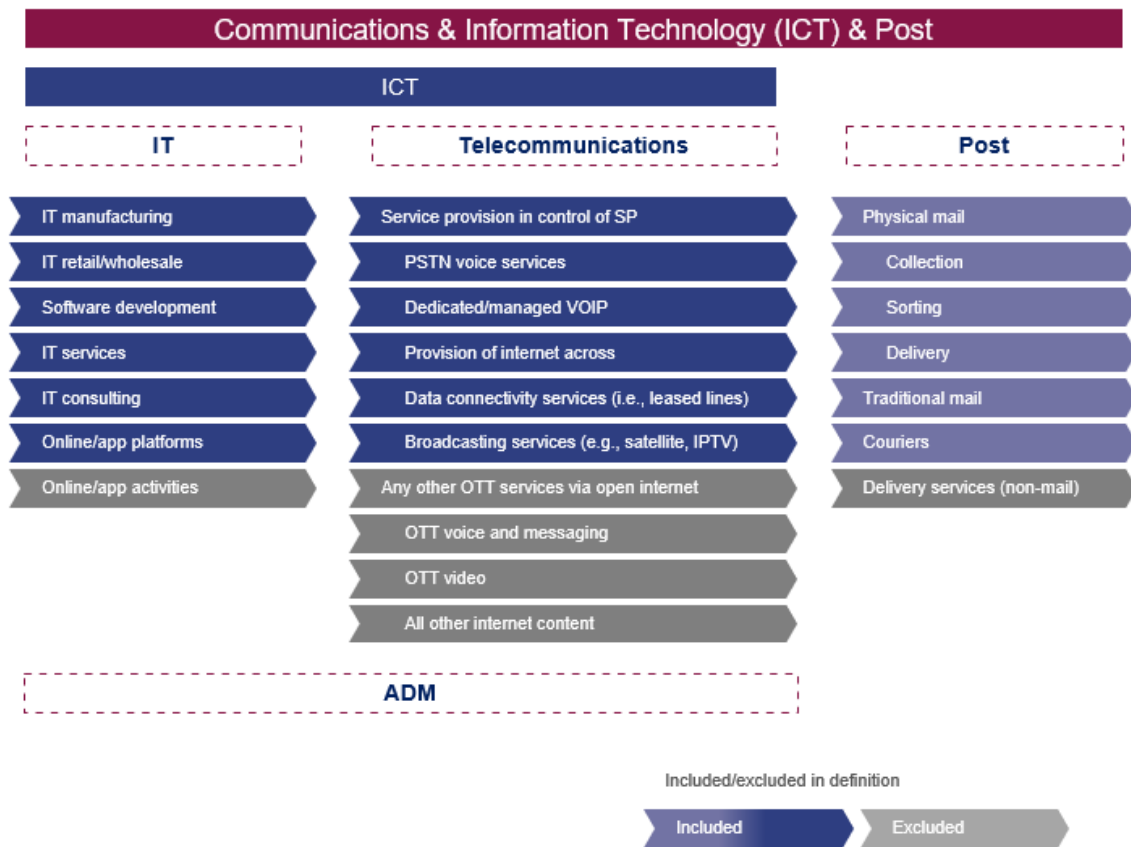


Figure 3: CRA Strategy 2020-2024, ICT sector definition

In the Strategy document, the ICT sector is defined to cover two main pillars: IT and telecommunications. Whilst IT includes IT manufacturing, IT retail, IT services, IT consulting, among others, telecommunications include provision of internet access, data connectivity services, among others (See Figure 3). Telecommunications shall be referred to Communications Technology (CT) as both terms are used interchangeably.

The CRA Strategy recommends further detailing the ICT sector definition. The ICT Classification addresses this particular Strategy's recommendation and further structures the sector into multiple, more detailed levels of ICT categories, while an additional layer of the ICT value chain is introduced too.

## 6. Methodology and Approach

This chapter explains how the current ICT classification has been developed:

- highlighting the current limitations that drive the need for new ICT taxonomy principles and categories and
- describing the key principles and general approach for setting up the suggested classification system.

The ICT classification detailed in this document has been developed as part of the research framework design for the CRA ICT Sector Research Study 2022. The classification categories and principles have been validated through the CRA ICT Survey conducted between March and June 2022. The overall categories structure and logic have been refined as per feedback from the survey respondents on their ability to classify their business activities.

The current ICT classification has been finalized based on further inputs received from key stakeholders, including the Planning and Statistics Authority and the licensing platforms in Qatar within the public consultation (conducted between September and December 2022) on the relevance of the classification in the context of Qatar's ICT market.

### 6.1 Initial situation

The need for a new industry taxonomy for the Qatar ICT sector is clear. Currently, a detailed classification system that reflects the specific market perspective and regulatory requirements is missing. Most government registers and databases<sup>3</sup> available in Qatar and relevant to the ICT sector apply non-sector specific categories, mostly on the United Nations ISIC coding system, which presents obvious limitations when applied in terms of categorization and in-depth analysis of the ICT industry.

The ISIC taxonomy does not provide a specific directory for the ICT sector – instead, it encompasses all sectors' economic activities. As much as there is a dedicated Section J Information and Communication, which also includes media-related activities, such as publishing and content

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<sup>3</sup> For example, PSA national accounts, MOCI business registration process, CRA ICT sector reports and measurements, etc.

production. Therefore, the ISIC-based proxy definition for ICT lacks precision and granularity and cannot be fully aligned with the CRA Strategy ICT definition. It also fails to include some other important ICT-related business activities, e.g., ICT-specific hardware manufacturing. Hence, using the ISIC Section J Information and Communication coding categories as a classification structure is found not suitable, nor sufficient (See Table 11 in the Appendix).

Alternatively, another ISIC directory can be referred to the ICT sector, as an aggregation for the ICT sector” (See Table 10 in the Appendix). However, it also has limitations in defining ICT activities. It is not a directory, but an aggregation of ICT-related ISIC codes, and it does not have a cascaded structure that can move from higher to more granular levels of detail.

Further to the above, the latest ISIC revision was published by the United Nations Statistics Division in 2008<sup>4</sup>. Therefore, it has limitations in classifying new ICT products and services that have emerged in the market over the past 10+ years and are currently core drivers of the ICT industry development. For example, software has diversified in many directions to serve various new market demands and use cases, but only one ISIC code (5820) for software publishing exists. More generally, most relevant segments demand more granularity to reflect current market developments.

Therefore, to overcome the limitations of the ISIC classification — not allowing relevant sector segmentation and depth, measurements, or analysis — a new taxonomy was found necessary to be defined. This new ICT-specific classification system is aimed to overcome the existing limitations of the ISIC code-based system, as well as serve the purpose of CRA as an ICT regulator and key use cases for both government policy makers and sector players more generally.

## 6.2 Key principles

The developed ICT Classification is based on the following general guiding principles:

- 1) Comprehensiveness - ensure it covers all main and subsidiary business activities and services of the ICT sector.

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<sup>4</sup> Source: ISIC revision 4, United Nations, Statistics Division (2008), [https://unstats.un.org/unsd/publication/seriesm/seriesm\\_4rev4e.pdf](https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf)

- 2) Exclusiveness - ensure no overlaps exist among the different categories to avoid one service/product being classified into multiple categories.
- 3) International perspective - secure comparability with other country/regional market data by being aligned with other relevant international classifications.
- 4) Future readiness - reflect new and high-impact market trends based on new technologies; be flexible and accommodating of future ICT sector changes.
- 5) Granularity - structure classification in multiple layers (category levels) to be comprehensive and layered enough to reflect the full range of business activities within the ICT sector.
- 6) Relevance - contain enough relevant ICT-tailored components, instead of staying on a general/aggregated level, relevant in local market context.

The ICT Classification follows a balanced approach across five dimensions of considerations (See Figure 4) and aims to...

- A) ... strike a balance between simplicity vs. complexity of categorization.
- B) ... support both the measurement of the ICT sector in Qatar, as well as its development
- C) ... focus both on categories that are relevant in Qatar today, as well as on currently small categories with a high growth and/or future potential for Qatar.
- D) ... include current technologies while ensuring it can be updated regularly with potential future technologies.
- E) ... strike a balance between the comparability of categories to other countries whilst tailoring the categorization to Qatar's structure and requirements.

