Milan State University

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PhD Research Project:

Developing an Ecosystem Framework to Explore ICT Contribution to Socio-economic Development;

An Empirical Analysis in MENA Region

Supervisor:

Prof. Luciano Pilotti

Department of Economics, Management and Quantitative Methods (DEMM)

PhD Candidate:

Masoumeh Maddah

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1 University of the Western Cape
2 Professor of management studies at the Judge Business School, Cambridge University, UK
3 Professor of Information Systems at the London School of Economics
4 Independent Consultation in ICT4D Field
5 Assistant Director of Singapore Internet Research Center, Nanyang Technological University
6 Senior Scientific Officer and Project Leader at theJoint Research Center of the European Commission
7 Research Project Manager/Lecturer, Howard College, University of KwaZulu-Natal, South Africa

Abstract

ICT is often considered as one of the main drivers and enablers of development in both developed & developing countries. Considering different aspects of ICT contribution to development like social, economic, cultural and political impacts, all these aspects should be noted simultaneously in exploring interactions between ICT and development. Furthermore, existing literature on ICT development is so fragmented in developing countries especially countries located in MENA region. To narrow this literature gap, there is a need for an integrated and comprehensive ecosystem framework that would explain the contribution of ICT to socio-economic development in MENA region by taking advantage of ecosystem perspective. The ecosystem perspective is valuable in grasping all the contextual factors, interactions and ICT entities which cause ICT-based socio-economic development.

In addition to need for a comprehensive model to understand the relations between ICT and socio-economic development by ecosystem insight, on the other hand the scarce of relevant researches which have been addressed to both disruptive and progressive transformation impacts of ICT in MENA countries make this sort of study timely and worthwhile. Hence, the main objective of this research is to explore ICT contribution to socio-economic development in MENA countries through developing an ecosystem framework labeled as “ICT-based socio economic development (ISED) ecosystem framework”.

To develop ISED ecosystem framework three research questions were defined. These research questions are as follows:

1. What are the main elements of ISED ecosystem framework?
2. What are the appropriate indicators to measure sub-pillars of ISED ecosystem framework?
3. How do sub-pillars of ISED ecosystem framework vary in selected countries of MENA region?

Based on both qualitative and quantitative analyses, this study investigates ICT contribution to socio-economic development across 17 selected MENA countries including: Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syrian, Tunisia, United Arab Emirates, and Yemen. To address first two research questions grounded theory research method and Delphi research method are employed. For third research question, guidelines of constructing composite index and correlation analysis are applied.

In this way four sub-pillars concerning key ICT Entities which are interacting in a particular context have been determined. Also, six sub-pillars considering contextual factors (Capital Portfolio) which play key roles in obtaining particular level of ICT-based socio-economic development (ISED) have been defined. Moreover, the appropriate indicators in each sub-pillars were determined to measure these 10 sub-pillars in 17 MENA countries.

The empirical analyses unveil that there are a huge intra-regional gap in MENA region considering various sub-pillars of ISED ecosystem framework. Moreover, the correlation analysis shows that the 10 sub-pillars of ISED ecosystem framework are strongly and positively correlated and affect each other. The sub-pillars of ICT entity (IE) alone are not enough to allow ICTs to show fully their potential. It means that the six sub-pillars of capital portfolio (CP) that reflect the status quo of a nation plays a significant role to allow ICTs to appear their full potential. In other words, the serious weaknesses on 6 sub-pillars of contextual factors across MENA region hinder the overall potential of this region to leverage ICT entities to improve the level of ICT-based socio-economic development.

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List of Abbreviation

ICT	Information Communication Technology
ISED	ICT-based Socio-economic Development
IE	ICT Entity
CP	Capital Portfolio
MENA	Middle East and North Africa
QAT	Qatar
UAE	United Arab Emirates
KWT	Kuwait
BAH	Bahrain
SAU	Saudi Arabia
OMN	Oman
LBN	Lebanon
IRN	Iran
JOR	Jordan
NSC	National Social Capital
NPSC	National Process &structural Capital
NNR	National Natural Resource
PUE	Provide/Use Entity
IDI	ICT Development Index
RPE	Rule/Procedure Entity
WGI	Worldwide Governance Indicators
ICPS	International Centre For Prison Studies
IPB	ICT Price Basket
WB	World Bank
UNESCO	United Nations Educational, scientific and Cultural Organizations
ITU	International Telecommunication Union database
WITSA	World Information Technology and Services Alliance
UNCTAD	United Nations Conference on Trade and Development
OECD	Organization for Economic Co-operation and Development
CF	Choice Framework
CA	Capability Approach
SLF	Sustainable Livelihood Framework
WDI	World Development Indicator
GITR	Global Information Technology Report
TUN	Tunisia
MOR	Morocco
EGY	Egypt
SYR	Syria
ALG	Algeria
LYB	Libya
IRQ	Iraq
YEM	Yemen
NRC	National Renewal Capital
NFC	National Financial Capital
NHC	National Human Capital
IIE	ICT Infrastructure Entity
FIE	Fund/Innovation Entity
NRI	Network Readiness Index
IMF	International Monetary Fund
HDR	Human Development Report
GEM	Global Entrepreneurship Monitor
UNFPA	United Nations Population Fund
UNDP	United Nation Development Program
WHO	World Health Organization
OPEC	Organization of the Petroleum Exporting Countries
UNODC	United Nations Office on Drugs and Crime
IASP	International Associations of Science Parks

Chapter 1

Research Proposal

1 Research Proposal

1.1 Introduction

Broadly speaking, information and communication technology (hereafter ICT) is often considered as one of the main drivers and enablers of development in both developed & developing countries. Particularly, the accelerated development of ICT over past two decades has had great impact on countries' social and economic process across the globe. So, a large number of economists, sociologists and policy-makers argue that the progress in ICT would significantly empower human development indicators, increase the productivity of various economic sectors and totally enhance the welfare level in a society theoretically and practically. They generally conclude that not only ICT is a prerequisite but also does play crucial role in achieving social and economic development goals.

The massive increase in computer processing power that is becoming available to hundreds of millions of users, the development of powerful networks for linking individual computers, the increase in the number of internet users and mobile phone subscriptions; are transforming the knowledge, social and economic environment in many countries and , potentially, in all.

ICT sector has a crucial role in economic development, job creation, labor productivity, poverty alleviation and providing an open public sphere (Kozma, 2005). ICT sector can also play a significant role to enhance accountability and responsiveness of government agencies, increase learning opportunities, cultural creativity, and support the development of a knowledge-based and innovation.

So many scholars and researchers, concerning the importance of this issue, have generally tried to examine the contribution of ICT to the development and to explore their interrelations in particular. Existing literature shows us that most of these attempts have focused on investigating the economic effects of ICT in developed and developing nations. Nevertheless, as ICT has great contribution to the economic developments, other aspects of development such as social and political aspects can be investigated from this perspective. This strand of literature indicates that ICT could have some implicit and explicit social and political effects which could even marginalize economic impacts. Therefore, different aspects of ICT contribution to the development like

social, economic, cultural and political aspects should be noted in exploring ICT contribution to socio-economic development. In spite of the importance of this issue, existing literature is fragmented so that there is a need for an integrated and comprehensive model that would explain the contribution of ICT to socio-economic development.

1.2 Issue relevance

In light of the importance of ICT contribution to development lots of scholars and researchers made many efforts to explore the interaction between ICT and development. But most of these studies aim to investigate just the economic impacts of ICT in countries (both developed and developing nations) in the past decades. Examining the contribution of ICT to GDP growth and productivity was initiated by Ark et al (2002) and Daveri (2002) for most EU economies and Jorgenson (2003) for G7 economies. There are other related studies, namely, DrikPilat (2004) for OECD countries, khuong Vu (2004), KehbumaLangima (2005) for South Africa, European Commission (2006), International Telecommunication Union (2006), InfoDev (2007), Tenzin Norbhu (2009) for Bangladesh, Nicholas Bloom et al (2010) and Harold Gruber et al (2011).

On the other hand, concerning the expansion and progress of ICT, this technology completely *"hyperconnected"* with its social and economic context as well as cultural and political circumstances. So, present era has been called *"hyper-connected era"* (GITR, 2013). Hyper-connectivity is a term invented by Canadian social scientists Anabel Quan-Hassa and Barry Wellman, arising from their studies of person-to-person and person-to-machine communication in networked organization and networked societies.

The main drivers of hyper-connectivity process are the rapid growth of mobile broadband services and social media. In hyper-connected era the internet and its associated services are accessible and instant (GITR, 2013). People and businesses link with each other immediately. This phenomenon is changing interactions between players of socio-economic context such as consumers and enterprises, citizens and government, clients and service providers. Besides new opportunities to enhance the quality of life that resulted from hyper-connectivity phenomenon, it can introduce new threats concerning individual rights and cybercrime.

To model this hyper-connectivity, developing an ***ecosystem framework*** can be so fruitful in mapping interactions among all key players and main contextual factors.

However, the ecosystem perspective is valuable in grasping all contextual factors, interactions and ICT key players which cause ICT-based socio-economic development, existing literature on ICT shows that ecosystem perspective has been mostly neglected so far. Moreover, the Interactions between ICT and development is often regarded from one specific aspect (social, economic, cultural or political), so existing literature is fragmented. Indeed, addressing to economic, infrastructural and social issues in ICT development literature are very common but considering all interrelations, contextual factors, and ICT players in an integrated systematic perspective have been so rare. Thus, it seems there is a gap in the literature that could be narrowed by applying ecosystem perspective in exploring ICT-based socio-economic development. The ecosystem perspective can aggregate and integrate parameters and factors in ICT development form all aspects. It also helps us to envisage the effects of ICT sector on social welfare and cultural evolution and reciprocally how social and cultural context influences ICT development. This can be expanded to the political and legal environment relation with ICT development and its effects on political and legal issues in practice. Summarily, by applying ecosystem perspective help us to demonstrate systematically ICT contribution to socio-economic development. With the help of ecosystem framework, the contribution of ICT to socio-economic development would be analyzed in a systematic and holistic way.

As well, the lack of relevance research in Middle East and North Africa (MENA) countries and the need to better understand the relationship between ICT and socio-economic development in MENA region concerning its geographic and strategic position, makes this research timely and worthwhile. Also comparing countries in MENA region will help us to draw lessons to empower the level of ICT-based socio-economic development in countries with weak performance. Hence, the main objective of this research is *to investigate ICT contribution to socio-economic development through developing an ecosystem framework.* In this research the term "ICT-based socio-economic development" refers to the transformation which ICT is understood to contribute.

1.3 Main Objective

Exploring the contribution of ICT not only in economic development but also in other aspects of development such as social and political development is significant. Therefore need for a comprehensive model to reveal the relations between ICT and socio-economic development including all ICT players, contextual factors, and interactions among them that pay attention to both disturbing and progressive transformation impacts of ICT call for an in-depth research.

Notwithstanding the importance of this issue, there is no existing comprehensive research that both empirically and theoretically explores the contribution of ICT to socio-economic development.

The main objective of this research is to explore ICT contribution to socio-economic development through developing an ecosystem framework by taking advantages of Choice Framework (CF) and Capability Approach (CA) concepts.

To explore ICT contribution to socio-economic development we will apply both qualitative and quantitative examinations. Since ICT-based socio-economic development is a multi-dimensional concept and there is no comprehensive framework that reflects all dimensions of this concept, we are going to develop these multi-dimensional concept through an interpretive research approach.

1.4 Sub-Objectives

Based on the main objective, following research sub-objectives are undertaken in this research;

- Developing an ICT-based socio-economic (ISED) ecosystem framework including all interacting entities, rivalry/cooperative interactions, institutions, social structures and components of socio-economic context in macro level.
- Determining the dimensions of ICT-based socio-economic development.
- Collecting a set of relevant indicators and data to measure the main elements of ISED ecosystem framework concerning the international organizations reports and widely accepted data sets.

- A comparative analysis of MENA (Middle East and North Africa) region countries in terms of the elements of ISED ecosystem framework.
- Exploring the interrelation among main elements of ISED ecosystem framework to analyze ICT contribution to socio- economic development.

1.5 Research questions

The main objective of this research is developing an ecosystem framework in order to investigate the ICT contribution to socio-economic development -considering ecosystem metaphor and choice framework. We labeled this ecosystem framework: "ICT-based socio-economic development (ISED) ecosystem framework". This framework paves the road for the construction of a meaningful composite index (CI) to measure ICT-based socio-economic development.

The research questions that we investigate to answer through this study are as follows:

1. What are the main elements of ICT-based socio-economic development (ISED) ecosystem framework?
    - What are the ICT key players/entities of ICT-based socio-economic development ecosystem framework?
    - How do ICT for development (ICTD) experts define interactions among ICT key players?
    - What are the main contextual factors of ISED ecosystem?

    The degree to which an ISED ecosystem framework is effective and efficient depends on components of its national capital portfolio. These factors play a key role in determining particular development path. They work as the potential to make desired ICT-based socio-economic development.

    - What are the main dimensions of ICT-based socio-economic development as the outcome/impacts (both progressive and disruptive) of ISED ecosystem framework? (concerning to various aspects of development simultaneously such as social aspects, economic aspects, political aspects and cultural aspects)
2. What are the appropriate indicators to measure elements of ISED ecosystem framework?

- What are the appropriate indicators to measure ICT key players/entities?
- What are the appropriate indicators to measure main factors of pertinent context?

3. What interrelations and associations are there among main elements of ISED ecosystem framework?
    - How do ICT-based socio-economic development indicators vary in various countries of MENA region?
    - How do indicators of contextual factors vary in various countries of MENA region?
    - How do ICT players/entities indicators of ISED ecosystem framework vary in various countries of MENA region?

1.6 Research approach

ICT contribution to socio-economic development is associated to many internal and external factors. As long as there is no pervasive theory, it is vital to apply "multi-method" and "mixed-method" approaches to analyze ICT contribution to socio-economic development.

Both "multi-method" and "mixed method" approaches are used to respond to the three research questions. It means to answer first two research questions we have employed two types of qualitative inquiries (interpretive research method) such as grounded theory method and Delphi research method. To investigate last research question we have applied quantitative research approach.

1.7 The level of analysis

The term "level of analysis" points to the "*location, size or scale of a research target"* (Yurdusev, A. Nuri, 1993). Subramaniam (2004) states three general levels of analyses may occur in each research: micro-level, meso-level or middle-range, and macro-level with respect to both geographical and institutional dimensions. These levels of analyses are not necessarily mutually exclusive in that they can occur at the same time (Subramaniam, 2004). The research population

at the micro-level analyses is an individual or a small group of individuals in a particular social context. In Macro-level analyses the outcomes of interactions are traced over a large population. A meso-level analysis indicates a population size between the micro and macro levels, such as a community or an organization. Moreover, meso-level may applied to analyses that are particularly developed to unveil relation between micro level and macro level.

Table 1. The level of analysis for socio-economic development

Level of analysis	Dimensions	
	Geographical	Institutional
Micro	Local / Village	Individuals / businesses / communities
Meso	Province / Regional	Supportive context / supportive organizations
Macro	National	National policies / the regulatory environment

In this research the level of analysis that has been selected to explore ICT contribution to socio-economic development is macro level.

1.8 Research design

This section describes both qualitative and quantitative steps which will be used in this study to answer the research questions.

1.8.1 Qualitative steps

The development of ICT has initiated a profound transformation of the world into a hyper-connected society. It is obvious that people, business, and governments now have much better access to information, knowledge and wisdom than before in terms of scale, scope, and speed. Furthermore this wealth of information, knowledge and wisdom is endlessly growing through unprecedented fast and robust communication and exchange.

With this premise, on theoretical front, an ecosystem framework of ICT-based socio-economic development (ISED) will be developed to explore ICT contribution to socio-economic development in this research. For This purpose, theoretical exploration will be directed in the following steps:

- Comparing the structures which are used by international organizations to model ICT contribution to socio-economic development.
- Exploring various definition of ICT-based socio-economic development.
- Identifying the advancing and disturbing impacts of ICT-based socio-economic development.
- Determining main elements of the ICT-based socio-economic development (ISED) ecosystem framework including key ICT players and main contextual factors.
- Determining interactions among elements of ISED ecosystem framework
- Determining main dimensions of ICT-based socio-economic development as the outcome of ISED ecosystem framework.
- Determining the appropriate indicators from official and widely accepted reports to measure various elements of ISED ecosystem framework
- Defining main pillars and sub-pillars of the developed ISED ecosystem framework regarding determined elements to map a hierarchical structure as the starting point of quantitative phase.

1.8.2 Quantitative steps

In quantitative phase, this research conducts empirical examinations to investigate the interrelations among the main elements of ICT-based socio-economic development (ISED) ecosystem framework in Middle East and North Africa (MENA) region. Furthermore, the association between ICT-based socio-economic development as the outcome of ISED ecosystem framework and the elements of this ecosystem in MENA countries will be investigated.

The Middle East and North Africa includes Israel and Iran and all the members of the Arab League: Algeria, Bahrain, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, West Bank and Gaza, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen. This region contains countries with various political, economic and cultural conditions. MENA region includes various type of regimes like republican and monarchical regimes, nations with very high oil and

gas resources, non-oil countries, small and large states, and very rich nation like Qatar and poor countries,

The quantitative examinations will be conducted in the following steps:

- Measuring various elements of ISED ecosystem framework for 17 countries of Middle East and North Africa (MENA) region and comparing MENA countries position.
- Exploring the relations among proposed elements of ISED ecosystem framework through computing Spearman Correlation Coefficient (Correlation Analysis)
- Constructing an ICT-based socio-economic development (ISED) composite index regarding the proposed ISED ecosystem framework to measure and compare ICT-based socio-economic development across 17 MENA countries. This composite index enables both scholars and policy-makers to measure this multi-dimensional concept effectively, without dropping the underlying information base.

These measures simplifies and make possible cross-country comparison of ICT-based socio-economic development in different countries of MENA region and also would be fruitful in benchmarking of best practices in order to draw policy lesson and initiatives for less developed countries in this region.

According to "*Economic Developments and Prospects*" report (2013), the MENA region is divided into three main groups:

1) The GCC oil exporters: The first group contains the Gulf Cooperation Council (GCC) countries, namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates;
2) Developing oil exporters: Algeria, the Islamic Republic of Iran, Iraq, Libya, the Syrian Arab Republic, and the Republic of Yemen;
3) Oil importers: oil importers include countries with strong GCC links (Jordan, and Lebanon) and those with strong EU links and located in North Africa (Morocco, Tunisia and the Arab Republic of Egypt).

1.9 Data

In this research empirical examinations will be carried out to test the developed ecosystem framework. Considering proposed ISED ecosystem framework and selected indicators, the cross section data will be collected for 17 countries of MENA region from official and widely accepted international organizations for the most recent year (year 2013).

The data will be compiled from the following sources:

WDI, ITU, WGI, WB,WITSA, UNDP, Economist, OECD, UNCTAD, UNESCO, UNFPA, GEM, Doing Business, MF, HDR, IASP, Gallup World Poll Database, UNODC, WHO, OPEC, Arab Social Media Report, Freedom HOUSE, ICPS, Freedom House, Heritage.org, and GITR.

Chapter 2

Theoretical Background

2 Theoretical background

2.1 Theories of development

Development is defined as a progressive process of growth (Oxford English Dictionary, 2008). Development represents vertical advancement where society moves from lesser to greater level of energy, efficiency, quality, complexity, comprehension, creativity, enjoyment and accomplishment (Jacobs et.al, 1999). Therefore development would result in increased pace of service use for social and economic well-being of society.

Development refers to improvements in literacy, life expectancy, rates of poverty, environmental quality, freedom and social justice among other measures of social aspect of society (Abbot, 2003).

Baqir (2009) describes some of the famous development theories such as Modernization theory (Rostow, 1990), Dependency theory (Amin, 1976), World System theory (Wallerstein, 2004), State theory (Preston, 1996), Economic Development theory (Abbott, 2002), Social Development (Szirmai, 2005) and discusses although a particular theory cann't explain ICT-based development, the economic theories of development are more helpful to explain ICT based development. Concerning this fact, in the following lines some related studies about economic theories of development will be discussed. Regarding these studies we could infer that economic development is a situated and context-specific process. So ICT does not serve all societies equally well as a tool for development.

Main focus in economic theories of development is to have an efficient market that the production capacity for production, resources allocation, and market mechanisms for trade are effective (Granovetter, M., 1985).

In neo-classical economic theory, economic growth relies on two fundamental assumptions (Weintraub, 2007):

> *"- The rational behavior of economic agents including individuals and business organizations"*

"- The capacity of market competition to eliminate inefficient producers and to create equilibrium of production and consumption at optimal conditions of full employment and the lowest consumer prices."

Regarding this view, development could be defined all process, policies, procedures, and efforts that help to transform the socio-economic regimes into such free markets. The policies to achieve this kind of transformation are: removing existing barriers for trade and more reasonable privatization. Avgerou argues governments following these implications need to play more regulatory role of overseeing the legal framework that is required for the free market (Avgerou, 2002). Walsham and Avgerou (2000) discuss the lack of attention to this recent point has led to an interpretation that the free market tends to 'market failures'.

The most important questioning to the neo-classical economic viewpoint of development arises from the New Institutional Economics (NIE) theory. The neo-classical theory is based on the "*rational individual choice*". NIE theory presumes the main idea of neo-classical theory in which this theory is built, is unreal because individuals seldom have complete information about the market (Toye, J. 1995). Accordingly, economic transactions demand the search for appropriate information, and such a search necessarily involves costs. In addition, for minimizing risks, economies need negotiations and formation of contracts and also mechanisms to implement such contracts. Moreover, the rationality of individuals' choices is more concerned with their 'mental models' (Douglass North 1995), that means individuals' values about the world which are formed culturally. As a whole, these items can lead to inefficient economies. NIE broadens the analysis of rational behavior across cultural and political dimensions. It changes slightly attention to the significance of institutions, that is, the formal rules and informal conventions that govern the behavior of economic actors – whether individuals or firms. Institutions are significant because they limit the scope of search of economic choices, thereby diminishing transaction costs. They also lessen uncertainty by providing enforcement mechanisms. While market competition prevail the core mechanism for enhancing efficiency, new institutional economies shows non-economic and economic institutions play an important role in shaping the economy. Avgerou (2009) argues that a network of organizations ise required to act in their own rights in financial and capital markets, Also, independent regulatory authority play a crucial role in

providing rules and policies that influence the decisions of economic actors. As a matter of fact, NIE concerns non-market institutions as mechanisms for controlling the costs and risks of the market, thus serving the economic interests of rational individuals and firms.

In the specialized language of NIE, economic change is '*path dependent*', in that it is constrained by the historically developed institutions of a society (Douglass North, 1991).

Stiglitz (2002), criticize policies that aim to reduce the role of government in developing countries as he argues that strong and effective government, rather than less government, is required for the transition to effective markets. He contends some developing countries such as China and Malaysia have done better in poverty alleviation and avoiding crises. Stiglitz (2002) argues that governments in these countries have built the essential institutions regarding the particular needs and concerns of their countries.

Other critics of neo-classical economic theory highlight the significance of politics in the development process (Leftwich 2000). Leftwich (2000) states that the understanding of "*market-led development process"* has been changed in two ways regarding to politics:

> *"First, it highlights the centrality of state government in shaping the course of development. Second, it reinforces the contextual, historically contingent nature of a society's development process".*

Wade (1990) holds that the government in "*developmental states"* like South Korea, Singapore, and China has interventionist role and use state power to manage market.

Studies of technology innovation in the "*developmental states"* have also unveiled the significance of interventionist role of government in fostering high-tech industries, as well as in steering technology innovation across industries (Freeman 1987; Hobday 1995; Archibugi and Michie 1997).

Regarding above literature it is not surprising that efforts of different countries to benefit from ICT as a development tool don't have equal results. The contextual factors, the historically developed institutions and social relations that embedded in a nation influence the scale, scope, and speed of the desirable ICT-based socio-economic development impacts.

2.2 Definition of socio-economic development

Contemporary approaches on development identify ICT as a requirement for economic growth and the improvement of social conditions. Puri (2007) discussed the role of ICT in creating a better world and referred to socio-economic development as a means to advance the less developed countries. Hammed (2007) argues that ICT-based socio-economic development considers number of areas that could gain by using ICT in each of these areas. In order to understand the contribution of ICT to socio-economic development, it is important to first understand the concept of socio-economic development.

A remarkable feature of the world at the beginning of the 21st century is the inequalities between the socio-economic conditions of different countries. It seems appropriate to define socio-economic development as a combination of socio and economic development. So first we define social development and economic development separately.

The term social development is normally associated with changes in society that are considered beneficial (Houtman, 2004). Social development may mean different things to different people in different contexts. Social development refers to the opportunities for education, social interactions and evolution of social customs, fashion and trends (Blakely, 2001).It is important to find out what does social development specifically mean with in terms of the role of ICT in bringing about social changes. Kozma (2005) explains social development as what follows:

> *"Social development is the set of broader social changes resulting from the convergence of computers and communication technologies, their assimilation throughout society and their use for communication, collaboration, and the sharing of knowledge. As ICTs become more accessible and embedded in society they offer the potential to restructure organizations, promote collaboration, increase democratic participation of citizens, improve the transparency and responsiveness of governmental agencies, make education and health care more widely available, foster cultural creativity, and enhance the social integration of individuals with different abilities and groups of different cultural backgrounds."*

On the other hand, Blakely (2001) states that economic development means job creation and pervasive improvement in the quality of life and accelerated economic activities (Blakely, 2001). World Bank (2008) defines economic development in terms of *"qualitative change and restructuring in a country's economy in connection with technological and social progress"*.

Economic development refers to increase in economic wealth of regions or countries for the well-being of their inhabitants (Abbott, 2002). The cornerstone of economic development efforts is increased opportunities for economic activities including higher job availability and higher pay. The literature shows a number of different measures for economic development in different contexts. Some of these measures include quantitative numbers such as GDP growth, capacity of market, employment, productivity. Baqir (2007) argues that the result of economic development is improvement in social aspects of society like quality of life, poverty, learning opportunity, healthcare opportunity, quality of pertinent, and democratization. The role of ICT and economic development has been emphasized in the literature. There are several studies that examined ICT based economic development in developing nations suggest that ICT growth has a close relationship with economic development.

With respect to definition of social development and economic development the assertion that "socio-economic development is a combination of socio and economic development" is acceptable. However, Baqir (2009) believes that socio-economic development is a concept much more than a mere combination of social and economic development. He states socio-economic development is a multidisciplinary concept and is used in different academic discipline such as sociology, psychology, economics, political science, geography, management and health sciences to describe enhancement of quality of life for ordinary citizens.

From economics perspective, socio-economic development is considered as a "*potpourri of economic, social, cultural and political forces"* (Lewis, 1954).

From sociology view, Socio-economic development refers literacy, information, freedom of choice, social stability, autonomy, and social values (Ramos, 2006).

Moreover, Szirmai (2005) considers socio-economic development refers to income, learning opportunity, human capabilities, politics, culture, ecology, health opportunity, life expectancy,

freedom (association and personal), personal safety, and the extent of participation in civil society.

Blakeley (2000) argues that from political science view, socio-economic development considers economic power, wealth, income, direct and indirect economic benefit such as job creation, improvement in quality of life, and accelerated economic activities. In other world the concept of socio-economic development is at the heart of political science.

Hsieh et.al. (2008) measures a concept as complex as socio-economic development in terms of income and education. Even though Puri (2007) talks about socio-economic development as a possible way of creating a better world. He does not give any further detail of what does creating a better world entail? Hsieh, Rai and Keil (2008) analyzed behavior models of socio-economically advantage and disadvantage to understand digital divide.

2.3 Dimensions of socio-economic development

The literature on dimensions of socio-economic development shows that there is no agreement on the definition of this term and different academic fields such as political science, economics, social science and sociology define this expression differently. Consequently the defined dimensions for socio-economic development include various concepts. Concepts like sustainability, living standards, well-being, empowerment and poverty alleviation have been considered in existing literature (Choudhury, Zaman&Harahap, 2007).

Madon (2000) identifies four dimensions for socio-economic development within the context of internet growth in developing countries. These four dimensions include:

"1) Social wellbeing, 2) economic growth, 3) political wellbeing, 4) physical environment".

In addition, she distinguishes three application areas for internet within social wellbeing dimension including: *"health, 2) education and 3) poverty alleviation and empowerment."* One internet application within economic growth dimension include: "*economic productivity"*, one application of internet within political wellbeing dimension include: *"democracy"* and one application area for internet within physical environment dimension include: "*sustainable development."*

Table 2. Dimensions of socio-economic development within the context of internet

Socio-economic Dimensions	Application Areas for Internet
Social wellbeing	health, education, poverty alleviation and empowerment
economic growth	Economic productivity
political wellbeing	Democracy
physical environment	Sustainable development

She represents the relationship among socio-economic development, internet growth and dimensions of socio-economic development through figure 1.

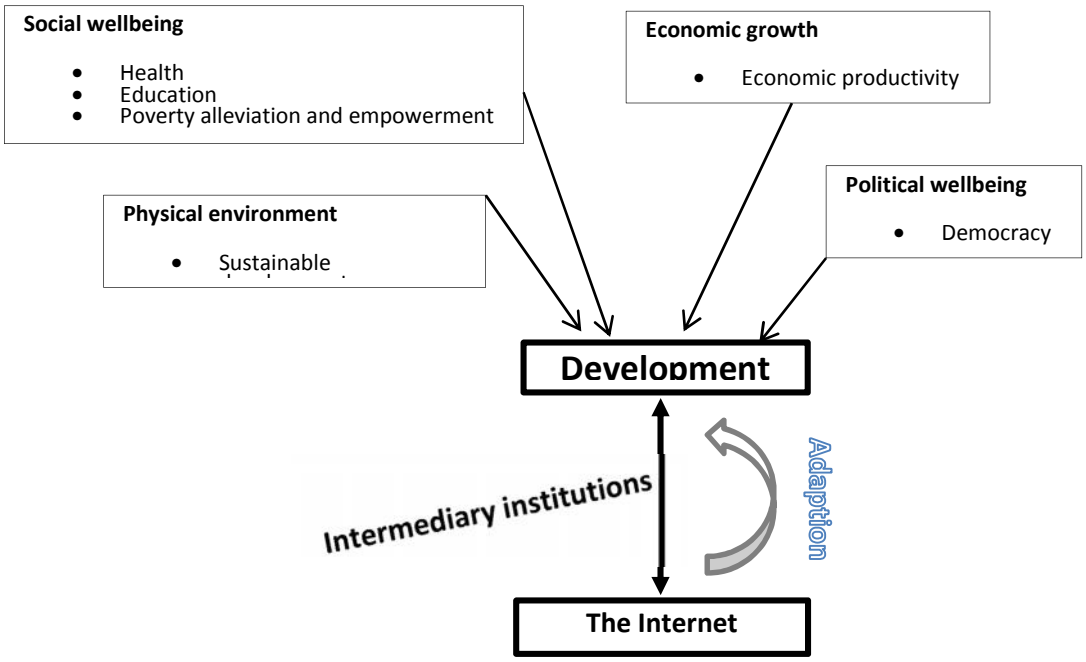


Figure 1. Internet and socio-economic development; Conceptualizing the Interaction (Source: Madon, 2000)

In Baqir's study (2009) five dimensions for socio-economic development have been identified. These dimensions are based on qualitative data and have been defined by analyzing the citizens' narratives in developing countries. These five dimensions include:

"1) Social contact, 2) economic transformation, 3) quality of life, 4) cultural evolution, 5) personal security and criminal use."

He represents these dimensions of socio-economic development through a model. Baqir (2009) states the dimensions of socio-economic in his research extend the dimensions of socio-economic that are defined by Madon (2000). He argue the "quality of life" dimension covers all

applications of internet which Madon (2000) was defined within “social wellbeing” and “political wellbeing” dimensions. Also, Madon has not identified “personal security and criminal use” and “cultural evolution” as dimensions of socio-economic development. Besides, “economic transformation” demonstrates the impact of ICT on business whether it is positive or negative while the “economic growth” with respect to economic productivity address to positive aspect of ICT impacts on businesses.

2.4 Definition and evolution of ICT

ICT is a very diverse and heterogonous complex sector. Blurton (2002) defined ICT as a *“diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information.”*(Blurton, c., 2002). These technologies include computers, the Internet, wireless networks, mobile broadband, broadcasting technologies (radio and television), and telephony. Mansel (1994) states that ICT refers to “*a myriad of stand-alone media as well as computer-mediated networks that link a personal computer to the Internet. ICT is an integrated system that incorporates the technology and infrastructure required to store, manipulate, deliver and transmit information*”. Jovanovic/Rousseau (2005) define ICT as a technology with special and far-reaching characteristics. They state three main characteristic for ICT: (1)ICT is pervasive and spreads to all sectors, (2) ICT improves over time and hence keeps lowering the costs for users, and (3) ICT spawns innovation and facilitates research, development and market introduction of new products, services or processes.

Information and communication technologies have provided new communication capabilities for nations such as instant messaging, voice over internet protocol (VoIP), and video-conferencing. Social networking websites provide facilities for their users to stay in contact and communicate from all over the world on a regular basis.

The European information Technology Observatory (2009) categorized the ICT market into three segments including: information technology (IT), telecommunications (TC), and consumer electronics

Shapiro and Mathur (2011) have divided ICTs into two groups of activities. First, ICT producing activities and second, ICT using activities. The first group activities will be categorized into two sub groups including:

> *"- ICT producing manufacturing activities: are those which manufacture products intended to fulfill the function of information processing and communication or must use electronic processing to detect, measure or record physical phenomena or control of physical process.*
>
> *- ICT producing service activities: are those activities that produce service which are meant to enable the function of information processing and communication by electronic means."*

.

For a number of years, researcher and policy makers have made many efforts to measure the importance of the *"ICT sector"*. The lack of a standard definition for the ICT sector, made impossible monitoring its impacts.

For the first time in 1997, at the OECD the Committee for Information, Computer and Communications Policy (ICCP) established a research group to develop a standard definition for the ICT sector. This group determined a definition for ICT sector on the basis of a list of industries drawn from the third revision of the International Standard Industrial Classification (ISIC. rev.3). The definition of ICT sector was revised in 2002, reflecting the release of ISIC Rev. 3.1 (United Nations Statistics Division, 2002). After that this group made periodic reviews on ICT sector definitions. In 2006 the revisions to ISIC Rev. 4 were completed and a good opportunity to review the ICT sector definition was presented (UNSD, 2008). The OECD was an active participant in the ISIC revision process and the classification includes improvements to ICT-related categories.

Shapiro and Mathur (2011) have stated ICT sector comprise four sub-industries: (1) computer and electronic products; (2) publishing (including software); (3) information and data processing services; and (4) computer systems design and related services.

Table3. The OECD ICT sector definition (based on ISIC Rev. 4, 2006-2007)

Industry groupings	ISIC	Industry titles
ICT manufacturing industries	2610	Manufacture of electronic components and boards
	2620	Manufacture of computers and peripheral equipment
	2630	Manufacture of communication equipment
	2640	Manufacture of consumer electronics
	3230	Manufacture of magnetic and optical media
ICT trade industries	4651	Wholesale of computers, computer peripheral equipment and software
	4652	Wholesale of electronic and telecommunications equipment and parts
ICT services industries	5820	Software publishing
	6110	6110 Wired telecommunications activities
	6120	6120 Wireless telecommunications activities
	6130	6130 Satellite telecommunications activities
	6190	6190 Other telecommunications activities
	6201	6201 Computer programming activities
	6202	6202 Computer consultancy and computer facilities management activities
	6209	6209 Other information technology and computer service activities
	6311	6311 Data processing, hosting and related activities
	6312	6312 Web portals
	9511	9511 Repair of computers and peripheral equipment
	9512	9512 Repair of communication equipment

Source: From OECD (2006a). The codes and titles were checked against the final (November 2008) version of ISIC Rev. 4.

In the table 4 the evolution of ICT from early era to hyper-connected era has been shown. Hyper-connectivity is redefining interactions among different factors of pertinent context. However this phenomenon provide new opportunities to improve living standards, it can introduce new threats concerning individual rights, privacy, the flow of personal data, cultural evolution and cybercrime.

Table 4. evolution of ICT: from early era to hyper-connected era

Early Era or Mainframe Computing Era	1950	First commercial computer was announced
	1953	Magnetic core memory first used
	1954	First mass-produced computer (IBM 650)
	1957	First commercial FORTRAN program
	1962	First interactive computer game
	1964	First networked computer BASIC programming language was created
	1969	Internet was invented First UNIX operating system First computer controlled robot
Mini Computing Era	1971	Email was invented
	1972	First modern video game
	1975	First email client Microsoft Corporation was founded
	1976	Apple computers were announced
	1977	Home gaming was born Stores begin to sell PCs

		First PC Modem was developed
Client/Server Computing Era	1980	First Hard Disk Drive(HDD)
	1981	Electronic Data Exchange(EDI) VAN(Value Added Network) services started MS-DOS released
	1982	Commodore 64 released
	1984	Domain Name System was created Apple Macintosh was launched
	1986	Internet newsgroups were born(using internet-standard TCP/IP connections) Pixar is founded
	1987	Internet growth
	1988	First computer virus Open Source Initiative(OSI) was founded (OSI is an organization dedicated to promoting Open Source Software)
World Wide Web Era	1991	The World Wide Web was launched to the public Windows 3.0 was launched
	1992	Linux was Launched (the first open source operating system)
	1993	First Graphical Internet Browser Browsers such as Netscape launched
	1994	Development of common protocols for the evolution of World Wide Web Yahoo was created
	1995	Amazon, eBay were introduced(Internet shopping)
	1996	Hotmail become first web-based email service Web TV was introduced
	1997	The cable Modem was introduced
	1998	Google search engine was launched Windows 98 released
	1999	Salesforce.com launched as a company specializing in software as a service Napster was launched
Cloud Computing, Social Networking and Mobile Internet Era	2000	Dot com bubble bursts Amazon played a key role in the development cloud computing by modernizing their data centers
	2001	Use of broadband begin rising Wikipedia was launched(collective Web content generation)
	2004	Take part in the internet, blogging, chatting and social networking(Web 2.0 became a mainstream concept) Facebook was launched
	2005	YouTube was launched (bringing free online video hosting and sharing to the masses
	2006	Twitter was created Amazon launched Amazon Web Service(AWS) Java officially went 'open'. It was the largest source code released under Open Source till date
	2007	Mobile internet access or mobile web First iPhone announced
	2008	Eucalyptus became the first open-source software for deploying private and hybrids clouds.
	2009	Salesforce launched Force.com(it is a cloud computing platform as a service system from salesforce.com Mobile broadband access

		Microsoft launched windows 7
	2010	Cloud service got much needed boost with the launch of i-services for iPad and iPhones customers
Hyper-connected Era	2011	Several start-ups were founded that leverage the cloud services.
	2012	exponential growth of mobile broadband and social media are drivers of hyper-connectivity

Source: Author based on www.timetoast.com , www.internetsociety.com, www.darrenstraight.com , www.history-timelines.org , www.timerime.com, www.library.thinkquest.org , www.ictlounge.com

2.5 ICT and development approaches

ICT and development research is based on the belief that ICT has, potentially, the capacity to contribute towards the improvement of various aspects of life. Most of the ICT researches focus just on the progressive impacts of ICT. In these type of literature ICT is considered merely as an advancing tool that transform the socio-economic condition positively.

Eggleston (2002) believes the ICT technology improve the markets' functions. He believes ICT helps to reduce transaction cost and make efficient choices by providing information for both producers and consumers (Eggleston et al. 2002). Porter et al. (2002b) in *Global Competitiveness Report 2001-2002* provide an analysis that differentiates the role of ICT for development in three different groups of countries with specific socio-economic conditions including: low, medium, and high income nations.

> *"At the low-income level, economic growth is determined mainly by the mobilization of land, primary commodities and unskilled labor. At middle-income level, national economies get integrated into the international production system and economic growth is increasingly achieved by adopting foreign technologies in local production. Economies at the high-income level achieve global competitiveness through rapid technology innovation and high rates of learning, especially science-based learning."*

According to this report, the transformation impacts of ICT completely depend on to the capacity and level of development of a country's market economy. Indeed, the results of the report unveil that

> "*The hardest transition along their three-stage model of development is from a technology-importing, efficiency-based 'middle' level economy to the innovation-based,*

high-income knowledge economy. They point out that the challenge for policy lies in the process of adaptation to new institutional conditions at the transition points of the model."

Most of the ICT and development studies are based on the premise that ICT can transform the socio-economic conditions of a nation in a positive manner. (Mann 2004; Sahay 2001; Walsham et al. 2007).

For instance in Kraemer et al. (2009) study and Ma et al. (2005) the development potential of ICT is a taken-for-granted, however each of these studies have made particular assumptions about the meaning and nature of the development process that ICTs are intended to contribute.

Among ICT and development studies, Heek (2002) and Avgerou (2009) have made notable efforts to shed light on the some disturbing impacts of ICT.

Heeks (2002) categorizes related impacts of ICTs to the framework of two vectors. He determines three perspectives regarding to the *"ICTs impacts"* (impacts continuum) from *"optimism"* to *"pessimism"* on the vertical vector. At the beginning of this continuum are people which connect ICTs with principally negative impacts (Pessimists) such as unemployment or criminal use. At the midpoint of this continuum there are some people that believe ICTs have both positive and negative impacts (neutrals) and at the end of this continuum are people who link ICTs with mostly positive impacts (optimism). As well as he determines three perspectives with respect to *"causes of ICT impacts"* (impact causes continuum) on the horizontal vector. At the beginning of this horizontal continuum are *"technological determinists"* that believe it is principally innate characteristics of technology that determine ICTs impacts. At the end of this continuum are people that believe substantially human preferences within social context determine ICTs impacts (social determinists). At the midpoint of this continuum are people who believe the causes of impacts are either technological or social and it is contingent.