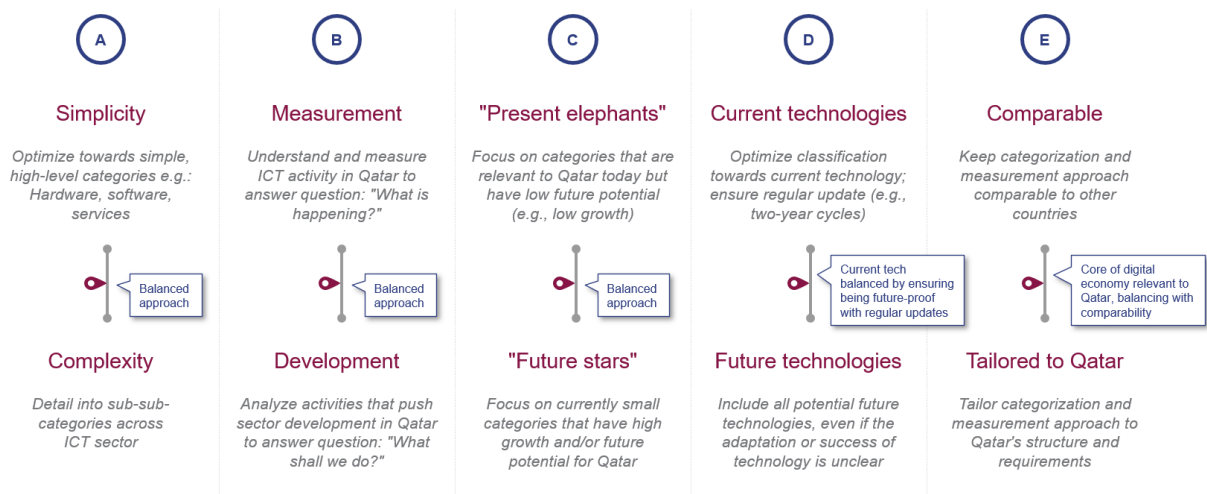


Figure 4: Multi-dimensional balanced approach for the ICT Classification

### 6.3 Taxonomy development approach

To gain a better understanding, various ICT taxonomy references have been listed based on research on the available international classification standards and best practices from benchmark countries and relevant peers. The key references considered include<sup>5</sup>:

- Global Industry Classification Standard
- International Standard Industrial Classification (ISIC)
- North American Industry Classification System
- UK Standard Industrial Classification
- KSA CITC IT/ET Sector Classification

<sup>5</sup> <https://www.msci.com/our-solutions/indexes/gics#:~:text=GICS%C2%AE%20is%20an%20industry,consistent%20and%20exhaustive%20industry%20definitions.>  
<https://unstats.un.org/unsd/classifications/Econ/isic>  
<https://www.naics.com/>  
<https://www.ons.gov.uk/methodology/classificationsandstandards/ukstandardindustrialclassificationofeconomicactivities>  
<https://www.citc.gov.sa/en/services/tech/PublishingImages/Pages/default/ITETSectorClassification.pdf>  
[https://www.idc.com/getdoc.jsp?containerId=IDC\\_P336](https://www.idc.com/getdoc.jsp?containerId=IDC_P336)  
<https://doi.org/10.1787/ab16c396-en>



- IDC Worldwide Black Book Taxonomy
- OECD taxonomy and definition of ICT sector

The above references have been shortlisted based on the key principles mentioned in Section 6.2 above. These principles are seen as criteria to evaluate each referenced classification, as follows:

- International perspective: level of comparability against other available data under the same classification; the more worldwide use, the better.
- Being up-to-date: extent of capturing new market trends, market dynamics, and shifting business trends in the ICT industry.
- Serve required level of granularity: level of hierarchies and details. The more hierarchies in the structure the better the ability to segment the market into multiple levels; also, the more sub-segments the more detailed categorization is possible.
- Relevance for ICT sector: level of comprehensiveness and applicability for the ICT sector.

Assuming that each criterion is equally important, the following three references have been shortlisted (See Figure 5):

#### 1) International Standard Industrial Classification (ISIC)

ISIC is considered the backbone of industry classifications globally. For example, the North American Industry Classification System (NAICS) has an official mapping with ISIC to build connectivity. As mentioned earlier, it also applies as a base for alignment with existing classification systems in Qatar. Therefore, while the ISIC system is neither up-to-date, nor entirely relevant to the ICT sector, it brings a significant background in establishing the basic context and logic.



































#### 2) KSA CST Information Technology and Emerging Technologies (IT/ET) Sector Classification

Since KSA is a regional peer, its sector performance and governance present many comparable characteristics, with direct implications on the sector taxonomy (albeit more tailored to IT than ICT). Released in March 2021, the Saudi Arabia's Space & Technology Commission sector classification system is equally focused on Emerging Technologies, which makes it future-oriented. However, whilst long-refined conversion tables allow

comparability between more established taxonomies, the KSA sector classification lacks comparability to other classification systems.

### 3) IDC Black Book Taxonomy

Among leading research institutions' ICT classifications, IDC Taxonomy is considered as the most relevant reference in the current context. IDC taxonomy is future-oriented and reflects on various new market trends. Furthermore, it is specific to the ICT sector, so its relevance and granularity are higher than others. It is the most fitting classification approach for the objectives articulated in both the CRA mandate and the key principles established in this document. Another expected benefit is the possibility of leveraging IDC research data for market sizing and benchmarking purposes<sup>6</sup>.

|   |  International perspective |  Up-to-date |  Granularity |  Relevance for ICT sector |   |
|---|--|---|---|---|---|
| Global Industry Classification Standard                 |                           |            |              |                          |  |
| International Standard Industrial Classification (ISIC) |                           |            |              |                          |  |
| North American Industry Classification System           |                           |            |              |                          |  |
| UK Standard Industrial Classification                   |                           |            |              |                          |  |
| IT/ET Sector Classification (KSA)                       |                           |            |              |                          |  |
| Worldwide Blackbook Taxonomy (IDC)                      |                           |            |              |                          |  |

**Figure 5: Shortlisted ICT Classification References**

Guided by the key principles detailed in Section 6.2, our approach builds on the shortlisted classification references to incorporate best practices and tailor them to the needs to the local market, ensures emerging technologies are effectively reflected to future-proof the ICT classification and its use, and adds a value chain dimension to enable policy-driven sector development analyses. The outcome of the approach is presented in the next chapter.

<sup>6</sup> As IDC market data for Qatar is not available, direct benchmark is not possible, which limits the usability and data availability, but emphasizes the importance and potential relevance of this classification for Qatar

In the future, the ICT classification established with this document will be subject to periodic reviews by the CRA, which may take revisions and updates of the referenced classifications and approach, as necessary. In addition, the Classification may need to be further assessed in line with the latest developments in the ICT products and services sector supplied globally and to Qatar's market and, as such, updated accordingly.

## 7. ICT Classification Overview

### 7.1 Overall structure and principles

As mentioned above, the ICT sector taxonomy has three levels of granularity: Category 1, Category 2, and Category 3. Adjacent to these three categories, a horizontal layer of value chain activities (e.g., R&D, sales) is added to map the business profiles of local market players across all categories. Understanding local players' focus and activities across the value chain elements is important from a regulatory perspective and such extra classification layer shall provide the necessary visibility and base for further assessment and analysis.

The general ICT Classification structure is visualized in Figure 1. It is designed as flexible and future-proof: it can accommodate new technologies, e.g., by categorizing a new technology as part of the ETs, by adding a new layer, or by adding a new canvas on top of ICT, which would follow the same structure of categories and value chain layer, but could encompass any other technologies. Thus, the modular structure gives room for future adjustments to reflect on new market trends or additional technologies to be considered.

The ICT Classification is designed to be inclusive and activity-based as companies can be (and typically are) active across several aspects (multiple categories and sub-categories, as well as value chain aspects). It is assumed that underlying technologies might change, but the activities will remain. Companies are expected to expand and develop across the activities defined in the Classification, as the spectrum of activities covered by one player may change over time (See Figure 1).

## 7.2 Category 1 Overview

Category 1 consists of three main segments under the domain of IT and one segment for CT (See Table 1).

|         | Category 1                          | Clarification  |
|---------|-------------------------------------|--|
| IT & ET | Services                            | Any value chain activity in ICT-specific services (R&D / service packaging / sales & marketing / after sales support)  |
|         | Software (including platforms)      | Any value chain activity (R&D / development / sales & marketing / after sales support & service activities) in applications, applications deployment and development, and infrastructure software            |
|         | Hardware (including infrastructure) | Any value chain activity (R&D / manufacturing / sales & marketing / after sales support & service activities) in devices, and infrastructure equipment, other  |
| CT      | Telecommunications services         | Any value chain activity (R&D / manufacturing / sales & marketing / after sales support & service activities) in telecommunications, including fixed / mobile / other infrastructure or data/voice providers |

**Table 1: ICT Classification Category 1**

For the sake of clarity, it is important to note that in the Classification structure, “Services” are seen both from an ICT activity-based category perspective, as well as from a value chain perspective (See Figure 1). Thus, Category 1 “Services” includes activities of ICT-specific services (i.e., services that assist in the implementation, management, and operation of computer systems, network equipment, software, etc.). The value chain step “After Sales Support & Services” applies to all categories, including the category “Services”. For example, for IT this value chain step refers to support provided to a customer after the product or service has already been purchased; for CT it includes installations and claim handling, etc.

## 7.3 Categories 2 and 3 Overview

Category 2 consists of 15 segments and Category 3 consists of 60 segments representing ICT specific activities, with an additional layer to reflect on the value chain activities (See Table 2). Definitions of the business activities included under these categories are described in the next chapter.

| Category 1                     | Category 2  | Category 3  | Value chain |                      |       |                               |
|--------------------------------|---|---|-------------|----------------------|-------|-------------------------------|
|                                |   |   | R&D         | Manufact. / Develop. | Sales | After sales support & service |
| Services                       | Traditional IT Managed services                       | Technology outsourcing  |             |                      |       |                               |
|                                | Traditional IT Project oriented                       | Application development   |             |                      |       |                               |
|                                |   | IT consulting   |             |                      |       |                               |
|                                |   | Systems and network implementations   |             |                      |       |                               |
|                                | Traditional IT Support services                       | IT deployment and support   |             |                      |       |                               |
|                                |   | IT education and training   |             |                      |       |                               |
|                                | Other traditional IT services                         | Other   |             |                      |       |                               |
|                                | Emerging Technologies (ET) specific services          | Cybersecurity services  |             |                      |       |                               |
|                                |   | Big Data and Artificial Intelligence / Machine Learning services              |             |                      |       |                               |
|                                |   | Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality) services |             |                      |       |                               |
|                                |   | Internet of Things / Machine-to-Machine (M2M) services                        |             |                      |       |                               |
|                                |   | Blockchain / Distributed Ledger services                                      |             |                      |       |                               |
|                                |   | Edge & Cloud Computing services   |             |                      |       |                               |
|                                |   | Other Emerging Technologies specific services                                 |             |                      |       |                               |
| Software (including platforms) | Traditional IT application development and deployment | Analytics and business intelligence   |             |                      |       |                               |
|                                |   | Application development software  |             |                      |       |                               |
|                                |   | Application platforms   |             |                      |       |                               |
|                                |   | Data management software  |             |                      |       |                               |
|                                |   | Integration and orchestration middleware                                      |             |                      |       |                               |
|                                |   | Software quality and lifecycle tools  |             |                      |       |                               |

| Category 1 | Category 2   | Category 3  | Value chain |                      |       |                               |
|------------|--|---|-------------|----------------------|-------|-------------------------------|
|            |  |   | R&D         | Manufact. / Develop. | Sales | After sales support & service |
|            |  | Other traditional IT application deployment and development                                 |             |                      |       |                               |
|            | Traditional IT applications                                | Collaborative applications  |             |                      |       |                               |
|            |  | Content workflow and management applications  |             |                      |       |                               |
|            |  | Customer Relationship Management (CRM) applications   |             |                      |       |                               |
|            |  | Engineering applications  |             |                      |       |                               |
|            |  | Enterprise Resource Management (ERM) applications   |             |                      |       |                               |
|            |  | Production applications   |             |                      |       |                               |
|            |  | Supply Chain Management (SCM) applications  |             |                      |       |                               |
|            |  | Other traditional IT applications   |             |                      |       |                               |
|            | Traditional IT infrastructure software                     | Endpoint management software  |             |                      |       |                               |
|            |  | Network software  |             |                      |       |                               |
|            |  | Physical and virtual computing software   |             |                      |       |                               |
|            |  | Storage software  |             |                      |       |                               |
|            |  | System and service management software  |             |                      |       |                               |
|            |  | Other traditional IT infrastructure software  |             |                      |       |                               |
|            | Emerging technologies (ET) specific platforms and software | Cybersecurity platforms and software  |             |                      |       |                               |
|            |  | Big Data and Artificial Intelligence / Machine Learning platforms and software              |             |                      |       |                               |
|            |  | Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality) platforms and software |             |                      |       |                               |
|            |  | Internet of Things / Machine-to-Machine (M2M) platforms and software                        |             |                      |       |                               |

| Category 1   | Category 2  | Category 3   | Value chain |                      |       |                               |
|--|---|--|-------------|----------------------|-------|-------------------------------|
|  |   |  | R&D         | Manufact. / Develop. | Sales | After sales support & service |
| Hardware (including infrastr.)                                   |   | Blockchain / Distributed Ledger platforms and software   |             |                      |       |                               |
|  |   | Edge & Cloud Computing platforms and software  |             |                      |       |                               |
|  |   | Other ET specific platforms and software   |             |                      |       |                               |
|  | Traditional IT devices  | Phone  |             |                      |       |                               |
|  |   | Peripheral   |             |                      |       |                               |
|  |   | Personal computing device  |             |                      |       |                               |
|  | Traditional IT infrastructure                                   | Network equipment  |             |                      |       |                               |
|  |   | Server/storage   |             |                      |       |                               |
|  | Other traditional IT hardware and infrastructure                | Other hardware and infrastructure which does not fit to Devices / Infrastructure                 |             |                      |       |                               |
|  | Emerging technologies (ET) specific hardware and infrastructure | Cybersecurity hardware and infrastructure  |             |                      |       |                               |
|  |   | Big Data and Artificial Intelligence / Machine Learning hardware and infrastructure              |             |                      |       |                               |
|  |   | Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality) hardware and infrastructure |             |                      |       |                               |
|  |   | Internet of Things / Machine-to-Machine (M2M) hardware and infrastructure                        |             |                      |       |                               |
|  |   | Blockchain / Distributed Ledger hardware and infrastructure                                      |             |                      |       |                               |
|  |   | Edge & Cloud Computing hardware and infrastructure   |             |                      |       |                               |
| Other Emerging Technologies specific hardware and infrastructure |   |  |             |                      |       |                               |

| Category 1                   | Category 2 | Category 3   | Value chain |                      |       |                               |
|------------------------------|------------|--|-------------|----------------------|-------|-------------------------------|
|                              |            |  | R&D         | Manufact. / Develop. | Sales | After sales support & service |
| Tele-communications Services | Fixed      | Voice  |             |                      |       |                               |
|                              |            | Data   |             |                      |       |                               |
|                              | Mobile     | Voice  |             |                      |       |                               |
|                              |            | Data   |             |                      |       |                               |
|                              | Other      | Other (including non-terrestrial networks, e.g., HAPS, LEO satellites) |             |                      |       |                               |

Table 2: ICT Classification Categories 2 and 3 with Value Chain Activities Layer

## 8. ICT Classification Categories and Value Chain Activities Definitions

The following tables provide definitions across all Category 1 verticals ( IT Services, IT Software, IT Hardware, and Telecommunications Services) and further detailing them on Category 2 and 3 levels.