By combination of three point of views regarding to the ICT impacts and three viewpoints concerning the causes of ICTs impacts, Heeks (2002) defines a framework consist of nine distinguishing positions on ICTs and development. This framework could help us to better conception of various positions on ICT-based socio-economic development.

Avgerou (2010) identifies two perspectives with concern to the nature of the ICT innovation process and also two perspectives on the development transformation which ICT is understood to contribute (ICT-enabled development). The perspectives regarding the nature of ICT innovation process including *"transfer and diffusion"* and *"socially embedded action"*. The perspectives related to the development transformation including *"progressive transformation"* and *"disruptive transformation"*.

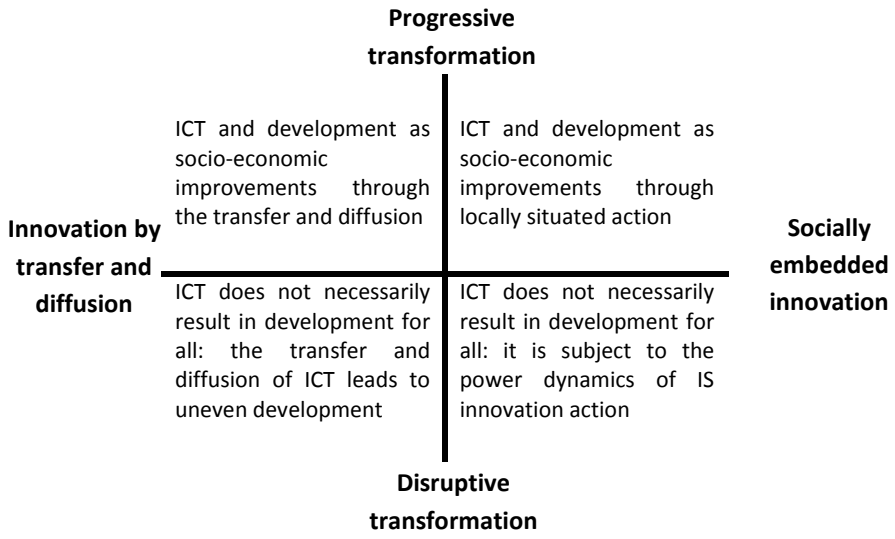


Figure 2. Discourses on ICT and development (Source: Avgerou, Information technologies and international development 2010)

By combination of four perspectives regarding the nature of the ICT innovation process and the nature of the development transformation process, Avgerou (2010) defines four distinguishing discourses on ICT and development. Regarding the results of this research she concludes that studies on ICT-enabled socio-economic development remain weak.

2.6 The interaction between ICT expansion and socio-economic development

The UNDP report (2001) discusses how technological innovation enhances human capabilities. On the other hand, human capabilities are an important means for achieving technological innovation. Therefore, technology innovation and development are *"mutually reinforcing, creating a virtuous circle"* (UNDP, 2001).

Gruber and Koutroumpis state that the relationship between ICT expansion and socio-economic development should be addressed from two different aspects: first, the increase of socio-economic development due to the increase in ICT infrastructure and its externalities; second, the increase in the demand for ICT services due to higher socio-economic development (Gruber, H., Koutroumpis, P., 2011)

Walsham&Sahey (2006) argue that the potential of ICT in transforming the socio-economic condition of a nation can be investigated in the form of several dimensions.

Baqir's study (2009) reveals that the nature of ICT expansion and socio-economic development interaction could be explained by five major concepts. These five concepts are "*policy development*", "*enabling legislations*", "*planning*", "*affordability*", and "*availability*".

Figure 3. ICT expansion and socio-economic development (Source: Baqir, 2009)

A framework of the stages of socio-economic development is developed by Baqir (2009). These stages are "*awareness*", "*shaping*", "*growth*", and "*actualization*" respectively. The first stage is reached by increasing the awareness of stakeholder about the benefits of ICT based socio-economic development around the world (global development), in neighboring countries (regional competition) and success stories. Awareness regarding success practices of the ICT based socio-economic development, stimulate stakeholder to shaping the environment through developing policy, enabling legislation and drawing plan. Shaping stage make appropriate environment for the next stage, growth. These shaping efforts create an environment for ICT growth (affordable and available services). The growth stage leads to actualization of socio-

economic development that is the last stage. Finally the success stories resulting from actualization of socio-economic development, besides global development in ICT sector and regional competition create a condition for the next repetition of socio-economic development stages.

2.7 Features of framework which are used by international organizations to model ICT contribution to socio-economic development

Over the past years, many international organizations such as International telecommunication Union (ITU), World Bank and World economic Forum attempt to monitor and measure the level of ICT development in developed and developing nations. The attention of international organization to measuring ICT development and ranking economies with regards to ICT indices shows the importance of ICT in social and economic transformation. So, exploring some of these measures and finding their association with socio-economic situation of economies could allow us to understand the interrelations among various viewpoints of ICT development and also the development impacts of ICTs. Furthermore, we aim to find out which of these measures focus not only on output indicators, but also on impact metrics such as the impacts of ICT development on social and economic development.

2.7.1 Networked Readiness Index (NRI)

The Networked Readiness Index (NRI) framework was launched in 2002 to assess ICT for competitiveness and development in different nations. The NRI became the most exhaustive framework for estimating nations in the use of ICT with respect to main interest groups namely, individuals, businesses, governments.

Due to ICT has become global and "*ubiquitous*" the policy attention has been focused on making the best use of this technology to enhancing social and economic aspects of nations rather than just providing access. Consequently, the framework and definition of some indices such as NRI have been modified in line with these changes. In the global information technology report (World Economic Forum, 2012) has been introduced a new edition of NRI framework. This modified framework is based on five main ideas including:

1) In evolving NRI framework, aspects related to ICT readiness and ICT usage are key precedents to acquire any other impacts. It means ICT impacts will appear if this technology is used by individuals, businesses and governments.
2) This framework includes features to find out whether the social and economic environment of a nation (market condition, regulatory framework) has enough capacity to benefit from ICT. It means enabling environment is another precedent to obtaining more economic and social benefits.
3) Evolving NRI framework contains features to measure both social and economic impacts of ICT. This framework is introducing an ICT impact sub-index separating from usage.
4) The interaction among all factors within an ICT ecosystem and consequently, starting a *"virtuous cycle"* is another feature of new NRI framework. High rate of ICT use and more positive impacts result in driving various actors to continue improving NRI framework conditions and consequently, improving more impacts and benefits.
5) The NRI new framework must comprise features to identify policy orientations. Since the development of ICT associates with the capability of a nation to provide an "*institutional framework*" with effective regulations and ICT-friendly government policy so, this feature is so important.

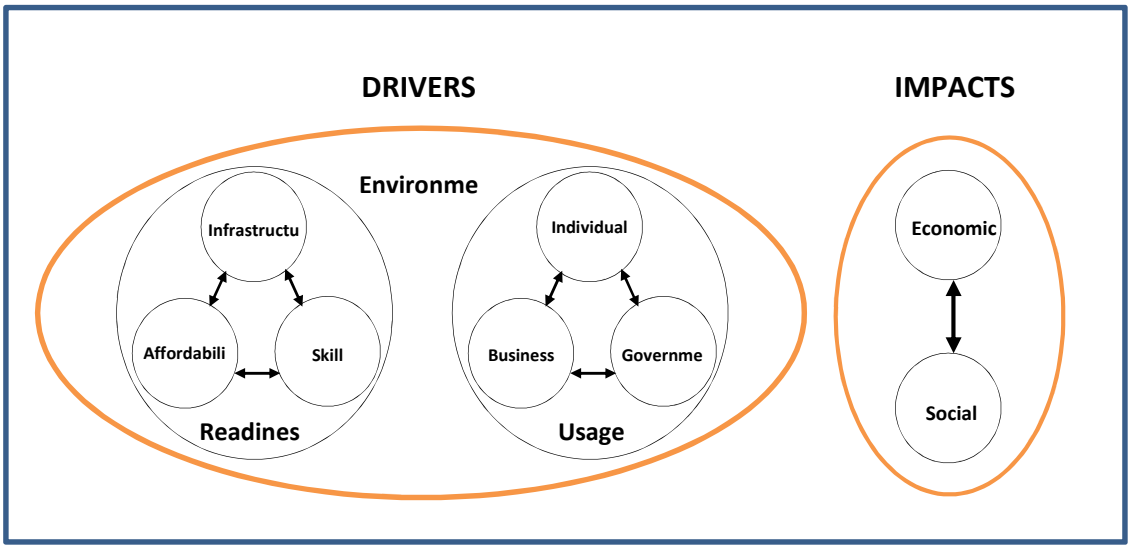


Figure 4. The evolved NRI framework (Source: the global information technology report, 2012)

As you see the evolving NRI, include 4 sub-indices. These are 1) environment, 2) readiness, 3) actual usage of all key actors and 4) social/economic impacts. The three former are considered as condition drivers for latter sub-index. These sub-indices are categorized to 10 pillars and 53 variables. The NRI score is calculated through a simple average of the four composing sun-index scores.

Table 5. The elements of Network Readiness Index (NRI)

Sub-index	Pillars	Variables
Environment	Political and regulatory environment	Effectiveness of law-making bodies, Laws relating to ICT, Judicial independence, Efficiency of legal framework in settling disputes, Efficiency of legal framework in challenging regulations, Intellectual property protection, Software piracy rate, Number of procedures to enforce a contract, Time to enforce a contract
	Business and innovation environment	Availability of latest technologies, Venture capital availability, Total tax rate, Time required to start a business, Number of procedures required to start a business, Intensity of local competition, Tertiary education enrollment rate, Quality of management schools, Government procurement of advanced technology products
Readiness	Infrastructure and digital content	Electricity production, Mobile network coverage rate, International Internet bandwidth per Internet user, Secure Internet servers, Accessibility of digital content
	Affordability	Mobile cellular tariffs, Fixed broadband Internet tariffs, Internet and telephony sectors competition index,
	Skills	Quality of the educational system, Quality of math and science education, Secondary enrollment rate, Adult literacy rate,
Usage	Individual usage	Mobile telephone subscriptions, Internet users, Households with a personal computer, Households with Internet access, Fixed broadband Internet subscriptions, Mobile broadband Internet subscriptions, Use of virtual social networks,
	Business usage	Firm-level technology absorption, Capacity for innovation, PCT patent applications, Extent of business Internet use, Extent of staff training,
	Government usage	Government prioritization of ICT, Importance of ICT to government vision of the future, Government Online Service Index,
Impact	Economic impacts	Impact of ICT on new services and products, PCT ICT patent applications, Impact of ICT on new organizational models, Employment in knowledge-intensive activities,
	Social impacts	Impact of ICT on access to basic services, Internet access in schools, ICT use and government efficiency, E-Participation Index

2.7.2 Digitization

Digitization means "*the mass adoption of connected digital technologies and application by consumers, enterprises, and governments*". Friedrich and et al. (2012) believe that digitization provide economic social and political benefits.

In the Global Information Technology report (2012) the amount of a nation's digitization is determined through six components and 24 indicators. Also four separate phases is defined with respect to the *digitization score* which a country is obtained on a scale of 0 to 100. These four development phase that shows the level of digitization are called: a) *"constrained economies"* with digitization score less than 25, b) *"emerging economies"* with digitization score between 25 and 30, c) *"transitional economies"* with digitization score between 30 and 40 and d) *"advanced economies"* with digitization score more than 40.

These six components and 24 variables are according the following table:

Table6. The digitization score with respect to digitization attributes

Attributes	Definition of attributes	Variables	The stage of digitization
Ubiquity	Extent to which consumers and enterprises have universal access to digital services and applications	Fixed broadband penetration	**constrained economies:** face challenges in basic digitization building blocks such as access and affordability
		Mobile phone penetration	
		Mobile broadband penetration	
		PC population penetration	
		3G mobile connection penetration	
Affordability	Extent to which digital services are priced in a range that makes them available to as many people as possible	Fixed-line installation cost	
		Fixed cost per minute	
		Mobile connection fee	
		Mobile prepaid tariff	
		Fixed broadband Internet access tariff	
Reliability	Quality of available digital services	Investment per subscriber (mobile, broadband, and fixed)	**Emerging economies:** face challenges in reliability
Speed	Extent to which digital services can be accessed in real time	International Internet bandwidth (bits/second/ Internet user)	**Transitional economies:** show minor advances in the speed, usability and skill indexes
		Broadband speeds (peak Mb/s, average Mb/s): % above 2 Mb/s	
Usability	Ease of use for digital services and the ability of local ecosystems to boost adoption of these services	Internet retail as % of total retail	
		E-government web measure index	
		% of individuals using the Internet	
		Data as % of wireless ARPU (average revenue per user)	
		Domains by country per 100 inhabitants	
		IP addresses per 100 inhabitants	
		Social Network Unique Visitors per month	
		Average SMS usage per customer	
		Engineers per 100 inhabitants	

Skill	Ability of users to incorporate digital services into their lives and businesses	% of labor force with more than secondary education	**Advanced economies:** These countries have made significant strides in addressing ICT usability and developing a talent base to take advantage of available technologies, products, and services while improving the speed and quality of digital services

Source: Global Information Technology report(2012), data from ITU, Ovum, Euromonitor, Akamai, ILO (Laborsta), Global Insight, UN, WCDM, Webometrics, Bgexpert, Internet World Stats, UNESCO, Wireless Intelligence, and Telecom Advisory Services; Booz & Company analysis.

The digitization attributes are as the following line:

1) "*Ubiquity: the extent to which consumers and enterprises have universal access to digital services and applications"* (ITU's World Telecommunication/ ICT Indicators, Hartley and Mackenzie 2009, and Wireless Intelligence.)
2) *"Affordability: the extent to which digital services are priced in a range that makes them available to as many people as possible"*(ITU's World Telecommunication/ ICT Indicators and the World data Bank World Development Indicators)
3) *"Reliability: the quality of available digital services"* (ITU's World Telecommunication/ICT Indicators.)
4) *"Speed: the extent to which digital services can be accessed in real time"* (ITU's World Telecommunication/ICT Indicators and Akamai State of the Internet report, 2010)
5) *"Usability: the ease of use of digital services and the ability of local ecosystems to boost adoption of these services"* (Euro monitor World Retail Data and Statistics, the UNPAN's "E-government Web measure index," ITU's World Telecommunication/ ICT Indicators, Webometrics, Bgexpert, and Internet World Stats, Wireless Intelligence.)
6) *"Skill: the ability of users to incorporate digital services into their lives and businesses"* (The UNESCO Institutes for Statistics)

Also this composite index -digitization- has contribution to social, political and economic aspects of an economies and its effect will differ regarding the digitization's level of this nation. It means that economic impacts of digitization speed up as nations move from *"constrained"* economies

to *"emerging"* economies or from *"emerging"* to *"transitional"* economies or finally, from transitional economies to advanced economies (Sabbagh and et al., 2012).

However many studies often apply the level of inequality in a society to measure the social impacts (as measured by GINI coefficient), Sabbagh and et al. (2012) have analyzed social impact of digitization with respect to two areas;

1) The level of quality of life in a society
2) The quality of access to basic services that a society requires

The indices are used to estimate first area are *"Wellbeing Thriving"* index (The Gallup Wellbeing Thriving Index) and *"Better Life"* index (Organization for Economic Co-operation and Development, the OECD Better Life Index).

The index is used to estimate the second area is *"Human Development Index"* (The UNDP Human Development Index (HDI), 2010).

The result of analysis shows that these three indices are correlated with the level of digitization and as nations mature in to greater digitization, the degree of these indices will increase. Sabbagh and et al. (2012) also analyzed the impact of digitization on government effectiveness in three areas: 1) the transparency of governmental activities through Corruption Perception index (Corruption Perception Index), 2) the delivery of e-government services through E-government Development index (UNPAN E-government Surveys), 3) provisioning of public education through Inequality-Adjusted Education index (UNDP Human Development Index, 2010). The result of analyzes on government effectiveness shows that as nations transform into more digitization, effectiveness of e-government services, transparency of society and delivery of basic government services such as public education will improve.

2.7.3 The Information Society Measure

International Telecommunication Union (ITU) publishes annually the Information Society reports. These reports trace information society development through two composite indices including: the ICT Development Index (IDI) and the ICT Price Basket (IPB). This report reveals valuable

information concerning the trend of ICT development in both developed and developing countries and its impact on social and economic aspects of nations.

The ICT development Index (IDI) measures the level of ICT development in both developed and developing countries. Through this index the advance in ICT development in nations and also the extent to which these nations can make use of ICTs to enhance growth and development could be monitored. (ITU. 2012)

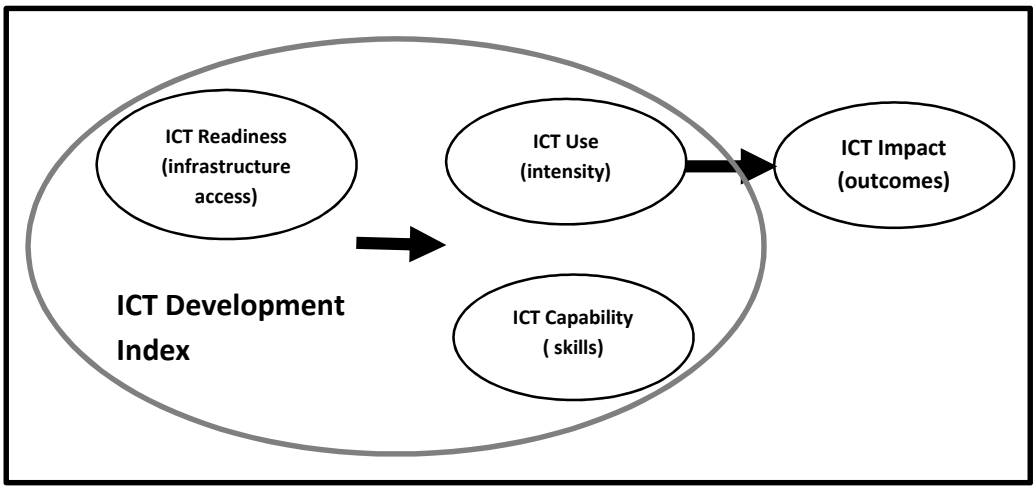


Figure 5. Three stages in the evolution towards an information society (Source: ITU)

It is necessary for countries are transiting toward knowledge-based society or information society to be aware that ICTs can be development enabler if applied properly. So, IDI's conceptual framework defines three key steps to passing ICT development process and becoming an information society. These three steps are ICT readiness, ICT intensity and ICT impacts. To pass these steps a combination of three factors are crucial. These factors are the availability of ICT infrastructure and access, a high level of ICT usage, and the capability to use ICTs effectively. All these factors correspond to sub-indices of IDI including: ICT access, ICT use and ICT skills.

- **ICT Development Index (IDI)**

The IDI is a composite index combining 11 indices into one benchmark value (scale of 0 to 10) and is divided into three sub-indices including: 1) Access indices, 2) Use indices and 3) Skill indices. The indicators included in these three sub-indices are as following table:

Table 7. IDI indicators

Steps to become an information society	Crucial factors to passing information society steps	IDI sub-index (corresponds factors)	Indicators in each IDI sub-index
Step1: ICT readiness: reflecting the level of networked infrastructure and access to ICTs	the availability of ICT infrastructure and access	ICT Access	Fixed telephone line penetration Mobile cellular penetration International internet bandwidth per internet user Proportion of households with computer Proportion of households with internet
Step2: ICT intensity: reflecting the level of use of ICTs in the society	a high level of ICT usage	ICT Use	Internet user per 100 inhabitants Fixed broadband subscribers per 100 inhabitants Mobile broad subscriptions per 100 inhabitants
Step3: ICT impact : reflecting the result/outcome of efficient and effective ICT use	the capability to use ICTs effectively	ICT skills (Maximizing the impact of ICTs depends on)	Adult literacy rate Secondary gross enrolment ratio Tertiary gross enrolment ratio

Source: ITU, the information society report, 2012

The result of IDI measure in 2011 demonstrates that the Republic Korea stands at first and Sweden follows it. The other top ten countries are Denmark, Iceland, Finland, the Netherland, Luxembourg, japan, the United Kingdom and Switzerland. The global average score of IDI is 4.15 and that regional average score of the Arab States region and the African countries are below the global average score of IDI. The increase of IDI values of all 155 countries included in the research shows the incremental growth of ICT in all over the world. The values of IDI in developed country are approximately twice greater than IDI values in developing country. It means that digital divide between developed and developing nations is considerable. The greatest change rates in IDI value over 2010 and 2011 related to developing countries that it shows quick growth of ICT infrastructures and ICT services (ITU, 2012).

- **ICT Price Basket(IPB):**

The demand and spread of ICT services associate with the price of these services. Prices strongly influence willingness to subscribe to a service. So, in measuring the information society not only

the IDI that consider availability, usage and capability are important, but also addressing the price and affordability of ICT services are imperative.

The ICT Price Basket (IPB) follows the affordability of ICT services in countries. This tool provides helpful information on the cost of ICT services such as fixed-telephone, mobile-cellular and fixed-broadband services. For this aim, it synthesizes the tariff of fixed-telephone, mobile-cellular and fixed-broadband internet into one measure and set in order nations based on the its tariff, in relation to gross national income (% of GNI per capita).

The last edition of IPB value in 2011 shows that the affordability of these ICT services are increased in both developed and developing countries. But in the least developed countries (LDCs) - much low income- these ICT services are less affordable. The IPB also shows that most of the countries with highest income levels have the most affordable ICT services. The result of IPB values in 2011 demonstrate that the Macao (china) stands at first and Norway follows it. The other top ten countries are Singapore, Qatar, Luxembourg, the United Arab Emirates, Denmark, Hong Kong(China), Sweden and the United States. The greatest reduction in mobile-cellular price in developed nations reveals that notable competition and high liberalization have remarkable effect on decreasing price of services. Also, in developed countries the mobile broadband service is more affordable than developing countries, but in developing countries the mobile broadband is more affordable than fixed-broadband because the latter require much larger infrastructure investments.

2.7.4 ICT Performance Measure

Information communication technology for Development (IC4D) is a regular publication of the World Bank on the critical role of information and communication technology (ICT) in socioeconomic development. The IC4D 2009 introduces a new performance measures (scored among 1 to 10) in terms of access to ICT, affordability of ICT and ICT adoption in government and business. Through ICT performance measures, policy makers could compare their own ICT performance in opposition to other nations and also monitor the ICT progress path. The populations of all 150 countries which are included in the calculation of ICT performance measures are more than one million.

Table 8. Dimensions and indicators of ICT performance measure

Dimensions	Indicators
Access to ICT	• Telephone lines (per 100 people) • Mobile cellular subscriptions (per 100 people) • Internet users (per 100 people) • Personal computers (per 100 people) • Households with a television set (%)
Affordability of ICT	• Price basket for residential fixed line (% of monthly GNI per capita) • Price basket for mobile call (% of monthly GNI per capita) • Price basket for Internet (% of monthly GNI per capita)
Adoption of ICT application	• United Nations Web Measure Index • Secure Internet servers (per 1 million people)

Source: World Bank, world development indicators (WDI) database.

The result of ICT performance measures of different nations shows that there is a strong association between level of countries income and the ICT performance measures. It means that the average values of all three dimensions of ICT performance measure for high income countries are between 9 and 9.06. These measures for countries with low income are between 2.14 and 2.50. While low ICT performance of latter countries is to some extent the consequence of low average level, it is to a large extent because of restricted competition, weak regulation and absence of both private investment and foreign direct investment (FDI). On the other hand, countries with strong ICT performance measures have effectual regulation, strong institutions to enforce fair competition, liberalized ICT industries and supportive government.

2.8 Concrete evidence of ICT contribution to socio-economic development

2.8.1 Socio-economic impacts of mobile broadband

Mobile broadband is defined as "*any mobile or cellular technology that delivers minimum data rates in the hundreds of kilobits per second(kb/s) to end users and peak rates in the Megabits per second (Mb/s)*"(Bold and et al. 2012).

Mobile broadband term is the marketing term for wireless internet access through a portable modem, mobile phone, USB wireless modem, or other mobile services. Although broadband has a technical meaning, wireless-carrier marketing uses the phrase *"mobile broadband"* as a synonym for internet access. In Wireless Intelligent database (2012) is predicted more than

eighty percent of broadband connections will be mobile by 2016. Data services over mobile networks or high-speed access to the internet, deliver transformative impact and has great potential to improve societies and empower individuals.

For instance, In Taiwan, China mobile broadband technologies are predicted to contribute US$11.6 billion to the economy by 2016, an equivalent of 1.8 percent of GDP (Analysys Mason 2011b).

The quick expansion of mobile broadband is establishing smartphones as the most extensive internet access device. Gartner (2011) reported that total downloads of mobile applications reached 8 billion in 2010 and should surpass 100 billion by 2016 (Gartner, 2011c). In South Africa smartphones and mobile broadband technologies are used by nurses to improve access to healthcare within communities (Qualcomm, 2011).

Mobile broadband has the potential to affect different aspects of people's life in societies like employment, healthcare, and education.

In the healthcare sector, mobile healthcare applications enable governments to provide access to quick and cost effective healthcare services for their people. China's Wireless *"Heart Health project"* is deploying a "*3G-enabled cardiovascular screening and monitoring system*" among resource-scarce community health clinics (Qualcomm, 2010). This project demonstrates how 3G mobile broadband can provide healthcare services for removed and underserved areas.

A study (Juniper Research, 2011) on the market of remote screening of patients which using mobile networks shows that this market will increase to US$1.9 billion by 2015.

Also there is more evidence that in low and medium income countries, women with access to mobile broadband take advantage of more educational and healthcare opportunities (Hood, L. 2011).

Accordingly, mobile broadband can enable individuals participate in managing their own health and thus make better their quality of life.

2.8.2 ICT contribution to GDP growth

During the 1990's ICT Technologies have contributed to acceleration in GDP and labor productivity growth rates in a number of developed countries, in particular in the US. This has

been evidenced by numerous research results on the impact of ICT on macro, industry and micro-level. For instance, Jorgenson (2001), Jorgenson and Stiroh (2000), Oliner and Sichel (2002), Stiroh (2002a) focused on Macro level on USA; Colecchiaand Schreyer (2001), van Ark et al. (2002), Daveri (2002), Jalava and Pohjola (2002) explored the impacts of ICT on the EU-15 countries; Stiroh (2002b), Timmer et. al. (2003) and OECD (2003) examined the impacts of ICT on the industry level in the US and the EU and finally, OECD (2004, 2003) addressed on micro level in the US and the EU.

The methodology of measuring the contribution of ICT to growth and productivity is based on original work by Solow (1957) and Jorgenson and Griliches (1968) and later extended by inter alia Oliner and Sichel (2000) and Jorgenson and Stiroh (2000).

ICT enterprises have direct contributions in GDP growth from their own operations and also have indirect contributions through the benefits other sectors derived from the use of ICT. The studies of the impacts of ICT on the firm-level suggest factors that under these conditions/factors the ICT use is gainful for firms. For instance Gretton et al. (2004) reported that positive effects of ICT use on multifactor productivity correlated to the level of human capital's skills. Arvanitis (2004) found out that if ICT investment is accompanied with organizational changes, firms could gain more advantages. Also, numbers of studies propose a strong association between the use of ICT and firms' capability in innovation. Baldwin, et al. (2004) shows this factor effects firms' adoption in term of advanced technologies. Moreover, several evidence suggests the effect of ICT is different across firms with respect to size and age of firm (Maliranta and Rouvinen, 2004).

Piatkowski (2004) believes that ICT sector can impact economic growth through four channels in order to ICT products and services are both outputs from the ICT industries and inputs into ICT-using industries.

These four channels are as what follows:

> *"1. Production of ICT goods and services, which directly contributes to the aggregate value added generated in an economy. The direct contribution of ICT production can be estimated through multiplication of the nominal share of ICT production in GDP by a real growth rate of the value of ICT production.*

2. Increase in total factor productivity (TFP) of production in ICT sector, which contributes to aggregate TFP growth in an economy;

3. Use of ICT capital as in input in the production of other goods and services; ICT capital has higher marginal rates of return than non-ICT capital. Hence, ICT investment enhances the quality of growth as any increase in the share of ICT capital in the overall capital stock results in higher growth of output (Jorgenson 2001).

4. Contribution to economy-wide TFP from increase in productivity in non-ICT producing sectors induced by the production and use of ICT (spillover effects); ICT can add to growth also through the so-called spillover effects of ICT production and use. Spillover effects can be defined as acceleration in TFP growth on macro, industry or micro level due to indirect productivity-stimulating effects of ICT production and/or use."

2.9 ICT and Hyper-connectivity phenomenon

Over the past decade, the world has become increasingly *"hyper-connected"*. So in analyzing ICT contribution to socio-economic development, the *"hyper-connectivity"* phenomenon must be taken into account.

The term refers to several means of communication and ICT impact on personal social and organizational behavior. Fredette et al. argue six key attributes of hyper-connectivity phenomenon in Global Information Technology Report (2012).

These attributes are: 1) "*always on*", 2) "*readily accessible*", 3) "*information rich*", 4) "*interactive*", 5) "*not just about people*", and 6) "*always recording*".

With respect to these attributes *"hyper-connectivity"* is driving great changes in variety fields such as education, healthcare, labor force, political sphere, sustainable environment and climate changes.

"Hyper-connectivity" provide noticeable advantages in *"neo-urbanization"*, like upgrading standards of living in remote area and quick development of smaller cities that would be able to bring a lot of facilities that characterize metropolitan regions. (followwill et al. 2010).

On the political sphere, due to the availability of connectivity anywhere and at any time, governments and political institutions are under pressure to revise their functions and process.

So the smart government is becoming an integral part in most governmental model (Bittinger, 2011).

As a key component of smart governance, *"mobile government"* or *"m-government"* provide a rapid and simple way to communicating with people (Eskandar et al. 2011).

In the field of education, hyper-connectivity provide more opportunities of online leaning and *"virtual education"*. This trend has been described as *"ed-YOU-cation"*[8] which indicates the potential of technology to provide anytime and anywhere learning plans.

"Hyper-connectivity" is influencing healthcare too. The *"Machine-to-machine-to-human"* (M2M2H) solution can enhance remote care and support patient care (Media Lab Asia, 2005). Consequently, the healthcare costs will be reduced surprisingly.

Due to the "hyper-connectivity", new business models are emerging and business environment is changing a lot. *"Hyper-connectivity"* phenomenon will transform the supply chain and facilitate interactions among manufacturers, suppliers, customers and remote distribution points in a well-organized process. (European commission, 2008). By the same token, enterprise managers should be able to respond in an active procedure to what clients and customers are saying to each other. In a nutshell, the hyper-connectivity phenomenon require 24/7 interaction with clients through various ways, mainly web (Cole and Brillhart, 2011).

"Hyper-connectivity" has a great effect on the workforce and organizing the labor force. Part and parcel of today's workforce is using different technologies to keep connection with business networks to enhance productivity. Emerging the *"non-linear career paths"* stem from hyper-connectivity phenomenon. People have *"multi-careers"* and *"multi-occupational"* working lives (Verdon, 2010). The global information technology report (GITR report, 2012) puts forth 10 forces that identify the future of working world in 2020. These forces include: 1) *"globalization"*, 2) *"the millennial generation"*, 3) *"culture of connectivity"*, 4) *"the knowledge economy"*, 5) *"social learning"*, 6) *"corporate social responsibility"*, 7) *"participation"*, 8) *"the digital workplace"*, 9) *"mobile technology"*, and 10) *"demographics".*

In the sustainability field, since many activities such as government-related, education, healthcare and business can come to pass in virtual environment so it will decrease carbon

8 . http://edyoucation.wordpress.com

emissions (Robert, 2011). The climate Group (2008), argue that proper application of ICT result in *"the reduction of carbon footprint of other sectors by nearly five times the consumption of the ICT sectors themselves."* By and large, the appearance of hyper-connectivity could drive considerable effects on climate change by enabling the intelligent transport system, encouraging *"eco-driving"* and optimizing journey management like *"pay-as-you-go"* pricing for road usage (Ferreira, 2011).

The technologies that enable hyper-connectivity can be either have promising or disturbing impacts. Their impact absolutely depend on the context these technologies are used.

Events in MENA region (Middle East and North Africa) the political changes that are called "Arab Spring" show how "hyper-connectivity" has become the accelerator of political movement and socio-economic changes. So the main issue regarding the related hyper-connected tools is deploying these tools to gain the most advantages and never make them go away. On this basis the vital matter that government leaders, policy makers and business managers must take into consideration is how they prepare users about possible security vulnerabilities and functional solutions (Pedley 2011).

2.10 Need for developing an Ecosystem Framework to investigate ICT contribution to socio-economic development

In previous sections some theories, approaches and evidence were proposed that unveils the ICT has a great capacity to contribute towards the improvement of various aspects of life (Kraemer et al. 2009, Walsham et al. 2007, Mann 2004, and Sahay 2001).

Regarding socio-economic view of development as the main concern of this research, perhaps it would be so difficult to explain ICT-based socio-economic development through a specific theory per se, although taking advantage of the theories of development may be fruitful in this way. For instance, North (1991) from neo-institutionalism point of view believes that economic change is "*path dependent*", so that it is constrained by the historically developed institutions in a society. This argument implies that development is a *"context-specific"* process that is intertwined with autochthonous politics and historically-formed institutions. So it is not amazing that ICT as an instrument for development does not benefit all societies to the same extent. Therefore the

social relations embedded within nations may extremely change the scope, scale and speed of desirable impacts of ICT based development.

Moreover, taking a look at different structures that were employed by international organization, show us that one of the main approach to improve ICT contribution to development is providing access to ICT services and networks in order to enhance ICT usage by people. On the basis of this approach, investment in ICT infrastructures and networks are regarded as a national initiative with the high priority for the countries. Subsequently, some composite indices were launched which directly and indirectly impose this view to ICT sector enhancement such as "ICT performance measure", "information society measure", "ICT development index", "digitization index", and "network readiness index". Then, countries are divided in terms of their ICT infrastructure development which this has resulted in a new expression named "digital divide" as a new form of inequality in the world.

Nevertheless, some new views have been gradually evolved that form a new approach to investigate the ICT impacts on social and economic status of the countries. In line with this approach, some studies have addressed to ICT as a tool for social and economic advancements within a market regime and have clarified the conditions under which ICT plays this kind of developmental role. For instance, the report of UNDP (2001) tries to find a plain relation between ICT technology and admirable development affects particularly the internet. UNDP report attempts to qualify how technology, especially ICT, is 'enabling' development effects. Although the authors of the report explicitly recognize that technology may well be "*a reward of development"*, rather than being a tool for development, they are eager to abandon this interpretation and convince readers that *"technology is a tool for, not just a reward of development".*

However, the framework and definition of some these composite indices have been modified in line with ICT evolution and emerging the hyper-connectivity phenomenon, existing view of *"stage by stage development"* influence ICT indices. It means countries are being classified with respect to their position on the stages of ICT development path. This stage by stage development are illustrated by S-curve

All in all, main literature gaps regarding existing literature particularly when it comes to the ICT contribution to socio-economic development are as what follows:

- Interactions between ICT and development is often regarded from one specific aspect (social, economic, cultural or political), so existing literature is *fragmented;*
- The lack of research which pays attention to both *Disturbing* and *Promising* impacts of ICT;
- The lack of framework which pays attention to all contextual factors and ICT key players, simultaneously due to explore ICT contribution to socio-economic development.
- The lack of practical and comprehensive definition for ICT-based socio-economic development
- Paying less attention to characteristics of hyper-connectivity phenomenon in studies related to ICT contribution to socio-economic development.

To narrow mentioned literature gaps, there is a need for an integrated and comprehensive framework that would explain the contribution of ICT to *socio-economic development* by taking advantage of ***ecosystem perspective***.

To sum up, the existing literature concerning ICT-based socio-economic development is not integrated and well-structured and this gap indicates that there is no general agreement on the definition and main elements of this term and various academic disciplines and fields define elements of this phenomenon differently. Consequently, there is a wide range of various and dispersed definition and elements for ICT-based socio-economic development.

This research considering all aforementioned literatures put forth a new integrated ecosystem framework that contains all interacting entities of ICT-based socio-economic development, interactions among these entities, main components of pertinent context, and finally dimensions of ICT-based socio-economic development (as the outcomes of ecosystem framework) that helps us to conceptualize and explore ICT contribution to socio-economic development.

2.11 Theoretical background of ICT-based socio-economic development (ISED) ecosystem framework

As explained in section 2.10 the main objective of this research is developing an ICT-based socio-economic development (ISED) ecosystem framework to narrow mentioned literature gaps. To elaborate such ecosystem framework guiding us to conceptualize ICT contribution to socio-economic development, I have got a lot of benefit from the Sen's capability approach (1999) as an analytical framework, the choice framework (klein, 2010) and sustainable livelihood framework (DFID,1999). Also I have largely taken advantage of the Fransman's ecosystem perspective (2010) to visualize ISED ecosystem framework.

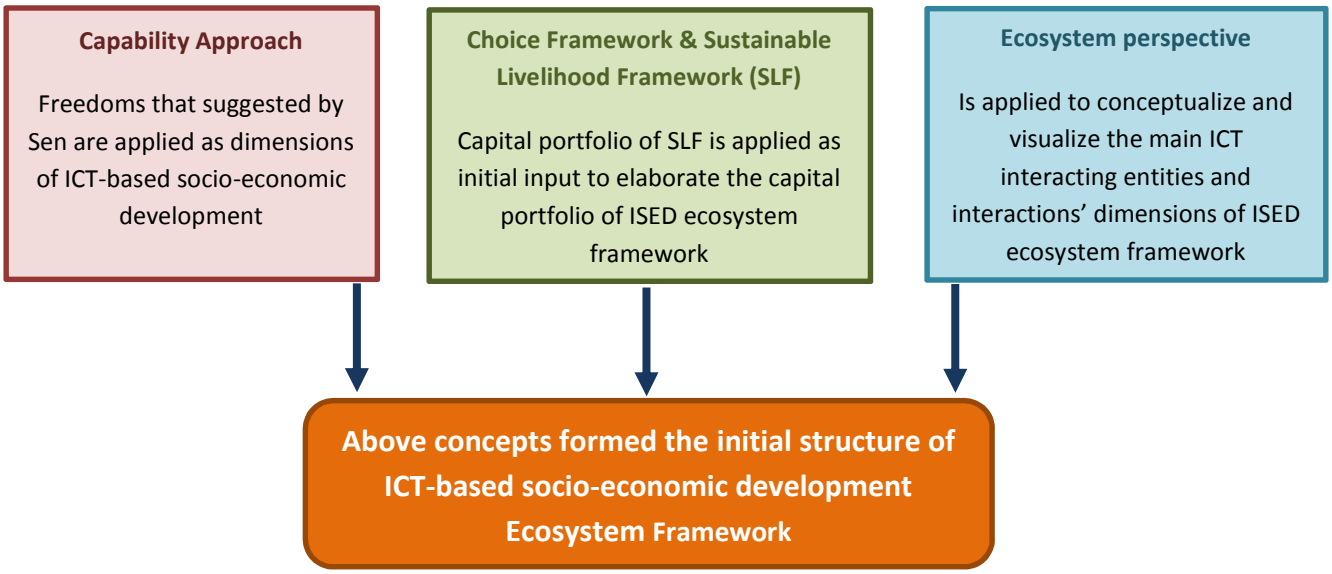


Figure 6. Theoretical background of ecosystem framework

In the following lines these concepts have been explained briefly.

2.11.1 Capability Approach

Several scholars have applied the capability approach (CA) for ICT for development (ICT4D) studies, e.g. in terms of using the CA as an analytical framework, including (Grunfeld et al., 2011; Walsham, 2010; Zheng & Walsham, 2008; Barja & Gigler, 2007; De, 2007; Zheng, 2007; Walsham & Sahay, 2006). The attention in much of these literature was given to users' capabilities to benefit from ICT technologies to obtain desired functioning.

However the increasing understanding that various aspects of ICT4D could be analyzed trough the CA, a few number of published researches has applied the CA to clarify the mechanisms through which ICT can contribute to capabilities, particularly from the perspective of the freedoms identified by Sen as being helpful "*to the overall freedom people have to live the way they would like to live*" (Sen, 2001). Researchers who concentrated on the freedoms in Sen's capability approach such as De (2007) was not done from the users' overview, but rather as a perspective of intended and unintended consequences of a land records system.

Moreover, Walsham (2010) in exploring ICT contribution to the broader development of India, applied Sen's freedoms not as an interpretive research approach. He employed these concept just as literature.

In this research the capability approach has been used to determine the main dimensions of ICT-based socio-economic development. In applying the CA to identify dimensions and sub-dimensions of ICT-based socio-economic development, we have focused on capabilities of people which are increased by ICT deployment to achieve freedoms at the country level. To do this, we focus on five freedoms that suggested by Sen that are 1) political freedom, 2) economic facilities, 3) social opportunities, 4) transparency guarantees and 5) protective security. He believes that these five freedoms would contribute to the general capabilities of people to live more freely.