### 8.1 IT Services

Below Table 3 provides the definitions for the business activities under Information Technology Services (Category 1), across Category 2 (inclusive of five segments) and Category 3 (inclusive of fourteen segments).



| Category 1: IT Services                      |   |                                     |  |
|--|---|-------------------------------------|--|
| Category 2                                   | Category 2 Definition   | Category 3                          | Category 3 Definition <sup>7</sup>   |
| Traditional IT Managed services              | Long-term, contractual arrangement in which a service provider takes ownership of managing all or part of a client's information systems infrastructure and operations based on a service-level agreement (recurrent support)                 | Technology outsourcing              | <ul style="list-style-type: none"> <li>• Key horizontal BPO (customer care business process, finance &amp; accounting process, HR process, procurement process outsourcing)</li> <li>• Application management</li> <li>• Hosted application management</li> <li>• Hosted infrastructure services</li> <li>• IT outsourcing</li> <li>• Network and endpoint outsourcing services</li> <li>• Pro-active monitoring of System/Services</li> </ul> |
| Traditional IT Project oriented              | Project-based IT services to 1) develop customized code sets to meet a client's business needs, 2) improve organizational IT performance, 3) deliver technical solution that addresses an organization's specific technical or business needs | Application development             | <ul style="list-style-type: none"> <li>• Custom application development</li> </ul>   |
|  |   | IT consulting                       | <ul style="list-style-type: none"> <li>• IT consulting (business of providing IT-related expert advice), e.g., assessment of IT infrastructure and architecture and design of IT infrastructure)</li> </ul>  |
|  |   | Systems and network implementations | <ul style="list-style-type: none"> <li>• Network consulting and integration</li> <li>• Systems integration</li> <li>• Pro-active monitoring of System/Services</li> </ul>  |
| Traditional IT Support services              | IT support that helps to install and deploy hardware and software as well as IT education/training  | IT deployment and support           | <ul style="list-style-type: none"> <li>• Hardware deployment and support</li> <li>• Software deployment and support</li> </ul>   |
|  |   | IT education and training           | <ul style="list-style-type: none"> <li>• IT education and training (business of providing IT-related knowledge and skills, e.g., through trainings and teaching)</li> </ul>  |
| Other traditional IT services                | Other traditional IT services   | Other                               | <ul style="list-style-type: none"> <li>• Other traditional IT related services</li> </ul>  |
| Emerging Technologies (ET) specific services | Services related to the seven Emerging Technologies (ET) areas identified for IT sector   | Cybersecurity services              | <ul style="list-style-type: none"> <li>• Services for protecting networks, devices, and data from unauthorized access or criminal use</li> <li>• Services for ensuring confidentiality, integrity, and availability of information</li> </ul>  |

<sup>7</sup> Sources: Based on desktop research of specific category, including dictionaries

| Category 1: IT Services |   |   |   |
|-------------------------|---|---|---|
| Category 2              | Category 2 Definition   | Category 3  | Category 3 Definition <sup>7</sup>  |
|                         | Emerging Technologies are innovative technologies that have been recently developed, are under development or will be developed within the next few years, and that are creating, or are expected to create, significant social or economic effects | Big Data and Artificial Intelligence / Machine Learning services              | <ul style="list-style-type: none"> <li>Services for the use of processes and technologies, including AI and ML, to combine and analyze massive datasets with the goal of identifying patterns and developing actionable insights.</li> </ul>  |
|                         |   | Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality) services | <ul style="list-style-type: none"> <li>Services for all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables</li> </ul>   |
|                         |   | Internet of Things (IoT) / Machine-to-Machine (M2M) services                  | <ul style="list-style-type: none"> <li>Services for any technology that enables networked devices to exchange information and perform actions without the manual assistance of humans</li> </ul>  |
|                         |   | Blockchain / Distributed Ledger services                                      | <ul style="list-style-type: none"> <li>Services for distributed ledger type of databases that are shared, replicated, and synchronized among the members of a decentralized network</li> </ul>  |
|                         |   | Edge and Cloud Computing services   | <ul style="list-style-type: none"> <li>Services for edge computing which is the deployment of computing and storage resources at the location where data is produced</li> <li>Services for cloud computing which is the delivery of computing services and solutions (e.g., storage, database, analytics) real-time, over the internet and on demand</li> </ul> |
|                         |   | Other Emerging Technologies (ET) services                                     | <ul style="list-style-type: none"> <li>Services for Next Gen. Networks (e.g., laser and quantum communications) and Next Gen. Computing (e.g., quantum computing)</li> <li>Other ET specific services</li> </ul>  |

Table 3: ICT Classification: IT Services Definitions

## 8.2 IT Software (including Platforms)

The below Table 4 provides definitions for business activities under IT Software (Category 1), across four segments at Category 2 level and more than twenty Category 3 segments.

| Category 1: IT Software (including Platforms)         |   |  |   |
|---|---|--|---|
| Category 2  | Category 2 Definition   | Category 3                               | Category 3 Definition   |
| Traditional IT application development and deployment | Tools and platforms used primarily by developers to build, test, and deploy software as well as process, govern, and analyze data | Analytics and business intelligence      | <ul style="list-style-type: none"> <li>Advanced and predictive analytics software</li> <li>End-user query, reporting, and analysis</li> <li>Spatial information systems</li> </ul>  |
|   |   | Application development software         | <ul style="list-style-type: none"> <li>Business rules management systems</li> <li>Development language, environments, and tools</li> <li>Modeling and architecture tools</li> <li>Software construction components</li> </ul> |
|   |   | Application platforms                    | <ul style="list-style-type: none"> <li>Deployment-centric application platforms</li> <li>Model-driven application platforms</li> <li>Robotic process automation software</li> <li>Transaction processing monitors</li> </ul>  |
|   |   | Data management software                 | <ul style="list-style-type: none"> <li>Database administration and development tools</li> <li>Data integration and intelligence software</li> <li>Data management systems</li> </ul>  |
|   |   | Integration and orchestration middleware | <ul style="list-style-type: none"> <li>Business-to-business middleware</li> <li>Event stream processing software</li> <li>Integration software</li> <li>Managed file transfer software</li> </ul>                             |
|   |   | Software quality and lifecycle tools     | <ul style="list-style-type: none"> <li>Automated software quality</li> <li>Software change, configuration, and process management</li> </ul>  |
|   |   | Other                                    | <ul style="list-style-type: none"> <li>Other traditional IT related application development and deployment</li> </ul>   |

| Category 1: IT Software (including Platforms) |   |   |   |
|---|---|---|---|
| Category 2                                    | Category 2 Definition   | Category 3  | Category 3 Definition   |
| Traditional IT applications                   | Commercial, industrial, and technical programs and code sets designed to automate specific sets of business processes in an industry or business function and make groups or individuals in the organization more productive or support education or data processing in personal activities | Collaborative applications                          | <ul style="list-style-type: none"> <li>• Conferencing applications</li> <li>• Email applications</li> <li>• Enterprise community applications</li> <li>• Team collaborative applications</li> </ul>   |
|   |   | Content workflow and management applications        | <ul style="list-style-type: none"> <li>• Capture applications</li> <li>• Content sharing and collaboration applications</li> <li>• Creative applications</li> <li>• Document applications</li> <li>• Discovery applications</li> <li>• Enterprise content management applications</li> <li>• Enterprise portals</li> <li>• Persuasive content management applications</li> </ul>  |
|   |   | Customer relationship management (CRM) applications | <ul style="list-style-type: none"> <li>• Advertising applications</li> <li>• Contact center applications</li> <li>• Customer service applications</li> <li>• Digital commerce applications</li> <li>• Marketing campaign management applications</li> </ul>   |
|   |   | Engineering applications                            | <ul style="list-style-type: none"> <li>• Collaborative product data management applications</li> <li>• CAD/CAE/CAM applications</li> </ul>  |
|   |   | Enterprise resource management (ERM) applications   | <ul style="list-style-type: none"> <li>• Enterprise asset management applications</li> <li>• Enterprise performance management applications</li> <li>• Financial applications</li> <li>• Human capital management applications</li> <li>• Order management applications</li> <li>• Payoff management applications</li> <li>• Procurement applications</li> <li>• Project and portfolio management (PPM) applications</li> </ul> |
|   |   | Production applications                             | <ul style="list-style-type: none"> <li>• Other operations applications</li> <li>• Production and grid management applications</li> <li>• Service industry and public sector applications</li> </ul>   |

| Category 1: IT Software (including Platforms)              |  |   |   |
|--|--|---|---|
| Category 2   | Category 2 Definition  | Category 3  | Category 3 Definition   |
|  |  | <ul style="list-style-type: none"> <li>Supply chain management (SCM) applications</li> </ul>  | <ul style="list-style-type: none"> <li>Inventory management applications</li> <li>Logistics applications</li> <li>Production planning applications</li> </ul>   |
|  |  | <ul style="list-style-type: none"> <li>Other</li> </ul>   | <ul style="list-style-type: none"> <li>Other traditional IT related applications</li> </ul>   |
| Traditional IT infrastructure software                     | Software solutions that provide the basic foundational layers of software that enable bare metal infrastructure hardware resources to host higher-level application development / deployment software / application software and provide virtualization / management software and share the use of those resources | <ul style="list-style-type: none"> <li>Endpoint management software</li> </ul>  | <ul style="list-style-type: none"> <li>Client endpoint management</li> <li>Output management tools</li> </ul>   |
|  |  | <ul style="list-style-type: none"> <li>Network software</li> </ul>  | <ul style="list-style-type: none"> <li>Network infrastructure software</li> <li>Network management software</li> </ul>  |
|  |  | <ul style="list-style-type: none"> <li>Physical and virtual computing software</li> </ul>   | <ul style="list-style-type: none"> <li>Operating systems and subsystems</li> <li>Other computing software</li> <li>Software-defined computing software</li> <li>Virtual client computing</li> </ul>   |
|  |  | <ul style="list-style-type: none"> <li>Storage software</li> </ul>  | <ul style="list-style-type: none"> <li>Archiving software</li> <li>Data replication and protection</li> <li>Software-defined storage controller software</li> <li>Storage and device management software</li> <li>Storage infrastructure software</li> </ul>          |
|  |  | <ul style="list-style-type: none"> <li>System and service management software</li> </ul>  | <ul style="list-style-type: none"> <li>IT automation and configuration management software</li> <li>IT operations and management software</li> <li>IT service management software</li> </ul>  |
|  |  | <ul style="list-style-type: none"> <li>Other</li> </ul>   | <ul style="list-style-type: none"> <li>Other traditional IT infrastructure software</li> </ul>  |
| Emerging Technologies (ET) specific Platforms and Software | Platforms and software related to the seven Emerging Technologies (ET) areas identified for IT sector;<br><br>Emerging Technologies are innovative technologies that have been recently developed, are under development or  | <ul style="list-style-type: none"> <li>Cybersecurity platforms and software</li> </ul>  | <ul style="list-style-type: none"> <li>Platforms and software for protecting networks, devices, and data from unauthorized access or criminal use</li> <li>Platforms and software for ensuring confidentiality, integrity, and availability of information</li> </ul> |
|  |  | <ul style="list-style-type: none"> <li>Big Data and Artificial Intelligence / Machine Learning platforms and software</li> </ul>              | <ul style="list-style-type: none"> <li>Platforms and software for the use of processes and technologies, including AI and ML, to combine and analyze massive datasets with the goal of identifying patterns and developing actionable insights.</li> </ul>            |
|  |  | <ul style="list-style-type: none"> <li>Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality) platforms and software</li> </ul> | <ul style="list-style-type: none"> <li>Platforms and software for all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables</li> </ul>   |

| Category 1: IT Software (including Platforms) |   |  |   |
|---|---|--|---|
| Category 2                                    | Category 2 Definition   | Category 3   | Category 3 Definition   |
|   | will be developed within the next few years, and that are creating, or are expected to create, significant social or economic effects | Internet of Things (IoT) / Machine-to-Machine (M2M) platforms and software | <ul style="list-style-type: none"> <li>Platforms and software for any technology that enables networked devices to exchange information and perform actions without the manual assistance of humans</li> </ul>  |
|   |   | Blockchain / Distributed Ledger platforms and software                     | <ul style="list-style-type: none"> <li>Platforms and software for distributed ledger type of databases that are shared, replicated, and synchronized among the members of a decentralized network</li> </ul>  |
|   |   | Edge Computing and Cloud Computing platforms and software                  | <ul style="list-style-type: none"> <li>Platforms and software for edge computing which is the deployment of computing and storage resources at the location where data is produced</li> <li>Platforms and software for cloud computing which is the delivery of computing services and solutions (e.g., storage, database, analytics) real-time, over the internet and on demand</li> </ul> |
|   |   | Other Emerging Technologies (ET) specific Platforms and Software           | <ul style="list-style-type: none"> <li>Platforms and software for Next Gen. Networks (e.g., laser and quantum communications) and Next Gen. Computing (e.g., quantum computing)</li> <li>Other ET specific platforms and software</li> </ul>  |

Table 4: ICT Classification: IT Software Definitions

### 8.3 IT Hardware (including Infrastructure)

Table 5 below provides definitions for business activities under IT Hardware (Category 1), across Category 2 level (inclusive of four segments), and thirteen Category 3 segments.

| Category 1: IT Hardware (including Infrastructure) |   |            |   |
|--|---|------------|---|
| Category 2   | Category 2 Definition   | Category 3 | Category 3 Definition   |
| Traditional IT Devices                             | Instruments that use electric current to encode, analyze, or transmit information | Phone      | <ul style="list-style-type: none"> <li>Feature/analogue phone (portable phone that can make and receive calls and texts but with limited other functionalities)</li> <li>Smartphone (portable phone that includes computing functions)</li> </ul> |
|  |   | Peripheral | <ul style="list-style-type: none"> <li>Hardcopy peripheral</li> <li>PC monitor</li> </ul>   |

| Category 1: IT Hardware (including Infrastructure)              |   |  |   |
|---|---|--|---|
| Category 2  | Category 2 Definition   | Category 3   | Category 3 Definition   |
|   |   | Personal computing device  | <ul style="list-style-type: none"> <li>• Desktop</li> <li>• Notebook</li> <li>• Tablet</li> </ul>   |
| Traditional IT Infrastructure                                   | Hardware needed for network or server/storage   | Network equipment  | <ul style="list-style-type: none"> <li>• Electronic devices required for communication, interaction, and data transmission on a computer network</li> </ul>   |
|   |   | Server/storage   | <ul style="list-style-type: none"> <li>• External storage system</li> <li>• Non-x86/x86 server</li> </ul>   |
| Other traditional IT Hardware and Infrastructure                | Other hardware which does not fit to traditional IT Devices or Infrastructure   | Other traditional IT Hardware  | <ul style="list-style-type: none"> <li>• Other hardware which does not fit in above categories ( e.g., radars, frequency jammers, TETRA radio, VHF and UHF radios)</li> </ul>   |
| Emerging Technologies (ET) specific Hardware and Infrastructure | Hardware and Infrastructure related to the seven Emerging Technologies (ET) areas identified for IT sector<br><br>Emerging Technologies are innovative technologies that have been recently developed, are under development or will be developed within the next few years, and that are creating, or are expected to create, significant social or economic effects | Cybersecurity hardware and infrastructure  | <ul style="list-style-type: none"> <li>• Hardware and infrastructure for protecting networks, devices, and data from unauthorized access or criminal use</li> <li>• Hardware and infrastructure for ensuring confidentiality, integrity, and availability of information</li> </ul> |
|   |   | Big Data and Artificial Intelligence / Machine Learning hardware and infrastructure              | <ul style="list-style-type: none"> <li>• Hardware and infrastructure for the use of processes and technologies, including AI and ML, to combine and analyze massive datasets with the goal of identifying patterns and developing actionable insights</li> </ul>                    |
|   |   | Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality) hardware and infrastructure | <ul style="list-style-type: none"> <li>• Hardware and infrastructure for all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables</li> </ul>  |
|   |   | Internet of Things (IoT) / Machine-to-Machine (M2M) hardware and infrastructure                  | <ul style="list-style-type: none"> <li>• Hardware and infrastructure for any technology that enables networked devices to exchange information and perform actions without the manual assistance of humans</li> </ul>   |
|   |   | Blockchain / Distributed Ledger hardware and infrastructure                                      | <ul style="list-style-type: none"> <li>• Hardware and infrastructure for distributed ledger type of databases that are shared, replicated, and synchronized among the members of a decentralized network</li> </ul>   |

| Category 1: IT Hardware (including Infrastructure) |                       |  |   |
|--|-----------------------|--|---|
| Category 2   | Category 2 Definition | Category 3   | Category 3 Definition   |
|  |                       | Edge Computing and Cloud Computing hardware and infrastructure | <ul style="list-style-type: none"> <li>Hardware and infrastructure for edge computing which is the deployment of computing and storage resources at the location where data is produced</li> <li>Platforms and software for cloud computing which is the delivery of computing services and solutions (e.g., storage, database, analytics) real-time, over the internet and on demand</li> </ul>                          |
|  |                       | Other Emerging Technologies (ET) hardware and infrastructure   | <ul style="list-style-type: none"> <li>Hardware and infrastructure for Next Gen. Networks (e.g., laser and quantum communications) and Next Gen. Computing (e.g., quantum computing)</li> <li>LTE communication technology with dedicated frequencies for organization</li> <li>Other ET specific hardware and infrastructure (e.g., LTE communication technology with dedicated frequencies for organization)</li> </ul> |