2.11.2 Choice Framework and sustainable livelihood framework

Most of the development approaches mainly focus just on economic growth that is not enough broad to grasp the multi-lateral impacts of ICT with respect to individuals' choices. The most significant questioning to the growth-focused perspective of development has attained from Amartya Sen's capability approach. Sen defined development as

> "*A process of expanding the real freedoms that people enjoy to lead the lives they have reason to value*"

Kleine (2010) states:

"In Sen's approach, functionings are the various things a person may value doing or being … and person's "capability" refers to the alternative combinations of the functionings that are feasible for her/him to achieve. The focus of development thus becomes increasing a person's capability set, or her/his substantive freedom to lead the life she/he values."

In spite the conceptual strength of capability approach, researchers have made every effort in order to operationalize this approach. Alsop and Heinsohn (2005) set up a framework that associate *"individual agency"* with "opportunity structure" in order to achieve *"degrees of development"* that capacitate development outcomes. The *"degrees of empowerment"* encompass *"existence of choice"*, *"use of choice"* and *"achievement of choice"*.

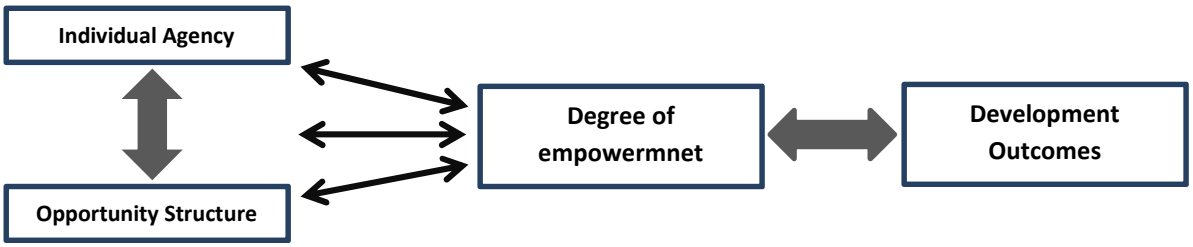


Figure 7. The process of empowerment (Source: Alsop and Heinsohn 2005)

The extent to which an individual is empowered related to his *"individual agency"* and the present *"opportunity structure"*. Alsop and Heinsohn (2005) define individual agency as

"The capacity to make meaningful choices and is measured by an individual's asset endowment, consisting of psychological, informational, organizational, material, social, financial and human assets". As well as Alsop and Heinsohn (2005) state that "an actor's opportunity structure is shaped by the presence and operation of the formal and informal institutions and measured by the presence and operation of laws, social norms and customs".

Another attempt to operationalize capability approach is the sustainable livelihood framework (SLF) that is applied by the UK Department for international Development (DFID, 1999). Based on the sustainable livelihood framework;

"People perform an operation inside a vulnerable context in which they own livelihood assets (capital portfolio) and negotiate policies, institutions and processes to develop livelihood strategies to achieve a set of livelihood outcomes".

One of the advantages of SLF is introducing a "*capital portfolio"* as the livelihood assets. The capital portfolio of SLF includes human capital, natural capital, financial capital, social capital and physical capital.

Choice Framework (Klein, 2010) is another endeavor to operationalize the capability approach. Choice framework (CF) was extracted based on the Alsop and Heisohn (2005) and SLF (1999). Respecting to choice framework that was represented by Klein (2010), individuals can, by taking advantaged of their capital portfolio, reach an agreement with *"social structure"* in order to attain *"degrees of empowerment"*, like *"existence of choice"*, *"sense of choice"*, *"use of choice"*, and *"achievement of choice"* which then result in development outcomes. Klein (2010) states that there are some limitation to the application of the choice framework that it is necessary more theoretical work to narrow the limitations. Some of these limitations are as follows:

- Choice framework is applied largely on the micro level of the individual. How could choice framework be applied on the macro/country level?
- The complex relationships between different elements of choice framework are connected to the depth of theorization of each element. How could elements of choice framework be theorized more precisely?

2.11.3 ICT ecosystem

We have used ecosystem metaphor to emphasize that current research explores ICT contribution to socio-economic development entirely and holistically. Open epolicy Group (2005) defines ICT ecosystem as well:

> *"An ICT ecosystem encompasses the policies, strategies, processes, information, technologies, applications and stakeholders that together make up a technology environment for a country, government or an enterprise"*

According to above definition an ICT ecosystem is more than just a technological system. Smith and Elder (2010) believe that *"ICT ecosystem is a social system within which ICTs are embedded".* Benkler (2006) and Shirky (2008) believe the increasing expansion of new generation of information and communication technologies which are *"participatory"* and *"collaborative"* such as mobile phones and the emergence of the social networks are reshaping how individual access and share information. Also, these technologies are rapidly changing how they collaborate and organize.

Open epolicy groups (2005) explain when these new technologies constitute part of an ICT ecosystem, they provide a space for new social activities that bring gains like innovation, productivity, growth and eventually sustainable development.

Heeks (2008) States these new technologies *"decentralize innovation models"* and enhance development.

Benkler (2006) argues that if knowledge is a driver of development, more democratic access to information is one dimension of more equal development.

In this context, Khalil and Kenny (2008) state a very substantial question, *"How can we catalyze the impact of ICTs on development?"*

Smith and Elder (2010) answer to this question and believe

> "*Open ICT ecosystems provide the space for the transformation of social activities that can help to catalyze the development impacts of ICTs"*.

They mentioned the term "*<u>open</u> is a range of openness that shows degree of openness, from less to more open".*

The ecosystem metaphor is helpful in understanding the forces that cause movement in the socio-economic context. Fransman (2010) argues *"the ecosystem metaphor refers to a number of organisms that interact within an environment"*. He believes the ecosystem metaphor is helpful in understanding the forces that cause movement in the socio-economy. He states when

we decide to employ the ecosystem metaphor, three basic questions must be answered. These questions are;

1) What are the *"organisms"* which are interacting in an environment/context?
2) What are the *"symbiotic[9] interactions"* between organisms?
3) What are the living forces in which cause this system settling into movement?

9. The term symbiosis comes from the Greek meaning living together

Chapter 3

Research Design

3 Research Design

In this chapter the research method in qualitative phase and quantitative phase regarding the three major research questions has been explained. Moreover, the method that has been used to gather qualitative and quantitative data, details of interview protocols and participants of study have been addressed

ICT contribution to socio-economic development is associated to many internal and external factors. In order to grasp all these factors, it is vital to apply *"multi-method"* and *"mixed-method"* approaches to analyze ICT contribution to socio-economic development.

"Multi-method" and "mixed method" research are the most commonly used labels. In the Handbook of Mixed Methods research, distinctions were made between these two terms (Morse, 2003). Multi-method research involves multiple types of qualitative inquiry (e.g. interviews and observations) or multiple types of quantitative inquiry (e.g. surveys and experiments) and mixed methods which involve the mixing of the two types of data. *"Mixed-method"* research has become the most popular term for mixing qualitative and quantitative data in a single study (Johnson, Onwuegbuzie, & Turner, 2007). Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purpose of depth of understanding and providing much evidence to support results. (Johnson et al., 2007, pp. 123)

Both "multi-method" and "mixed method" approach were used to respond to the following three research questions. It means to answer first two research questions we have employed two types of qualitative inquiries (interpretive research method) such as grounded theory method and Delphi research method. To investigate last research question we have applied quantitative research approach.

Mason (1998) discusses that paying attention to make balance between *"tightness of control"* and *"richness in reality"* in research methods are vital. Applying *"multi-method"* and *"mixed method"* in this research were increased the balance between *"tightness of control"* and *"richness in reality"*.

1. What are the main elements included of ICT-based socio-economic development (ISED) ecosystem framework?
    - What are the interacting entities of ISED ecosystem framework?
    - How do ICT for development (ICTD) experts define interactions among entities of ISED ecosystem framework?
    - What are the main components of capital portfolio of ISED ecosystem?

      The degree to which an ISED ecosystem framework is effective and efficient depends on components of its national capital portfolio. These components of capital portfolio play a key role in determining particular development path. They work as the potential to make desired ICT-based socio-economic development.
    - What are the main dimensions and sub-dimensions of ICT-based socio-economic development as the outcome/impacts (both progressive and disruptive) of ISED ecosystem framework? (concerning to various aspects of development simultaneously such as social aspects, economic aspects, political aspects and cultural aspects)
2. What are the appropriate indicators to measure elements of ISED ecosystem framework?
    - What are the appropriate indicators to measure interacting entities?
    - What are the appropriate indicators to measure components of capital portfolio?
3. What interrelations and associations are there among main elements of ISED ecosystem framework?
    - How do ICT-based socio-economic development indicators vary in various countries of MENA region?
    - How do indicators of capital portfolio vary in various countries of MENA region?
    - How do interacting entities indicators of ISED ecosystem framework vary in various countries of MENA region?

3.1 Grounded theory research method

In this research in order to answer the first research question a process of theorization was used rather than merely describing the concepts. The differences between theory and description are explained by Strauss and Corbin (1990) as the following lines:

> *"First, theory uses concepts. Similar data are grouped and given conceptual labels. This means placing interpretations on the data. Second, the concepts are related by means of statements of relationships. In description, data may be organized according to themes. These themes may be conceptualizations of data, but are more likely to be precise summaries of words taken directly from the data. There is little, if any, interpretation of data. Nor is there any attempt to relate the themes to form a conceptual scheme."*

Grounded theory (GT) research method was emerged in the 1960s by Barney Glaser and Anselm Strauss. Though, a ramification of grounded theory developed and two researchers were separated (Glaser, 1992; Strauss & Corbin, 1990). The consequence of this ramification is two basal schools for grounded theory: "the Glaserian School and the Straussian School "(Stern, 1994). The differences between these two schools could have major effects in the running of research. For example, Strauss (1990) believes researcher should have a general opinion of the subject, while Glaser (1992) states researcher should start with an empty mind of area under research. Keith Ng and Stewart Hase (2008) state the main differences between these two schools of grounded theory relate mainly to the coding paradigms. Also they argue the differences between Strauss and Glaser as follow:

> *"Strauss, as he analyses the data, stops at each word to ask 'What if?' Glaser maintains attention on the data and asks, 'What do we have here?' (Stern 1994). Strauss brings to bear each likely incident that could relate to the data, whether it emerges from the data or not (Strauss & Corbin 1998, p. 77). Glaser focuses his attention on the data to allow the data to tell their own story. Glaser argues his approach is interpretive, contextual and emergent, while Strauss and Corbin is more likely to lead to the forcing of perceived notions on the data."*

This interpretive research method is one of the most popular qualitative research methods in the world and in various area have been employed. Jones and Alony (2011) argued the benefits of using grounded theory for IS research from various point of views. Since the information system (IS) area or information communication technology (ICT) sector are multi-dimensional and complex (Skyrius & Bujauskas, 2010), a perfect perception of these subjects requires extracting all their intertwined concepts and interactions (Fernández & Lehmann, 2005). An IS /ICT research which follows the guidelines of grounded theory method presented by Strauss and Corbin (1998) could exceed wide theme to provide a substantive theory (Fernández, Martin, Gregor, Stern, & Vitale, 2006).

Grounded theory has a bearing on theory that is developed inductively from analysis of a collection of data (Strauss & Corbin, 1990). To apply grounded theory approach a set of stages should be executed by researcher. Pursuing these steps help researcher to develop a theory as outcomes. The type of sampling that is applied in grounded theory method is purposive sampling or theoretical sampling. In this type of sampling, researchers select participants based on incipient finding or some criteria. Also the sampling process and data analyses occurred in *"alternating sequence"* or in "*iterative cycle of induction and deduction*". It means that early analyses of collected data lead to new findings that give researchers tips to more data collections. (Strauss and Corbin, 1990; Miles and Huberman, 1994). In next step, the researcher will conceptualize all the concepts are generated by the participants or interviewees until no new concepts, categories or relations among these categories are generated. Strauss and Corbin nominated this situation "theoretical saturation" (Strauss and Corbin, 1998). So the main procedures in this interpretive research method are reading textual databases and extracting key themes and the relations among these themes and then grouping these themes to develop a theory. The developed theory can be illustrated in the form of conceptual model or framework.

Strauss and Corbin (1998) suggest extracting main concepts and phenomena over interviews and translate them as several codes. These codes will be categorized into more precise groups that will ultimately form the basis for developing theory.

Charmaz (2006) believes coding is the starting step of data analysis. Coding is useful to transform the collected data through interview to more precise interpretations.

As explained, The important process in grounded theory reserach method is to extract key concepts of a textual database and then categorize these concepts to codes in order to develop a theory. There are three major coding techniques for qualitative data analysis that will be used during the analysis of data.

Open coding, provides a suitable starting point to recognize initial phenomena and generate a list of categories about the concept being studied by segmenting the information. Within each group researcher finds several properties or subgroups. The next coding technique is more precise than open coding and known as focused coding or selective coding. In focused coding one category are chosen as the core category, and other categories are related to this selected category (Cresswell, 2006). The other coding method is axial coding. Strauss and Corbin (1998) defined axial coding as

> "*the act of relating categories to subcategories along the lines of their properties and dimensions*"

The aim of axial coding is to add depness and structure to initial categories. Charmaz (2006) states that axial coding re-constructs data that has been broken up into separate codes by open coding method. Strauss and Corbin (1998) use axial coding to investigate conditions of situations described in the interview, their actions and consequences.

The general process of how to code an interview and develop a theory according to Strauss and Corbin (1998) is illustrated in figure 8.

Coding interview transcripts help researcher to determine main phenomena which are considerable for interviwees. To convert these phenomena to codes , researcher allocates conceptual label to them. The codes with similar characteristics are cooperated to make up more precise categories. Strauss and Corbin (1998) state:

> "*Categories can carry so-called properties and dimensions. A property is a general or specific characteristic of a category, whereas a dimension denotes the location of a property along a continuum or range*". By interconnecting these categories the basis for a theory will be originated.

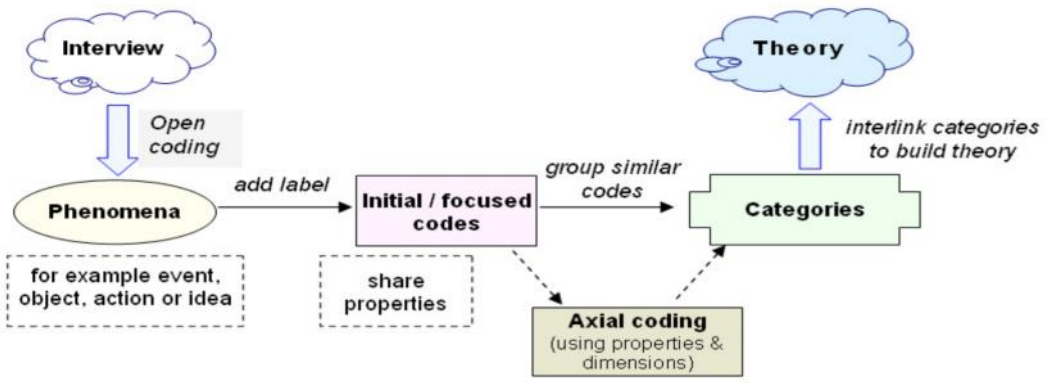


Figure 8. Steps of developing grounded theory

Source: Gorra, A., Kornilaki, M. (2010) Grounded theory: experiences of two studies with a focus on axial) coding and the use of the NVivo qualitative analysis software. Methodology: Innovative approaches to research, 1 (spring), pp.30-32.

In qualitative phase of this study, guidelines of Straussian School and Cresswell's (2006 edition) suggestions about grounded theory procedure have been pursued. These suggestions are as followes:

- the first suggestion is about the research question design in interviwe protocol. the researcher is suggested to design questions that help him/her to understand the interviewees' opinion about the main process. After determining the main processes, researcher could ask more detail questions to unveil other aspects of intended issue.
- The next suggestion related to data gathering phase in grounded theory research method. The researcher is suggested to continue gathering information to saturate the model.
- The last suggestion is about data analysis. The researcher is suggested to follow *"open coding"*, *"axial coding"*, or *"selective coding"* to proceed data analysis phase.

The result of these data gathering and data analyses process is evolving a theory with respect to research objectives.

3.2 Delphi research method

The Delphi method was developed by Norman Dalkey and Helmer (1963) at the RAND Corporation. Delphi method commonly is used for achieving convergence about a certain phenomenon from experts within this area (Dalkey, 1972). Also, this method is suitable to improve our understanding about an issue when there are not perfect knowledge about this issue (Adler & Ziglio, 1996; Delbeq et al., 1975). Delphi method is known as a means for "consensus-building" by employing a series of questionnaires to collect data (Young & Jamieson, 2001). It means that in this method several iterations are designed to achieve a consensus of opinions regarding a particular issue. Some scholars such as Ludwig (1994, 1997), and Custer, Scarcella, and Stewart (1999) believe that 3 iterations are sufficient in most cases to collect the needed information and to reach a consensus, however, others like Chia-Chien Hus and Brian (2007) suggested four iteration to achieve a consensus.

Skulmoski, Hartman, and Krahn (2007) stated that:

> *"The Delphi method is a flexible, effective and efficient research method that can be successful used by IS graduate students to answer research questions in information systems and to rigorously advance the IS body of knowledge."*

Skulmoski, Hartman, and Krahn (2007) have explored most of the graduate research which were applied Delphi technique and they compared the process that were employed in each of graduate research to develop Delphi method. Concerning these comparisons and explorations they suggested the following steps to apply Delphi research method:

1) Defining an accurate and precise research question is the beginning step in conducting Delphi research method. An exact research question motivate participant to spend enough time in completing questionnaire. Researchers could benefit from literate review's findings and theoretical gaps that exist in literatures to define the research question.
2) Selecting the research participants is the next and the most important step in conducting Delphi research method, because the research output in this method completely is based

on the participants' expertise. Participants could be selected homogeneous or heterogeneous and it completely related to the research question.

3) Conducting the first round of Delphi analysis; the first round usually begins with open-ended questionnaire.in this step the prepared questionnaires were distributed to the participants. After receiving responses, researcher analyzes questionnares according to the research objectives. Then researcher develops a well-structured questionnare based on the participants' responds for the second round of delphi method. To analyze the completed questionnares either qualitative coding or statistical method may be used. Sometimes, the purpose of the first round of Delphi technique is to brainstorm (R. Schmidt, 1997)
4) Conducting the second round of Delphi analysis; in this step the revised questionnaires will be distributed to the participants. Since the revised questionnaire shares the other participants' opinions, each participant has opportunity to make a comment on the opinions of other participants. This kind of verification increases the reliability of the results (Adler & Ziglio, 1996; Delbeq et al., 1975; Linstone & Turloff, 1975). Jacobs (1996) believes that consensus begins forming in this round. Again, after receiving the completed questionnaires, Researcher starts to analyze the completed questionnaires and then based on the new results begins to modify questions or define additional questions to verify these results. As a result of round two, "areas of disagreement and agreement" are identified in second round of Delphi analysis (Ludwig, 1997)
5) Conducting the third round of Delphi analysis; in this step similar procedures of round two are pursued. The result of this round of Delphi analysis (often final round) is more clarifications of participants' judgments that lead to more increase in the degree of consensus.
6) In the last step results of the Delphi analysis are generalized and documented. Skulmoski, Hartman, and Krahn (2007) stated that generalization of Delphi result are undertaken with a succeeding research phase like interviews or surveys.

Ludwig (1997) believes that the number of Delphi iterations depends largely on the degree of consensus sought by the investigators and can vary from two to five

3.3 Research method in qualitative phase

The main objectives in the qualitative phase of this study is elaborating an ICT-based socio-economic development (ISED) ecosystem framework, determining major dimensions of ICT-based socio-economic development as the outcomes of ISED ecosystem framework, and identifying the appropriate indicators to measure elements of ISED ecosystem framework.

To improve the research quality we applied "principles for interpretive research" which were introduced by Klein and Myers (1999) to conduct and evaluation of interpretive research in information systems (IS).

To do this, the Charmaz (2006) advice was followed in this study and an in-depth review of the literature was undertaken before starting data collection. We have benefited from relevant scientific papers, official records, published reports and statistics associated to international organization to identify basic entities of ISED ecosystem framework, intertwined interactions' dimensions of ICT entities, contextual factors of ISED ecosystem framework, initial list of dimensions of ICT-based socio-economic development, and initial list of appropriate indicators to measure these elements. Then we improved the initial findings over the following steps:

In start, by applying various data collection techniques the appropriate data was gathered for first and second research questions. Techniques were used for data gathering were semi-structured interviews, focus group discussions (FGD), and questionnaires.

Then we pursued guidelines of an interpretive approach (grounded theory) and Delphi research method for analyzing collected data.

Data collection and data analysis in qualitative phase of this study occurred in an alternating sequence or an iterative cycle, including using early findings in order to shape more data collection to develop new findings. Consequently, data collection and analysis occurred simultaneously and research process is iterative rather than sequential.

The participants / respondents included experts in ICT for development (ICT4D) area and ICT sector representatives. We employed a purposive sampling procedure to choose participants and

respondents. It means that certain participants were selected because they were considered to be the best source for answering research questions. The sample size was not pre-determined and we used a respondent-driven sampling technique to identify interviewees among ICT experts. We prepared a pilot list, then asked from first interviewee to recommend potential.

Our approach to analyze data was inductive. We explored interviews systematically, and then compare and contrast data across interviews in terms of the diversity of participants' perspective. The main challenges about the qualitative phase of this research were assessing the validity and generalizability of findings. Patton (2002) believes:

> *"Statistical analysis follows formulas while, at the core, qualitative analysis is a creative process, depending on the insights and perceptual capabilities of the analyst."*

Creswell (2006) and Dixon-Wood (2004) note that methodological rigor and research experience and skill, and relevance are appropriate criteria for assessing the validity of qualitative findings. About generalization issue, Cresswell (2006) states that:

> "*Although qualitative findings cannot be generalized in the same way as quantitative findings, they can be generalized across similar contexts."*

Mason (2002) believes that:

> *"Qualitative results can provide details about the settings studied and explanations of how and why things worked the way they did in each of those settings".*

To enhance the validity and reliability we employed diverse data gathering method and data sources (Triangulation) such as in-depth interviews, focus group discussions, and document reviews which lessened the bias risk by taking advantages of a wide range of participants' viewpoints.

In conclusion the extent to which a setting outside a study is similar to the study settings depends on how they match key factors. Patton (2002) relegate "transferability" to this kind of generalizability.

The discussions over the semi-structured interviews and focus group discussion were concentrated on the elements of ISED ecosystem framework. Also axial coding was used to analyze collected data in this section. For determining dimensions of ICT-based socio-economic development and indicators to measure elements of ISED ecosystem framework, suitable questionnaires were designed.

Based on Cresswell (2006) suggestions, 25 in-depth semi-structured interviews and 1 focus group discussions (FGD) with 12 participants were undertaken to explore first three sub-questions of first research question. By using early findings based on analyzing first phase of data gathering, more interviews were undertaken in second phase of data collection.

To answer forth sub-question of first research question a two-round Delphi research method was carried out with 15 research participants. To answer second research question a focus group discussions (FGD) with 12 participants and a three-round Delphi method with 12 participants were conducted.

More details about research design for this research question are shown in table 9

Table 9. Research design in qualitative Phase

Research questions	Research process	Sampling procedure	Techniques of data gathering	Approach to data analyze
1. What are the main elements included in the ICT-based socio-economic development (ISED) ecosystem framework?	- Iterative rather than sequential - Discovery process	- Purposeful - respondent-driven	-Semi-structured interviews and Focus Group Discussion meeting (FGD) for the first three sub-questions - Questionnaire for forth sub-question	grounded theory method and two-round Delphi research method
2. What are the appropriate indicators to measure elements of ISED ecosystem framework?	Three-round Delphi		- Questionnaires - Focus group discussion meeting	Three-round Delphi research method

3.3.1 The main elements of the ISED ecosystem framework (1st research question)

The first research question encompasses four sub-questions. The method of data analysis which was used to answer first three sub-questions was grounded theory method. The decision to use grounded theory methodology was supported by the scarce of existing theory regarding elements of ICT-based socio-economic development ecosystem. The method of data analysis for answering last (forth) sub-question was a two-round Delphi research method.

To develop different parts of the intended ICT-based socio-economic development Ecosystem framework within this research project a sound literature evaluation was conducted and relevant literature were applied. These literature are literature related to Ecosystem metaphor, the capital portfolio of sustainable livelihood framework (SLF, 1999), the resource portfolio of choice framework (Klein, 2010) and dimensions of socio-economic development (Madon, 2000 and Baqir, 2009). All These resources together helped us to determine the semi-structured interview protocol, focus group discussions (FGDs), and questionnaire as three important sorts of data gathering techniques.

- **The first three sub-questions:**

For first three sub-questions we improved interview protocol (Appendix 1) through guidelines of the grounded theory method. Also data collecting process was managed in two phases

1) In December 2013 through 14 semi-structured interviews and 1 focus group discussion with 12 participants as techniques of data gathering.
2) During July 2014 by the September 2014 through 11 semi-structured interviews as technique of data gathering.

The semi-structured interviews and FGDs in December 2013 were conducted during the Sixth International Conference on Information and Communication Technologies and Development (ICTD2013) hosted at the Cape Town University, South Africa. All the interviewee were ICT sector representatives and ICTD experts which have attended in this conference. We employed a purposive sampling procedure to choose participants and respondents which cover all geographical regions from Canada, USA, Australia, Africa, Europe and Asia. Initial findings of

literature review that formed the questions of interview protocol, besides these phase of interviews (December 2013) were applied for determining elements of ISED ecosystem framework. The questions of FGDs and semi-structured interviews with ICTD experts and ICT sector representatives got ahead regarding interviewees' answers. Each interview lasted more or less 30 minutes and the focus group discussion lasted about 3 hours.

For analyzing these semi-structured interviews the Cresswell (2006) suggestions were followed. Firstly, all interviews were transcribed. Then all transcribed interviews were read and annotated (memo writing) to extract main and more frequent concepts as codes. This step certified that the all extracted codes are grounded in collected data. The content analysis to extract codes from transcribed interviews was mainly manual. It means that we did not apply NVIVO software. After extracting initial findings as codes, these findings were described to clarify various aspects of these codes. In next step, categories were defined based on codes and their descriptions. All these steps enabled us to generalize findings in order to convert them in to a pattern. Lastly, based on the initial analysis of coding and relations among them an ISED ecosystem framework was developed. This ISED ecosystem framework as the basis of an integrated theory was improved in next phase of data collection.

As mentioned in section 3.1, the data gathering and data analysis were conducted in an iterative cycle. So in the next phase of data gathering, 11 ICTD experts were interviewed during July 2014 to September 2014. Since in the quantitative part (3rd research question) of this study Middle East and North Africa (MENA) region was aimed, all interviewees were selected from ICTD experts in MENA region. Eight interviews were done on Skype and three interviews with Iranian ICTD experts were done in their offices. Then all the previous stages that explained in first phase of data gathering were followed to analyze collected data in this phase. The consequences of these two phase of analyses are the presented ISED ecosystem framework.

- **The forth sub-question:**

To answer the forth sub-question a two-round Delphi research method was used. Through this method I applied an iterative process for achieving consensus from experts in ICT for

development (ICTD) area in MENA region about dimensions of ICT-based socio-economic development as the outcomes of ISED ecosystem framework.

To increase the degree of consensus on dimensions of ICT-based socio-economic development, the following steps were pursued.

At first, by reviewing literature related to dimensions of ICT-based socio-economic development especially, proposed dimensions by Baqir (2009) and Madon (2000), a questionnaire (Appendix 2) including initial list of ICT-based socio-economic development dimensions was designed.

Then I achieved consensus by conducting series of surveys using this questionnaire over the two rounds of Delphi research method. 15 experts were selected to answer the designed questionnaire from Middle East and North Africa (MENA) region.

In first round, the prepared questionnaire was distributed to the participants. In this round, experts also had opportunity to add new dimensions that they considered important to fill possible gap in the initial list of socio-economic development dimensions. Moreover, the perception of participants about progressive and disturbing (Avgerou, 2010) impacts of socio-economic dimensions was asked in this round of Delphi research method. Consensus began forming in this round. After receiving the completed questionnaire, Researcher started to analyze the completed questionnaire and then based on the new results began to modify questions or define additional questions to verify these results. The revised questionnaire based on the participants' responds was distributed to the participants to start second round of Delphi method. In second round similar procedures of first round were pursued.

As a result of conducting a two-round Delphi research method a set of ICT-based socio-economic development dimensions has been finalized as the outcome of proposed ISED ecosystem framework which explains both progressive and disturbing impacts of ICT. Then we categorized the modified list of ICT-based socio-economic development dimensions on the basis of five areas of freedoms that have been suggested in Sen's capability approach (1999).

What are the main elements included in the ICT-based socio-economic development (ISED) ecosystem framework?

Table 10. Research design for first research question

Sub-Questions	Theoretical background	Types of data sources	Research participants	Schedule of data gathering	Method of data analysis
What are the interacting entities of ISED ecosystem framework?	Ecosystem metaphor (Fransman, 2010)	- Semi-structure interview - Secondary Sources	ICT sector representative, ICTD experts	- 14 interviews in December 2013 and one FGD with 12 participants in December 2013 - 11 interviews From July 2014 by the September 2014	Interpretive research method (Grounded theory)
How do experts define interactions among entities of ISED ecosystem framework?		-Focus Group Discussion (FGD) - Secondary Sources			
What are the main components of Capital portfolio of pertinent context (contextual factors)	the capital portfolio of sustainable livelihood framework (SLF,1999) the resource portfolio of choice framework (Klein,2010)	-Semi-structure interview - Secondary Sources			
What are the main dimensions and sub-dimensions of ICT-based socio-economic development as the outcome (both progressive and disruptive) of ISED ecosystem framework? (concerning to various aspects of development simultaneously such as social aspects, economic aspects, political aspects and cultural aspects)	- Development theories Socio-economic development literature - ICT for development(ICTD) literature - Discourses on ICT and development - Capability approach (Sen, 1999) - Progressive and disruptive transformation aspects of ICT-based socio-economic development (Avgerou, 2010) - concrete evidence of ICT contribution to socio-economic development	- Secondary Sources encompass: published reports related to international organization and relevant scientific papers,	15 ICTD experts from MENA region	From July 2014 by the September 2014	Two-round Delphi research method

3.3.2 Developing hierarchical structure

The next step after developing the ISED ecosystem framework was developing a hierarchical structure accordance to different parts of this framework.

This hierarchical structure includes pillars and sub-pillars considering various parts of elaborated ecosystem framework. The pillars and sub-pillars of hierarchical structure are correspondent to various parts of proposed ecosystem framework.

Such a hierarchical design helps us to have better and clustered image of the driving factors behind the phenomenon.

This structure paves the road for the construction of a meaningful composite index (CI) to measure ICT-based socio-economic development as the outcome of proposed ecosystem framework. This composite index would make possible cross-country comparison of ICT-based socio-economic development in different countries of MENA region.

Then we determined associated indicators in each sub-pillar of this hierarchical structure by applying Delphi method (in second research question).

3.3.3 The appropriate indicators to measure elements of ISED ecosystem framework (2nd research question)

To answer the second research question Delphi research method was used. Through this method I applied an iterative process for achieving convergence from experts within ICT for development (socio-economic development) area about individual indicators associated to each sub-pillars of hierarchical structure (as explained, these sub-pillars are correspondent to various parts of ISED ecosystem framework).

In what follows, steps for achieving consensus about individual indicators will be addressed.

At first we prepared an initial list of indicators regarding various parts of ISED ecosystem framework by reviewing literature related to indicators which are used by international organizations in ICT performance, socio-economic development and capital portfolio. The initial list of indicators that has been introduced in this step was based on this premise that any given country has an ICT-development S-curve. So in selecting related indicators all stages of development path including *"ICT-readiness", "intensity"* and *"ICT impacts"* have been taken into account.

Two different types of data gathering were used in second research question. Firstly, I conducted a focus group discussion (FGD) meeting to improve conceptual consistency of gathered indicators and their compatibility to literature. Secondly, I carried out a three-round Delphi method to achieve consensus and assess the importance and feasibility of selected indicators. I achieved consensus by conducting a series of surveys using questionnaires (Appendix 3) over the three rounds of Delphi research method. The main participants in FGD and panelists who participated in the Delphi rounds were number of specialists in the areas of "ICT for development (ICTD)" that attended the Sixth International Conference on Information and Communication Technologies and Development (ICTD2013) hosted at the Cape Town University, South Africa. Two requirements were considered to select these experts.

- Professional knowledge and experience in at least one of the two pillars of ISED ecosystem framework including the ICT entity pillar or capital portfolio pillar.
- Willingness and agree in participating over the survey.

The expert panelists were composed of 12 participants from different geographical region. In focus group discussion meeting, they received general overview on the categorized indicators and contextual information about the work they had to do. Then the initial list of categorized individual indicators into dimensions was modified on the basis of participants' opinions. For first round two various types of questionnaires -accordance to the two pillars considered in the ISED ecosystem framework- were designed to achieve consensus on the best indicators to use in describing and measuring the elements of ISED ecosystem framework. The prepared questionnaires were distributed to the participants. In the first round, experts also had an opportunity to add new indicators that they considered important to bridge possible gap in the initial list of indicators. Consensus began forming in this round.

After receiving the completed questionnaires, Researcher started to analyze the completed questionnaires and then based on the new results began to modify questions or define additional questions to verify these results. Since another two type of questionnaires for second round (revised questionnaires) shared the other participants' opinions, each participant had opportunity to make a comment on the opinions of other participants. This kind of verification increased the reliability of the results. The revised questionnaires based on the participants'

responds were distributed to the participants to start second round of Delphi method. In second round similar procedures of first round were pursued. The results of this round of Delphi analysis were more clarifications of participants' judgments that led to more increase in the degree of consensus. In third round, experts were requested to assess the importance and feasibility of every indicator through a unique general questionnaire that included both two pillars of ISED ecosystem framework.

These final indicators as the results of conducting a three-round Delphi method enable us to measure each sub-pillars and pillars of ecosystem framework.

What are the appropriate indicators to measure elements of ISED ecosystem framework?

Table 11. Research design for second research question

Sub Questions	Theoretical background	Types of data sources	Research participants	Schedule of data gathering	Method of data analysis
1. What are the appropriate indicators to measure interacting entities?	- Network Readiness Index(NRI) - Digitization measure - ICT Development Index (IDI) - ICT Price Basket (IPB) Index - ICT performance measure	- Focus group discussion - Questionnaire	12 ICTD experts	questionnaires from December 2013 to March 2014 - One FGD with 12 participants in December 2013	Delphi research method
2. What are the appropriate indicators to measure components of capital portfolio?	- Capital portfolio of sustainable livelihood framework (SLF,1999) - Resource portfolio of choice framework (Klein, 2010) - National intellectual capital				

3.4 Research method in the quantitative phase (3rd research question)

The main objectives in the quantitative phase of this study are to measure various elements of ISED ecosystem framework in 17 MENA countries, comparing selected countries in terms of these elements, and then constructing a composite index to measure degrees of *ICT-based socio-economic development* as the outcome of this ecosystem framework. Furthermore, we are going to check internal consistency and statistical coherency of proposed ecosystem framework that has been developed in the qualitative phase of this research.

Considering selected indicators in second research question, I collected data for 17 countries of MENA region (Middle East & North Africa) from official and widely accepted reports and data

base. Then I explored interrelations and associations among main elements of ISED ecosystem framework in MENA countries with respect to the following sub-questions:

- How do contextual factors indicators of ISED ecosystem framework vary in various countries of MENA region?
- How do interacting entities indicators of ISED ecosystem framework vary in various countries of MENA region?
- How do ICT-based socio-economic development composite index varies in various countries of MENA region?

Furthermore, I have explored and investigated the reciprocal interactions within and between these sub-pillars and pillars to check internal consistency and statistical coherency of proposed ecosystem framework by applying correlation analysis. It also directed us to envisage how social, political, cultural and legal context influences ICT technology usage and socio-economic development.

Finally, to measure ICT-based socio-economic development as the outcome of this ecosystem framework we constructed a composite index to compare MENA countries respecting to this composite index. This composite index is the combination of different aspects all related to the ISED ecosystem framework. Each aspect by and large can be measured by means of a set of selected indicators.

What interrelations and associations are there among main elements of ISED ecosystem framework?

Table 12. Research design for third research question

Sub-Questions	Technique of selecting final indicators in each sub-pillars	Method of data analysis
How do components of capital portfolio vary in various countries of MENA region?	Cronbach's Alpha test to Evaluate reliability of determined indicators. Spearman correlation coefficient to check inter-consistency of Indicators, sub-pillars and pillars.	Techniques to construct composite index Correlation analysis
How do interacting entities indicators of ISED ecosystem framework vary in various countries of MENA region?		
How do ICT-based socio-economic development composite index varies in various countries of MENA region?		

3.4.1 Data of MENA region

Considering proposed ISED ecosystem framework and selected indicators, we collected data for 17 countries of MENA (Middle East & North Africa) region from official and widely accepted reports such as HDR, WDI, ITU, GEM, UNDP, WGI, UN, WCR, etc. and also MENA region statistical reports.

The population of The Middle East and North Africa (MENA) are 355 million and a large majority of the population live in middle-income countries. This region is a diverse region that includes both the oil-rich countries and countries with scarcity in natural resources.

According to World Bank (2013) in MENA region the benefits of growth were not shared equally and the vulnerability is high. The word bank (2013) reported that

> "*This region came into the Arab Spring with multiple strengths, which included a young and educated population…*"

The process of political change and transition continued into 2014 with a great degree of heterogeneity across countries across the MENA region. The success of political changes in transition period will depend in large part on the capability of new governments to deliver notable improvements in the citizens' quality of life.

In 2013, growth in MENA decreased to 2.8 percent from 5.6 percent in 2012, but in 2014 increased to 3.5 percent and will strengthen to around average 4.2 percent in 2015.

In the long-term, MENA countries face the structural problems that predate the 'Arab Spring.' The region's main challenge is to create sustainable growth that delivers the quantity and quality of jobs needed. An inclusive and competitive private sector has proven to be one of the most effective and long-term solutions for unemployment, and will be critical in tackling the scale of the problem in MENA. An improvement in the political environment will help too by encouraging much needed investments in the labor–intensive tradable sectors like ICT sector.

The Middle East and North Africa includes Israel and Iran and all the members of the Arab League: Algeria, Bahrain, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, West Bank and Gaza, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen. "This region contains countries with various political, economic and cultural conditions. MENA region includes

various type of regimes like monarchical and republican regimes, different colonial legacies, oil and non-oil states, rich and poor states, small and large states, and Western and non-Western allies etc.". (Shirazi. F., 2008).

The countries in the region that are not included in this research are Israel, Djibouti, West Bank and Gaza. Israel, was not included because its socio-political situation is completely different from other MENA countries. Djibouti, West Bank and Gaza were not included due to a lack of sufficient data.

According to "*Economic Developments and Prospects*" report (2013), the MENA region is divided into three main groups. This report sometimes refers to a fourth group of countries, called countries in transition (This cluster includes countries that engaged in Arab Spring.) In this research we analyze ICT contribution to socio-economic development with respect to determined groups in the "*Economic Developments and Prospects*" report.

Countries in each cluster are as following table:

Table 13. Country groups in MENA region

GCC oil exporters	The first group contains the Gulf Cooperation Council (GCC) countries, namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates;
Developing oil exporters	Algeria, the Islamic Republic of Iran, Iraq, Libya, the Syrian Arab Republic, and the Republic of Yemen;
Oil importers	oil importers include countries with strong GCC links (Djibouti, Jordan, and Lebanon) and those with strong EU links and located in North Africa (Morocco, Tunisia and the Arab Republic of Egypt)
Countries in transition	Arab Republic of Egypt, Jordan, Lebanon, Libya, Syrian Arab Republic, Tunisia, Republic of Yemen.

3.4.2 Outlier detection and treatment:

Outlier is an observed value that is so extreme, either large or small- and stand apart from the rest of the distribution. Outliers generally spoil basic descriptive statistics like MEAN, STANDARD DEVIATION, CORRELATION COEFFICIENT, and cause misinterpretation. Therefore it is necessary to detect and treat outliers before it is too late. In this research to detect the problematic indicators we calculate SKEWNESS and KURTOSIS for all indicators;

IF |Skewness | > 2 AND kurtosis > 3.5 THEN

The indicators under this condition were a problematic indicators and were treated. We could treat potentially problematic indicators (those with skewness>2 AND kurtosis>3.5) either by winsorisation method (if few outlier values, roughly 5 percent of countries) or by box-cox transformation method.