Table 5: ICT Classification: IT Hardware definitions

## 8.4 CT: Telecommunications Services

Below Table 6 provides definitions for business activities under Communications Technology domain referring to Telecommunications Services (Category 1) and across Category 2 (inclusive of three segments) and for five Category 3 segments.

| Category 1: Telecommunications Services |                                  |            |   |
|---|----------------------------------|------------|---|
| Category 2                              | Category 2 Definition            | Category 3 | Category 3 Definition   |
| Fixed                                   | Wired telecommunications service | Voice      | <ul style="list-style-type: none"> <li>Transport of voice traffic over the public switched telephone network (PSTN) and integrated services digital network (ISDN)</li> </ul>   |
|   |                                  | Data       | <ul style="list-style-type: none"> <li>Provide access to the global IP network, or internet, for web browsing and communications applications</li> <li>Connectivity only (dial up, broadband such as DSL, cable)</li> </ul> |



| Category 1: Telecommunications Services |  |  |  |
|---|--|--|--|
| Category 2                              | Category 2 Definition  | Category 3                                 | Category 3 Definition  |
|   |  |  | <ul style="list-style-type: none"> <li>Fixed wireless connections purchased from an ISP network provider (Wi-Fi and WiMAX)</li> <li>Submarine telecommunications cable connectivity</li> </ul> |
| Mobile                                  | Wireless tele-communications service                                   | Voice                                      | <ul style="list-style-type: none"> <li>Mobile services related to voice</li> </ul>   |
|   |  | Data                                       | <ul style="list-style-type: none"> <li>Packaged data services for IP mobile devices</li> </ul>   |
| Other                                   | Mainly Non-Terrestrial Network (NTN), incl. HAPS, LEO, satellites etc. | Other (Including non-terrestrial networks) | <ul style="list-style-type: none"> <li>Other, mainly Non-Terrestrial Network (NTN), incl. HAPS, LEO, satellites etc.</li> </ul>  |

**Table 6: ICT Classification: Telecommunications Services Definitions**

## 8.5 Value chain activities

Below Table 7 provides lists examples for each value chain activity that is added as an additional layer on the ICT classification. It is worth noting once again that this layer gives substantial value to CRA (as regulator) in terms of providing visibility to local companies' business activities across the value chain and shedding light on different business models present in the local market. Accordingly, this could enable targeted market assessment and regulatory approach for the local ICT market in the future.

| Domain   | Value chain                                       | Clarifying examples  |
|--|---|--|
| Traditional Information Technology (IT) and Emerging Technologies (ET) | R&D   | <ul style="list-style-type: none"> <li>Potential application validated</li> <li>Proof-of-Concept demonstrated, analytically and/or experimentally</li> <li>Component and/or breadboard laboratory validated</li> <li>Component and/or breadboard validated in simulated or real environment</li> <li>System adequacy validated in simulated environment</li> <li>System adequacy validated in application</li> </ul> |
|  | Manufacturing (hardware) / Development (software) | <ul style="list-style-type: none"> <li>Involved in hardware manufacturing process related activities (engineering validation testing, design validation testing, product validation testing, mass manufacturing, and assembly)</li> <li>Involved in software development cycle activities (planning, creating, testing and deploying)</li> </ul>   |

| Domain                      | Value chain                   | Clarifying examples  |
|-----------------------------|-------------------------------|--|
|                             | Marketing & Sales             | <ul style="list-style-type: none"> <li>Distribute products through different channels</li> <li>Develop strategies to target relevant customers</li> <li>Define pricing strategy (e.g., software licensing and pricing)</li> <li>Define communications and advertising strategy</li> <li>Set up sales performance metrics and ROI analysis</li> <li>Define support and operations strategy</li> </ul> |
|                             | After sales support & service | <ul style="list-style-type: none"> <li>Installation and implementation services</li> <li>Any support provided to a customer after the product or service has already been purchased (e.g., sales of spare parts, customer support, warranty)</li> <li>Post-life cycle management (e.g., recycling)</li> </ul>  |
| Tele-communication Services | R&D                           | <ul style="list-style-type: none"> <li>Research and development of advanced network features</li> </ul>  |
|                             | Production                    | <ul style="list-style-type: none"> <li>Build up and roll out the network</li> <li>Network deployment and maintenance</li> <li>Product or service development</li> </ul>  |
|                             | Marketing & Sales             | <ul style="list-style-type: none"> <li>Provide wholesale / retail network capacity to consumers, as an operator</li> <li>Define pricing strategy</li> <li>Develop strategies to target relevant customers</li> <li>Define communication and advertising strategy</li> <li>Set up sales performance metrics and ROI analysis</li> <li>Define support and operations strategy</li> </ul>               |
|                             | After sales support & service | <ul style="list-style-type: none"> <li>Installations</li> <li>Repair and claim handling</li> <li>Return and exchange handling</li> <li>Warranty and replacements</li> </ul>  |

*Table 7: ICT Classification Value Chain Activities Definitions*

## 9. Mapping with ISIC

Another important aspect of the classification development is mapping the classification categories to the ISIC codes, given that majority of data, reports and analysis across the Qatari government structures (e.g., PSA, MOCI, etc.) are based on ISIC codes. Therefore, making use of the existing data (for example, MOCI's list of registered businesses) requires such alignment (See Table 8).

The ISIC codes have been mapped against the ICT sector classification in the table below (See Table 8). Every IT-related ISIC code has been clearly mapped, which proves that the recommended classification system is aligned with the United Nation’s ISIC definitions. Since ET-related activities are not cascaded down to the same level as traditional IT and CT-related activities, ISIC codes for ET constitute the sum of all ISIC codes (for each specific level 1 category).

| Category 1  | Category 2                                   | Category 3  | Relevant ISIC                |
|-------------|--|---|------------------------------|
| IT Services | Traditional IT Managed services              | Technology outsourcing  | 6202                         |
|             | Traditional IT Project oriented              | Application development   | 6201                         |
|             |  | IT consulting   | 6202                         |
|             |  | Systems and network implementations   | 6202                         |
|             | Traditional IT Support services              | IT deployment and support   | 9511, 9512                   |
|             |  | IT education and training   | 6202, 8545                   |
|             | Other traditional IT services                | Other   | 6201, 6202, 6209, 9511, 9512 |
|             | Emerging Technologies (ET) specific services | Cybersecurity services  | 6201, 6202, 6209, 9511, 9512 |
|             |  | Big Data and Artificial Intelligence / Machine Learning services              | 6201, 6202, 6209, 9511, 9512 |
|             |  | Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality) services | 6201, 6202, 6209, 9511, 9512 |
|             |  | Internet of Things / Machine-to-Machine (M2M) services                        | 6201, 6202, 6209, 9511, 9512 |
|             |  | Blockchain / Distributed Ledger services                                      | 6201, 6202, 6209, 9511, 9512 |
|             |  | Edge Computing services   | 6201, 6202, 6209, 9511, 9512 |
|             |  | Other Emerging Technologies specific services                                 | 6201, 6202, 6209, 9511, 9512 |

| Category 1                        | Category 2  | Category 3  | Relevant ISIC    |
|-----------------------------------|---|---|------------------|
| IT Software (including Platforms) | Traditional IT application development and deployment | Analytics and business intelligence                         | 5820, 4651, 6311 |
|                                   |   | Application development software                            | 5820, 4651, 6311 |
|                                   |   | Application platforms                                       | 5820, 4651, 6311 |
|                                   |   | Data management software                                    | 5820, 4651, 6311 |
|                                   |   | Integration and orchestration middleware                    | 5820, 4651, 6311 |
|                                   |   | Software quality and lifecycle tools                        | 5820, 4651, 6311 |
|                                   |   | Other traditional IT application deployment and development | 5820, 4651, 6311 |
|                                   | Traditional IT applications                           | Collaborative applications                                  | 5820, 4651, 6311 |
|                                   |   | Content workflow and management applications                | 5820, 4651, 6311 |
|                                   |   | Customer Relationship Management (CRM) applications         | 5820, 4651, 6311 |
|                                   |   | Engineering applications                                    | 2630, 4652, 6311 |
|                                   |   | Enterprise Resource Management (ERM) applications           | 2630, 4652, 6311 |
|                                   |   | Production applications                                     | 5820, 4651, 6311 |
|                                   |   | Supply Chain Management (SCM) applications                  | 5820, 4651, 6311 |
|                                   |   | Other traditional IT applications                           | 5820, 4651, 6311 |
|                                   | Traditional IT infrastructure software                | Endpoint management software                                | 5820, 4651, 6311 |
|                                   |   | Network software  | 5820, 4651, 6311 |
|                                   |   | Physical and virtual computing software                     | 5820, 4651, 6311 |

| Category 1  | Category 2   | Category 3  | Relevant ISIC                            |                        |
|---|--|---|--|------------------------|
|   |  | Storage software  | 5820, 4651, 6311                         |                        |
|   |  | System and service management software  | 5820, 4651, 6311                         |                        |
|   |  | Other traditional IT infrastructure software  | 5820, 4651, 6311                         |                        |
|   | Emerging Technologies (ET) specific Platforms and Software | Cybersecurity platforms and software  | 5820, 4651, 6311                         |                        |
|   |  | Big Data and Artificial Intelligence / Machine Learning platforms and software              | 5820, 4651, 6311                         |                        |
|   |  | Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality) platforms and software | 5820, 4651, 6311                         |                        |
|   |  | Internet of Things / Machine-to-Machine (M2M) platforms and software                        | 5820, 4651, 6311                         |                        |
|   |  | Blockchain / Distributed Ledger platforms and software                                      | 5820, 4651, 6311                         |                        |
|   |  | Edge & Cloud Computing platforms and software   | 5820, 4651, 6311                         |                        |
|   |  | Other ET specific platforms and software  | 5820, 4651, 6311                         |                        |
|   | IT Hardware (incl. infrastructure)                         | Traditional IT Devices  | Phone                                    | 2630, 4651             |
|   |  |   | Peripheral                               | 2640, 2680, 4651, 4652 |
|   |  |   | Personal computing device                | 2610, 2620, 4651, 4652 |
| Traditional IT Infrastructure                                   |  | Network equipment   | 2630, 4652, 6311                         |                        |
|   |  | Server/storage  | 2630, 4652, 6311                         |                        |
| Other traditional IT Hardware and Infrastructure                |  | Other hardware and infrastructure which does not fit to Devices / Infrastructure            | 2610, 2620, 2630, 2680, 4651, 4652, 6311 |                        |
| Emerging Technologies (ET) specific Hardware and Infrastructure |  | Cybersecurity hardware and infrastructure   | 2610, 2620, 2630, 2680, 4651, 4652, 6311 |                        |
|   |  | Big Data and Artificial Intelligence / Machine Learning hardware and infrastructure         | 2610, 2620, 2630, 2680, 4651, 4652, 6311 |                        |

| Category 1                  | Category 2 | Category 3   | Relevant ISIC                            |
|-----------------------------|------------|--|--|
|                             |            | Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality) hardware and infrastructure | 2610, 2620, 2630, 2680, 4651, 4652, 6311 |
|                             |            | Internet of Things / Machine-to-Machine (M2M) hardware and infrastructure                        | 2610, 2620, 2630, 2680, 4651, 4652, 6311 |
|                             |            | Blockchain / Distributed Ledger hardware and infrastructure                                      | 2610, 2620, 2630, 2680, 4651, 4652, 6311 |
|                             |            | Edge & Cloud Computing hardware and infrastructure   | 2610, 2620, 2630, 2680, 4651, 4652, 6311 |
|                             |            | Other Emerging Technologies specific hardware and infrastructure                                 | 2610, 2620, 2630, 2680, 4651, 4652, 6311 |
| Tele-communication Services | Fixed      | Voice  | 6110, 6190                               |
|                             |            | Data   | 6110, 6190                               |
|                             | Mobile     | Voice  | 6120, 6190                               |
|                             |            | Data   | 6120, 6190                               |
|                             | Other      | Other (including non-terrestrial networks, e.g., HAPS, LEO satellites)                           | 6130, 6190                               |

Table 8: ISIC codes aligned to ICT Classification Categories 1-3

## 10. Use cases

To further verify the relevance and utility of the designated ICT sector taxonomy, key use cases are identified as follows (See Figure 7):

- **Category 1:** Applicable to market sizing; immediate comparison is limited due to the high-level definition.
- **Category 2:** Applicable to market sizing, market analysis and regulatory assessments; some categories are comparable based on applied definitions.

- **Category 3:** Applicable to market sizing, market analysis, ICT businesses database and publishing list of active market players, company-level assessments and comparability; comparison is possible due to granular definitions.

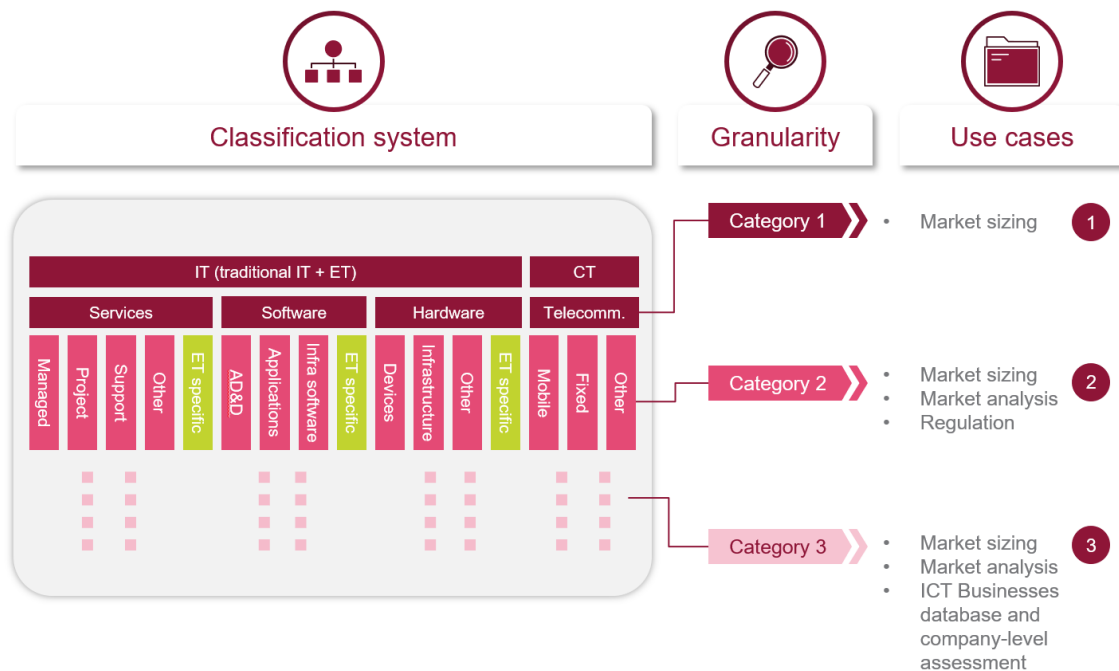


Figure 6: ICT Classification Use Cases Overview

## 10.1 Market Sizing

Category 1, which is the most aggregated and high-level classification layer, may be used for market sizing-related tasks, for example market sizing and segmentation for Qatar’s ICT industry (based on revenues, volumes, numbers of companies, number of employees, etc.).