In this study there were a few outlier values. So we treat them by assigning the next best values of problematic indicators to countries that made this problem (winsorisation method)

3.4.3 Missing data Imputation:

A limitation for this study was missing data for some countries in some selected indices. There are several imputation techniques that can be applied to estimate missing data. Three common methods for dealing with missing data are: (1) case deletion, (2) single imputation or (3) multiple imputation. Case deletion method, simply leaves out the missing records from the analysis. The other two approaches consider the missing data as part of the analysis and try to impute values through either single imputation such as mean/median/mode substitution, regression imputation, hot-and cold-deck imputation, expectation-maximization imputation, or multiple imputation like Markov Chain Monte Carlo algorithm. Each of the imputation techniques, like any other method employed in the process, has their own strengths and weaknesses. Single imputation is known to underestimate the variance, because it partially reflects the imputation uncertainty. The multiple imputation method that presents several values for each missing value can more successfully depict the uncertainty because of the imputation. The most important consideration is to ensure that the data imputed will reflect or estimate a country's actual level of variables. In this research two methods of data imputation were used. Because of the large numbers of missing data, the datasets for Djibouti, West Bank and Gaza were excluded (case deletion imputation method). For others, given that country characteristics is correlated with national income, hot-deck imputation was chosen as the method for estimating the missing data. Hot deck imputation uses data from countries with "similar" characteristics where observed units

in the sample are used to substitute values. Based on mathematical “similarities”: Manhattan distance:

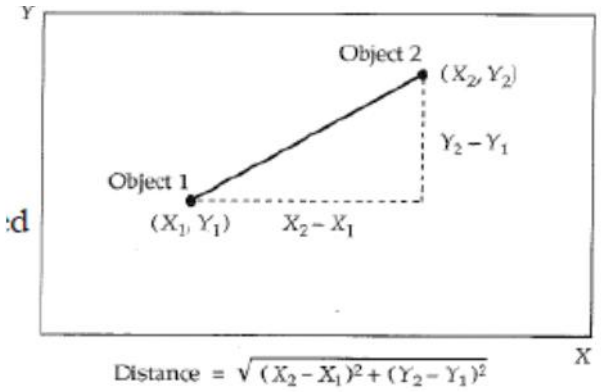
$$d_{ij} = \sum_{k} \left| {}_{k}x_{i} - {}_{k}x_{j} \right|$$

Index k goes through all the indicators jointly observed on units i and j

Normalized and corrected values

The missing value for unit *j* is the observed value for the same indicator on the most similar unit.

Or Euclidean distance:



In this research GDP per capita and the classification of MENA region in the World Bank report were used as the main criterions in identifying countries with similar characteristics. According to “*Economic Developments and Prospects*” report (World Bank, 2013), the MENA countries is divided into three main clusters. This report sometimes refers to fourth clusters of countries, called countries in transition.

For example, missing data for country X were estimated for a certain indicator by first identifying the countries that have similar levels of GDP per capita and that are from the same cluster. Then the indicator that has a known relationship to the indicator to be estimated was considered. For instance, inflation rate data of country X was estimated by using average inflation data of country B, C, D, and etc. from the same cluster, with similar level of GDP per capita and similar level of

inflation rate. The same logic was applied to estimate missing data for all indices included in the study.

3.4.4 Normalization

Another challenge for this study was different quantitative and qualitative indicators with various scales and units. So, it was essential to normalize data to have the same unit of measurement before aggregating data.

To select the appropriate normalization method, we should take into account:

- Whether we want to keep extreme values (i.e. reward for exceptional behavior),
- Whether the aggregate index, included different indicators, is time dependent.
- Whether we want to benchmark against a reference country,

In this research for a meaningful integration of the quantitative score and qualitative rating, all values were rescaled by Min-Max normalization method. In this method each indicator X_{qc} for a generic country *C is* transformed in:

$$\mathrm{I}_{\mathrm{q,c}} = \frac{x_{q,c} - \min_c \left(x_{q,c}\right)}{\max_c \left(x_{q,c}\right) - \min_c \left(x_{q,c}\right)}$$

Where $min_c\,(x_q)$ and $max_c\,(x_q)$ are the minimum and the maximum value of X_{qc} across all countries *C.* In this way the normalized indicators I_{qc} have the same range of variation [0, 1], lying between 0 and 1, but not necessarily the same variance. More generalized formula in any cases which lower scores is better, is:

New Value = (old value-Min)/ (Max-Min) * direction + 0.5 (1-direction)

This data rescaling procedure was repeated for all numerical indicators to reach to a value score between [0, 1].

3.4.5 Calculating Cronbach's alpha test

In this stage "Cronbach's alpha" test was used to evaluate the reliability of the measures. This test which is one of the most common estimate of internal consistency of items in a model, Measures the internal consistency in the set of indicators, i.e., how well they describe a one-dimensional construct. Cronbach's Alpha measure were used to check:

- Whether indicators belonging to one sub-pillar can work together?
- If the set of indicators belonging to one sub-pillars are appropriate to describe the phenomenon

This calculation was the first measure used to assess the quality of the metrics. So Cronbach's alpha is considered an adequate index of the inter-item consistency and reliability of independent and dependent variables. Nunnally (1978) suggests that constructs have reliability values of 0.7 or greater.

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k} var(X_i)}{var\left(\sum_{i=1}^{k} X_i\right)}\right) \qquad \begin{array}{l} X - indicator \\ k - number\ of\ indicators \end{array}$$

3.4.6 Aggregation rule

In literature several aggregation methods are discussed. Aggregation methods are divided into three main types including (1) aggregation based on scores, (2) aggregation based on rank and (3) aggregation based on the outranking matrix. The techniques in each type may be *"compensatory"* or *"non-compensatory"*.

One of compensatory aggregation method based on scores is arithmetic mean. Although this technique is the most widespread method to aggregate indicators, sub-pillars and pillars, it imposes restrictions on the nature of individual indicators. For example this method requires normalized indicators and also implies perfect and constant substitutability. Perfect substitutability means that how much you care about one dimension has nothing to do with its initial value. To calculate this measure we use this formula:

$$CI_c = \sum_{q=1}^{Q} w_q I_{qc}$$

$$\text{with } \sum_q w_q = 1 \text{ and } 0 \le w_q \le 1, \text{ for all } q=1,..,Q \text{ and } c=1,...,M.$$

Another aggregation method based on scores which is partially compensatory is geometric average. In this method we try to give sort of more importance to the pillars that were doing not well and it is the main advantages of this aggregation method to arithmetic aggregation method. Because in some issues we would like that a country makes more efforts on more weak pillars. A key statistical feature with this method is that if decline 1% in an indicator lead to the same impact on the aggregated index. This method requires normalized and positive values and also implies imperfect substitutability. The main features of geometric aggregation method are as follows:

- Implies only partial compensability; it means poor performance in one pillars cannot be fully compensated by good performance in another.
- Rewards balance by penalizing uneven performance between pillars
- Encourages improvement in the weak pillars. For instance the lower the performance in a particular pillars, the more urgent it becomes to improve in that pillars.

To calculate this measure we use this formula:

$$CI_c = \prod_{q=1}^{Q} x_{q,c}^{w_q}$$

In this study to create aggregated index, more than one aggregation method were applied at different levels of aggregation. In sub-pillars level we used arithmetic aggregation method and in pillars level we employed geometric aggregation methods.

3.4.7 Correlation analysis to analyze the underlying structure

The major goal of this step is to verify whether the nested structure of our intended phenomenon is well-defined. In the other words we want to check if the proposed 10 sub-pillars that constitute the ISED ecosystem framework are statistically well-balanced. So to analyze the underlying structure of intended phenomenon and to describe the associations among these 10 sub-pillars correlation matrix analysis has been used.

In this research to explore the relations and internal consistency among 10 sub-pillars of ISED ecosystem framework the Spearman correlation coefficients matrix was computed.

Michaela Saisana (2008) states the following suggestions about corrrelatin measure:

- 0.4 – 0.8 correlation coefficients between the pillars and the aggregated index
- All correlation coefficients should have the expected (desired) sign (correlation of indicators with pillars and and agrregated index)

3.5 Sum up

In this chapter, research design regarding the three main research questions was discussed in depth. The grounded theory research method and two-round Delphi research have been applied for first research question that result in an ISED ecosystem framework. For second research question a three-round Delphi research method has been carried on to obtain consensus about appropriate indicators to measure various parts of proposed ecosystem framework. For empirical part (addressing third research question) correlation analysis and composite index guidelines have been used to unveil how different parts of ISED ecosystem framework vary across selected countries in MENA region. In next two chapters, the results of qualitative phase and quantitative phase will be discussed in details. The figure 10 presents the road map for conducting qualitative and quantitative analyses in following chapters.

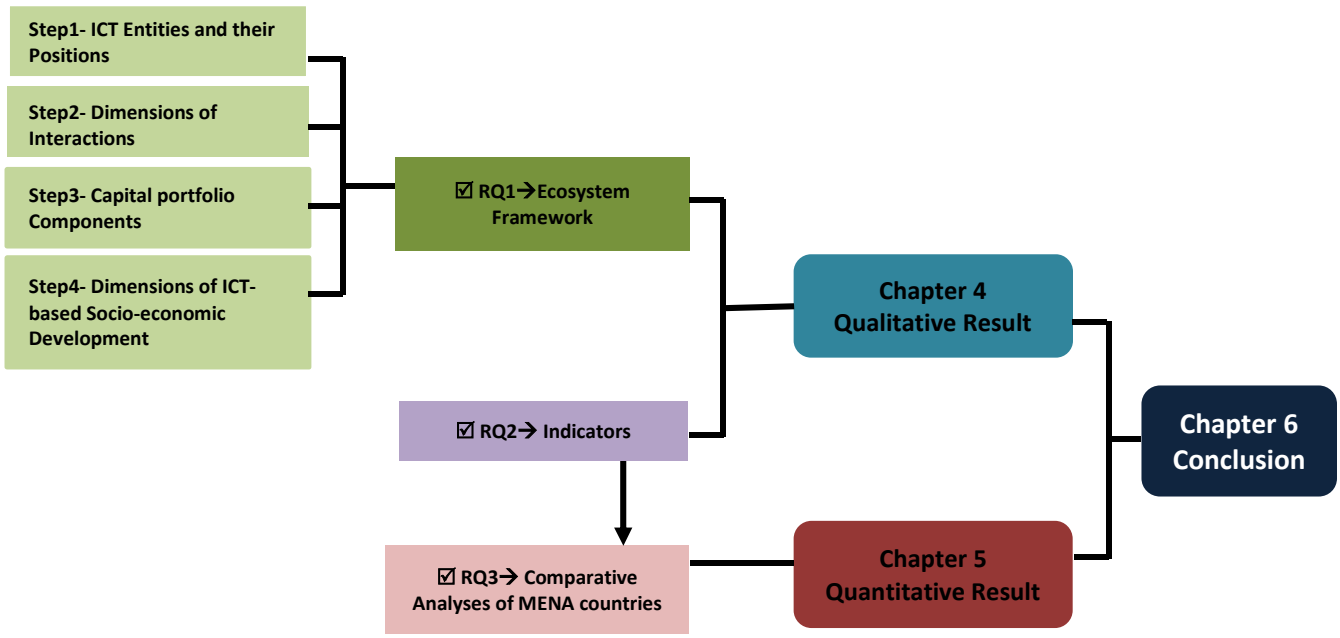


Figure 9. Road map for analysis in qualitative and quantitative phase

Chapter 4

Qualitative Phase

Analyses and Results

4 Qualitative Phase Analyses and Results

By applying grounded theory and two-round Delphi research method and then relating ICT entities, contextual factors of pertinent environment, dimensions of interactions among these elements, and eventually ICT-based socio-economic development dimensions, "the ICT-based socio-economic development (ISED) ecosystem framework" is established. To this end, one focus group discussion meeting plus 25 semi-structured interviews with ICTD experts and ICT industry representatives have been conducted.

In focus group discussion meeting main findings concerning to literature have been presented and on the basis of participants' opinions small alterations were made in interview protocol. The interviewees for the first phase of semi-structured interviews were selected through a purposive sampling procedure among ICTD experts and ICT industry representatives which attended in 6th international conference on information and communication technologies development (ICTD2013). The interviews for first phase of data gathering were arranged over the ICTD conference 2013 by requesting meeting in advance. These semi-structured interviews started with an initial interview protocol (Appendix 1) but further questions were introduced if needed. To analyze data from first phase of semi-structures interviews of 14 participants each of these interviews were transcribed and then the transcribed interviews were explored to identify codes and concepts within them. These codes are units of information which were considered saturated when no further information can be found by running more semi-structured interviews. Since the NVIVO software has just the ability to count existence of dissimilar words that might be repeated in transcript, extracting codes were done manual. All these codes are supported with rich descriptive quotes from the data. To increase the reliability of results, the data gathering and analysis were conducted in two phases. As Cresswell (2006) suggests, the data gathering phase in this research is carried out in a "Zigzag" manner and iterative way. It means that I move backward and forward between gathering and analyzing data. The numbers of iterations for gathering data and analyzing collected data are related to codes which have been saturated.

Over the second phase of data gathering 11 interviewees were selected among ICTD experts from Middle East and North Africa (MENA) region and all interviews started with an interview protocol

(Appendix 1). To analyze collected data in second phase all the previous stages that explained in the first phase of data gathering were followed.

Based on these two phases of data gathering dimensions of interactions and two axial coding patterns were created. The axial coding patterns were used to identify sub-pillars of ICT entities (IE) and capital portfolio (CP) by categorizing similar codes (These sub-pillars corresponded to codes which were extracted over the grounded theory analysis.)

Besides conducting focus group discussion meeting and semi-structures interviews as data gathering techniques, several in-depth document reviews were applied to improve validity and lessen bias risk in this research. Moreover, the findings which result from exploring these literature provided a starting point for designing interview protocol. I have used Sen's capability approach to determine initial dimensions and sub-dimensions of ICT-based socio-economic development. The choice framework (CF) -as a scheme of operationalizing the capability approach (CA) – and capital portfolio of sustainable livelihood framework (DFID, 1999) were applied as initial input to determine the capital portfolio of pertinent context in which other elements of intended framework perform inside it. Finally, the ecosystem perspective in ICT context (Fransman, 2010), was utilized to conceptualize and visualize the main ICT entities and interactions of ICT-based socio-economic development. (These concepts have been described in detail in section 2.11).

Main parts of ISED ecosystem framework which resulted from conducting grounded theory research method and two-round Delphi method are as follows:

- ICT Entities (IE) and their positions: encompass all ICT players are interacting in an environment/context that ICT development take place with contributing these entities. Each ICT entity has particular position in the ecosystem framework. It means that ICT interacting entities place at least in one of these positions with respect to their roles and interactions.
- Dimensions of Interactions: The interactions among various entities of ISED ecosystem framework are multi-dimensional. These interactions as continually advancing processes initiate knowledge flow all over this ISED ecosystem framework and generate dynamic changes.

- Capital Portfolio (CP) components: All ICT entities and interactions are defined in a broader context with specific economic and social conditions as well as cultural and political circumstances that are formed particular contextual factors. The overall condition of contextual factors would be suitable for obtaining ICT-based socio-economic development and cause this system settling into dynamically changing/movement.

ICT Entities (IE) and Capital Portfolio (CP), besides interactions among them form an ICT-based socio-economic development (ISED) ecosystem framework (hereafter ISED ecosystem framework). The consequences of the reciprocal interactions within this ecosystem framework, can be converted into:

- ICT-based Socio-economic Development: Based upon the interactions among ICT entities of ecosystem framework, by taking advantages of suitable capital portfolio the direct and indirect impacts of ICT development could be stimulated in the form of ICT-based socio-economic development in various dimensions. (Outcome of ISED ecosystem framework)

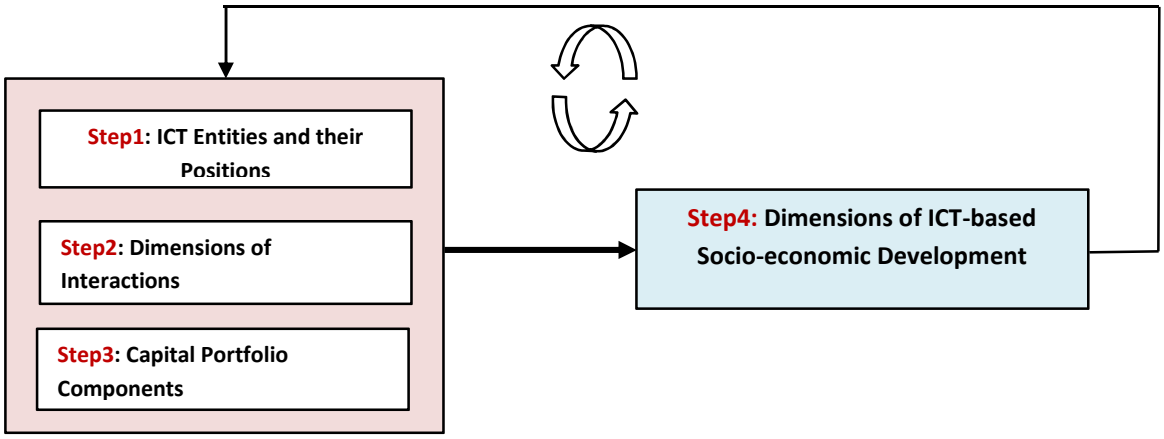


Figure 10. The interactions among various elements of ISED ecosystem framework

Regarding the Klein's framework there are primary and secondary outcomes/impacts. Except of the *Choice (choice in ICTs)* as primary outcome/impact which is both aim and axiom means of development (Sen, 1999), other ISED ecosystem outcomes are not necessarily progressive. It

means that in addition to advancing outcomes of ICT-based socio-economic development, the disturbing impacts have been paid attention.

4.1 Feature of ISED Ecosystem Framework

To determine appropriate structure to develop ISED ecosystem framework, the features of frameworks which are used by international organization to model ICT contribution to socio-economic were investigated. Then by taking advantages of the main strengths and weaknesses of each framework with respect to s-curved development path, the features of ISED ecosystem framework were determined. In section 2.7, we explored and compared various features of frameworks which are used by international organizations to model ICT contribution to socio-economic development. These comparisons not only helped us to unfold strengths and weaknesses of previous frameworks, but also helped us to reveal gaps regarding frameworks which were defined to conceptualize ICT contribution to socio-economic development. In this section besides explaining main findings respecting to this comparison, we explain the features of ISED ecosystem in this research have been defined.

Whatever ICT has become global and ubiquitous the policy attention has been focused on making the best use of this technology to improve social and economic status of nations rather than just providing access. Consequently, the framework and definition of some indices such as "ICT performance measure" (IC4D, 2009), "human development index" (UNDP, 2010), "information society measure" (ITU, 2012) and "network readiness index" (World Economic Forum, 2012) have been modified in line with these changes.

Despite these evolutions, existing view of "stage by stage development" influence ICT indices so that countries are being classified with respect to their position on the stages of ICT development path. This stage by stage development are illustrated by S-curve (Figure 11) which depicts three stages of ICT development path including: ICT readiness, intensity and ICT impact. In this regard, the lower income countries with lower level of ICT development are corresponded to readiness stage of ICT development path. Developing countries with medium level of ICT development are corresponded to intensity stage of ICT development path and developed countries with higher level of ICT development are corresponded to the impacts stage of ICT development path.

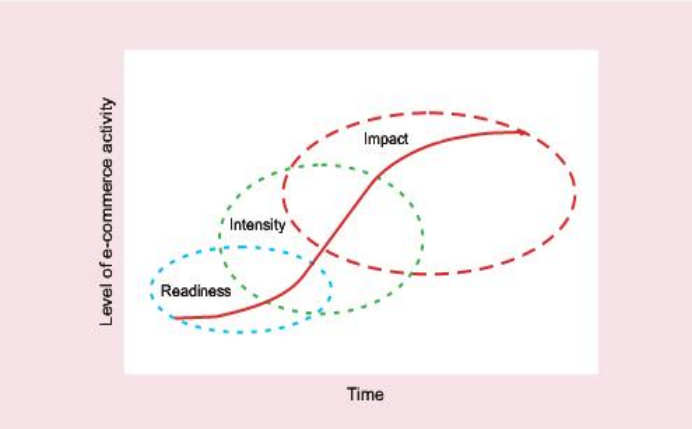


Figure 11. ICT Development path (Source: E-commerce and Development Report, UNCTAD, 2004)

It seems that in a "hyper-connected era" that ICT has become ubiquitous each country still follows the S-curved development but the level of ICT development is different with respect to the quality and quantity of ICT sector infrastructures and networks.

It means that as soon as an ICT infrastructure or technology is set up then its impacts or outcomes would start to influence the socio-economic dimensions of the people life and country status. But the intensity of this influence is dependent to the degree of the ICT infrastructure and networks enhancement for access and usage by inhabitants, businesses and government. It means that each country has an ICT development S-curved but the level of S-curved varies with the quality and quantity of infrastructures and networks in ICT sector.

Regarding this, the ISED ecosystem framework that was introduced in current research is based on this premise that any given country has its own ICT development S-curved (Figure 12) while the level of S-curved varies in different countries.

So in developing ISED ecosystem framework (defining elements and related indicators) all stages of development path encompassing ICT readiness, intensity and ICT impact have been taken into account, simultaneously.

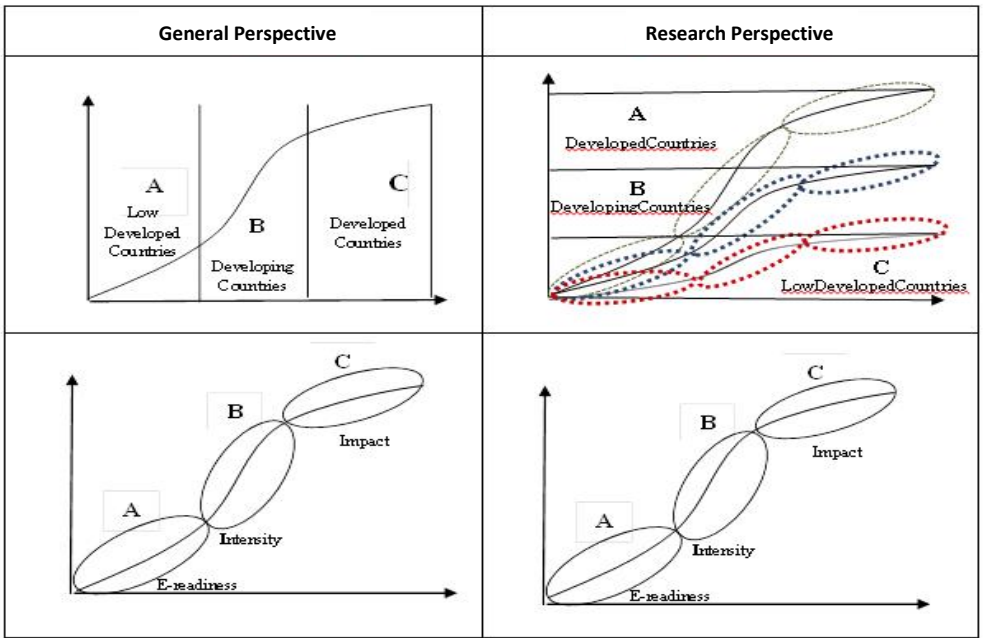


Figure 12. Current research perspective based on ICT development path

4.2 ICT Entities (IE) and Their Positions

The first sub-question that was answered dealt with the ICT Entities of ISED ecosystem framework. ICT Entities of ecosystem framework provide vision into the main key players of ISED ecosystem framework. A list of ICT Entities (IE) was developed from grounded theory analyses of 25 semi-structured interviews with ICTD experts and ICT sector representatives. About 18 separate codes were determined on the basis of transcribed interviews. Table (14) shows the extracted open codes. The frequency of a code means that code was saturated and more data gathering doesn't lead to more codes.

Table 14. Open coding of ICT entities

	Open Codes	Frequency	
		ICTD experts (16 interviewees)	ICT industry representatives (9 interviewees)
First phase and second phase of semi-structure interviews	affordable and high quality ICT infrastructures	16	9
	Individuals, Households	15	9
	Government	16	9
	Entrepreneurs	11	5
	Businesses	16	9
	Operators	16	9
	ICT Service Providers	14	8
	ICT Product Providers	14	9
	Competing ICT enterprises	16	8

	Regulation authority	16	9
	Universities	12	8
	ICT incubators & technology parks	10	7
	ICT R&D institutions, Innovation centers	11	6
	Financial institutions	15	8
	Legal institutions	16	9
	Standard setting institutions	11	9
	ICT Enterprises' Suppliers	13	9
	ICT Enterprises' Partners	8	7
	Cooperating ICT enterprises	10	5

The open coding pattern for ICT interacting entities reveals that main key ICT players are co-operating ICT enterprises, competing ICT enterprises, institutions, final consumer-users, operators, regulation authority and entrepreneurs that cooperatively or rivalry interact with each other to achieve the development outcomes they desire to, by taking advantages of their contextual factors.

The next step in the analysis was grouping these open codes into categories. In this stage the codes which were similar to each other were categorized into the similar groups. Based on the grouping similar codes into categories and Cresswell's suggestions (2006) for developing axial coding, an axial coding of the ICT interacting entities was developed. (Figure 13)

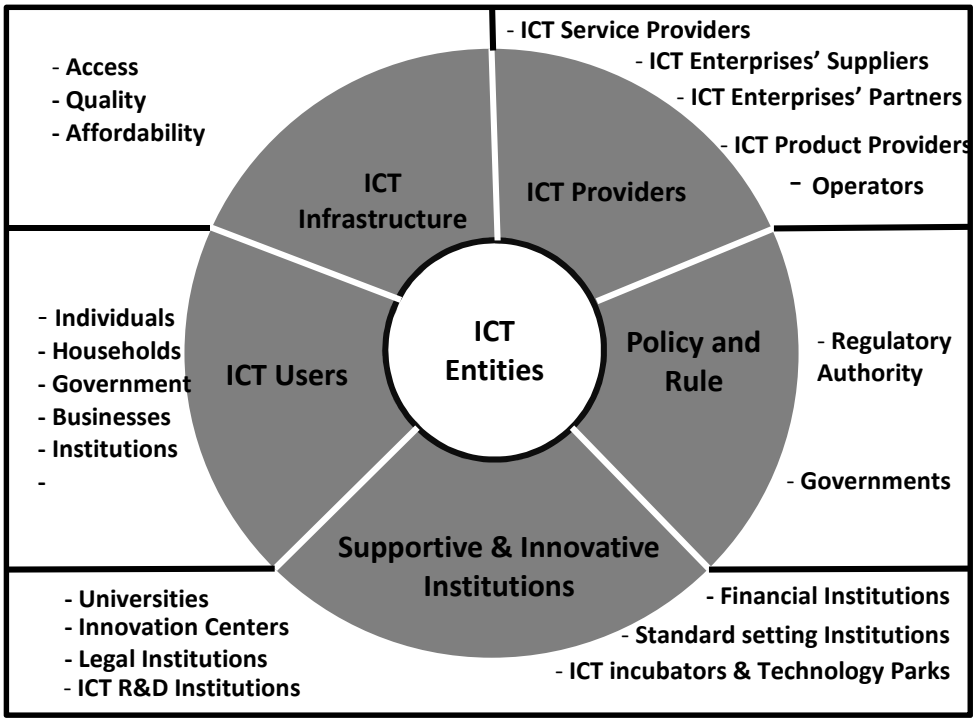


Figure 13. Axial coding of ICT Entities

In the following line I will explain the ICT Entities of ISED ecosystem framework which are the result of the interpretive research method analyses.

- **ICT infrastructure entity:**

ICT infrastructure entities contain various ICT services and products and ICT equipment. For instance, mobile phones and internet-based applications such as email, blogs, forums, social networking sites (SNS) such as Facebook and Twitter, Voice Over Internet Protocol (VOIP) programs such as Skype, equipment like computers, servers, platforms which Internet providers use to deliver content and applications. All these ICT products, application and equipment make up a dynamic system that cause ICT-based socio-economic development regarding its contextual factors.

- **ICT enterprises:**

The other ICT interacting entities of the ICT-based socio-economic ecosystem framework are ICT enterprises. ICT enterprises consist of operators, ICT service providers and ICT producers that provide ICT infrastructure, ICT services and ICT product as ICT technologies with given quality and affordability characteristics in the exchanging market. These ICT enterprises that are on the supply side, are fragmented into a) co-operating ICT enterprises and b) competing ICT enterprises. Co-operating ICT enterprises consist of ICT enterprises' suppliers, ICT enterprises' partners and finally intermediate users of ICT enterprises that use the output of other ICT enterprises. Competing ICT enterprises compete with each other in both ICT product markets and ICT factor markets such as the ICT labor markets, the capital markets, the market for management or entrepreneurial resources.

- **Final consumer-users:**

The second group of interacting entities are final consumer-users of ICT enterprises - on the demand side. They are divided into Households and individuals, Businesses and government. These group of interacting entities -with various requirement and priorities- apply various ICT services and products. They use and benefit from usage of ICT technology with respect to

their budget constraints, leisure time, cultural and social background, job status and duty priorities.

- **Government:**

Not only government as a big user demands a large amount of ICT services and products but also in relation to the ICT technology has a policy making position. The main role of government in position of policy making is to develop enabling legislation and regulatory framework for market formation and beneficiary of ICT private sector potential in the market. Government also designs plans, policies and strategies to incentive local and foreign investors, encourage software development for export, support research&development potential in ICT sector, set up affordable and secure ICT infrastructure, provide access to national database, and develop e-services and ICT applications in government, in trade, in health and education.

But it does not mean that government is almighty. Government tries to deal with a greatly complicated ICT-based socio-economic ecosystem so it's ability to centrally and rationally plan should always be doubted in such a complex system. Therefore, government should systematically record and monitor the performance of national ICT-based socio-economic ecosystem and compares performance with the best or with the other comparable ICT-based socio-economic ecosystem. Intervention can be as prioritization of ICT area, highlighting both ICT opportunities and ICT weaknesses and establishing an appropriate economic incentive Regime. However universal service obligation (USO) in remote areas requires direct intervention of government because of the market failure to deliver this kind of services.

- **Regulatory Authority:**

In all countries, there is usually a regulatory authority of ICT sector to regulate specially the ICT sector and activities. The regulatory institution not only determine what ICT enterprises can and cannot do but also manages and controls affordability and quality of ICT supply to the final consumer-users (individuals/households and businesses). The regulatory institution regulate activities of pertinent ICT enterprises like operators, ICT producers and ICT service

providers who provide and sell ICT technologies and foster the long-term development of the ICT. Summarily effective regulation has resulted in many benefits, such as greater economic and technological growth, increased investment in the ICT sector, better quality of service, lower prices and higher penetration rates. The level of regulatory intervention will vary from country to country, and will depend on various factors, including the level of market maturity, the legal and regulatory framework, and the regulatory issues arising from new technologies and services.

- **Entrepreneurs:**

The entrepreneurs convert innovative ideas to new ICT products and services through innovative technological processes on the supply side. The entrepreneurs' activities could be conducted within technology parks and ICT incubators or ICT research centers or through universities. Activities of entrepreneurs are affected by the regulatory institutions. In other words, regulatory functions directly or indirectly influence entrepreneurs' activities from new idea formation to the product commercialization.

- **Universities:**

The main role of universities in the ISED ecosystem framework is providing skilled-person-power and promoting high quality human resources. Universities also back up research and development process in ICT technology. World Bank report (2002) identified two main functions of universities in supporting knowledge-driven economic growth:

> *"The capacity to train a qualifies and adaptable labor force including high level scientists, professionals, technicians, teachers for basic and secondary education, as well as future government."*
>
> *The capacity to generate new knowledge"*

- **ICT incubators and technology parks:**

Technology parks and ICT incubators prepare the ground and the necessary infrastructure for nurturing entrepreneurs and promoting the activities of ICT enterprises in the private sector

and also increase competitiveness and growth of knowledge-based activities. As well, they encourage public-private partnership, to secure a better role for the ICT private sector in the national economy, and to boost local economy.

- **Institutions:** The ICT-based socio-economic ecosystem consists of more than co-operating ICT enterprises, competing ICT enterprises and final consumer-users of ICT enterprises. Institutions are the next group of interacting entities in an ICT-based socio-economic ecosystem that shape aforementioned entities and also form innovative capabilities. The determined institutions for ISED ecosystem framework are regulatory institution, universities, ICT incubators and technology parks, ICT research institutes, standard setting institutions and financial institutions. These institutions have been explained in the following line;
    a. **ICT Research institutes:** both governmental and non-governmental research institutes play significant role in development, design and implementation of successful operational projects in ICT sector. Also they develop usage of suitable theories adapted to country needs in ICT sector.
    b. **Standard setting institutions:** in a greatly complicated ecosystem like ICT-based socio-economic ecosystem, standards yield a pivotal collaborative method that helps to develop knowledge. Generally, standards are set within standard setting organizations (SSOs), which can be both purely private or involve varying degrees of government oversight. The development of standards results in many benefits, which vary depending on the purpose of the standard and the product or service they cover.
    c. **Legal institutions:** in ICT sector institutions relating to intellectual property (IP) rights and patenting have a crucial role in enhancing the ICT enterprises ability to produce vying ICT service/products. To sum up, these institutions improve the innovative capabilities of entrepreneurs and ICT enterprises.
    d. **Financial institutions:** financial institutions encompass public or private investors such as public or private banks or venture capitalist.

Each of the ICT Entities of ISED ecosystem framework has particular position in the framework. These positions have been depicted in table 15

Table 15. Position of ICT entities

Position of ICT Entities	
D	Demand-side
S	Supply-side
I	Intermediary
N	Nurture
P	Policy/rule making

It means that interacting entities place at least in one of these positions with respect to their role and their interactions. Some entities are placed in more than one position regarding their various roles in this ecosystem framework. Demand-side position (position "D") encompasses entities that use ICT services and buy ICT based technology products throughout their price and quality. Supply-side Position (position "S") includes entities that provide and sell ICT infrastructures, ICT services and ICT products as ICT technologies. In intermediary position (position "I"), there are ICT infrastructure entities consist of services, products and infrastructure with given quality and affordability characteristics. The intermediary position is a bridge between demand-side, supply-side and other entities who have a role in the ISED ecosystem framework. Nurture position (position "N") includes entities that not only nurture human capital in ICT sector but also invest, support, facilitate and accelerate research and development activities on new technologies in ICT sector. Furthermore institutions such as standard setting institutions and legal institutions that have been located in "N" position guide the ICT market to operate better and enhance the ICT enterprises procedures. Finally, in Policy-making position (position "P") there are entities such as government and regulatory authority that mange, design policies and regulate the ICT sector and activities for market formation and beneficiary of all entities in the market.

4.3 Dimensions of ICT Entities' Interactions

As explained in previous section ICT enterprises are divided into two main groups, co-operating ICT enterprises and competing ICT enterprises. The interactions between and within these two

groups, can be divided into two main types; cooperative interactions and competitive rivalry interactions.

The interactions type between competing ICT enterprises such as different active operators, various ICT service providers and ICT producers are both competitive and co-operative. It means that not only they compete with each other in their products and factor markets in terms of quality and affordability characteristics, but also they learn from their competitors, imitate them and reap benefit from the flow of knowledge. However, from the viewpoint of enterprises that lose their potential to gain from their knowledge, these knowledge flow act as an externalities. Consequently, the interactions between this groups of ICT enterprises not only are competitive type, but also are co-operative type.

Moreover, ICT enterprises interact with their suppliers and partners to supply their factor market requirements. These interactions increase their power to remain, succeed and make progress in the ISED ecosystem framework. Therefore the interactions between ICT enterprises and their suppliers and partners are cooperative.

The interactions between final/intermediate users such as government as the biggest users of ICT services and productions, individuals and households with their suppliers -could be an operator, an ICT service providers or an ICT producers- are another co-operative symbiotic interaction. Final/intermediate consumers through using the ICT technologies obtain applicable knowledge and reflect this knowledge to the suppliers of ICT service or ICT producer. In other words, these interactions are formed in a market with advantages for users and also profit for suppliers.

The main feature of co-operative interactions is originating new knowledge between ICT technology users and ICT technology creators through learning, imitating, exploring or adapting. These knowledge flows, as the most important force, cause dynamically changing in over the ICT-based socio-economic ecosystem. The crucial point in ICT-based socio-economic ecosystem is that all the symbiotic interactions as continually advancing processes initiate knowledge flow all over this ISED ecosystem framework and generate dynamic changes.

All these entities and interactions are formed and accomplished within a given context with specific economic and social conditions as well as cultural and political circumstances. At the

national level and with respect to sustainable livelihood framework (SLF, 1999) we could interpret these economic, social, cultural and political circumstances as a portfolio of national capitals -each country has its own capital portfolio. These capitals could, depending on ICT enterprises conversion factors, institutional settings and interactions between them, be converted into ICT-based socio-economic outcomes/impacts.

The interactions among various ICT Entities of ISED ecosystem framework are multi-dimensional. Not only the nature of these interactions are either co-operative or competitive, but also there are five dimensions for these interactions.

Table 16. Dimensions of ICT entities' interactions

Dimension of Interactions	
D1	Information flow
D2	Provide/sell - Use/buy
D3	Fund/nurture
D4.1	Operational/procedure flow
D4.2	Policy/rule flow
D5	Innovation flow

Each interaction involves dimension "D1" that is information flow. This dimension is a two-way flow that provides each entity in the ecosystem framework with information about other entities to make an interaction. For instance, the final consumer/user gets information about the ICT service or product and also about the ICT enterprise that is seller. Simultaneously, the ICT enterprises by selling to the final/intermediate users gets information about the consumer/user. Also, final/intermediate consumers through using the ICT technologies obtain applicable knowledge and reflect this knowledge to the suppliers of ICT service or ICT producer. This dimension of interaction could be generalized to all interactions that embedded in this ecosystem framework. Dimension D1 causes dynamically changing in over the ISED ecosystem framework through obtaining applicable information and reflecting this information.

Some interactions involve dimension "D2" such as interactions between entities in supply-side Position (position S) with other entities in the ISED ecosystem framework. For example an operator sells or provide its ICT service or ICT infrastructure to final users, intermediate users or institutions. The main point in dimension "D2" is that although an ICT service or ICT infrastructure

are provided by the operator to other entities, some entities may not directly pay for these ICT services or ICT infrastructures. Payment will be made by a third party. It means that this dimension of interaction does not necessarily result in a financial flow. For instance, final users in remote regions don't pay for universal service obligation (USO).

Dimension "D3" of interactions is a fund/nurture interaction between and within entities in nurture position (position N) and entities in intermediate position (position I). For example, technology parks and research institutes empower and nurture each other through high-skilled labor force and innovative idea (within position N). Furthermore entrepreneur convert innovative ideas to new ICT product and services (between position N and position I).

Dimension "D4" of interactions includes either policy/rule flow (dimension "D4.1") or operational/procedure flow (dimension "D4.2") flow between entities in policy/rule making position (position p) and some entities in Nurture position (Position N). The policy/rule flow or operational/procedure flow not only determine rules under which the ICT entities of ISED ecosystem framework operate but also cause more efficient provision and production of ICT technologies tailored to the diversity of ICT entities. For example ICT standard setting institutions and intellectual property laws affect the operations and procedures of some entities of ISED ecosystem framework.

The last but not the least dimension of interactions is an innovation flow (dimension "D5") interaction. This dimension employs the results of other four dimensions to innovate. It means that innovation emerges from this recent dimension of interactions in this framework. This dimension of interactions is the fuel of the ISED ecosystem framework.

Table 17. Correspondence between ICT entities and dimensions of interactions

Position of entity	Entity	ICT enterprises	Individual / households	Businesses	Government	ICT technology	Entrepreneur	Regulatory	Financial institutions	Universities	ICT Research institutes	incubators and tech-parks	ICT Standard setting institutions	Legal institutions
S	ICT enterprises	D1	D1,D2	D1,D2	D1,D2, D4	D1,D2	D1,D2, D5	D1, D2, D4	D1, D3	D1, D3, D5	D1, D3, D5	D1, D3, D5	D1, D2, D4	D1, D2, D4
D	Individuals and households	D1,D2	D1	D1	D1, D4	D1,D2	D1	D1, D4	D1	D1	D1	D1	D1	D1
D	Businesses	D1,D2	D1,	D1,	D1, D4	D1,D2	D1	D1, D4	D1	D1	D1	D1	D1	D1
D,P	Government	D1,D2, D4	D1, D4	D1, D4	D1,	D1,D2	D1, D4	D1, D4	D1,D4	D1, D3, D4	D1, D3, D4	D1, D3, D4	D1, D4	D1, D4
I	ICT technology	D1,	D1,	D1,	D1,	D1,	D1,D2, D5	D1, D2, D4	D1, D3	D1, D3, D5	D1, D3, D5	D1, D3, D5	D1, D2, D4	D1, D2, D4
D,N	Entrepreneur	D1,D2, D5	D1, D4	D1,	D1, D4	D1,	D1,	D1, D4,D5	D1,D3	D1, D3, D5	D1, D3,D5	D1,D3, D5	D1	D1
P	Regulatory	D1, D2, D4	D1,	D1, D4	D1, D4	D1,	D1, D4,D5	D1,	D1, D4	D1, D4	D1, D4	D1, D4	D1,D4	D1, D4
N,D	Financial institutions	D1, D3	D1,	D1,	D1, D4	D1,	D1,D3	D1, D4	D1,	D1, D3	D1, D3	D1, D3	D1	D1
N,D	Universities	D1,D2, D5	D1,	D1,	D1, D3, D4	D1,	D1, D3,D5	D1, D4	D1, D3	D1,	D1, D3, D5	D1, D3, D5	D1,D4	D1
N,D	ICT Research institutes	D1,D2, D5	D1,	D1,	D1, D3, D4	D1,	D1, D3,D5	D1, D4	D1, D3	D1, D3, D5	D1,	D1, D3, D5	D1, D4	D1,D4
N,D	ICT incubators and tech-parks	D1,D2, D5	D1,	D1,	D1, D3, D4	D1,	D1,D3, D5	D1, D4	D1, D3	D1, D3, D5	D1, D3, D5	D1,	D1,D4	D1,D4
N,D	ICT Standard setting institutions	D1, D2, D4	D1,	D1,	D1,D4	D1,	D1,	D1,D4	D1,	D1,D4	D1, D4	D1,D4	D1,	D1, D4
N,D,P	Legal institutions	D1, D2, D4	D1,	D1,	D1, D4	D1,	D1,	D1, D4	D1	D1	D1,D4	D1,D4	D1, D4	D1,

4.4 Capital Portfolio in ISED Ecosystem Framework

All ICT interacting entities and interactions among them which explained in previous parts, take place within an environment with particular contextual factors that which altogether form an ICT-based socio-economic development ecosystem framework.

The third sub-question that was answered dealt with the capital portfolio of the ISED ecosystem framework. In this research the capital portfolio of pertinent context have been defined the capacity of a nation to fully leverage ICTs to obtain socio-economic development and were measured by a set of assets. The extent to which a country benefit from ICTs to obtain meaningful level of ICT-based socio-economic development related to its ICT entities (IE) and the present set of assets that might be considered as weaknesses or strengths of a nation. This set of assets which have been introduced as the contextual factors of nations were labeled "*Capital Portfolio"* of ISED ecosystem framework. The presented ISED ecosystem framework in this research, associate "ICT entities" with "capital portfolio" in order to achieve "degrees of ICT-based socio-economic development". In the following line I will explain the components of capital portfolio of ISED ecosystem framework which are the result of conducting grounded theory research method to answer third sub-question.

To do this, a list of main contextual factors was developed from analyzing 25 semi-structured interviews with ICTD experts and ICT industry representatives. About 21 separate codes were determined on the basis of transcribed interviews. Table (18) shows the extracted open codes. The frequency of a code means that code was saturated and more data gathering doesn't lead to more codes.

Table 18. Open coding of ICT interacting entities

	Open Codes	Frequency	
		ICTD experts (16 interviewees)	ICT industry representatives (9 interviewees)
First phase and second phase of semi-structure interviews	Social Safety	16	7
	Gas Resources	15	4
	Economy Structure	16	9
	Perception of happiness	11	3
	Government Structure	16	9
	Literacy	16	9
	National Income	14	9

	Civil Lliberties	14	6
	Population	16	5
	Business Structure	12	9
	Entrepreneurial Activities	10	9
	Environmental structure	11	3
	Research and Development Structure	15	7
	Oil Resources	16	5
	Life expectancy	5	3
	Human Rirhts	13	6
	Health expenditures	10	5
	Entrepreneurial Intention	11	8
	Women Rights	13	7
	Labor Force	15	9
	Fear of Failure of a business	11	-

The next step in the analysis phase was grouping these open codes into categories. In this stage the codes which were similar to each other were categorized into the similar groups. Based on the Cresswell's suggestions (2006), an axial coding (Figure 14) of the capital portfolio components was developed.

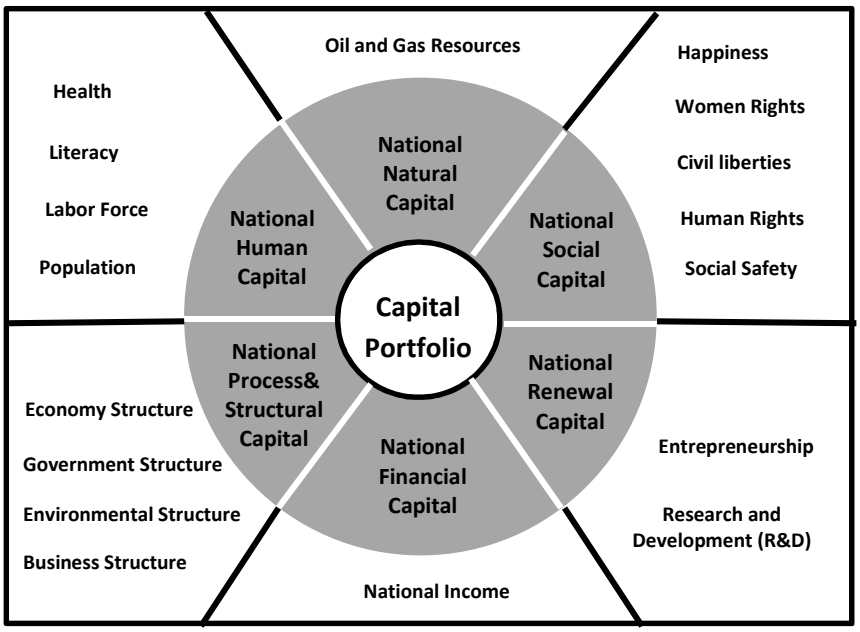


Figure 14. Axial coding of capital portfolio

Totally, this research propounds an ecosystem framework that encompasses not only the interactions and ICT entities of ICT-based socio-economic ecosystem but also the components of capital portfolio of the pertinent context (contextual factors). The reciprocal interactions of these

interacting entities plus taking advantages of capital portfolio components of pertinent context might lead to achieve the socio-economic development outcomes which these entities desire to. In this way, the proposed ecosystem framework defines and locates six components of capital portfolio (CP). In following line, these components have been defined.

- **National Human Capital (NHC)**

National human capital refers to a countries' capability in labor force, literacy, young people and other competencies that result in realizing and implementing tasks.

- **National Process and Structural Capital (NPSC)**

National process and structure capital refers to all business, government, and economy structures that enhance the countries' capability to benefit from tangible and intangible assets to create value.

- **National Renewal Capital (NRC)**

National renewal capital reflects a country's innovation system and Entrepreneurial activities to improve and renew itself to make progress.

- **National Social Capital (NSC)**

National social capital refers to a country's capabilities in political rights, women rights, civil liberties, happiness, and social safety that provide an attractive atmosphere.

- **National Financial Capital (NFC)**

In this study national financial capital is defined as financial wealth of a nation as a result of past national economic activities which measured by gross domestic product (GDP) at purchasing power parity (PPP) per capita

- **National Natural Resources (NNR)**

  Here in this study, national natural resources refer as:" A country's natural wealth and resources which potentially have economic value for country and also can provide and support other value creative processes".

4.5 Dimensions of ICT-based socio-economic development

The literature review on dimensions of ICT-based socio-economic development revealed that different scholars like Baqir (2009) and Madon (2001) have defined this phenomenon differently and there is not complete consensus on the dimensions of ICT-based socio-economic development. Moreover, scarce research has been done to expand and modify the socio-economic development dimensions that they have defined. To increase the degree of consensus on dimensions of ICT-based socio-economic development, the following steps were pursued.
Accordance to literature on dimensions of ICT-based socio-economic development especially, determined dimensions by Baqir (2009) and Madon (2001), a questionnaire (Appendix 2) including initial list of ICT-based socio-economic development dimensions was designed.

Table 19. The initial list of ICT-based socio-economic development

Baqir's perspective (2009)	Madon's perspective (2001)
- Quality of life consist of opportunities for education and healthcare, participation in the political process, self-efficacy, self-fulfillment - Economic transformation includes new business opportunities, effective management of current business - Cultural evolution includes changes in social behavior, westernization, addiction of ICT use, waste of time, pornography - Personal security and criminal use - Social contact contains staying in touch with family, develop new friendship	- Social wellbeing contains health, education, poverty alleviation and empowerment - Economic growth includes economic productivity - Political wellbeing consist of democracy - Physical environment contains sustainable development

The prepared questionnaire was distributed to the participants. Through this questionnaire the *"Relevance"* of each dimension of ICT-based socio-economic development was determined by

participants. The participants also had an opportunity to add new dimensions that they considered important to complete the initial list of dimensions. Moreover, the perception of participants about progressive and disruptive aspects of these dimensions were asked with respect to discourses on ICT transformation (Avgerou, 2010). It means that in determining the relevance of each dimensions to ICT-based socio-economic development as outcome of ISED ecosystem framework in addition to advancing factors, disturbing factors (dark side of ICT) have been taken into account. The results of this questionnaire led to more increase in the degree of consensus.

The expert panelists that participated in this part of research were ICTD experts in Middle East and North Africa (MENA) region.

To obtain consensus about initial list of dimensions of ICT-based socio-economic development, a two-round Delphi research method was carried out.

In designed questionnaire, the "Relevance" characteristic of each dimension was asked in a Likert scale of four points, from "*unimportant*" to "*very important*".

During analysis of the results of the first round of Delphi, the dimensions were classified into three groups based on the answers of the expert panelists to "*Relevance*" characteristic. In designed questionnaire (Appendix 2), the "Relevance" characteristic of each dimension was asked in a rating scale of four points from *"unimportant"* to *"very important"*. To analyze the results we calculated the percentage in which the determined dimensions in *"Relevance"* characteristic were labeled as "important" or "very important". If a dimension in the *"Relevance"* characteristic had been answered "important" or "very important" by at least 66% of experts, this dimension was maintained either without changes or with some changes. Otherwise, the dimension was removed from the list of dimensions and was not assessed in the next round. On the basis these criteria to maintain or remove the dimension, three groups of dimensions were proposed:

Group 1- maintained dimensions were those in which were maintained either without changes or with some changes

Group 2- Added dimensions were those dimensions in which were proposed by Expert panelists

Group 3- Deleted dimensions were those in which have been removed from initial list

In second round more assessments were carried out regarding those dimensions in which had been added by participants. (Dimensions in group 2). Moreover, the perception of participants about progressive and disturbing impacts of maintained dimensions (dimensions in group 1) and added dimensions (dimensions in group 2) were asked. The results have been obtained in second round enjoy high degree of consensus.

As a result of conducting a two-round Delphi research method a set of ICT-based socio-economic development dimensions has been finalized as the outcome of proposed ISED ecosystem framework which explains both progressive and disturbing impacts of ICT.

Then we categorized the modified list of ICT-based socio-economic development dimensions on the basis of five areas of freedoms that have been suggested in Sen Sen's capability approach (1999). These five areas cover simultaneously all various aspects of development such as social aspects, economic aspects, political aspects and cultural aspects.

Amartya Sen (1999) defined development as *"A process of expanding the real freedoms that people enjoy to lead the lives they have reason to value"*. Five freedoms that suggested by Sen are 1) *"political freedom"*, 2) *"economic facilities"*, 3) *"social opportunities"*, 4) *"transparency guarantees"* and 5) *"protective security"*.

We merged more similar areas into one area. For example we merged *"Political Freedom"* and *"Transparency Guarantees"* as one area. Also, *"Social Opportunities"* and *"Protective Security"* as one area. Since all these areas focus on progressive impacts of ICT, we determined one more area regarding disturbing impacts of ICT.

The dimensions of ICT-based socio-economic development, especially disturbing dimensions have been determined within the context of ICT development in MENA region with its particular cultural, religious and social conditions. It means that one might expect different dimensions in other context.

Table 20 illustrates the final dimensions of ICT-based socio-economic development during a two-round Delphi research method. These dimensions have been explained in more detailed in the following lines:

Table 20. Dimensions of ICT-based Socio-economic development

	Main aspects of ICT-based socio-economic development	Dimensions of ICT-based socio-economic development
Advancing impacts	**Political Freedom & Transparency Guarantees**	Democratic participation of citizens
		Political mobilization
		Transparency of governmental agencies
		Enhance accountability
		Accelerating the political changes
		Participation in the political process
		Freedom of association
		Freedom of expression
		Social movements
		Awareness of political issues through public access to political web sites, social networks and internet blogs
	Economic Facilities	More competitive SMEs
		High-paying jobs
		New business opportunities
		Effective management of current business
		Labor productivity
		Poverty alleviation
		Network externalitie (direct or indirect)
		Faster and more efficient interactions with other businesses
		Lower transaction cost
		Knowledge spillover or learning effects
	Social Opportunities & Protective Security	Health care opportunities
		Education and learning opportunities
		Empowerment
		Changes in limitative customs
		Evolution of social behavior
		Develop new friendship
		Staying in touch with family and friends
		Social interactions
		self-efficacy
		self-fulfillment
		Environmental quality (ecology)
		Sense of security
		Leisure time
Disturbing impactss	**Criminal/Illegal use of ICT & Cultural Changes**	Pornography / Child pornography
		Trickery activities
		online fraudulence
		Software piracy rate
		Cyber-terrorism
		e-terrorism
		Addiction of ICT use
		Changes of socio-cultural norms
		Changes of ideological values
		Westernization
		Personal privacy

- **Political Freedom & Transparency Guarantees**

Internet-based applications, social networking sites (SNS), Voice over Internet Protocol (VOIP) programs and mobile phone play an important role in accelerating the political changes and enhancing accountability.

The e-government applications/facilities would reduce ambiguities in government and business transactions and enhance accountability and impede corruption related issues considering some government officials.

On the political aspect, ICT technologies are seen as a catalyst for civil democratic changes. ICTs can stimulate fast democratization in the countries of the world where democracy has not been embedded. ICTs can help the actors by stimulating important parts of population and making alternative discourses to non-democratic (authoritarian or monarchical) regimes. Moreover, ICTs can support democratic consolidation by contributing to the development of an *"open public sphere"* and helping pro-democracy actors to remain engage in transition phase. The role of information communication technologies could be discussed with respect to their importance in strengthening transitions to democracy.

The Arab Spring is the most important and top example of the use of ICTs for political changes. There is a broad agreement that new communication tools enabled citizens in Egypt and Tunisia to share information which played an important role as accelerators of the social protests that ended the previous regimes. People employed these tools to express their dissatisfaction with economic and political situation and also contact others who were unhappy. Mobile phones (particularly smart-phones), video-sharing platforms, and social networks, were applied increasingly by Arab activists to gather and spread information that result in weakening the regimes' control. The main point is that ICTs should be considered as a facilitator and accelerator factor that just helped Arab activists to conduct and organize protests over the democratic changes, rather than decisive factor in triggering the Arab spring.

- **Social Opportunities & Protective Security**

There are many areas of ICT that could increase social opportunities and enhance quality of people's life. The role of ICT in poverty alleviation by underlining the extended opportunities for

vulnerable people and poor people especially in deprived region is noticeable. The use of ICT can empower individuals through more learning opportunities. The learning opportunities has been wide spread from access to free educational contents to *"virtual learnings"*. Moreover, the use of ICT is considerable in providing rural healthcare facilities due to most of the rural areas in MENA countries suffer from the shortage of qualified health service.

Also, role of ICT in increasing entrepreneurial opportunities is considerable. ICT can transform interactions and lead to free and open interactions.

In MENA region there are several countries with high rate of highly-skilled emigrants due to unstable political condition. So ability to stay connected with family is a very important dimension of ICT-based socio-economic development.

Increased opportunities for entertainment is another dimension of ICT development that are appropriate for spending leisure time. Another dimension of ICT-based socio-economic development is awareness of the social issues.

In some less developed countries in MENA region, ICT devices have sometimes safety mechanism. These devices play an accompanying role for citizen especially women that take care of them through staying in touch with family if they found their self in an unusual situation.

- **Economic Facilities**

Economic facilities refers to effective management of business, increase in the size of existing business, new business opportunities, developing new business ideas, changing the nature of competition. This dimension of ICT-based socio-economic development result in creating high-skilled and high-paying jobs, making advantages in many industries through *spillover* effect, and accelerating the creation of more competitive SMEs. Information and communication technologies also enable firms to interact with other businesses faster and more efficiently, facilitate communication and decrease the transaction costs. Also, ICT development could generate notable direct and indirect *"network externalities[10]"* and *"knowledge spillovers11"* or

10. Network externalities, which occur when the efficiency or value of a product or service increases as the product or service is adopted by more users.

11 . The knowledge that enables a firm or industry to successfully adopt ICT technologies tends to naturally spread or spill over to other firms and industries.

learning effects. Furthermore, ICT development can improve "*total factor productivity"* and *"labor productivity".*

- **Criminal/Illegal use of ICT & Cultural Changes**

In addition to positive and progressive dimensions of ICT development, the disturbing dimensions of ICT-based socio-economic have been taken into account in this research.

ICT development plays critical role in the evolution of cultural values, Trickery activities, online fraudulence, e-terrorism[12], cyber-terrorism[13], child pornography, software piracy rate, addition of ICT use that cause a lot of waste of time, changes of social and cultural norms are some disturbing dimensions of ICT-based socio-economic development.

The particular cultural and religious conditions of MENA countries region carry implications for areas of ICT applications. Notwithstanding, many efforts to restrict the use of internet contents that are considered socially and religiously inappropriate, ICT-based cultural changes are inevitable in this region. Some participants considered it a threat for traditional customs and religious values (socio-cultural norms). ICT may cause cultural evolution that is not approved by many citizens in MENA region. Moreover, access to the internet facilitate access to contents that are considered *"sexually inappropriate"*.

12 . An internet based terrorism or an online war triggered by e-mails or sms or mms instigating political or religious or regional sentiments of the people across the world.

13 . Premeditated, politically motivated attack against information, computer systems, computer programs, and data which results in violence against non-combatant targets by sub-national groups or clandestine agent

4.6 ISED ecosystem framework

Consequently, ICT entities, interactions between entities and national capital portfolio, all together, accomplish the ICT-based socio-economic development (ISED) ecosystem framework (figure 15).

The interactions among ICT entities by taking advantages of specific capital portfolio of pertinent context lead to degrees of ICT-based socio-economic development for each country with specific development path.

Based on the result of qualitative phase of this research, The ICT-based socio-economic development as the outcome of intended framework has both progressive and disruptive transformations. Three progressive dimensions including economic facilities, social opportunities and protective security, political freedoms and transparency guarantees, and one disturbing dimensions including Criminal/Illegal use of ICT & Cultural Changes were determined for ICT-based socio-economic development in this research.

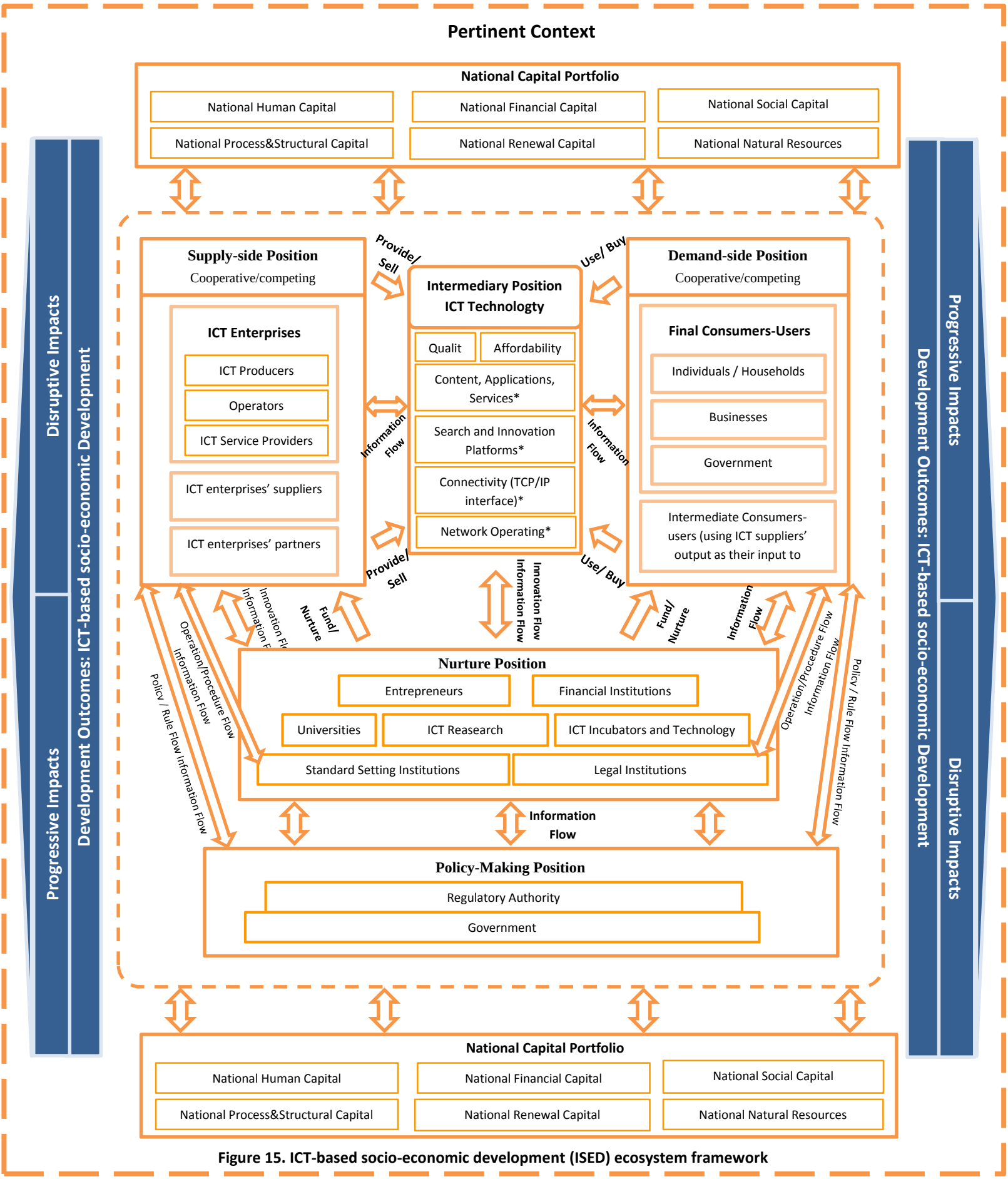


Figure 15. ICT-based socio-economic development (ISED) ecosystem framework

4.7 Hierarchical Structure of Pillars and Sub-pillars of ISED Ecosystem Framework

In this section a hierarchical structure on the basis of different parts of ISED ecosystem framework was formed. This hierarchical structure includes two main pillars and ten sub-pillars. All these pillars and sub-pillars correspond to different elements of ISED ecosystem framework. As explained in previous sub-sections, ICT entities and capital portfolio are two main elements of the ISED ecosystem framework. These two elements construct pillars of hierarchical structure. The interacting entities (IE) pillar and capital portfolio (CP) pillar contain 4 sub-pillars and 6 sub-pillars, respectively. In what follows, all these sub-pillars are explained.

The interacting entities (IE) pillar consists of four sub-pillars:

- ICT infrastructure entity (IIE): ICT-based socio-economic development as a process requires technological capacity that in this research is reffered by ICT infrastructure entity with three main characteristics including access, quality, and affordability. In other words, ICT sectors could have enabling role only if these three features be present and ready;
- Provide/use entity (PUE): this entity includes all players that located in “Demand –side” and “Supply-side” positions of ISED ecosystem framework. These players use, buy, provide, and sell ICT services and products with given quality and affordable characteristics;
- Rule/procedure entity (RPE): all entities located in “Policy-making” position of ISED ecosystem framework.
- Fund/innovation entity (FIE): all entities located in “Nurture” position of ISED ecosystem framework.

The national capital portfolio (CP) pillar is consist of six sub-pillars which all correspond to the components of national capital portfolio. These 6 sub-pillars are as follows:

- National Human Capital (NHC): people’s capability such as knowledge, education and other competencies in realizing national tasks and implementing national value creation;
- National Process and Structure Capital (NPSC): all systems and structures that enhance the countries’ capability to benefit from national tangible and intangible assets to create value;

- National Renewal Capital (NRC): a country's innovation capabilities to improve and renew itself to make progress;
- National Social Capital (NSC): a country's capabilities in providing an attractive and competitive atmosphere;
- National Natural Resources (NNR): a country's natural wealth and resources which potentially have economic value for country;
- National Financial Capital (NFC): financial wealth of a nation as a result of past national economic activities.

The figure (16) shows the hierarchical structure of pillars and sub-pillars of ISED ecosystem framework.

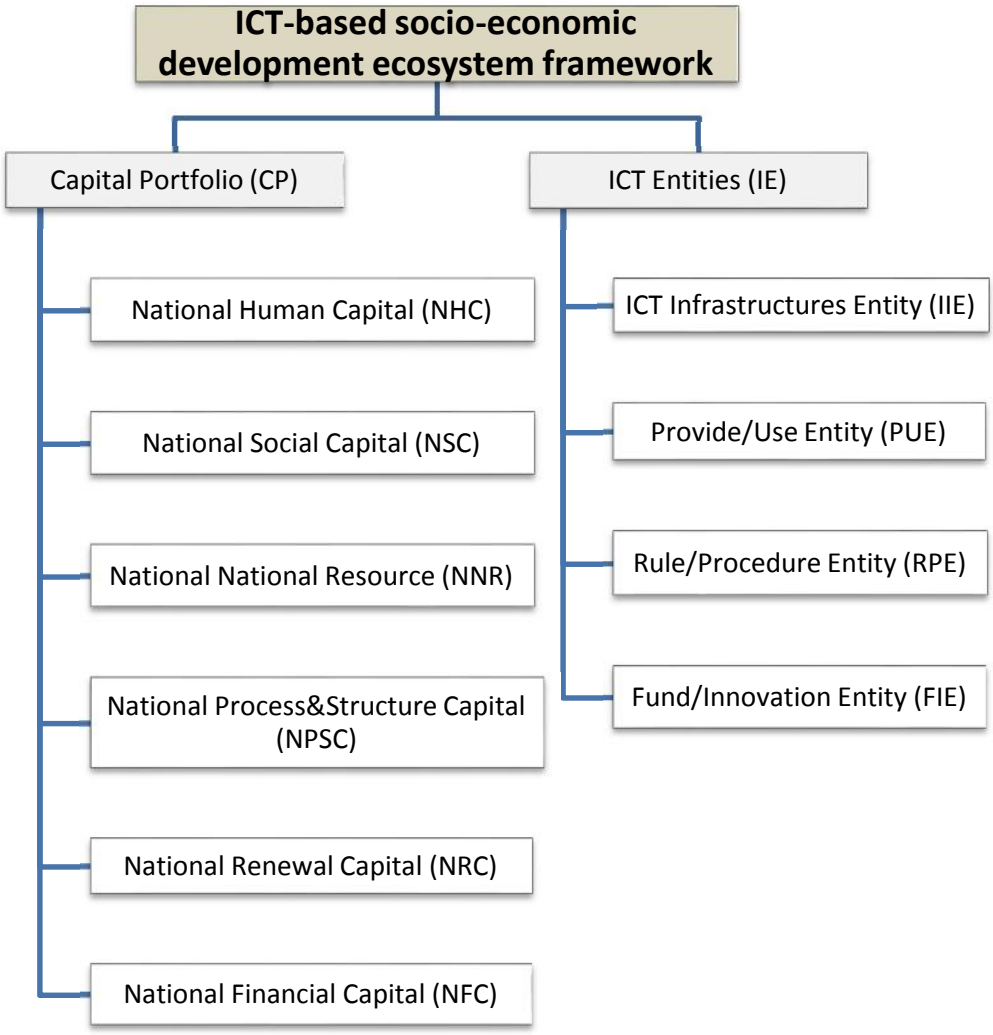


Figure 16. ISED Hierarchical Structure

4.8 Appropriate Indicators to Measure ISED Ecosystem Framework's elements

The quality and accuracy of the quantitative phase depends on the quality of basic data, improvements in data collection and indicator development. In other words, the quality of final results will be mainly influenced by the appropriate and relevant indicators. Ideally, indicators must be selected on the basis of the pertinent theoretical framework and relevant concepts. Drawing on OECD Quality Framework (2011), in selecting data and indicators these four dimensions should be taken into account: 1) *"relevance"*, 2) *"validity"*, 3) *"reliability"*, and 4) *"comparability"*. In this research we considered an iterative process to select indicators for ICT entities and capital portfolio of the ISED ecosystem framework. Various indicators considering main elements of this framework were selected in three stages.

Table 21. Indicators selection stages

Stage	Types of data source	Objective
1st stage: providing initial list of indicators	Reviewing literatures related to capital portfolio of sustainable livelihood framework, resource portfolio of choice framework, network readiness index, digitization measure, ICT development index, ICT price basket, ICT performance measure	110 indicators and indices extracted by reviewing related literatures
2nd stage: conceptual consistency	Focus group discussion (FGD)	The expert panelists (composed of 12 participants) received general overview on the categorized indicators and contextual information about the work they had to do
3rd stage: achieving consensus	Questionnaires	Verifying the accuracy and appropriateness of the selected indicators

In the first stage, by reviewing capital portfolio of sustainable livelihood framework, resource portfolio of choice framework, network readiness index, digitization measure, ICT development index, ICT price basket, and ICT performance measure, 110 indicators were extracted. In the second stage, a focus group discussion meeting was carried out. The expert panelists were composed of 12 participants received general overview on the categorized indicators and contextual information about the work they had to do. Then the appropriateness of defined

hierarchical structure regarding pillars and sub-pillars of ISED ecosystem framework were determined.

Table 22. Pillars and Sub-pillars of ISED ecosystem framework

Capital Portfolio (CP) pillar		
Title of Sub-pillars		**Dimensions**
NSC	National social capital	Happiness
		Social Safety
		Human Rights
		Civil liberties
		Women Rights
NHC	National human capital	Population
		Literacy
		Labor Force
		Health
NNR	National natural resources	Oil and Gas resources
NPSC	National process and structural capital	Business Structure
		Government Structure
		Economy Structure
		Environmental Structure
NRC	National Renewal Capital	R & D
		Entrepreneurship
NFC	National Financial Capital	National Income

ICT Entity (IE) pillar		
Title of sub-pillar		**Dimensions**
IIE	ICT infrastructure entities	Access
		Affordability
		Quality
PUE	ICT Provide/use entities	Supply-side entities
		Demand-side entities
RPE	ICT Rule/procedure entities	ICT policy-making entities
FIE	ICT Fund/innovation entities	Nurturing entities

To obtain consensus about initial list of indicators that could precisely describe the 10 sun-pillars of ISED ecosystem framework, a three-round Delphi method was carried out. To analyze the questionnaires in each round we pursued the procedures which had been applied in Third Mission Project (Carrión, 2012)

The objective of the first and second rounds of Delphi research method was to identify the most relevant indicators belong to the ICT interacting entities (IE) and capital portfolio (CP) pillar. During analysis of the results of the first round of Delphi, the indicators were classified into four categories based on the answers of the expert panelists to "*Relevance*", "*Validity*", "*Reliability*", and "*comparability*" characteristics. These characteristics were described in a Likert scale of four points, from "*unimportant*" to "*very important*".

To analyze the results we calculated the percentage in which the determined characteristics were labeled as "important" or "very important". If an indicator in the "Relevance" characteristic have been answered "important" or "very important" by at least 66% of experts, this indicator was

maintained. Otherwise, the answers to the rest characteristics were considered in order to decide if the indicator was maintained or not. In the case that the indicator was maintained, all its characteristics were reconsidered to determine whether the indicator could be maintained either without modifications or with more modifications through next round of Delphi method. On the basis of these criteria to maintain the indicator with modifications or without modifications, five groups of indicators were proposed.

Group 1- Unchanged indicators are those in which are maintained without changes

Group 2- Modified indicators are those in which are maintained with some changes

Group3- Doubtful indicators are those in which are undecided

Group 4- Added indicators are those indicators in which are proposed by Expert panelists

Group 5- Deleted indicators are those in which have been removed from initial list

The indicators were categorized in groups 2, 3, and 4 need more assessments to know if these indicators will be maintained or not in the final set of indicators. Indicators in group 5 were removed from initial list of indicators and not appraised in the next round.

Table 23. Template used to analyze first and second rounds of Delphi

Group 1- Unchanged indicators are those in which are maintained without changes Group 2- Modified indicators are those in which are maintained with some changes Group3- Doubtful indicators are those in which are undecided Group 4- Added indicators are those indicators in which are proposed by Expert panelists Group 5- Deleted indicators are those in which have been removed from initial list Note: Those indicators which belong to group 5 will be removed from the survey and are not shown in next Delphi round		
Code of indicators	**Title of indicators**	**Group**

In second round an assessment was carried out regarding those indicators that a consensus was not reached during the first round (indicators in group 2 and 3). Furthermore, the new indicators that proposed in first round by expert panelists were asked to be apprised in second round. The results achieved in second round enjoyed a very high degree consensus.

In third round of Delphi method the expert panelists were requested to evaluate the "importance" and "feasibility" of indicators for both IE and CP pillars of ISED ecosystem

framework. They were asked to use a rating scale of 1 to 7, from the least to the most important and feasible. To analyze the results of third round, the values for each indicators regarding experts' opinions were calculated. On the basis of each indicator's importance score, the relative significance of this indicator could be identified. The degree of feasibility implied whether further study phases should be defined or not.

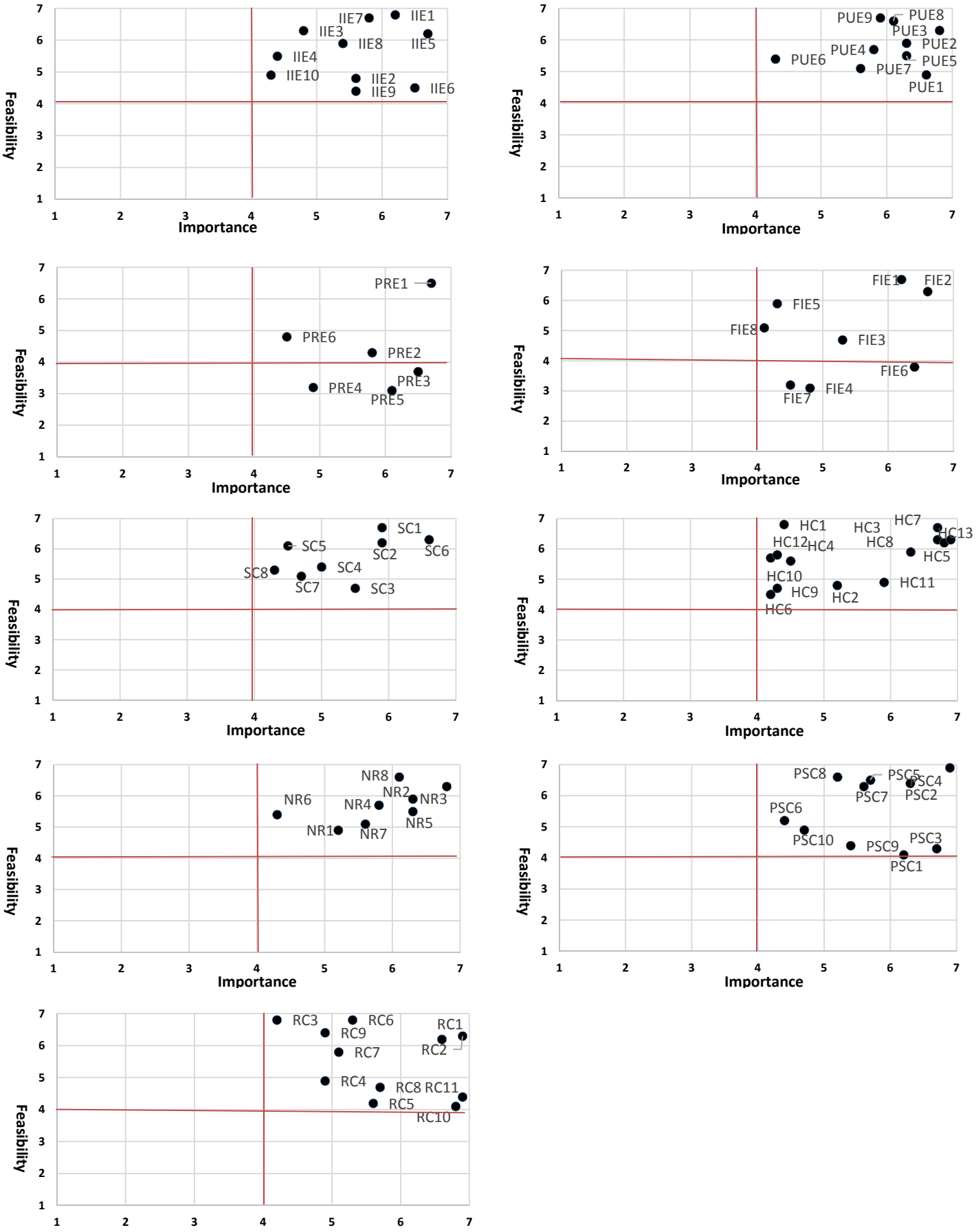


Chart 1. Importance and feasibility of selected indicators

As a result of conducting the three-round Delphi research method a collection of appropriate indicators have been finalized which explain the sub-pillars of ISED ecosystem framework. The results of first two rounds of Delphi method reflect the opinion of expert panelists for refinement of the initial set of indicators. The results of third Delphi round show that all final indicators have been rated above the average score concerning the "importance". It verifies the *"robustness"* of the final results. Furthermore, third round's results shed light on the fact that all indicators in various sub-pillars of capital portfolio pillar are feasible. However, there are some uncertainty about the feasibility of some indicators on sub-pillars of IE pillar.

The table 24 illustrates the initial and final number of indicators during the first, second, and third rounds of Delphi research method.

Table 24. Indicators over different rounds of Delphi research method

Delphi Round	Questionnaire	Number of indicators	
		Initial	Final
First round	Q1: Accordance to capital portfolio (CP) pillar	64	56
	Q2: Accordance to ICT interacting entities (IE) pillar	46	39
Second round	Q3 (Revised Q1): Accordance to CP pillar	56	49
	Q4 (Revised Q2): Accordance to IE pillar	39	33
Third round	Q5: Accordance to both CP and IE pillars	49+33	49+33

Table 25. Indicators of capital portfolio (CP) pillar in Delphi method

Sub-pillars of capital portfolio	Dimensions	Indicators	Time references	Name of data source	Measurement / formula
National social capital (NSC)	happiness	SC1- Happiness index	2013	HDR	
	Social Safety	SC2- Homicide rate	2008–2011	WDI	%, per 100,000 people
		SC3- Assault victims	2010	Gallup	%, per 100,000 people
		SC4- Crime	2007	ICPS	%, per 100,000 people
		SC5- Perception of safety	2012	Gallup	%, Refers to people answering "yes" to the question: "Do you feel safe walking alone at night?"
	Political Rights	SC6- Political Rights Index	2013	Freedom house	measured on a 1-to-7 (worst) scale
	Civil liberties	SC7- Civil liberties Index	2013	Freedom house	measured on a 1-to-7 (worst) scale
	Women Right	SC8- Women Right Index	2011	Freedom house	measured on a 1-to-7 (best) scale
National human capital (NHC)	Population	HC1- Total population	2013	UNFPA	Numerical, million
		HC2-Share of Young People to total population	2012	WDI	Percentage
	Literacy	HC3-Number of tertiary teachers			Thousands
		HC4-Public expenditure on education	2011	UNESCO	%, as a share of GNP
		HC5-Adult Literacy Rate	2008-2012	WDI	%, per 100,000 people
		HC6-Enrolment in Tertiary total	2011-2012	UNESCO	Numerical, per 100,000 inhabitants
	Labor Force	HC7-Labor force participation	2012	WDI	% , as a ratio of total population age 15-64
		HC8-Employment to population	2012	WDI	% of 15+ population
		HC9-Female labor force	2012	WDI	%, as share of total labor force
		HC10-Science & engineering Enrolment	2007	UNESCO	%, as share of total enrolment
		HC11-Brain drain	2011	World bank	%, as a share of tertiary-educated population
	Health	HC12-Health Expenditure	2012	WDI	%, as a share of GDP
		HC13-Life expectancy	2012	WDI	Numerical
National natural resources (NNR)	Oil and Gas resources	NR1-Crude Oil Exports	2012	OPEC	1000 billion barrels per day (b/d)
		NR2-Crude Oil Production	2012	OPEC	1000 barrels per day (b/d)
		NR3-Natural gas marketed production	2012	OPEC	million standard cubic meter (cu m)
		NR4-Natural Gas Exports	2012	OPEC	billion standard cubic meter (cu m)
		NR5-Exports of Petroleum Products	2012	OPEC	1000 barrels per day (b/d)
		NR6-Value of petroleum exports	2012	OPEC	Million $
		NR7-Output of Petroleum Products	2012	OPEC	1000 barrels per day (b/d)
National process and structural capital (NPSC)	Business Structure	PSC1-Doing Business	2013	Doing Business	A nation's ranking on the index is based on the average of 10 sub-indices: starting a Business, Getting Electricity, Dealing with Construction Permits, Registering Property, Getting Credit, Protecting Investors, Paying Taxes, Trading Across Borders, Enforcing Contracts, Resolving in Solvency
	Government Structure	PSC2-Governance Indicator	2012	WGI	A nation's ranking on the index is based on the average of 6 sub-indices: Voice and Accountability, Political Stability & Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption
		PSC3-E-government Readiness	2012	UN	It is a comparative ranking of the countries of the world according to two sub-indices: the state of e-government readiness and the extent of e-participation
	Economy Structure	PSC4-Economic Freedom Index	2014	Heritage.org	Is measured on a 0 (repressed) to 100 (mostly free) value
		PSC5-Inflation Rate	2010-2013	WDI	(%)

		PSC6-GINI index	2007-2011	WDI	A Gini coefficient is measured on a 0-1 value. zero expresses perfect equality, where all values are the same and a Gini coefficient of one expresses maximal inequality
		PSC7-FDI (foreign direct investment) inflows	2010-2012	WDI	% of GDP
		PSC8-Capital goods gross imports	2003-2007	WDI	Million $
		PSC9-Current account balance	2008	WDI	Million $
	Environmental Structure	PSC10-Carbon dioxide emissions	2010	WDI	Per capita metric tons
National Renewal Capital (NRC)	R & D	RC1-full-time equivalent (FTE) Researchers	2008-2011	UNESCO	%, per million inhabitants
		RC2-Gross Domestic Expenditure on R&D (	2008-2011	KAM	%, GERD as a share of GDP
		RC3-PCT (patent cooperation treaty)Patents	2013	GCR	applications/million pop
		RC4-Ventura capital	2013	GCR	on a 1-to-7 (best) scale, survay data
		RC5-Science and technology parks and incubators	2010	IASP	
		RC6-High tech exports	2010	WDI	(% of manufactures)
		RC7-Technology absorption	2013	GCR	on a 1-to-7 (best) scale, survay data
		RC8-Capital goods export	2008-2011	KAM	Million $
	Entrepreneurship	RC9-Entrepreneurial Attitudes	2012-2013	GEM	A nation's ranking on the index is based on the average of 7 sub-indices: Perceived Opportunities, Perceived Capabilities, Fear of Failure Rate, Entrepreneurship as Desirable Career Choice, Media Attention for Entrepreneurship, High Status Successful Entrepreneurship, Entrepreneurial Intention
		RC10-Entrepreneurial Activity	2012-2013	GEM	A nation's ranking on the index is based on the average of 6 sub-indices: Nascent Entrepreneurship Rate, New Business Ownership Rate,Early-Stage Entrepreneurial Activity (TEA), Established Business Ownership Rate, Business Discontinuation Rate, Necessity-Driven Entrepreneurial Activity (% of TEA)
National Financial Capital (NFC)	National Income	GDP per capita ($)	2012	World Bank	Numerical, Purchasing Power Parity (PPP)

Table 26. Indicators of ICT entities (IE) pillar in Delphi method

Sub-pillars of ICT interacting entities	Dimensions / position	Indicators	Time references	Name of data source	Measurement / formula
ICT infrastructure entities (IIE)	Access	IIE1- Fixed telephone subscriptions	2012	IDI	%, per 100 inhabitants
		IIE2- Households with computer	2012	IDI	%, proportion of households with computer
		IIE3- Mobile Cellular subscriptions	2011-2012	Information society report	%, per 100 inhabitants
		IIE4- Households with internet access	2011-2012	IDI	%, proportion of households with internet access
	Quality	IIE5- Secure Internet servers	2012	IDI	Per 1 million people
		IIE6- International Internet bandwidth	2012	IDI	Bit/s per internet user
	Affordability	IIE7- Price basket for residential fixed line	2011-2012	ICT price basket	% of monthly GNI per capita
		IIE8- Price basket for mobile call	2011-2012	ICT price basket	% of monthly GNI per capita
		IIE9- Cost of fixed-broadband	2011-2012	ICT price basket	% of monthly GNI per capita
		IIE10- Cost of Mobile -broadband	2011-2012	ICT price basket	% of monthly GNI per capita
ICT provide/use entities (PUE)	Supply-side and demand-side positions	PUE1- Individuals using the internet	2012	Internet World Stats	percentage
		PUE2- Mobile broadband penetration	2012	IDI	100, per 100 inhabitants
		PUE3- Fixed broadband penetration	2012	IDI	100, per 100 inhabitants
		PUE4- Use of online public services by citizens	2012	GITR	Proxy: Government online service index, is measured on a 0-1(best) scale
		PUE5- Business-to-consumer internet use	2012	NRI	Is measured on a 1-to-7 (best) scale
		PUE6- Business-to-business internet use	2012	NRI	Is measured on a 1-to-7 (best) scale
		PUE7- Social Network Unique Visitors per month	2013	Arab Social Media Report	Proxy: Facebook penetration rate
		PUE8- ICT Export	2012	WDI	%, as a share of total export
		PUE9- ICT Import	2012	WDI	%, as a share of total import
ICT rule/procedure entities (RPE)	policy-making position	RPE1- Laws relating to ICT	2012	GITR	Is measured on a 1-to-7 (best) scale
		RPE2- Freedom on the Web	2013	freedom house	Is measured on a 0 (mostly free) to 100 value
		RPE3- Existence of Software Copyright Law	2012	GITR	Proxy: Intellectual Property Protection, Is measured on a 1-to-7 (best) scale
		RPE4- Importance of ICTs to government vision	2012	NRI	Is measured on a 1-to-7 (best) scale
		RPE5- Existence of USO Policy	2012	GITR	Proxy: effectiveness of law-making bodies, Is measured on a 1-to-7 (best) scale
		RPE6- Independence of Regulatory	2012	NRI	Is measured on a 1-to-7 (best) scale
ICT fund/innovation entities (FIE)	facilitating position	FIE1- ICT Expenditure	2011	Digital Planet	as % of GDP
		FIE2- Telecom Investment ($)	2009-2011	ITU	Million $
		FIE3- Level of e-participation development	2012	GITR	Is measured as a 0–1 (best) scale
		FIE4- Availability of latest ICT technology	2012	NRI	Proxy: availability of latest Tech, Is measured on a 1-to-7 (best) scale
	Innovate	FIE5- ICT PCT(Patent Cooperation Treaty) patents,	2012	GITR	application /million pop
		FIE6- Knowledge-intensive jobs % workforce	2012	NRI	Is measured on a 1-to-7 (best) scale
		FIE7- Existence of new organization model	2012	NRI	Is measured on a 1-to-7 (best) scale
		FIE8- Intensity of competition among ICT enterprises	2012	GITR	Proxy: Intensity of local competition, Is measured on a 1-to-7 (best) scale

Chapter 5

Quantitative Phase

Analyses and Results

5 Quantitative Phase Analyses and Results

The main objectives of the quantitative phase in this research are investigating the interrelations among the main elements of proposed ISED ecosystem framework and constructing an ICT-based socio-economic development (ISED) composite index to measure and to compare ICT-based socio-economic development (as the outcome of intended framework) across 17 MENA countries.