It should be noted that information captured and analyzed at Category 1 classification level does not necessarily constitute a basis to benchmark Qatar against other countries or other sources given the customized approach to the ICT Classification. One should always test the comparability of various classification categories across sources before conducting any comparative analysis. Comparability must be tested beforehand by analyzing the exact definition and measurability of a specific category.

## 10.2 Market Analysis and Regulatory Assessments

At Category 2 level the ICT Classification may serve the goal of understanding the market from a qualitative perspective (e.g., especially for analyzing the results and drawing insights from the annual ICT Sector Survey). This level of classification also enables further market analysis and regulatory assessments for targeted initiatives for the ICT sector.

Potential outcome of this use case could be also a market attractiveness analysis per segment (e.g., per Category 2) in terms of growth, maturity, export capabilities, innovation, competitiveness. Another objective of the ICT classification is to provide a sector-specific taxonomy framework for regulatory assessments and further targeted market segmentation and analysis on Category 2 level segments based on the nature of its business.

## 10.3 ICT Businesses Database and Company-level Assessment

The most granular Category 3 level of the Classification could serve to populate the ICT businesses directory and building a published list of ICT companies active in Qatar, which is a CRA initiative. The expected use in this case refers to:

- Maintaining up-to-date records on active ICT businesses in Qatar and publish the data
- Identify ICT activities on a company level
- Provide detailed measurements on the ICT supply maturity and sophistication at company level/ of the ICT sector overall, both static and over time.

# 11. Appendix

## 11.1 ISIC rev.4 definition for ICT sector

The International Standard Industrial Classification of All Economic Activities (ISIC)<sup>8</sup> is the international reference classification of productive activities. It also specifies ISIC codes related to

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<sup>8</sup> UN, DESA Statistics Division, ISIC rev.4, <https://unstats.un.org/unsd/classifications/Econ/isic>



ICT activities, across the value chain, from manufacturing and trade to services. (See Table 9 below).

| <b>ICT sector</b>                   |   |
|-------------------------------------|---|
| <b>ICT manufacturing industries</b> |   |
| 2610                                | Manufacture of electronic components and boards                     |
| 2620                                | Manufacture of computers and peripheral equipment                   |
| 2630                                | Manufacture of communication equipment                              |
| 2640                                | Manufacture of consumer electronics                                 |
| 2680                                | Manufacture of magnetic and optical media                           |
| <b>ICT trade industries</b>         |   |
| 4651                                | Wholesale of computers, computer peripheral equipment and software  |
| 4652                                | Wholesale of electronic and telecommunications equipment and parts  |
| <b>ICT services Industries</b>      |   |
| 5820                                | Software publishing   |
| 61                                  | <b>Telecommunications</b>   |
| 6110                                | Wired telecommunications activities                                 |
| 6120                                | Wireless telecommunications activities                              |
| 6130                                | Satellite telecommunications activities                             |
| 6190                                | Other telecommunications activities                                 |
| 62                                  | <b>Computer programming, consultancy and related activities</b>     |
| 6201                                | Computer programming activities                                     |
| 6202                                | Computer consultancy and computer facilities management activities  |
| 6209                                | Other information technology and computer service activities        |
| 631                                 | <b>Data processing, hosting and related activities; web portals</b> |
| 6311                                | Data processing, hosting, and related activities                    |
| 6312                                | Web portals   |
| 951                                 | <b>Repair of computers and communications equipment</b>             |

|      |  |
|------|--|
| 9511 | Repair of computers and peripheral equipment |
| 9512 | Repair of communications equipment           |

**Table 9: ISIC rev.4 ICT Sector Breakdown**  
Source: UN, DESA Statistics Division, ISIC rev.4

Further to that, ISIC contains stand-alone Section J Information and Communication, which includes the production and distribution of information and cultural products, the provision of the means to transmit or distribute these products, as well as data or communications, information technology activities and the processing of data and other information service activities (See Table 10). This section has served a guideline on how ICT related business activities should be defined. It is leveraged as a major reference for the development of this ICT classification, with a marginal difference: retailers of ICT products are included as a part of ICT market in the document, not only just wholesalers.

## 11.2 ISIC rev.4 Classification of Section J, Information and Communication

| 11 Division        | Group | Class | Description  |
|--------------------|-------|-------|--|
| <b>Division 58</b> |       |       | <b>Publishing activities</b>   |
|                    | 581   |       | Publishing books, periodicals, and other publishing activities   |
|                    |       | 5811  | Book publishing  |
|                    |       | 5812  | Publishing directories and mailing lists   |
|                    |       | 5813  | Publishing newspapers, journals, and periodicals   |
|                    |       | 5819  | Other publishing activities  |
|                    | 582   | 5820  | Software publishing  |
| <b>Division 59</b> |       |       | <b>Motion picture, video, and television program production, sound recordings, and music publishing activities</b> |
|                    | 591   |       | Motion picture, video, and television program activities   |
|                    |       | 5911  | Motion picture, video, and television program production activities  |
|                    |       | 5912  | Motion picture, video, and television program post-production activities   |

|                    |     |      |   |
|--------------------|-----|------|---|
|                    |     | 5913 | Motion picture, video, and television program distribution activities |
|                    |     | 5914 | Motion picture projection activities                                  |
|                    | 592 | 5920 | Sound recording and music publishing activities                       |
| <b>Division 60</b> |     |      | <b>Programming and broadcasting activities</b>                        |
|                    | 601 | 6010 | Radio broadcasting  |
|                    | 602 | 6020 | Television programming and broadcasting activities                    |
| <b>Division 61</b> |     |      | <b>Telecommunications</b>   |
|                    | 611 | 6110 | Wired telecommunications activities                                   |
|                    | 612 | 6120 | Wireless telecommunications activities                                |
|                    | 613 | 6130 | Satellite telecommunications activities                               |
|                    | 619 | 6190 | Other telecommunications activities                                   |
| <b>Division 62</b> |     |      | <b>Computer programming, consultancy and related activities</b>       |
|                    |     | 6201 | Computer programming activities                                       |
|                    |     | 6202 | Computer consultancy and computer facilities management activities    |
|                    |     | 6209 | Other information technology and computer service activities          |
| <b>Division 63</b> |     |      | <b>Information service activities</b>                                 |
|                    | 631 |      | Data processing, hosting, and related activities; web portals         |
|                    |     | 6311 | Data processing, hosting, and related activities                      |
|                    |     | 6312 | Web portals   |
|                    | 639 |      | Other information service activities                                  |
|                    |     | 6391 | News agency activities  |
|                    |     | 6399 | Other information service activities n.e.c.                           |

**Table 10: ISIC rev.4 Classification of Section J**  
Source: UN DESA Statistics Division, ISIC rev.4

### 11.3. Comparison against KSA CST Classification

|             | KSA CST Classification  | CRA ICT classification   |
|-------------|---|--|
| <b>Pros</b> | <ul style="list-style-type: none"> <li>Simple and easy to understand since there are only two levels of categories</li> <li>Well-reflecting strategic focus of KSA IT/ET sector, by making “as a service” and Emerging Technologies as a standalone Level 1 category</li> </ul>   | <ul style="list-style-type: none"> <li>More exclusive three level of categories, thanks to the “canvas” concept as well as a value chain layer</li> <li>Better mapped different value chain activities of market players to enhance market understanding</li> <li>Very detailed, considering several levels of categories, a value chain layer and technology stacks</li> </ul>              |
| <b>Cons</b> | <ul style="list-style-type: none"> <li>Not exclusive from each other under classification categories, e.g., Artificial Intelligence under Emerging Technologies can be also associated with Business Software under Software</li> <li>Not clear in terms of how different value chain activities will be understood under the classification</li> <li>Not very detailed, due to a simple structure</li> <li>Not exhaustive, especially regarding Emerging Technologies</li> </ul> | <ul style="list-style-type: none"> <li>More sophisticated structure requires detailed understanding for analysis, since there are 3 levels of categories and a value chain layer</li> <li>Non-explicit strategic focus in the classification system, since it prioritizes exhaustiveness and exclusiveness of the structure, rather than making certain technologies more visible</li> </ul> |

**Table 11: Comparison against KSA Classification**

Source: KSA Communications, Space & Technology Commission, Information Technology and Emerging Technologies (IT/ET) Sector Classification