Firstly, regarding the hierarchical structure a dataset was prepared and then, the 10 sub-pillars of ISED ecosystem framework were computed by aggregating finalized indicators in each sub-pillar. It helps to unveil how different sub-pillars vary across 17 MENA countries. Then capital portfolio and ICT entity pillars are calculated separately by integrating their sub-pillars. Finally, by aggregating main elements of ISED ecosystem framework a composite index is constructed. This composite index shows the degree of ICT-based socio-economic development across 17 selected countries in MENA region.

Then the Spearman correlation coefficients matrix is computed to explore the relations among main elements of proposed ecosystem framework. This matrix contributes to verify whether the sub-pillars and pillars of ISED ecosystem framework are statistically justified by the selected indicators.

5.1 Data Structure

As the starting step, a dataset of all sub-pillars' indicators (on the basis of already selected indicators in section 4.8) for 17 MENA countries is formed. Collected data relates to each country's situation in year 2013. For those unavailable data of this year, corresponding available data from year 2012 or the most recent years have been applied. Then problematic indicators (those with skewness>2 and kurtosis >3.5) were treated through assigning the next best values.

To impute missing data two methods of data imputation were applied. The case deletion imputation method was applied because of large number of missing data for Djibouti, Palestine, Sudan and Malta datasets. For others, given that country characteristics were correlated with national income, hot-deck imputation method was used. The other criterion applied to identify

countries with similar characteristics was the classification of MENA region in World Bank report based on natural resources. Furthermore, for a meaningful integration of indicators with various scales and units, all values were rescaled by applying min-max normalization method. Thanks to min-max normalization method, I obtained indicators range from 0 and 1 that are comparable. The variance of normalized indicators depends on the variance of original indicators.

The next step of dataset preparation was the verification of the reliability and validity of sub-pillars' indicators by applying "Cronbach's Alpha test". Table (27) and table (28) respectively shows the result of Cronbach's Alpha test for IE and CP sub-pillars.

Table 27. Cronbach's Alpha test for sub-pillars of ICT entities

ICT Infrastructure Entity (IIE)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.915	.915	10

Provide/Use Entity (PUE)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.880	.889	9

Rule/Procedure Entity (RPU)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.914	.908	6

Fund/Innovation Entity (FIE)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.831	.864	8

Table 28. Cronbach's Alpha test for sub-pillars of capital portfolio

National Social Capital (NSC)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.673	.684	5

National Human Capital (NHC)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.709	.805	10

National Natural Resources (NNR)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.884	.884	7

National Process & Structural Capital (NPSC)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.700	.666	10

National Renewal Capital (NRC)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.753	.678	10

To increase reliability, six indicators were removed from national social capital (NSC) and national human capital (NHC) sub-pillars. This leads to the increase of Cronbach's Alpha from 0.589 to 0.673 and 0.459 to 0.709 for NSC and NHC respectively. Also to increase Cronbach's Alpha from 0.530 to 0.7 level, three indicators of national process and structural capital (NPSC) sub-pillar were removed. The other sub-pillars were not changed. It means that the amounts of Cronbach's Alpha test for them were greater than 0.7 as the threshold level. Regarding Cronbach's Alpha test results, 33 and 40 indicators were confirmed to measure sub-pillars of ICT entity (IE) and capital portfolio (CP), respectively. The final lists of indicators have been shown in table (29) and table (30).

Table 29. Final indicators of ICT entities (IE) pillar

Sub-indices	Definition	Sub-indices	Definition
ICT Infrastructure Entity sub-indices			
IIE1	Fixed telephone subscribtions per 100 inhabitants	IIE6	international Internet bandwidth bit/s per internet user
IIE2	households with computer	IIE7	price basket for residential fixed line
IIE3	Mobile Cellular subscriptions per 100 inhabitants	IIE8	price basket for mobile cellular
IIE4	Percentage of households with internet access	IIE9	cost of fixed broadband
IIE5	secure internet servers/ million pop	IIE10	cost of mobile-broadband
Reliability (IIE Cronbach's Alpha = 0.915)			
Provide/Use Entity sub-indices			
PUE1	percentage of individuals using the internet	PUE6	business-to-business internet use
PUE2	mobile broadband subscriptions per 100 inhabitants	PUE7	facebook penetration rate
PUE3	fixed broadband subscriptions per 100 inhabitants	PUE8	ICT Service Export (% of total service export)
PUE4	business-to-consumer internet use	PUE9	ICT good import (% of total good import)
PUE5	use of online public services by citizens		
Reliability (PUE Cronbach's Alpha = 0.880)			
Rule/Procedure Entity sub-indices			
RPE1	laws relating to ICT	RPE4	Government prioritization of ICT Proxy: Importance of ICTs to gov. Vision*
RPE2	Freedom on the web	RPE5	Existence of USO policy Proxy: effectiveness of Law-making bodies*
RPE3	Existence of software copyright law Proxy:Intellectual Property Protection*	RPE6	Independence of regulatory (private share in ICT section)
Reliability (RPE Cronbach's Alpha = 0.914)			
Fund/Innovation Entity sub-indices			
FIE1	ICT Expenditure As % of GDP	FIE5	ICT PCT patents, applications/million pop.
FIE2	Telecom Investment	FIE6	ICT R&D labor force Proxy:knowlrdge-intensive jobs % workforce
FIE3	Level of e-participation development	FIE7	Intencity of competition among ICT interprise Proxy: intensity of local competition*
FIE4	Availability of latest ICT technology Proxy: Availability of latest technology*	FIE8	Existance of new organization model
Reliability (FIE Cronbach's Alpha = 0.831)			
(*) Indicators followed by an asterisk (*) are measured on a 1 to 7 scale			

Table 30. Final indicators of capital portfolio (CP) pillar

Sub-indices	Definition	Sub-indices	Definition
National Social Capital sub-indices			
SC1	Perception of Happiness	SC7	Civil liberties
SC4	Crime	SC8	Women Rights
SC6	Political Rights		
Reliability (NSC Cronbach's Alpha = 0.673) SC2, SC3, SC5 sub-indices was removed to achieve reliability			
National Human Capital sub-indices			
HC2	Share of young people to population	HC9	Female labor force
HC4	Public expenditure on education	HC10	Science and Engineering enrolment
HC5	Adult literacy rate	HC11	Brain Drain
HC7	Labor force participation rate	HC12	Health Expenditure
HC8	Employment to population	HC13	Life Expectency
Reliability (NHC Cronbach's Alpha = 0.709) HC1, HC3, HC6 sub-indices were removed to achieve reliability			
National Natural Resources sub-indices			
NNR1	Crude Oil exports	NNR5	Exports of petroleum products
NNR2	Crude Oil Production	NNR6	Value of petroleum exports
NNR3	Natural gas marketed production	NNR7	Output of Petroleum Products
NNR4	Natural gas exports		
Reliability (NNR Cronbach's Alpha = 0.884)			
National Process & Structural Capital sub-indices			
PSC1	Doing Bbusiness index	PSC5	Inflation Rate (%)
PSC2	Governance Indicators	PSC8	Capital goods gross imports(US$ mil)
PSC3	E-government Readiness index	PSC9	Current Account Balance
PSC4	Economic Freedom Index		
Reliability (NPSC Cronbach's Alpha = 0.700) PSC6, PSC7, PSC10 sub-indices were removed to achieve reliability			
National Renewal Capital sub-indices			
RC1	Full-time equivalent (FTE) Researchers	RC6	High Techs exports
RC2	R&D expenditure	RC7	Technology absorption
RC3	PCT (Patent Cooperation Treaty) patents	RC8	Capital goods export
RC4	Venture capital	RC9	Entrepreneurial Attitudes
RC5	S&T parks and Incubators	RC10	Entrepreneurial Activity
Reliability (NRC Cronbach's Alpha = 0.753)			
National Financial Capital index			
FNC1	GDP (PPP) per capita		

5.2 ICT entities' sub-pillars

The first main element of ISED ecosystem framework is the ICT entity (IE) pillar that has been composed from four sub-pillars namely, ICT infrastructure entity (IIE), provide/use entity (PUE), rule/procedure entity (RPE), and fund/innovation entity (FIE). So the main aim of this section is to get a sense of the broad picture of the ICT entity's sub-pillars across MENA countries. To this end, firstly the countries' scores in each sub-pillar of ICT entity are calculated and then MENA countries are ranked based on their scores. Table 31 depicts the scores and rankings of the 17 selected countries.

Table 31. Countries' scores and ranks on ICT Entities (IE)

country	ICT Infrastructure Entity (IIE)		Provide/Use Entity (PUE)		Rule/Procedure Entity (RPE)		Fund/Innovation Entity (FIE)	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
ALG	0.185	14	0.367	13	0.44	16	0.29	16
BAH	0.566	4	0.680	4	0.82	5	0.59	5
EGY	0.221	12	0.467	10	0.61	11	0.62	4
IRN	0.369	8	0.444	11	0.61	10	0.50	11
IRQ	0.136	16	0.245	14	0.50	13	0.34	14
JOR	0.270	9	0.488	9	0.76	6	0.54	8
KWT	0.622	3	0.706	3	0.64	9	0.44	12
LBN	0.394	7	0.644	6	0.71	7	0.58	7
LYB	0.142	15	0.239	16	0.59	12	0.40	13
MOR	0.250	11	0.431	12	0.49	14	0.50	10
OMN	0.436	6	0.583	7	0.87	3	0.59	6
QAT	0.812	1	0.771	2	0.95	1	0.65	3
SAU	0.484	5	0.674	5	0.85	4	0.82	2
SYR	0.198	13	0.225	17	0.44	15	0.29	17
TUN	0.257	10	0.514	8	0.65	8	0.51	9
UAE	0.803	2	0.826	1	0.89	2	0.84	1
YEM	0.081	17	0.242	15	0.40	17	0.33	15

In the following, each sub-pillar is defined and countries scores and rankings are discussed in greater detail. Moreover, on the basis of World Bank (2013) classification placing MENA countries into three main groups, each group's average scores in four sub-pillars of ICT entity are compared. According to *"Economic Developments and Prospects"* report the first group includes the Gulf Cooperation Council (GCC) countries which are United Arab Emirates, Bahrain, Kuwait, Oman, Qatar, and Saudi Arabia. The second group encompasses Algeria, Islamic Republic of Iran, Iraq, Libya, Syrian Arab Republic, and Republic of Yemen which are developing oil exporters. The last group contains oil importers countries which are Jordan, Lebanon, Morocco, Tunisia, and Arab Republic of Egypt.

5.2.1 ICT Infrastructure Entity (IIE)

The ICT-based socio-economic development as a process requires a technological capacity in each country which is referred by ICT infrastructure. In practice, ICT infrastructure acts as an enabler. In this regard, there are three main features of ICT infrastructure which none of them can guarantee this function by itself. In other words, ICT infrastructure could play enabling role for "socio-economic development" only if all three features be present and ready. These features are access, quality and affordability of ICT infrastructures. These three features are measured through 10 indicators which were finalized in previous section to calculate ICT infrastructure

entity (IIE) of ISED ecosystem framework. MENA countries' total scores for IIE (ICT Infrastructure Entity) are measured through aggregating 10 indicators by arithmetic average method (Table 31). Then, MENA countries ranked by their ICT infrastructure entity score (Chart 2).

Considering the countries' IIE scores, there is a point that these scores don't show the real value of this sub-pillar in each country. These scores are just signals that show how well a country performs compared with other countries. So these scores reveal one country's position relatively (not exact position) to the others. Qatar ranks as the best country in IIE sub-pillar (table 31 and chart 2). With a small difference, United Arab Emirates (UAE) ranks second with 0.803 score. It means that these two countries perform relatively better than other MENA countries on this specific sub-pillar. Iraq and Yemen hold the lowest ranks with 0.136 and 0.081 scores, respectively. Iraq is suffering from violent conflict and the other is one of the Arab-spring countries that is in the midst of challenging political transitions. As you see the countries' scores at the bottom of ICT-infrastructure entity sub-pillar differ considerably with the countries' scores at the top of the IIE sub-pillar list. The other findings are as follows:

- All the top five nations in IIE sub-pillar are among the GCC states;
- All the bottom five nations in IEE sub-pillar are among developing oil exporter countries;
- Iran has the highest rank (8th place) among all developing oil exporter countries in IEE sub-pillar;
- Among oil importer nations, Lebanon (7th place) has the highest rank in IEE sub-pillar.

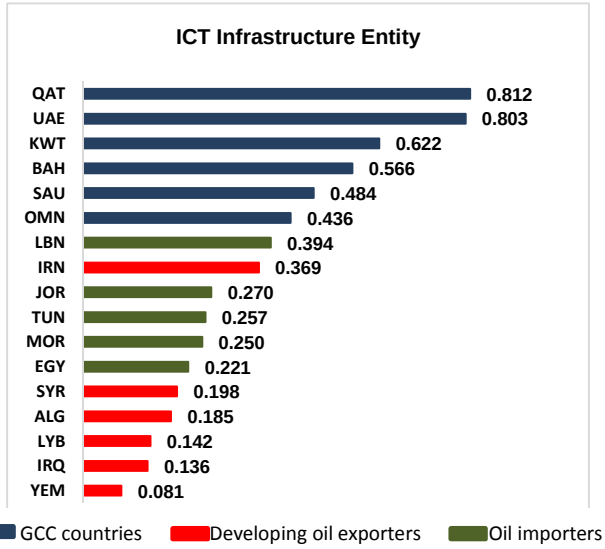


Chart 2. MENA countries rankings by ICT infrastructure entity (IIE)

The chart 3 shows that there is a considerable gap between GCC countries and the rest countries in MENA region on average scores of access, quality, and affordability characteristics of ICT infrastructures entity. Furthermore, the oil importers countries have more access to ICT infrastructures with better quality than the developing oil exporters.

Also, both the oil importer countries and the developing oil exporters enjoy ICT infrastructures with more or less the same affordable characteristics. The developing oil exporter group includes countries such as Syria, Iraq, Yemen, and Libya which suffer from social unrest, political instability, and security incidents with negative spillover effects on other countries in MENA region and geopolitical tensions.

Chart 3. Country groups comparision in terms of IIE indicators

5.2.2 Provide/Use Entity (PUE)

The provide/use sub-pillar refers to entities located in demand-side position and supply-side position of ISED ecosystem framework. These entities use, buy, provide and sell ICT services/technologies with given quality and affordability characteristics.

As shown in table 29, there are 9 finalized indicators to measure this sub-pillar. Accordingly, by applying arithmetic average method the normalized values of these nine indicators are aggregated to calculate MENA countries' scores for this sub-pillar and then to rank them (Table 31 and Chart 4).

Similar to the ICT infrastructure entity, United Arab Emirates and Qatar take the top two positions but in reverse order. As shown, United Arab Emirates ranks first place with a score of 0.826 and then Qatar is ranked the second position with 0.771 score. Libya and Syria have the lowest rankings with 0.239 and 0.225 scores, respectively. These two countries are suffering from violent conflict that has ruined people's life. The other findings are as follows:

- All the top five nations in PUE sub-pillar are among the GCC countries;
- All the bottom five nations in PUE sub-pillar are among developing oil exporters states;
- Lebanon is ranked highest among the oil importers nations, (6^{th} place) in PUE sub-pillar;
- Among developing oil exporters, Iran achieves the best position (11^{th} place) in PUE sub-pillar.

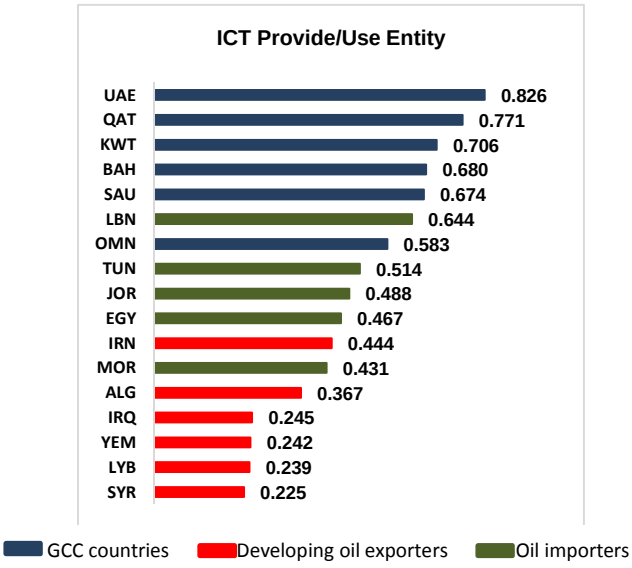


Chart 4. MENA countries rankings by ICT provide/use entity (PUE)

In chart 5, some indicators of provide/use sub-pillar have been compared across three country groups in MENA region. Among these six indicators, the "mobile broadband subscriptions" index indicating high speed access to the internet and other data services over mobile network delivers transformative impacts. It has great capacity to affect different aspects of societies such as healthcare, education and different socio-economic groups. Notwithstanding much evidence that countries with access to mobile broadband take advantages of more social and individual opportunities, the level of mobile broadband subscription indicator is so low in both developing

oil exporters countries and oil importers countries compare with GCC countries. This considerable difference results from the noticeable gap between GCC countries and the rest countries in MENA region on average scores of access, quality, and affordability characteristics of ICT infrastructures. Also, the same condition can be expected in "use of online public services" indicator in MENA region. The high level of mobile broadband and fixed broadband in GCC countries boost the online public services that result in high level of ICT usage in business-to-business and business-to-consumer. Considering the six indicators of provide/used sub-pillar, the GCC nations overtake both developing oil exporters and oil importers nations.

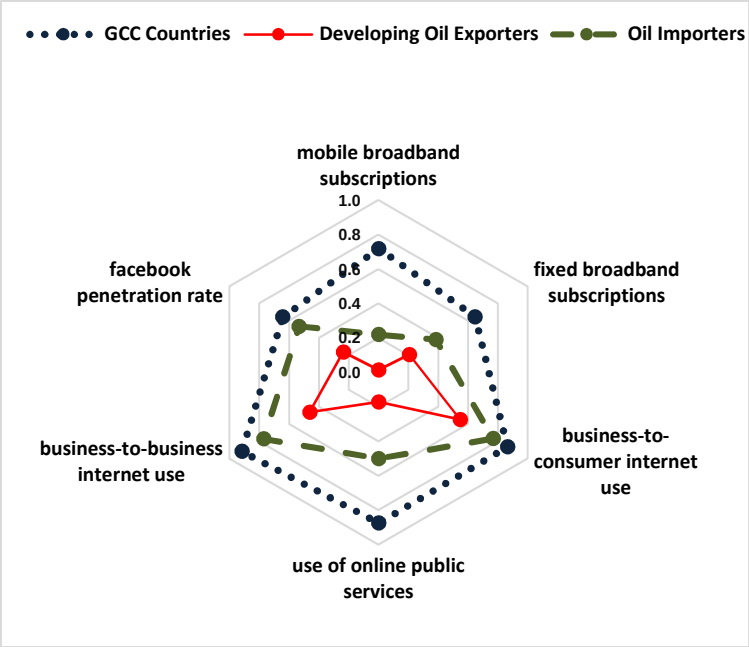


Chart 5. Country groups comparision in terms of PUE indicators

5.2.3 Rule/Procedure Entity (RPE)

The rule/procedure sub-pillar is consist of entities such as governmental, legal and regulatory institutions and authorities that manage and regulate the ICT sector activities for market formation and beneficiary of other entities in the ISED ecosystem framework. Indeed, ICT policy setting and implementation of these policies play crucial role in ICT-based socio-economic development process.

Regarding table 29, six indicators were finalized to calculate rule/procedure entity (RPE). Again, composite rule/procedure entity scores of MENA countries are calculated through aggregating these six indicators by arithmetic average method (Table31). Afterwards, MENA countries are ranked on the basis of their rule/procedure entity scores (chart 6).

As chart 6 depicts, Qatar ranks first place and with a small difference United Arab Emirates achieves second position with 0.0.95 and 0.89 scores respectively. It means that like two previous sub-pillars these two countries perform relatively better than other countries on this specific sub-pillar. Algeria and Yemen (an Arab-spring country) have lowest ranks with 0.44 and 0.40 scores respectively. The other findings are as follows:

- All the top five nations in RPE sub-pillar are among the GCC states;
- Iran has the highest rank (10th place) among all developing oil exporters' countries in RPE sub-pillar.
- Among oil importers nations, Jordan has the highest rank (6th place) in RPE sub-pillar.

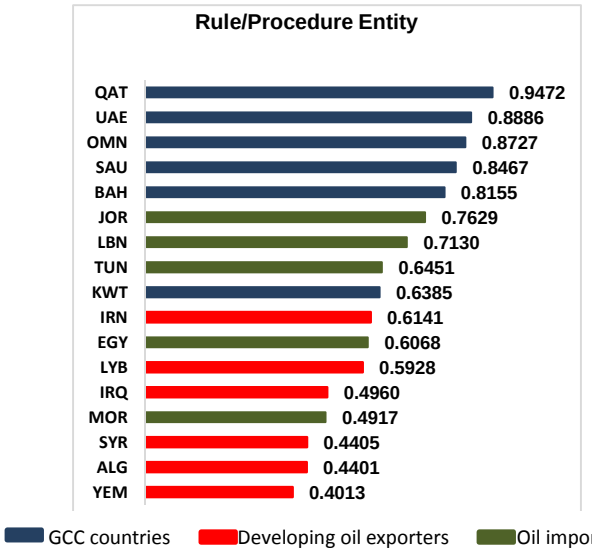


Chart 6. MENA countries rankings by ICT rule / procedure entity (RPE)

The chart 7 depicts the main indicators of rule/procedure entity (RPE) sub-pillar. The "government prioritization of ICT" is one of main and crucial indicators of RPE sub-pillar. The use of ICT would not lead to socio-economic development unless ICTs become part and parcel of government prioritizations. The other indicator of rule/procedure sub-pillar is "laws relating to

ICT" that plays an important role in benefiting from ICT potential. Occasionally, some laws related to ICT are tainted by some governments' officials as a way to limit access to media or web-site which report government misuse or opposition. It means that governments' authority is employed on passing legislations that restrict electronic media's ability.

The most challenging issue towards MENA countries' citizens is "freedom on the web". The diffusion of ICTs are breaking state information monopolies throughout the region, so governments in developing oil exporter countries and GCC nations employ censorship schemes for the internet and apply advanced technology to block public access to the websites that are considered politically, religiously or socially inappropriate. On the basis of Open Net Initiative (ONI) and Reporters Without Borders (RWB), the level of internet censorship and surveillance in a country is grouped in one of the five categories including; *"pervasive, substantial, selective, changing situation, and little or no censorship"*. Notwithstanding the GCC countries are the most connected countries in MENA region regarding "mobile broadband" and "use of online public servers", they all are listed as pervasive category. Also Iran, Syria and Yemen from developing oil countries group stand in this category. Oil importer countries enjoy better condition compared to GCC nations and developing oil exporters when it comes to "freedom on the web" indicator.

Central governments play remarkable roles in managing activities on the web in this region when is compared with much of the rest of the world. Filtering targets content critical of the government, pornographic Websites, gay and lesbian content, content that is critical of Islam, political blogs, and women's rights. According to Wheeler (2006) *"any use of the Internet to openly oppose the state is often punished by imprisonment"*. In other words, any activity that alters the status quo is considered a target for filtering. Wheeler (2006) argues that in the MENA region, the internet has the potential to *"create the conditions for free association"* while some leaders in the MENA region maintain that preventing pornography and the protection of Islamic values are the main reasons for filtering online content.

As Guillen and Suarez (2005) argue, governmental efforts to control the internet may include: 1) restricting access by controlling networks and instituting registration requirements; 2) restricting the content by filtering information, blocking forbidden sites, taking disciplinary actions and even virus attacks on banned sites; and 3) threatening to arrest or imprison those who access

unauthorized information or use the Internet to organize and mobilize politically. Filtering and censorship are also applied on other ICTs such as satellite dishes and mobile SMS messages. Summarily, MENA countries' governments claim that the imposed filtering of internet content is to protect national security, defend Islamic religious values, and protect the country from the harmful material distributed on the Internet. However, some research works on internet filtering show that the censorship imposed is mostly politically motivated.

The "existence of USO policy" indicator refers to reasonable access of all people, regardless of where they live or conduct business, to standard communication services. The universal service obligation (USO) takes on greater importance in rural and remote areas of nations, due to the higher cost of providing telecommunication services to these areas. As one can guess, the average score of this indicator in GCC countries is higher than the rest. The other indicators of RPE sub-pillar including "independence of regulatory" and " existance of software copyright law" reveal the extent to which ICT policies strengthen the capabilities of countries in capacity-building in the areas of ICT for development. As shown in chart 7, GCC nations benefit from higher level of capabilities in capacity-building in the area of ICT for development relative to two other groups.

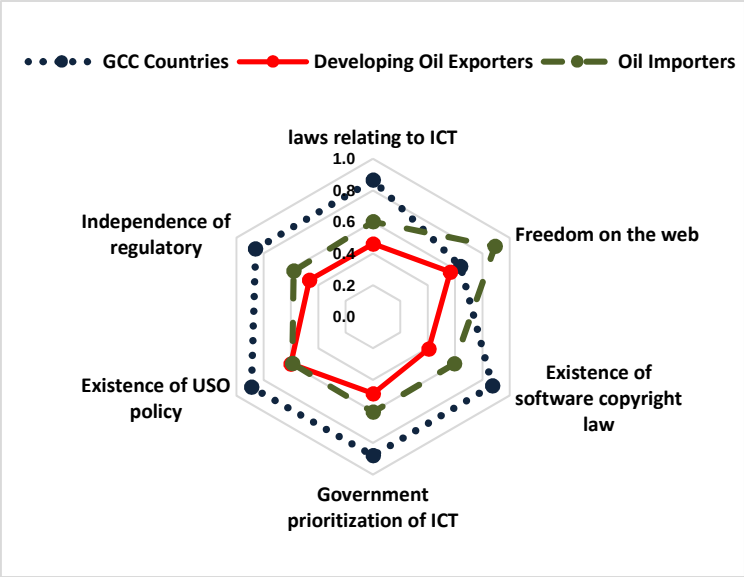


Chart 7. Country groups comparision in terms of RPE indicators

5.2.4 Fund/innovation Entity (FIE)

Fund/innovation sub-pillar includes types of entities of ISED ecosystem frameworks which not only nurture ICT sector human capital but also invest, support, facilitate and accelerate research and development activities of new technologies in ICT sectors.

To get studied countries scores for 8 indicators of this sub-pillar, the same routine has been followed (i.e. aggregation of the normalized values of indicators by applying arithmetic average method for each country). Accordingly, MENA countries scores (Table 31) and their rankings (Chart 8) for fund/innovation entity sub-pillar have shown.

United Arab Emirates and Saudi Arabia are ranked as the top two countries on fund/innovation entity sub-pillar with 0.84 and 0.82 scores. As it is obvious, there is no considerable difference between their scores. However, with rather big difference Qatar holds third position with the score of 0.65. Algeria and Syria are the two lowest-performing countries with 0.29 score. Also Yemen has the second-worst place with 0.33 score on this sub-pillar. The other findings are as follows:

- All the bottom five nations in FIE sub-pillar are among developing oil exporters states;
- Egypt is the best performer among the oil importers nations, (4th place) in FIE sub-pillar.
- Among developing oil Exporters, Iran occupies the highest position (11th place) in FIE sub-pillar.

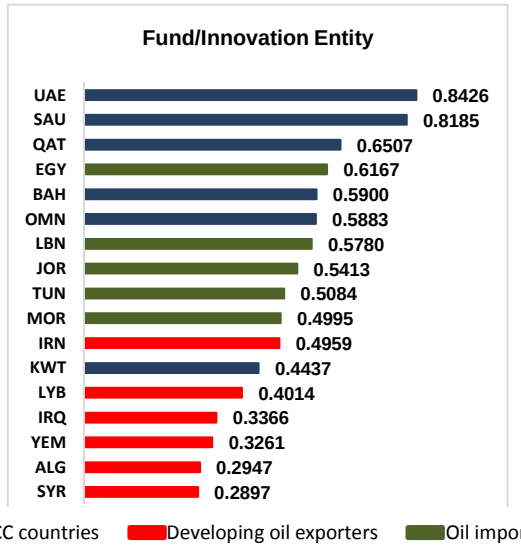


Chart 8. MENA countries rankings by ICT fund / innovation entity (FIE)

The chart 9 shows the main indicators of fund/innovation (FIE) sub-pillar. The GCC countries have focused on more efficient "ICT investments" to improve ICT infrastructures compare with developing oil exporters and oil importer countries. The "ICT investment" indicator comprises computer hardware (computers, storage devices, printers, and other peripherals); computer software (operating systems, programming tools, utilities, applications, and internal software development); computer services (information technology consulting, computer and network systems integration, web hosting, data processing services, and other services); communication services (voice and data communications services) and wired and wireless communications equipment (WITSA 2011). Furthermore, GCC countries benefit from a slightly higher level of "ICT R&D labor force" compare with oil importers and developing oil exporters countries, which result in the greater number of "ICT PCT patents". The GCC nations have focused on providing access to latest ICT technology.

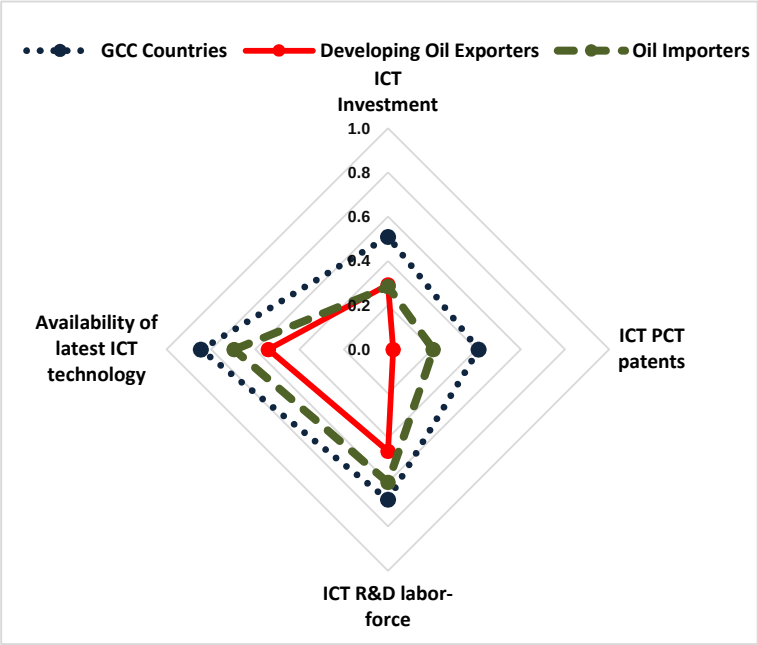


Chart 9. Country groups comparision in terms of FIE indicators

5.3 ICT Entity pillar's Score

The developed ISED ecosystem framework consists two fundamental pillars namely ICT entity (IE) pillar and capital portfolio (CP) pillar. The IE pillar itself encompasses four sub-pillars that were measured in previous section. To construct the IE pillar, the calculated scores of these four sub-pillars are aggregated by applying geometric average method. The geometric aggregation method Implies only partial compensability; it means poor performance in one of these four sub-pillars cannot be fully compensated by good performance in another. In this method, more importance is given to the sub-pillars that are doing not well and it is the main advantage of this aggregation method to arithmetic aggregation method. A key statistical feature with this method is that 1% increase in an indicator leads to the same impact on the aggregated index. So, if a country wants to improve its ICT entity (IE) pillar condition, it should make more efforts on the weakest sub-pillars. As depicted in chart (10), MENA countries ranked respecting to scores of IE pillar.

country	Interacting Entity Index(IEI) Pillar	
	Score	Rank
ALG	0.3064	13
BAH	0.6558	4
EGY	0.4435	11
IRN	0.4726	9
IRQ	0.2732	16
JOR	0.4827	8
KWT	0.5939	6
LBN	0.5184	7
LYB	0.2995	14
MOR	0.4428	12
OMN	0.6010	5
QAT	0.7881	2
SAU	0.6896	3
SYR	0.2745	15
TUN	0.4563	10
UAE	0.8393	1
YEM	0.2249	17

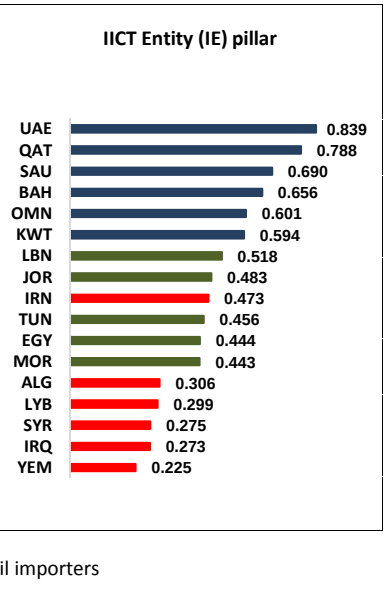


Chart 10. MENA countries rankings by ICT entity (IE) pillar

Six Gulf Cooperation Council (GCC) economies—United Arab Emirates, Qatar, Saudi Arabia, Bahrain, Oman, Kuwait —lead the rankings and hold the top six among 17 MENA countries. The four lowest-performing countries are Libya, Syria, Iraq and Yemen with 0.2995, 0.2745, 0.2732 and 0.2249 scores respectively. These four countries either are suffering from violent conflict or

are in the midst of challenging political transitions as an Arab-spring nation. Among the oil importer nations, Lebanon has the highest (7th place) score in ICT Entity pillar. Also, among developing oil exporters, Iran holds the highest position (9th place) in IE pillar.

The MENA region countries illustrate a large diversity and considerably differences in terms of the sub-pillars of ICT entity pillar. On the one hand, GCC nations have made more efforts to better performance on IE pillar in order to gain higher ICT-based socio-economic development. On the other hand, some nations in the MENA region depict very poor performance on IE pillar of ISED ecosystem framework. However, most of these countries are in unstable political situation preventing them from improving IE's sub-pillars.

The chart (11) shows IE pillar in terms of its 4 sub-pillars for the two best and the two worst countries in IE score. According to this comparison, there are considerable differences between IE sub-pillars' scores of the two-best performing and the two-worst performing countries. United Arab Emirates is leading the IE rankings (among 17 MENA countries, Israel excluded) because of the high performance in its sub-pillars. UAE enjoys an adequately affordable ICT infrastructure sub-pillar (2nd place), that results in a high level of provide/use sub-pillar (1st place). The UAE's regulatory authority has also made significant efforts to obtain a fairly supportive rule-making situation (1st place on the rule/procedure sub-pillar). It could lead to quite high technological capacity in ICT-related fields as evidenced by the absolutely well-performance fund/innovation sub-pillar (1st place).

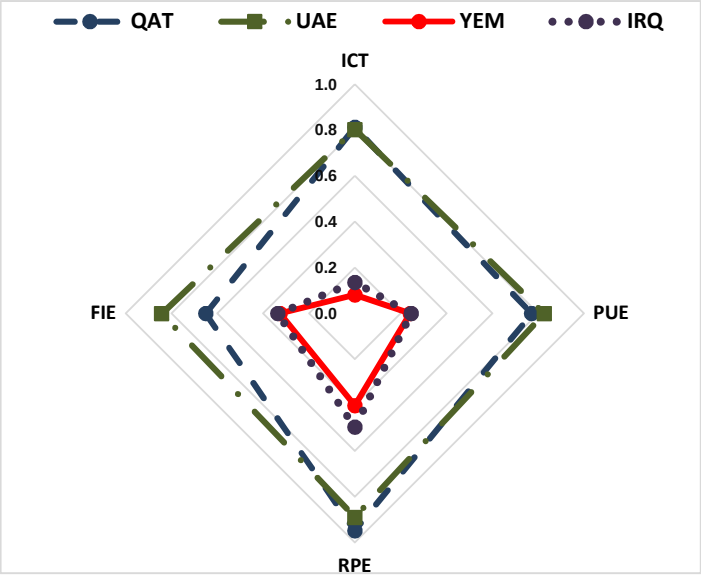


Chart 11. The best and worst countries in terms of sub-pillars of IE

The position of the Qatar as second best nation on IE pillar can be justified by its government's huge efforts to develop supportive ICT regulation (1st place). These efforts result in improving and upgrading ICT infrastructures sub-pillar (1st place).

5.4 Capital Portfolio's Sub-pillars

The second main element of ISED ecosystem framework is the capital portfolio (CP) pillar that has been composed from six sub-pillars namely, national human capital (NHC), national process and structure capital (NPSC), national renewal capital (NRC), national social capital (NSC), national natural resources (NNR) and national financial capital (NFC). So the main aim of this section is to get a sense of the broad picture of the capital portfolio's sub-pillars across MENA countries. To this end, firstly the countries' scores are calculated through aggregating confirmed indicators in each sub-pillar by applying arithmetic average method. Then MENA countries are ranked based of their scores. Then MENA countries are ranked based of their scores. Table 32 demonstrates the average scores and rankings of the 17 studied countries. In the following, each sub-pillar is defined and countries scores and rankings are discussed in greater detail. Moreover, on the basis of World Bank (2013) classification placing MENA countries into three main groups, each group's average scores in some sub-pillars of capital portfolio are compared.

Table 32. Scores of capital portfolio sub-pillars and ranks of MENA countries

country	National Social Capital (NSC)		National Human Capital (NHC)		National Natural Resource (NNR)		National Process&structure Capital (NPSC)		Natural Renewal Capital (NRC)		National Financial Capital (NFC)	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
ALG	0.507	10	0.444	14	0.351	3	0.435	10	0.3039	12	0.057	11
BAH	0.559	6	0.527	6	0.096	8	0.574	6	0.2874	14	0.246	6
EGY	0.448	12	0.566	3	0.043	11	0.420	11	0.5335	2	0.035	14
IRN	0.417	13	0.634	2	0.293	5	0.282	14	0.7079	1	0.077	9
IRQ	0.316	16	0.422	15	0.289	6	0.281	15	0.2619	17	0.071	10
JOR	0.562	5	0.486	12	0.000	14	0.464	9	0.4202	5	0.052	12
KWT	0.555	7	0.532	5	0.347	4	0.651	4	0.3185	11	0.601	2
LBN	0.553	8	0.519	7	0.000	14	0.402	12	0.4027	8	0.103	8
LYB	0.364	15	0.492	11	0.074	9	0.327	13	0.2827	15	0.111	7
MOR	0.620	3	0.507	9	0.000	14	0.507	7	0.5278	4	0.031	15
OMN	0.582	4	0.496	10	0.062	10	0.626	5	0.3504	10	0.251	5
QAT	0.683	2	0.679	1	0.539	2	0.716	3	0.4122	6	1.000	1
SAU	0.472	11	0.482	13	0.667	1	0.797	2	0.4115	7	0.268	4
SYR	0.313	17	0.421	16	0.005	13	0.187	17	0.2875	13	0.022	16
TUN	0.523	9	0.511	8	0.000	14	0.493	8	0.5313	3	0.045	13
UAE	0.759	1	0.561	4	0.245	7	0.837	1	0.3915	9	0.444	3
YEM	0.384	14	0.409	17	0.018	12	0.273	16	0.2821	16	0.016	17

5.4.1 National Human Capital (NHC)

This sub-pillar refers to a countries' capability in labor force, literacy, young people and other competencies that results in realizing and implementing task. As shown in former chapter, in total 10 indicators were finalized to calculate national human capital (NHC). All these selected indicators represent capabilities of a nation in education, experience, knowledge intuition and expertise which can be used in ICT-based socio-economic development.

Chart 12 shows national human capital (NHC) rankings across MENA countries. As can be seen, Qatar is ranked first in the NHC with a score of 0.679 and followed by Iran at the second place with 0.637score. In other words, it indicates that these two countries perform relatively better than other countries on this sub-pillar. Yemen as one of the Arab-spring countries occupies the lowest position, with a score of 0.409 in MENA region. Syria suffering from violent conflict holds the second worst ranking in terms of NHC sub-pillar with a score of 0.421 in the region. The other rankings are listed as follows:

- Saudi Arabia (13th place) is the only member of GCC nations amongst bottom five countries in NHC sub-pillar.
- The only developing oil exporter country among top five is Iran (2nd position).
- Egypt is the only oil importer among the top five nations (3rd place).

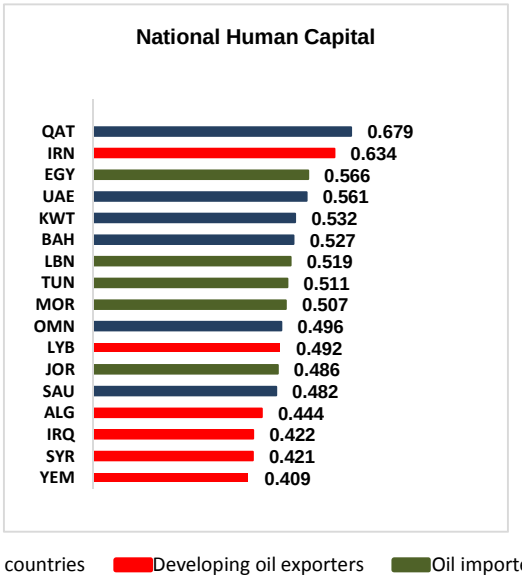


Chart 12. MENA countries rankings by national human capital (NHC)

The chart 13 represents average scores of main indicators of national human capital (NHC) including “health”, “literacy”, “labor force”, and “young people” for three groups of MENA countries.

The “literacy” indicator which can be considered as a proxy reflecting how capable potentially people are to benefit from the opportunities provided by ICT services and ICT products. In other words, the more literacy rate, the more likely people can use ICT services. Oil importers and developing oil exporters, having almost same average scores of “literacy” indicator, are in a better position compared with GCC nations.

The indicators regarding the share of young people and labor force in the total population present national capacities to drive economic development and increase gross domestic product (GDP). Although labor force is regarded as a precious asset for countries, unattractive labor markets and unsafe working conditions such as high unemployment rates, low wages and benefits and poor health and safety standards would increase the risk of brain drain phenomenon and losing skilled labor force because higher paid jobs or better working conditions may exist elsewhere. In this research the “labor force” indicator incorporates five sub-indicators to measure the extent to which a country could benefit from its labor force capacity. As chart 13 indicates, GCC countries surpass oil importer and developing oil exporter countries in terms of both “labor force” and “young people” indicators. Moreover, the GGC countries’ worse literacy rate condition compared with two former groups impedes they could fully benefit from their “labor force” capacity to improve their innovation system. This is supported by the evidence (shown in chart 17) which implies to the lower level of “R&D and innovation system” indicator of GCC countries compared to the other countries

In sum, national human capital as a capacity can play a key role in ICT-based socio-economic development process. Hence, as shown here, the country groups suffering from low level of average scores of human capital’s indicators might have more difficulties to benefit from the ICT for their socio-economic development.

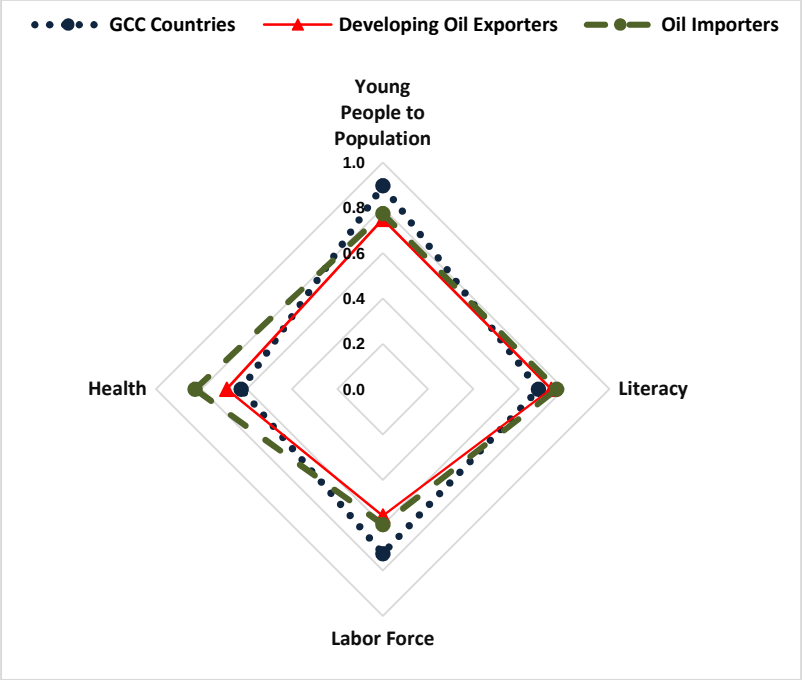


Chart 13. Country groups comparision in terms of NHC indicators

5.4.2 National Process and structure Capital (NPSC)

The national process and structure capital refers to all systems and structures that exploit countries' tangible and intangible assets to create value. So, for instance, the high national human capital would lead to the high national financial capital in a country if it benefits from strong structures and applies efficient processes. From ICT-based socio-economic development perspective, countries' process and structural capital have major effects on how they manage to leverage the ICT for their growth.

To calculate and compare NPSC condition across MENA countries, nine individual indicators have been used. As can be seen in the chart 14, there is a huge difference between the top and the low ranked countries. The United Arab Emirate holds highest ranking on NPSC among selected 17 countries in the MENA region. Saudi Arabia is ranked as the second-best country with a score of 0.797 while Yemen and Syria are the two worst countries with 0.273 and 0.187 scores respectively. Very surprisingly, Iran ranks third-worst country on NPSC while it has second best position on national human capital (chart 12) and the best position on renewal capital (chart 16). The other findings are listed as follows:

- All the top five nations in NPSC sub-pillar are among the GCC countries.
- All developing oil exporter states rank as the bottom five nations in NPSC sub-pillar.
- Morocco holds highest ranking among the oil Importers nations(7th place)
- Among developing oil exporter countries, Algeria occupies the highest position (10th ranking) in NPSC sub-pillar.

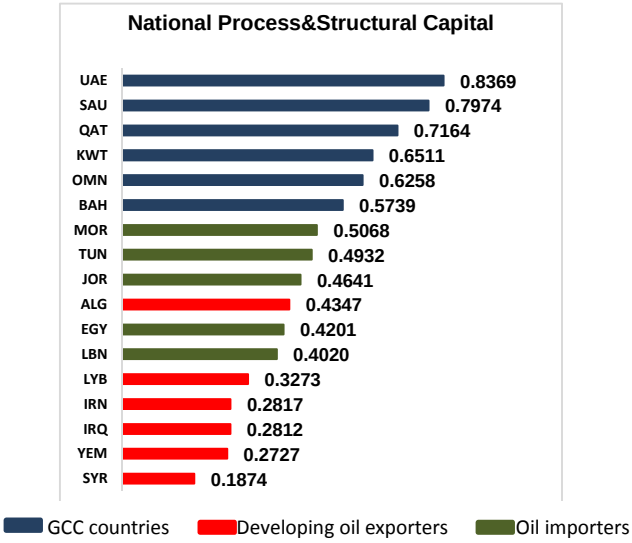


Chart 14. MENA countries rankings by national process&structural capital (NPSC)

Among others, "business structure", "government structure", and "economy structure" as three main indicators of countries' process and structural capital play crucial role to improve their capability to fully leverage the ICT for socio-economic development. In other words, the competent "business", "government" and "economy" structures enable the countries to benefit from their potentials in other sub-pillars of ISED ecosystem framework like human capital, ICT infrastructure entity, renewal capital, and provide/use entity to create value and promote the level of ICT-based socio-economic development.

Accordingly, chart 15 compares the average scores of these three indicators (business, government and economy structures) across three groups of MENA countries. As it can be seen, there is noteworthy difference among GCC, developing oil exporter and oil importer countries. The average scores of GCC countries in these indicators are far higher than both oil importer and developing oil exporters. Moreover, developing oil exporters fallowed by oil importers in all three indicator countries.

A cursory glance at political regimes within the MENA region countries shows that there is a variety of systems in this region such as monarchical, republican regimes, autocratic council/committee based system in which made up of theocratic constitution. Nevertheless, government structures highly centralized across MENA countries and most of the decisions, in several parts especially service delivery decisions, are made by the central government and subnationa authorities role is largely confined to carry out these decisions. Evidence from MENA countries reveals that the governance structure is really a key factor for sustainable development. Most importantly, political stability as one of the sub-indicators of government structure plays a critical role in preparing supportive environment of ICT growth. Besides, there are other main aspects of governance structure like “voice and accountability”, “government effectiveness”, “regulatory quality”, “rule of Law”, “control of corruption” which have considerable effects on ICT-based socio-economic development process.

The “economy structure” indicator refers to the intensity of government regulation on wealth-creating activities, government-controlled factors, government-incentive factors, and several macro-economic factors.

The “Doing Business Index”, used here as the proxy for the “business structure”, implies to how friendly the business environment of countries are in terms of starting new business; obtaining business license and credit, recruiting suitable workers; trade across borders; enforce contracts and protect investments; register property and pay taxes. Guillen et al. (2005) and Lundstrom (2005) argue that countries enjoying a high level of freedom and democracy also have a higher level of economic freedom. According to “Economic Freedom Index” (2006), the economic development process in most Middle Eastern countries suffer from government interventions and imposed regulations on the economy. Intervention here is mostly meant as the process of controlling resources through ownership while regulations are the enforced restrictions on businesses in the private sector through taxation, licensing, and/or bureaucratic corruption. The ICT sector might be affected by these kinds of interventions and regulations in different ways. For instance, the main activities in ICT sector such as telecommunication systems are either fully owned or controlled by governments in MENA region countries. Also free and fair competition is almost impossible for businesses considering the type of licensing applied on them.

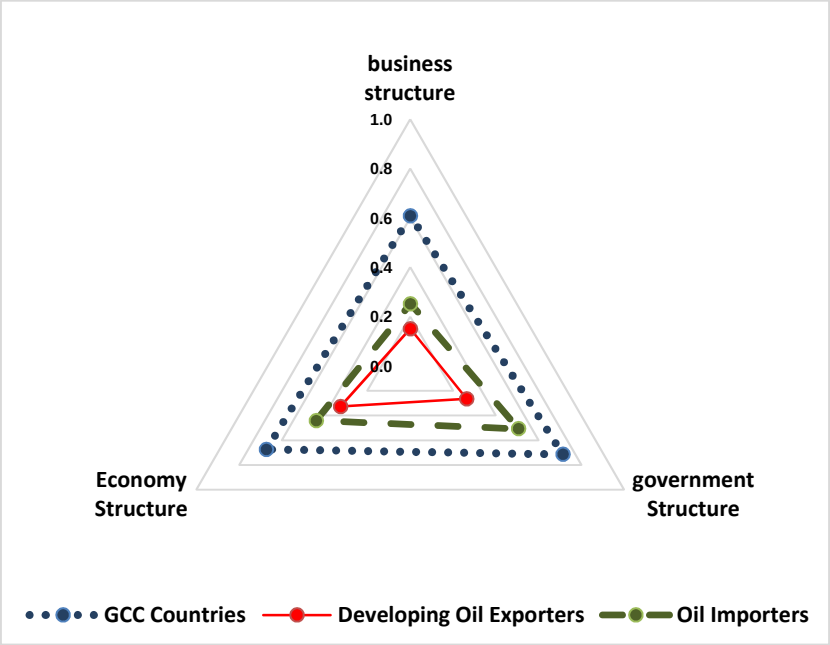


Chart 15. Country groups comparision in terms of NPSC indicators

5.4.3 National Renewal Capital (NRC)

As stated before, the national renewal capital (NRC) as a sub-pillar of capital portfolio of ISED ecosystem framework refers to a country's capabilities and innovative system to make progress. It is consist of 10 indicators on which MENA countries are ranked (Chart 16).

As can be seen, Iran with a score of 0.707 holds the highest and with a sizeable difference Egypt follows. Tunisia and Morocco are in the next places with 0.531 and 0.528 scores respectively. These four countries are relatively more enable than other MENA countries to improve and renew their innovative system to make progress. At the bottom, Iraq suffering from violent conflict is ranked in the lowest position with a score of 0.282. The next worst country in the region is Yemen. The other findings are as follows:

- The top five nations in NRC sub-pillar are a combination of four oil Importers –Egypt (2nd), Tunisia (3rd), Morocco (4th), Jordan (5th) – and one developing oil exporter nation – Iran (1st)
- There are no GCC nations among top five states in NRC sub-pillar.
- Qatar has the highest position (6th) among GCC nations.

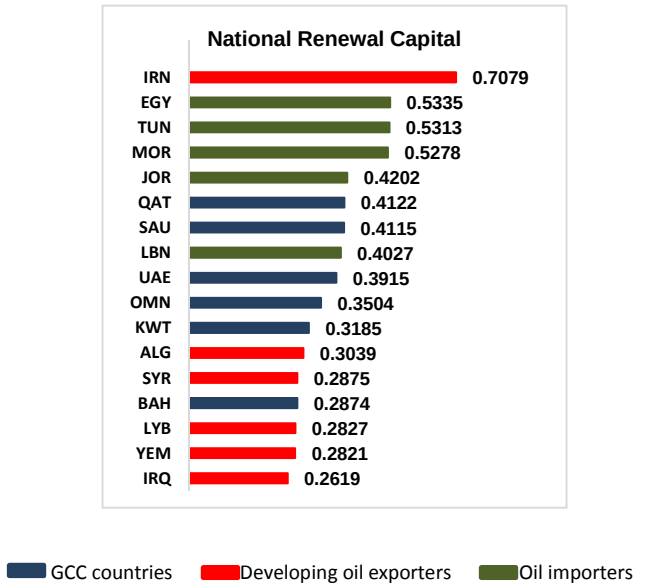


Chart 16. MENA countries rankings by national renewal capital (NRC)

Chart 17 depicts the comparison across MENA countries in terms of average scores of "entrepreneurial attitudes", "entrepreneurial activities" and "R&D and innovation system" as three selected indicators of national renewal capital (NRC) sub-pillar.

Entrepreneurship is one of the most important dynamic forces which shapes and drives the economies of nations in the 21st century. The entrepreneurial attitude refers to how people perceive their skills as regards to entrepreneurship and how they perceive the opportunities in their countries to start a business. In other words, it implies whether individuals find themselves qualified for entrepreneurship and see opportunities in their region for setting up a business. The entrepreneurial activity indicator refers to the average score of six sub-indices including "nascent entrepreneurship rate", "new business ownership rate", "early-stage entrepreneurial activity", "established business ownership rate", "business discontinuation rate", and "necessity-driven entrepreneurial activity". The "R&D and innovation system" indicator is represented by actual investments in research and development, level of innovation, and adoption of innovation.

The "R&D and innovation system" average score for oil importer group of countries is higher than score of GCC countries and that of developing oil exporter group of countries. While the latter two have almost the same average score in "R&D and innovation" indicator. The average score of "entrepreneurial activity" in developing oil exporters is slightly higher than that of oil importers

and the score of GCC countries which both have more or less the same level of entrepreneurial activity. Considering "entrepreneurial attitudes" indicator, all three groups of countries are rather at the same level; however the GCC countries perform better.

As shown in the chart 17, the overall level of MENA countries' capabilities to improve and to renew is unfavorable. This low level of renewal capital, as a growth-impeding weakness, restrains ICT-based development process in MENA countries.

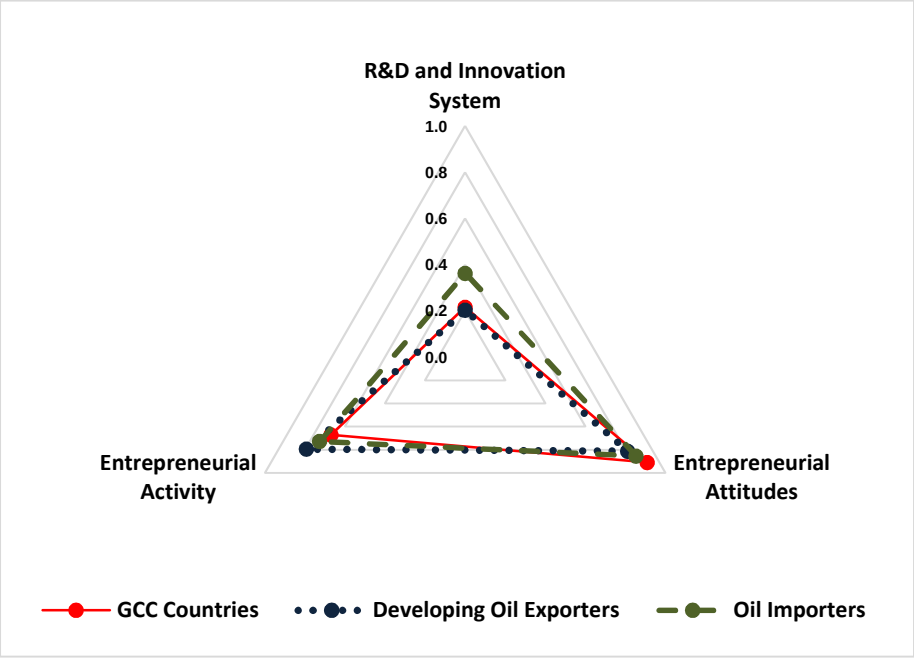


Chart 17. Country groups comparision in terms of NRC indicators

5.4.4 National Social Capital (NSC)

National social capital (NSC)refers to a country's capabilities in political rights, women rights, civil liberties, happiness, and social safety that provide an attractive atmosphere. The NSC sub-pillar is composed of five individual indicators to rank MENA countries (Chart 18).

As illustrated in chart 18, United Arab Emirates has the highest score (0.859) on NSC in the MENA region. Qatar is ranked as the second-best country with a score of 0.783 on NSC sub-pillar. Iraq and Syria are the two lowest countries with 0.416 and 0.413 scores respectively. Both these countries are suffering from violent conflict that has devastated people's life. The other findings are as follows:

- Three out of top five nations in NSC sub-pillar belong to the GCC group of countries – United Arab Emirate (1st), Qatar (2nd), Oman (4th) - and the other two are oil Importer nations – Morocco (3rd), Jordan (5th).
- All the bottom five nations in NSC sub-pillar are among developing oil exporter states.
- Among developing oil exporters, Algeria places the highest position (10th) in NSC

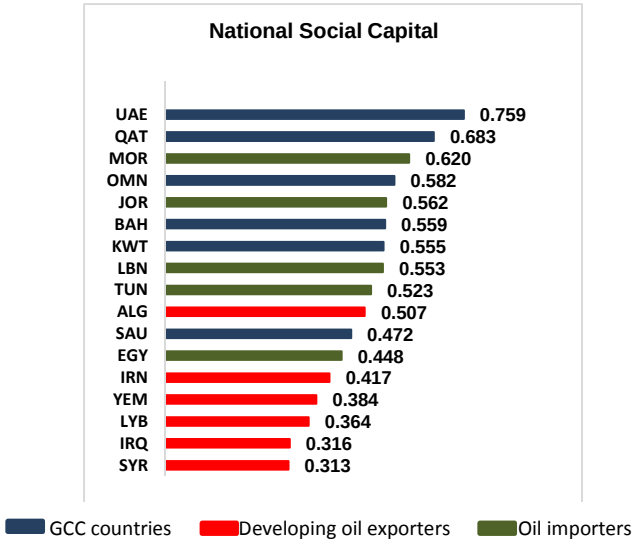


Chart 18. MENA countries rankings by national social capital (NSC)

In following, average scores for a number of national social capital (NSC) indicators, namely "women rights", "social safety", "political rights", "civil liberties" and "happiness" have been compared across MENA countries. (Chart 19)

Generally, there are numerous barriers against the complete awareness of women rights in nearly all MENA countries and women face systematic discriminations both in the laws and in the social customs. The GCC countries are the worst performers in "women rights" indicator and the gap between men and women rights are clearly substantial. In GCC countries, deeply unshakable societal norms, combined with conservative interpretations of Islamic laws, give women lesser position and throw them in a subordinate status. Moreover, progress in "women rights" is impeded by the lack of democratic institutions, independent judiciary, and freedom of association. However the average scores of "social safety", "political rights", and "civil liberties" indicators in oil importers countries are higher than the two other groups, while the Middle East

and North Africa region registered low “civil liberties” scores. The authoritarian regimes in the region have strictly constrained the potential of “civil society” and “political rights” and have restricted expression in the media and communities. The women and men who protested in the Egypt, Bahrain, Libya, Syria, Yemen, Jordan, and Algeria (as Arab Spring nations) were driven by domestic concerns, particularly against the violations of their “political rights”, “civil liberties”, and “women rights” by the domestic regimes, demanding new social contract based on “political rights”, “civil liberties”, and “women rights” and providing structural opportunities to human rights in the MENA region. Moreover, a combination of domestic, regional and international factors influences the violation or protection of human rights in the MENA region.

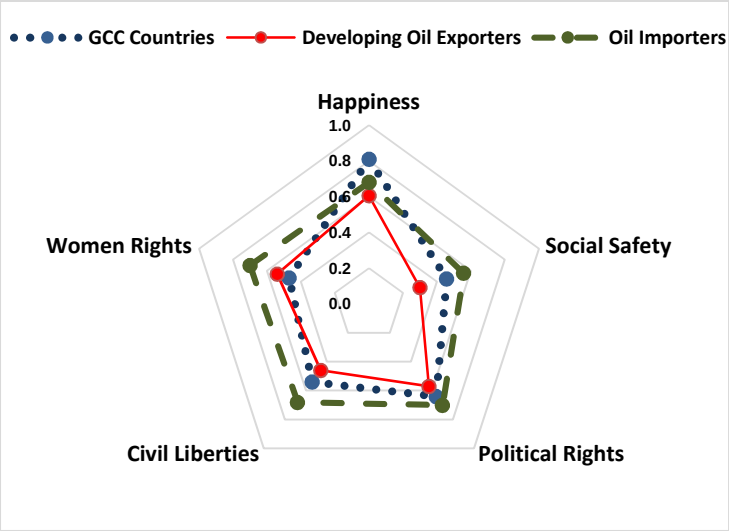


Chart 19. Country groups comparision in terms of NSC indicators

5.4.5 National Natural Resource (NNR)

National natural resources (NNR) refer to a country’s natural wealth and resources which potentially have economic value for the country. The NNR sub-pillar is composed of seven individual indicators which are applied to rank MENA countries (Chart 20).

As shown in the chart 20, Saudi Arabia is ranked the first position with a score of 0.667, followed by Qatar, Algeria, Kuwait and Iran with 0.539, 0.351, 0.342 and 0.293 respectively. It means that these five countries enjoy more natural resources which potentially could lead to considerable

economic gains for these countries. All these five countries are either GCC oil exporters or developing oil exporters. The countries ranked in the lowest positions are Tunisia, Lebanon, Jordon and morocco are totally oil importer. The oil and gas industry are largely ICT-dependent, as ICTs are used in different phases of oil and gas production, from searching for new reserves to refinery and transportation. ICTs provide possibilities for expanding proven crude oil reserves, improve the rate of crude oil extraction from existing wells, and provide additional means to discover new wells (UNCTAD, 2006).

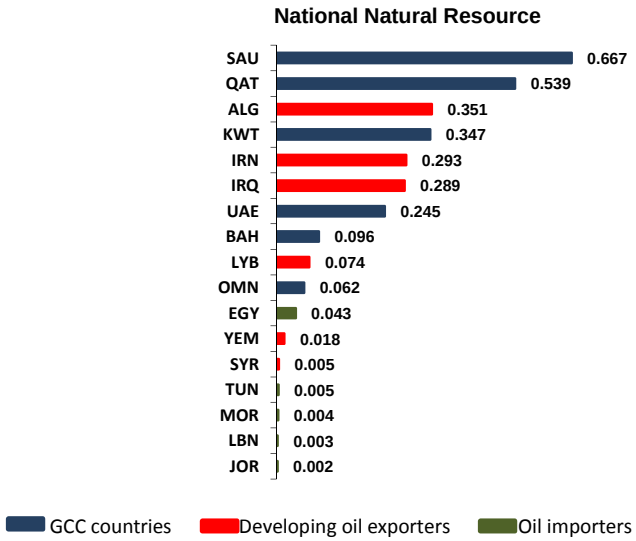


Chart 20. MENA countries rankings by national natural resource (NNR)

5.4.6 National Financial Capital (NFC)

In this study national financial capital (NFC) is primarily defined as financial wealth of a nation as a result of past national economic activities which represented and measured by gross domestic product (GDP) at purchasing power parity (PPP) per capita. This measure takes into account the relative cost of living and the inflation rates of countries, rather than using only exchange rates, which may distort the real differences in income. MENA countries are ranked with respect to their GDP (Chart 21). As shown, the top five countries are Qatar, Kuwait, United Arab Emirates, Saudi Arabia and Oman respectively. Not only these five countries are ranked as the top 5 best countries out of MENA region countries, but also based on other international comparisons like

World Bank (2013), these five countries are ranked among world's top 20 countries on GDP PPP per capita.

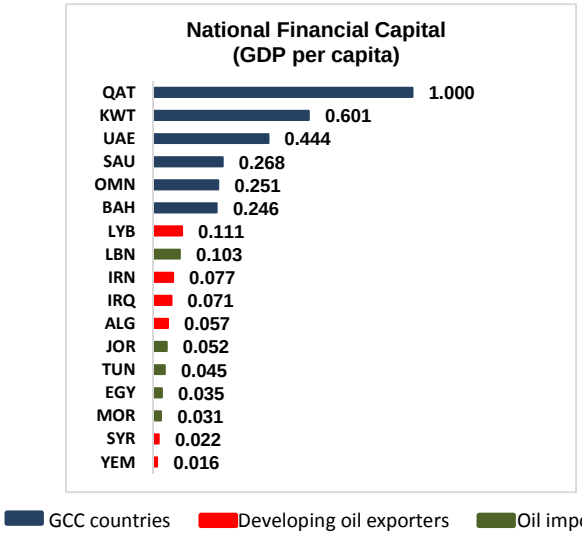


Chart 21. MENA countries rankings by nationa financial capital (NFC)

5.5 Capital Portfolio (CP) pillar's Score

Hitherto, the capital portfolio's sub-pillars have been measured and accordingly MENA countries ranked in the previous section. Here to construct the capital portfolio pillar, the calculated scores of its six sub-pillars are aggregated by applying geometric average method. This method implies only partial compensability which means poor performance in each of these six sub-pillars cannot be fully compensated by good performance in another. Through this method it is tried to give sort of more importance to the sub-pillars that are doing not well and in this regard, it is the main advantage of the geometric method over arithmetic aggregation method. A key statistical feature with this method is that 1% increase in an indicator leads to the same impact on the aggregated index. So, if a country wants to improve its capital portfolio condition, it should make more efforts on the weakest sub-pillars. In capital portfolio pillar we would like that a country makes more efforts on more weak sub-pillars.

Chart 22 depicts capital portfolio pillar's scores and rankings for MENA countries. Here besides 4 Cooperation Council (GCC) economies (Qatar, United Arab Emirates, Saudi Arabia and Kuwait), Iran as a developing oil exporter country is among the top five countries in capital portfolio pillar,

whereas all GCC economies dominate top six countries in the ICT entities pillar. The four lowest-performing countries are Jordan, Morocco, Yemen, and Syria with 0.138, 0.135, 0.131 and 0.106 scores, respectively. All these countries except Morocco have been suffering from ongoing political instability, social unrest, security incidents and geopolitical tensions.

Chart 22 depicts capital portfolio pillar's scores and rankings for MENA countries. Here besides 4 Cooperation Council (GCC) economies (Qatar, United Arab Emirates, Saudi Arabia and Kuwait), Iran as a developing oil exporter country is among the top five countries in capital portfolio pillar, whereas all GCC economies dominate top six countries in the ICT entities pillar. The four lowest-performing countries are Jordan, Morocco, Yemen, and Syria with 0.138, 0.135, 0.131 and 0.106 scores, respectively. All these countries except Morocco have been suffering from ongoing political instability, social unrest, security incidents and geopolitical tensions.

country	Capital Portfolio (CP) Pillar	
	Score	Rank
ALG	0.302	8
BAH	0.333	6
EGY	0.221	11
IRN	0.348	5
IRQ	0.268	9
JOR	0.138	14
KWT	0.496	4
LBN	0.153	12
LYB	0.241	10
MOR	0.135	15
OMN	0.324	7
QAT	0.659	1
SAU	0.500	3
SYR	0.106	17
TUN	0.141	13
UAE	0.504	2
YEM	0.131	16

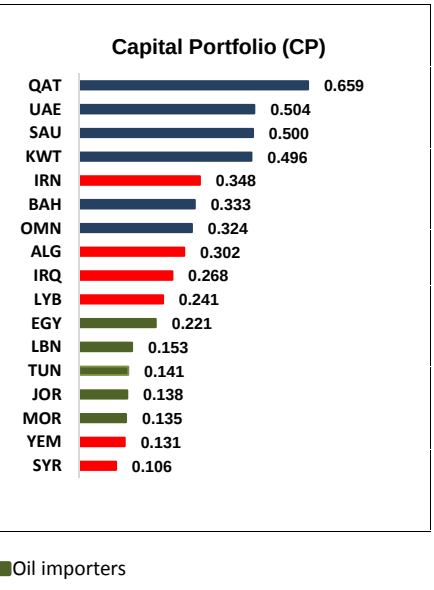


Chart 22.MENA countries rankings by Capital Portfolio (CP) pillar

Considering the sub-pillars of capital portfolio (CP), alike ICT entity (IE) pillar, there are huge diverse and remarkable differences across MENA region countries. On the one hand, GCC nations have made lots of efforts to improve their structures and infrastructures especially process and structural capital towards ICT-based socio-economic development. On the other hand, we see some nations in the MENA region which seriously suffer from very poor situation in several sub-

pillars of capital portfolio of ISED ecosystem framework. Chart 23 depicts a comparison between the two best (Qatar and United Arab Emirates) and the two worst countries (Yemen and Syria) in terms of their scores in capital portfolio sub-pillars. As it can be seen, there are sizeable differences across four countries especially in social capital, process & structural capital, and human capital sub-pillars.

Qatar is leading the capital portfolio rankings among 17 MENA countries because of its high performance in all sub-pillars of capital portfolio except for national renewal capital (6th place). Qatar enjoys an adequately supportive process and structural capital (3rd place), considerable human capital (1st place) and social capital (2nd place). These scores coupled with absolutely rich oil and gas resources results in a strong financial capital (1st place). The Qatar's regulatory authority has also made significant efforts to obtain a fairly supportive rule-making situation (1st place on the rule/procedure sub-pillar) that lead to in quite high technological capacity in ICT-related fields as evidenced by the absolutely well-performance ICT infrastructure sub-pillar (1st place).

Absolutely efficient process and structural capital (1st place) and strong social capital (1st place) account for the second best position of United Arab Emirates (UAE) among MENA countries in capital portfolio pillar of ISED ecosystem framework. Although UAE doesn't enjoy from huge national resources (7th place) in compare with other MENA countries, strong supportive process & structural capital with fairly rich national human capital (4th) strengthened the UAE economy and result in high national financial capital (3rd). Relatively poor national renewal capital in Qatar (6th) and UAE (9th) leads to weak national innovation system in these two nations.

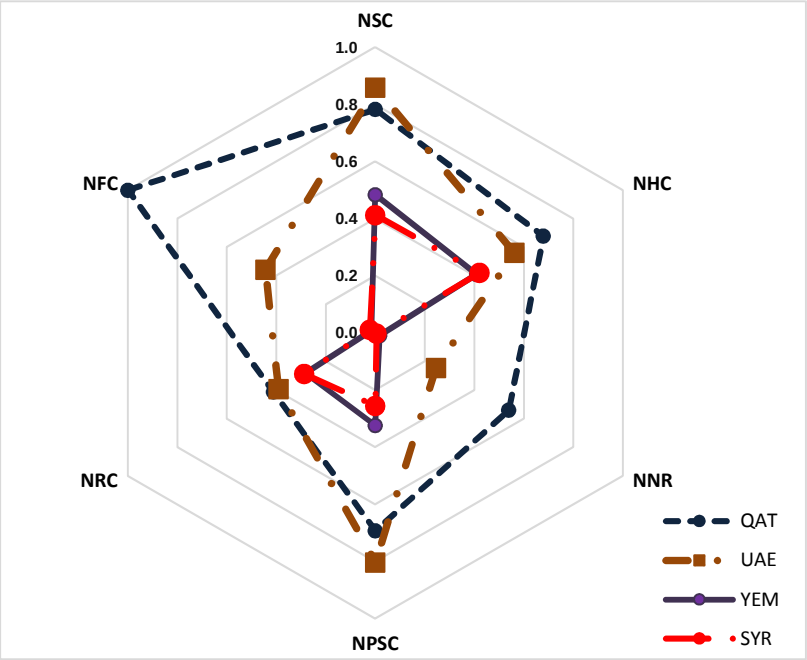


Chart 23.The best and worst Countries in terms of sub-pillars of CP

5.6 ICT-based socio-economic development (ISED) composite index

Since the ICT-based socio-economic development concept is influenced by many interrelated factors. So to estimate this multi-dimensional concept on the basis of presented ISED ecosystem framework, a composite indicator is suggested by compiling the pillars and sub-pillars of ISED ecosystem framework into a single index labeled ICT-based socio-economic development (ISED) Index. Such aggregate statistic summarizes more than sixty individual indicators into few dimensions to interpret them more easily. The ISED composite index would be regarded as a country's relative regional ranking. So, the resultant ranking from ISED composite index acts as a signal or alarm that indicates whether the position of a nation is suitable or not, relative to other nations in that region. This composite index attempts to highlight main weaknesses that impede MENA countries to fully leverage their ICT potential to obtain proper level of ICT-based socio-economic development. As already explained, ISED ecosystem framework comprises two main pillars. The capital portfolio (CP) pillar consist of six sub-pillars reflects the social, economic,

cultural and political circumstances of a nation and ICT entity (IE) pillar via its four sub-pillars refers to ICT development state in a nation. Furthermore, the reciprocal interactions within and between these two pillars might lead to achieve ICT-based socio-economic development impacts. Here, the development impacts have been defined as the outcomes of ISED ecosystem framework. Testing the cause and effect relationships among all elements of ISED ecosystem framework and providing an accurate estimate of outcomes of this framework require to run an econometric model that is not in the scope of this research.

Nevertheless, interactions among sub-pillars of ISED ecosystem framework are complex and are influenced with many internal and external factors, the ISED composite index aimed at revealing these relationships with the adoption of the proposed ISED ecosystem framework. Therefore, the ISED composite index can unveil how different countries in MENA region are reaping benefits from various level of ICT-based socio-economic development. The analysis of ISED index would shed light on intra-regional differences and heterogeneities across MENA region countries.

As depicted in chart 24, the Gulf Cooperation Council (GCC) countries show better outcomes in terms of ISED composite index compared to other groups of countries.

country	ISED composite Index	
	Scores	Rank
ALG	0.304	11
BAH	0.494	5
EGY	0.332	9
IRN	0.410	7
IRQ	0.271	14
JOR	0.310	10
KWT	0.545	4
LBN	0.335	8
LYB	0.270	15
MOR	0.289	13
OMN	0.463	6
QAT	0.723	1
SAU	0.595	3
SYR	0.190	16
TUN	0.299	12
UAE	0.672	2
YEM	0.178	17

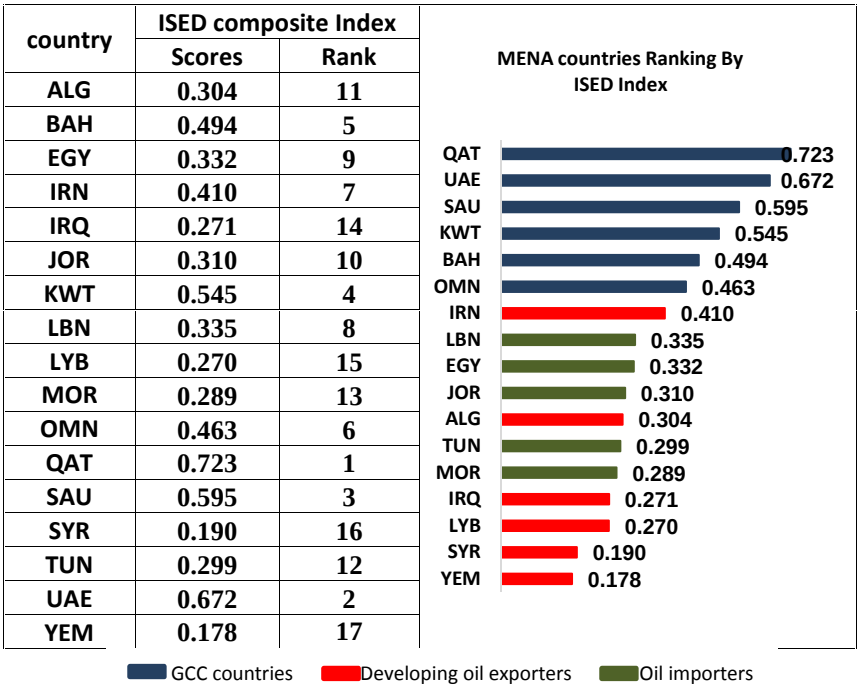


Chart 24. MENA countries rankings by the ISED composite index

Qatar holds the highest position based on the ISED composite index. Benefiting from rich human capital (1st place), favorable social capital (2nd place) in addition to the government's efforts to create an effective ICT regulation authority (1st place) to expand the ICT infrastructures (1st place), all have brought this position for Qatar in the ISED index ranking. However, this country needs to take some actions to improve the level of renewal capital (6th place) and process & structural capital (3rd place) to strengthen its national innovation system. A well-functioning national innovation system could result in higher level of ICT fund/innovation sub-pillar (3rd). Moreover, the gainful national natural resources (2st place) and consequently high level of financial capital (1st place), provide suitable condition for obtaining significant positive ICT-based socio-economic development outcomes.

The United Arab Emirates, as the second top country in term of ISED index among 17 MENA countries without large natural resource reserves (7th place) regarding other GCC nations, has gained a proper level of national financial capital (3rd place) by improving the efficiency of its process and structural capital (1st place). Moreover, government investments in ICT infrastructures (2nd place) in addition to the proper ICT rule/procedure entities (2nd place) and availability of latest ICT technologies (2nd place) have prepared the desirable conditions for business-to-business internet use (2nd place), business-to-consumer internet use (1st place) and use of online public services by citizens (2nd place). However, improving the renewal capital (9th place) and enriching national human capital (4th place) particularly at tertiary level should become a priority for this country if it intends to move towards a less resource-dependent and more knowledge-intensive economy.

Saudi Arabia, holding 3rd place on ISED index, possesses the most gainful natural resources (1st place) among selected MENA countries. Despite low social capital score (11th place) and poor human capital score (13th place) as well as unfavorable renewal capital score (7th place), this country benefits from high level of process & structural capital (2nd place) and telecom investment (1st place) that might result in fairly level of ICT infrastructure entity (5th place) and ICT provide/use entity (5th place). All these provide suitable condition for leveraging ICT and obtaining positive ICT-based socio-economic development outcomes. However, this level of ISED outcome doesn't necessarily contribute to the transition toward a less resource-dependent

economy, because of the level of human capital (13th place) and renewal capital (7th) in this nation.

5.7 The correlation Analysis

Here the main aim of the correlation analysis is to shed light on the relationships that exist between capital portfolio pillar –reflecting the social, economic, cultural, and political circumstances of a nation- and ICT entity pillar –reflecting the level of ICT development of a nation (as two main pillars of ISED composite index). So, chart 25 depicts the relationships between the scores in the capital portfolio (CP) pillar and the ICT interacting entity (IE) pillar showings of ISED composite index.

As it is shown in the chart 25, a positive and linear association exists between the scores of two pillars i.e. the higher capital portfolio of a country is, the higher ICT entity is. The correlation analysis suggests that a threshold in social, economic, cultural, and political circumstances may also exist for a country to start benefiting from the ICT development impacts. It means that a minimum set of circumstances are needed in order to obtain ICT-based socio-economic development outcomes.

Correlations

		NCP	IEI
NCP	Spearman's rho Correlation	1	.755**
	Sig. (2-tailed)		.000
	N	17	17
IEI	Spearman's rho Correlation	.755**	1
	Sig. (2-tailed)	.000	
	N	17	17

**. Correlation is significant at the 0.01 level (2-tailed).

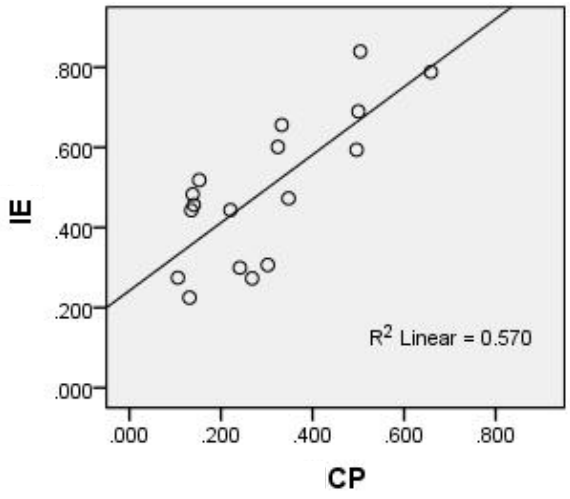


Chart 25. Correlation between CP and IE pillars

To explore the relations among sub-pillars of ISED ecosystem framework the Spearman coefficient correlation have been applied. Accordingly Spearman correlation coefficients for 10 sub-pillars of ISED ecosystem framework with confidence interval of 95% and 99% (2-tailed) have been computed (Table 33). Commonly used procedure, based on the Pearson's correlation coefficient, for making inferences about the correlation coefficient the implicit assumption is that the two variables are normally distributed. When this assumption is not justified or the relationship between two variables is non-linear, a non-parametric measure such as the Spearman correlation coefficient might be more appropriate.

As the table 33 indicates, there are positive, high and significant correlations among all sub-pillars of ISED ecosystem framework at 0.05 or 0.01 level (2-tailed) except for “national renewal capital” and “national natural resource”. There are very strong correlations among “process & structural capital”, “ICT infrastructure entity”, “provide/use entity”, and “rule/procedure entity”. In fact this high correlation largely supports defined role for “process & structural capital”. In other words, in presented ISED ecosytem framework, “process & structural capital” is considered as a key factor to enhance the nation’s capability using the other sub-pillars of capital portfolio to create value. Moreover, the correlations among “renewal capital”, “social capital”, and “human capital” are considerable.

The weakest correlation is between “natural resource” and the other sub-pillars of ISED ecosystem framework (except national financial capital). It means that subjects with higher values of “national natural resources” don’t tend necessirly to have higher values of other sub-pillars of ISED ecosystem framework.

By tracing the countries’ positions in various sub-pillars of ISED ecosytem framework, the aforementioned findings would become more clear. For instance a country like Iran despite the best position in “renewal capital”, second position in ‘human capital”, and fifth position in “national natural resource” among MENA countries, stands in the lower half of the rankings in sub-pillars of ICT entity of ISED ecosystem framework because of its poor position in “process & structural capital”. Totally, the laggers in terms of the level of “process & structure capital” are the worst in terms of sub-pillars of “ICT entity” pillar. On the other hand, the leaders in terms of

the level of “process & structure capital” are the best in terms of sub-pillars of “ICT interacting entity” pillar.

According to table 33, the “rule/procedure entity” is highly correlated with “ICT infrastructure entity” and “provide/use entities”, 0.809 and 0.767 respectively. Also, “process & structural capital” is highly correlated with “ICT infrastructure entity” and “provide/use entities”, 0.814 and 0.880 respectively. These results corresponded with defined role for “rule/procedure entity” and “process & structural capital” in ISED ecosystem framework. It means that subjects with higher values of “rule/procedure entity” and “process & structural capital” tend to have higher values of “ICT infrastructure entity” and “provide/use entity”. In other words, considering “rule/procedure entity” and “process & structural capital” conditions allow policy makers and decion makers to predict the situation of “ICT infrastructure entity” and “provide/use entity” with considerably greater accuracy.

Also, “rule /procedure entity” and “process & structural capital” are highly correlated with “social capital” (0.770, 0.784). It means that subjects with higher values of “rule/procedure entity” and “process & structural capital” tend to have higher values of “social capital”. In other words, knowing “rule/procedure entity” and “process & structural capital” allow countries to predict the situation of “social capital” with considerably greater accuracy than if they didn’t know them.

Natural resources and financial capital are correlated (0.658). This correlation was predictable especially in MENA region with highly natural resource based economies.

Based on proposed ISED ecosystem framework (figure 15), we defined nurture and supportive role for “fund/innovation entity” to facilitate “ICT infrastructure entity” and “provide/use entity” improvement. The correlation between “fund/innovation entity” and these two sub-pillars (0.750, 0.811) support this role for “fund/innovation entity” in proposed ISED ecosystem framework.

As discussed above, the correlation analyses contribute to clarify the interactions among various sub-pillars of ISED ecosystem framework that eventually these interactions lead to ICT-based socio-economic development, however still remains a long way to fully explore their cause and effects interactions.

Table 33. Spearman coefficient correlation

	NSC	NHC	NNR	NPSC	NRC	NFC	ICT	PUE	RPE	FIE
NSC	1.000									
NHC	.527*	1.000								
NNR	-.011	.192	1.000							
NPSC	.784**	.463	.358	1.000						
NRC	.365	.605*	-.168	.272	1.000					
NFC	.485*	.512*	.658**	.708**	-.032	1.000				
ICT	.743**	.691**	.344	.814**	.353	.797**	1.000			
PUE	.767**	.667**	.317	.880**	.316	.770**	.941**	1.000		
RPE	.770**	.537*	.236	.860**	.392	.650**	.809**	.767**	1.000	
FIE	.652**	.615**	.153	.779**	.475	.561*	.750**	.811**	.816**	1.000

Correlation is significant at the 0.05 level (2-tailed).*

Correlation is significant at the 0.01 level (2-tailed). **

5.8 ISED Gap in MENA region

So far, the ISED ecosystem framework, its main pillars and sub-pillars and comparative analysis across MENA region countries on the basis of their scores on aforementioned pillars and sub-pillars have been discussed in detail. In this section as the final part of the quantitative chapter, it is attempted to provide a broad and summary picture on ISED scores and positions of the countries and consequently the ISED gap across the MENA region.

The analysis of sup-pillars' scores of ISED ecosystem framework shows that there is a significant variation across the MENA region countries. Although it is difficult to create relatively homogeneous country groups in MENA region in terms of the level of their sub-pillars of ISED ecosystem framework, Chart 26 depicts the Gulf Cooperation Council (GCC) economies' scores of the 10 sub-pillars of ISED ecosystem framework compared to the other countries. While all the GCC economies are leading in the rankings, the rest of MENA countries are lagging behind. In this regard, the GCC economies are much stronger than other MENA countries and there is a significant gap within the MENA region countries.

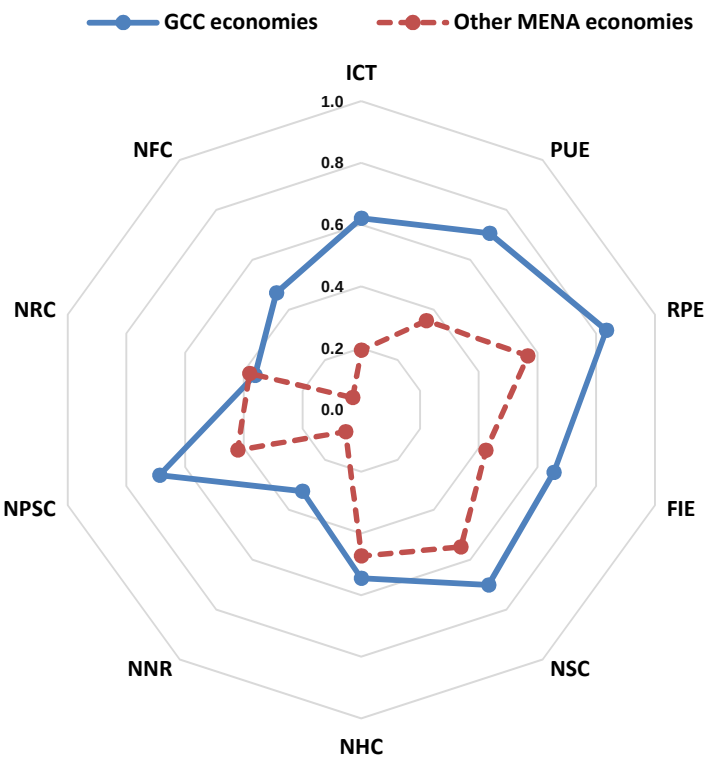


Chart 26. The ISED gap in MENA region

Accordingly, a number of key findings can be highlighted:

- The gap between GCC economies and the rest of MENA countries is reflected in nine sub-pillars of ISED ecosystem framework.
- Regarding access to affordable ICT infrastructures with a high quality, there is a huge gap between GCC nations and the rest of countries. Actually, GCC countries depict fairly well-developed "ICT infrastructures" sub-pillar, whereas other nations should start to strengthen the quality and variety of affordable "ICT infrastructure" sub-pillar.
- Among sub-pillars of ISED composite index, the gap in the "ICT provide/use" sub-pillar is one of the biggest gaps. Indeed, the "ICT Provide/use" sub-pillar indicates how different interest groups in demand-side and supply-side of ISED ecosystem framework benefit from ICT sector. The effective use of ICTs to enhance innovation and competitiveness greatly depends not only on developing ICT infrastructures but also on creating the right ICT regulation condition. So there are strong association between the level of

"rule/procedure" and "provide/use" sub-pillars. This association justifies the gap on the "rule/procedure" sub-pillar.

- The gap in terms of "national process and structural capital" sub-pillar depicts that GCC countries enjoy from a better situation of business, government, and economy structures, in compare with the rest of MENA nations. It means that GCC economies could potentially create more values from theirs tangible and intangible assets. This assertion could be confirmed regarding the gap between GCC countries and the others on the "national financial capital" sub-pillar.
- Most countries depict an undesirable level of national renewal capital (NRC). It means that all MENA countries should improve and boost their entrepreneurial activities, entrepreneurial attitudes, and their national innovation system.

To sum up, I try to classify the MENA countries based on both their capital portfolio (CP) scores and their ICT entity (IE) score compared with the MENA average scores. In fact, the position of each country is then determined according to whether it locates above or below the MENA region CP average and the IE average score. As depicted in chart 27, each country's position reflects its situation in relation to pillars of ISED ecosystem framework. Each country's position also indicates whether it is catching up or lagging behind the MENA countries' trend of leveraging ICT-based socio-economic development. The relative position of the countries to the MENA average scores paves the road for a classification. Based on this classification, four country groups can be identified:

Group 1: those countries whose both IE and CP scores are above average. Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates belong to this group.

Group 2: those countries whose CP scores are above average, but the IE scores are below average. Iran is the only country belongs to this group.

Group 3: those countries whose IE scores are above average, but CP scores are below average. Lebanon belongs to this group.

Group 4: those countries whose both IE and CP scores are below average. Tunisia, Jordan, Egypt, Morocco, Algeria, Libya, Iraq, Yemen, and Syria belong to this group.

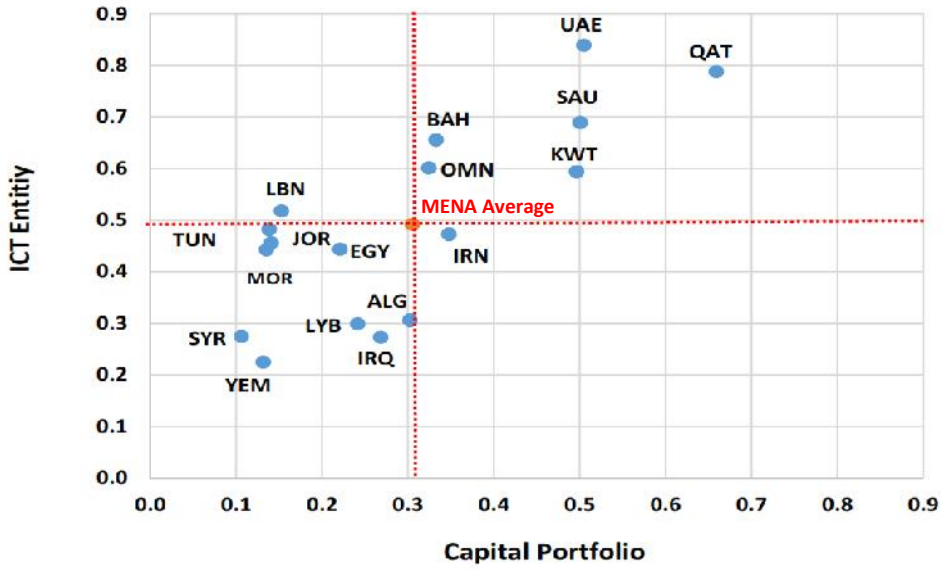


Chart 27. MENA countries' CP and IE average scores

In what fallows, the main findings based on this classification are addressed:

All the Gulf Cooperation Council (GCC) economies belong to group 1. It means the government in these economies have recognized the importance of investing in ICTs as a way to enhance socio-economic development. So these nations attempt to develop ICT entities of ISED ecosystem framework by taking advantages of the proper level of their capital portfolio.

All countries which belong to group 4, either are suffering from violent conflicts that have influenced all components of capital portfolio (such as Syria, Iraq, Libya), with spillovers to neighboring countries such as Jordan or are Aras-spring countries like Tunisia, Egypt, and Yemen which are in the midst of challenging political transitions that have worsened the component of capital portfolio. As a result of lower level of capital portfolio, the level of ICT interacting entities of ISED ecosystem would be dropped. Consequently, the lower level of pillars of ISED ecosystem lead to the lower level of ICT-based socio economic development as the outcome of ISED ecosystem framework.

However, CP score of Iran as the only country which belongs to group2, is greater than some countries in group 1, the score of ICT entity in Iran is lower than average level. Several different

reasons may explain this pattern for Iran. It would be because of the considerable weakness in the “process and structural capital” and “social capital” conditions that hampered Iran’s potential to enhance the level of ICT entity of ISED ecosystem framework. Furthermore, it would be because of some external factors like strong economic sanctions against Iran. These sanctions have targeted investments in oil, gas, petrochemicals, and exports of refined petroleum products as the main source of Iran’s financial capital. These sanctions also include web-hosting services for commercial endeavors, and domain name registration services. The consequence of the strong and positive correlation between capital portfolio pillar and ICT ientity pillar (as the main elements of ISED ecosystem framework) causes lower level of ICT-based socio-economic development (as the outcome of ISED ecosystem framework) in this country compare with GCC economies.

The only country in group 3 is the Lebanon. However, this nation is particularly lagging behind two-third of selected MENA countries on CP pillar, it’s IE pillar is slightly above average. It would be because of the fairly level of RPE sub-pillar (specially government prioritization of ICT).

Chapter 6

Conclusion

6 Conclusion

In this research project through developing an ISED ecosystem framework, ICT contribution to socio-economic development across selected MENA countries was investigated in great detail. In other words, an ISED ecosystem framework has been developed to determine all the contextual factors and ICT entities that cause ICT-based socio-economic development. Then to test the interrelations among the main elements of proposed ISED ecosystem framework, a comparative analysis across 17 MENA countries was carried out. The empirical findings show that there are positive and linear associations between the scores of two pillars of ISED ecosystem framework. It means that the higher capital portfolio (CP) of a country is, the higher ICT entity (IE) is.

The correlation analysis between CP and IE suggests that a threshold in social, economic, cultural and political circumstances may also exist for a country to start benefiting the ICT development impacts. It means that a minimum set of circumstances are needed in order to obtain ICT-based socio-economic development outcomes. The correlation analysis among 10 sub-pillars of ISED ecosystem framework sheds light on intertwined interactions among various sub-pillars of this framework that lead to ICT-based socio-economic development.

The main conlusions regarding qualitative and quantitative parts have been summarized as the following points:

- Conducting grounded theory research method helped us to determine main ICT Players, dimensions of interactions, and contextual factors of ISED ecosystem framework.
- The consequences of the interactions within and between the 10 sub-pillars of this ecosystem framework, can be converted into ICT-based socio-economic development impacts as the outcome of ISED ecosystem framework.
- The outcome of ISED ecosystem framework divided into three advancing impacts including: 1) political freedom and transparency guarantees, 2) social opportunities and protective security, 3) economic facilities and one disturbing impact contains criminal/illegal used of ICT & cultural changes.
- The elaborated ISED ecosystem framework unveils that however, ICTs have the potential to transform socio-economic conditions, the technological aspects of ICT alone are not enough to allow ICTs to show their fully potential. The capital portfolio of pertinent

context that reflects the status quo of a nation plays a significant role to allow ICTs to appear their full potential.

- Improvement of capital portfolio and raise more demands for ICT services/product are dependent upon each other.
- MENA countries suffer from undesirable process and structural capital and also weaknesses on social capital and human capital that impede their capacity to fully leverage the ICT growth that causes lower innovation and competitiveness potential.
- The serious weaknesses on renewal capital that refer to the ability of a nation to improve its national innovation system hinder the overall potential of this region to leverage ICT interacting entities to improve the level of ICT-based socio-economic development throughout the MENA region.
- The severe weaknesses in some components of capital portfolio like “human capital” and “renewal capital” of ISED ecosystem framework lead to highlighting the rise of the new digital divide that is the gap between nations which are attaining progressive social, economic, cultural, and political impacts related to the ICTs use and those that are not.
- Since there are significant differences on various sub-pillars of ISED ecosystem framework across MENA countries, it is necessary to maximize the positive impacts of ICT entities all through the MENA region and create synergies and positive spillover effects.
- Although some significant exceptions exist, the MENA region suffer from a relative poor ICT interacting entities, which are not affordable to access.
- The quantitative results show that GCC economies have made notably attempts to develop all sub-pillars of ICT interacting entities such as the ICT infrastructure entity especially mobile broadband infrastructure that has resulted in new electronic services.
- There are a huge intra-regional gap in MENA region on various sub-pillars of ISED ecosystem framework.
- The correlation analysis reveals strong positive relationship among “national human capital” and “national renewal capital”. It means subjects with higher level of national human capital in a nation tends to has higher level of national renewal capital.

- There is a strong correlation between “human capital” sub-pillar including literacy indicator and “Provide/Use” entity sub-pillar (0.668). The usage of ICT tools and services requires users to have access as well as the capability to learn and acquire a certain level of skills in order to use them effectively. People who possess this knowledge (the educated populace) will be able to use, create and disseminate information.
- The results of quantitative analysis displays that enjoying the higher level of renewal capital and human capital without paying attention to process and structural capital could not necessarily lead to higher level ICT-based socio-economic development.
- There are high positive correlations among “process & structural capital”, “financial capital” and 4 sub-pillars of ICT entities. It means that “process & structural capital” could play a crucial role to improve an economy’s capabilities to create value from ICT development.
- This study also indicates that there is a positive linear correlation between “provide/use entity” sub-pillar (including “mobile broadband penetration” and “social network visitors” sub-indicators) with “social capital” sub-pillar (including “civil liberties”, “political rights’, and “women rights” sub-indicators). It means that citizens subject with increased number of Internet users and social network users, tend to have higher level of civil liberties.
- Considering the interrelations among 10 sub-pillars of ISED ecosystem framework, a new composite index has been constructed in this research work labeled “ICT-based socio-economic development”. Constructing such composite index which is comprised of sub-pillars of ICT interacting entities and capital portfolio could likely reflect more accurate picture about the level of ICT-based socio-economic throughout MENA countries.

The results of quantitative phase not only shed light on the weaknesses and strengths of MENA region regarding proposed ISED ecosystem framework’s pillars and sub-pillars, but also could have some policy implications such as drawing ***ICT-related industrial policies*** and initiatives for less developed countries in this region.

In the following lines some specific ICT-related industrial policies have been suggested for MENA region countries that largely based on this research theoretical and empirical results.

As discussed in theoretical background chapter, ICT is regarded as a key factor in achieving dynamic and competitive knowledge-based economy. So, a strong ICT sector may support the development of a knowledge-based economy. Consequently an advanced knowledge-based economy will benefit from the ICT sector and in return it stimulates demand and innovation of ICT product/services. In this regard, the proposed ICT-related industrial policies would provide a platform to improve competitiveness and growth in ICT sector to facilitate achieving knowledge-based economy in MENA region. From an ICT4D expert's point of view one may argue that there are other findings or theories which may lead to other ICT-related industrial policies. This argument is fairly true. In generating these industrial policies the main elements of ISED ecosystem framework have been taken into account. The suggested industrial policies involve particularly two areas namely, "policies for ICT entity innovation" and "policies for capital portfolio's adaptability". Policies for ICT entity innovation are targeted towards both ICT supply-side and demand-side and capital portfolio adaptability policies are targeted towards improving the contextual factors adaptability. The suggested industrial policies are:

- ***Provide sectorial incentives in ICT research, development, and innovation (hereafter R&D&I) activities in ICT small and medium size enterprises (SMEs), universities and ICT research institute;***

Due to low incentives in R&D&I activities, the ICT SMEs and universities usually underinvest in service/product innovation which lead to lose their competitiveness in long run. So, these incentives could be financial or legal as well as direct or indirect. For instance direct subsidies to costs of technical facilities to conduct ICT R&D&I, marketing activities such as participation in trade exhibition. Indirect incentives may include tax reduction, public consulting services, resource sharing in public-private partnerships.

- ***Support to create "ICT standard setting institutions" and "ICT legal institutions";***

The lack of suitable standard setting and neutral legal institutions in MENA countries, impede ICT sector development. These institutions not only create a favorable environment for e-business but also, help to improve ICT and e-business practices' adaption in SMEs and large enterprises.

- ***ICT infrastructure enhancement;***

Establishing essential infrastructure to provide affordable and ubiquitous access to advanced telecom services, is vital to benefit from ICT. Moreover, Infrastructure policy related to ICT and e-business may also include the provision of ICT incubators and ICT technology parks and the provision of ICT and e-business-related information.

- ***Develop an independent ICT regulatory authority;***

The ICT regulatory authority is a public authority that is independent from arms of the government, exert autonomous authority over ICT sector activities. The regulator main activities consist definition of obligatory ICT standards or public support of standards developed by industry, public certification of electronic goods and processes, ICT professional codes, definition of entry rules to ICT markets, price interventions in the ICT market, tariffs or non-tariff barriers in foreign trade of ICT goods. Regulation policy may also include deregulation of industries such as telecommunications and the reduction of administrative burdens to e-business.

- ***Support to enhance ICT and e-business skills (e-skills);***

The optimization of ICT-based systems requires ICT user skills, e-business management skills, and ICT practitioner skills.

- ***Reengineering and improvement of government, business and economy structure;***

The process & structural capital which include all business, economy and government structures plays a crucial role to improve an economy's capabilities to reach ICT-based development which may help it to create value from non-renewable natural resource. So, if GCC countries and developing oil exporters' nations in MENA region want to diversify their economies that make them less dependent on international energy prices, they should change their strategy toward achieving a strong ICT sector. Such changes entail improvement and reengineering of business, government, and economy processes and structures.

- ***Improve cooperative ICTD activities;***

Due to the huge intra-regional ISED gap across MENA region, there is a critical need for ICT-related policies and initiatives on both national and regional levels to increase cooperation and to share best practices of MENA countries in ICT sector to close intra-regional gap.

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Appendix

Appendix 1. Interview protocol

Appendix2. Two-round Delphi questionnaire

Appendix 3.Three-round Delphi questionnaire

Appendix 4. Countries profile

8 Appendix

Appendix 1

Elements of ICT-based socio-economic development (ISED) ecosystem framework

Interview Protocol

Regarding the concept and feature of ICT-based socio-economic ecosystem framework which is explained by researcher in focus group discussion meeting, please answer to the following questions:

- How do you interpret the relationship between socio-economic development and ICT development?
- In your opinion, what is the overall conditions of ICT-based socio-economic development in developing countries?
- What are the key players/entities which are interacting in an ISED ecosystem framework?
- What positions could be identified for interacting entities with similar functions?
- What kind of interactions do you define among various entities of ISED ecosystem framework?
- In your opinion, how are entities' positions and interactions' dimensions corresponded?
- What are contextual factors which play key roles in determining particular ICT-based socio-economic development path?
- Are these contextual factors corresponded with capital portfolio of choice framework and sustainable livelihood framework?
- What bearing do capital portfolio of pertinent context have on the interacting entities of ISED ecosystem framework?
- What dimensions do you suggest for ICT-based socio-economic development?
- Regarding concept of Sen's capability approach how do you define dimensions of ICT-based socio-economic development?
- What is your interpretation about political and social aspect of ICT-based socio-economic development?
- What is your interpretation about cultural transform is derived from ICT development?
- What interrelations are there among different elements of ISED ecosystem framework?

Appendix 2

Dimensions of ICT-based socio-economic development

Title of Dimensions	Relevance of Dimensions			
	Unimportant	Slightly important	Important	Very important
Participation in the political process	☐	☐	☐	☐
Opportunities for education	☐	☐	☐	☐
Opportunities for healthcare	☐	☐	☐	☐
Self-fulfillment	☐	☐	☐	☐
New business opportunities	☐	☐	☐	☐
Effective management of current business	☐	☐	☐	☐
Changes in social behavior	☐	☐	☐	☐
Westernization	☐	☐	☐	☐
Addiction of ICT use	☐	☐	☐	☐
Pornography	☐	☐	☐	☐
Personal security	☐	☐	☐	☐
criminal use	☐	☐	☐	☐
staying in touch with family	☐	☐	☐	☐
develop new friendship	☐	☐	☐	☐
sustainable development	☐	☐	☐	☐
economic productivity	☐	☐	☐	☐
poverty alleviation and empowerment	☐	☐	☐	☐
democracy	☐	☐	☐	☐

Template used to analyze the questionnaires

Title of Dimensions	Groups of Dimensions		
	Unchanged or Modified	Deleted	Added
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐

Appendix 3

Template used for questionnaires in first and second rounds of Delphi method

Indicator's code	**Indicator's title**			
Category*	☐ **Unchanged**	☐ **Modified**	☐ **Doubtful**	☐**Added**
Measurement	☐**Numerical**	☐**Percentage**	☐**Nominal**	☐**Ordinal**
Type of data source	☐**Survey**		☐**Public data set**	
Time references	☐**The most recent data**		☐**n years' average**	

Indicator characteristics	**Unimportant**	**Slightly important**	**Important**	**Very important**
Relevance: importance of indicator for measurement of related pillar of ISED ecosystem framework	☐	☐	☐	☐
Validity: ability of the indicator to measure what really has to be measured	☐	☐	☐	☐
Reliability: a measure of the absence of random error associated with the indicator	☐	☐	☐	☐
Comparability: possibility of making adequate comparisons between different nations	☐	☐	☐	☐

Note: the item fallowed by (*) will be filled for second round questionnaires on the basis of first round results.

Template used for questionnaire in third round of Delphi method

Indicator's code	**Indicator's title**						
Category*	☐ **Unchanged**		☐ **Modified**		☐ **Doubtful**		☐**Added**
Selection criteria	**1****	**2**	**3**	**4**	**5**	**6**	**7*****
Importance: a measure to identify relative significance of each indicators							
Feasibility: expected facility of obtaining the information							

Note: the item fallowed by (*) will be filled for third round questionnaire on the basis of second round results.
The scale fallowed by (**) means the least important or the least feasible
The scale fallowed by (***) means the most important or the most feasible

Appendix 4

Countries Profile

Algeria

ISEDI	**ICT-based socio-economic development Index**	**11**
IE	**Pillar1: ICT Entities**	**13**
CP	**Pillar 2: Capital Portfolio**	**8**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**14**
IIE1	Fixed telephone subscribtions per 100 inhabitants	15
IIE2	households with computer	12
IIE3	Mobile Cellular subscriptions per 100 inhabitants	11
IIE4	Percentage of households with internet access	16
IIE5	secure internet servers/ million pop	15
IIE6	international Internet bandwidth	9
IIE7	price basket for residential fixed line	15
IIE8	price basket for mobile cellular	12
IIE9	cost of fixed broadband	10
IIE10	cost of mobile-broadband	12
	Sub-pillar 1.2: Provide/Use Entity	**13**
PUE1	percentage of individuals using the internet	15
PUE2	mobile broadband subscriptions per 100 inhabitants	17
PUE3	fixed broadband subscriptions per 100 inhabitants	9
PUE4	business-to-consumer internet use	17
PUE5	use of online public services by citizens	12
PUE6	business-to-business internet use	16
PUE7	facebook penetration rate	14
PUE8	ICT Service Export (% of total service export)	1
PUE9	ICT good import (% of total good import)	8
	Sub-pillar 1.3: Rule/Procedure Entity	**16**
RPE1	laws relating to ICT	14
RPE2	Freedom on the web	12
RPE3	Existence of software copyright law	17
RPE4	Government prioritization of ICT	14
RPE5	Existence of USO policy	16
RPE6	Independence of regulatory	15
	Sub-pillar 1.4: Fund/Innovation Entity	**16**
FIE1	ICT Expenditure As % of GDP	14
FIE2	Telecom Investment	13
FIE3	Level of e-participation development	14
FIE4	Availability of latest ICT technology	16
FIE5	ICT PCT patents, applications/million pop.	14
FIE6	ICT R&D labor force	10
FIE7	Intencity of competition among ICT interprise	17
FIE8	Existance of new organization model	17
	Sub-pillar 2.1: National Human Capital	**14**
HC2	Share of Young People to population	9
HC4	Public expenditure on education	2
HC5	Adult Literacy Rate	15
HC7	Labor force participation rate, total (% ages 15-64)	14
HC8	Employment to population ratio,+15,total(%)	14
HC9	Labor force, Female(% of total labor force)	11
HC10	Science and Engineering Enrolment Ratio (%)	15
HC11	Brain Drain	16
HC12	Life Expectency	14
HC13	Health Expenditure % of GDP	7

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**10**
PSC1	Doing B business index	15
PSC2	Governance Indicators	12
PSC3	Economic Freedom Index	13
PSC4	Inflation Rate (%)	7
PSC5	GINI index	12
PSC7	Current Account Balance	8
PSC8	Economic growth	9
PSC9	Capital goods gross imports(US$ mil)	4
PSC10	E-government index	14
	Sub-pillar 2.3: National Renewal Capital	**12**
RC1	Researchers	11
RC2	R&D expenditure	12
RC3	scientific & technical journal articles	5
RC4	Patents	6
RC5	Venture capital	15
RC6	S&T parks and Incubators	15
RC7	High Techs exports	14
RC8	Technology absorption	16
RC9	Capital goods export	7
RC10	Entrepreneurial Attitudes	7
RC11	Entrepreneurial Activity	**3**
	Sub-pillar 2.4: National Social Capital	**10**
SC1	Perception of Happiness	6
SC4	Crime	12
SC6	Political Rights*	6
SC7	Civil liberties*	5
SC8	Women Rights	2
	Sub-pillar 2.5: National Natural Resource	**3**
NNR1	Total freshwater withdrawal	7
NNR2	Crude Oil Production	7
NNR3	Crude Oil exports	7
NNR4	Natural gas marketed production	4
NNR5	Natural gas exports	2
NNR6	Exports of petroleum products	6
NNR7	Value of petroleum exports	8
NNR8	Output of Petroleum Products	7
	Sub-pillar 2.1: National Financial Capital	**11**
NFC1	GDP at PPP per capita	11

Algeria is an authoritarian regime. The head of state is the president. A constitutional amendment passed by the Parliament in 2008 removed the two five-year terms limitation. The President is the head of the army, the Council of Ministers and the High Security Council. He appoints the Prime Minister who is also the head of government. Sunni Islam is the predominant religion. The Algerian government passed new laws in 2012 that revised regulations on political parties, associations, the media, access to information, and electoral list quotas for female candidates. The new laws on associations and the media, in particular, were criticized for continuing to restrict the activities of civil society, freedom of the press, and access to information.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Bahrain

ISEDI	**ICT-based socio-economic development Index**	**5**

IE	**Pillar1: ICT Entities**	**4**
CP	**Pillar 2: Capital Portfolio**	**6**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
Sub-pillar 1.1: ICT Infrastructure Entity		**4**
IIE1	Fixed telephone subscribtions per 100 inhabitants	3
IIE2	households with computer	1
IIE3	Mobile Cellular subscriptions per 100 inhabitants	5
IIE4	Percentage of households with internet access	2
IIE5	secure internet servers/ million pop	4
IIE6	international Internet bandwidth	6
IIE7	price basket for residential fixed line	4
IIE8	price basket for mobile cellular	6
IIE9	cost of fixed broadband	5
IIE10	cost of mobile-broadband	3
Sub-pillar 1.2: Provide/Use Entity		**4**
PUE1	percentage of individuals using the internet	1
PUE2	mobile broadband subscriptions per 100 inhabitants	6
PUE3	fixed broadband subscriptions per 100 inhabitants	1
PUE4	business-to-consumer internet use	10
PUE5	use of online public services by citizens	1
PUE6	business-to-business internet use	4
PUE7	facebook penetration rate	7
PUE8	ICT Service Export (% of total service export)	16
PUE9	ICT good import (% of total good import)	12
Sub-pillar 1.3: Rule/Procedure Entity		**5**
RPE1	laws relating to ICT	4
RPE2	Freedom on the web	13
RPE3	Existence of software copyright law	4
RPE4	Government prioritization of ICT	3
RPE5	Existence of USO policy	5
RPE6	Independence of regulatory	4
Sub-pillar 1.4: Fund/Innovation Entity		**5**
FIE1	ICT Expenditure As % of GDP	7
FIE2	Telecom Investment	14
FIE3	Level of e-participation development	3
FIE4	Availability of latest ICT technology	1
FIE5	ICT PCT patents, applications/million pop.	9
FIE6	ICT R&D labor force	8
FIE7	Intencity of competition among ICT interprise	4
FIE8	Existance of new organization model	4
Sub-pillar 2.1: National Human Capital		**6**
HC2	Share of Young People to population (%)	3
HC3	Number of Tertiary Teachers	12
HC5	Adult Literacy Rate	3
HC7	Labor force participation rate, total (% ages 15-64)	3
HC8	Employment to population ratio,+15,total(%)	4
HC9	Labor force, Female(% of total labor force)	8
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	14
HC12	Sum of Olampyc Medals*	1
HC13	Brain Drain	4
HC14	Life Expectency	5
HC15	Health Expenditure % of GDP	10
HC16	Physisians per 1000 people	10
HC17	Nurses and midwievs	7

Code	Individual indicators	Rank
Sub-pillar 2.2: National Process & Structural Capital		**6**
PSC1	Doing B business index	4
PSC2	Governance Indicators	5
PSC3	Economic Freedom Index	1
PSC4	Inflation Rate (%)	6
PSC5	GINI index	5
PSC7	Current Account Balance	7
PSC8	Economic growth	8
PSC9	Capital goods gross imports(US$ mil)	15
PSC10	E-government index	2
Sub-pillar 2.3: National Renewal Capital		**14**
RC1	Researchers	14
RC2	R&D expenditure	14
RC3	scientific & technical journal articles	15
RC4	Patents	14
RC5	Venture capital	4
RC6	S&T parks and Incubators	12
RC7	High Techs exports	12
RC8	Technology absorption	7
RC9	Capital goods export	11
RC10	Entrepreneurial Attitudes	8
RC11	Entrepreneurial Activity	15
Sub-pillar 2.4: National Social Capital		**6**
SC1	Perception of Happiness	8
SC4	Crime	4
SC6	Political Rights**	6
SC7	Civil liberties**	6
SC8	Women Rights	9
Sub-pillar 2.5: National Natural Resource		**8**
NNR1	Total freshwater withdrawal	16
NNR2	Crude Oil Production	12
NNR3	Crude Oil exports	-
NNR4	Natural gas marketed production	10
NNR5	Natural gas exports	-
NNR6	Exports of petroleum products	7
NNR7	Value of petroleum exports	-
NNR8	Output of Petroleum Products	-
Sub-pillar 2.6: National Financial Capital		**6**
NFC1	GDP at PPP per capita	6

Bahrain is a constitutional hereditary monarchy. Its leadership consists of a Prime Minister as head of government and a King as head of state. In 1999, a National Charter was instituted which allows for freedom of assembly whereby political parties and organizations are allowed to operate and organize activities. Formal political parties, however, are considered illegal. The government owns all broadcast media; therefore, while there is limited freedom of expression in broadcast media, there is a greater degree of freedom of the press in the print media. Internet access and emails are generally unrestricted, although there have been reports of government monitoring of email communication.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Egypt

ISEDI	**ICT-based socio-economic development Index**	**9**
IE	**Pillar1: ICT Entities**	**11**
CP	**Pillar 2: Capital Portfolio**	**11**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**12**
IIE1	Fixed telephone subscribtions per 100 inhabitants	12
IIE2	households with computer	11
IIE3	Mobile Cellular subscriptions per 100 inhabitants	10
IIE4	Percentage of households with internet access	11
IIE5	secure internet servers/ million pop	11
IIE6	international Internet bandwidth	11
IIE7	price basket for residential fixed line	13
IIE8	price basket for mobile cellular	10
IIE9	cost of fixed broadband	9
IIE10	cost of mobile-broadband	9
	Sub-pillar 1.2: Provide/Use Entity	**10**
PUE1	percentage of individuals using the internet	10
PUE2	mobile broadband subscriptions per 100 inhabitants	7
PUE3	fixed broadband subscriptions per 100 inhabitants	11
PUE4	business-to-consumer internet use	7
PUE5	use of online public services by citizens	6
PUE6	business-to-business internet use	11
PUE7	facebook penetration rate	13
PUE8	ICT Service Export (% of total service export)	12
PUE9	ICT good import (% of total good import)	11
	Sub-pillar 1.3: Rule/Procedure Entity	**11**
RPE1	laws relating to ICT	7
RPE2	Freedom on the web	7
RPE3	Existence of software copyright law	10
RPE4	Government prioritization of ICT	11
RPE5	Existence of USO policy	14
RPE6	Independence of regulatory	8
	Sub-pillar 1.4: Fund/Innovation Entity	**4**
FIE1	ICT Expenditure As % of GDP	4
FIE2	Telecom Investment	3
FIE3	Level of e-participation development	2
FIE4	Availability of latest ICT technology	11
FIE5	ICT PCT patents, applications/million pop.	6
FIE6	ICT R&D labor force	3
FIE7	Intencity of competition among ICT interprise	15
FIE8	Existance of new organization model	7
	Sub-pillar 2.1: National Human Capital	**3**
HC2	Share of Young People to population (%)	13
HC3	Number of Tertiary Teachers	7
HC5	Adult Literacy Rate	14
HC7	Labor force participation rate, total (% ages 15-64)	8
HC8	Employment to population ratio,+15,total(%)	9
HC9	Labor force, Female(% of total labor force)	5
HC10	Total nobel prizes*	4
HC11	Science and Engineering Enrolment Ratio (%)	10
HC12	Sum of Olampyc Medals*	8
HC13	Brain Drain	13
HC14	Life Expectency	13
HC15	Health Expenditure % of GDP	8
HC16	Physisians per 1000 people	3
HC17	Nurses and midwievs	8

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**11**
PSC1	Doing B business index	10
PSC2	Governance Indicators	11
PSC3	Economic Freedom Index	12
PSC4	Inflation Rate (%)	14
PSC5	GINI index	14
PSC7	Current Account Balance	15
PSC8	Economic growth	12
PSC9	Capital goods gross imports(US$ mil)	3
PSC10	E-government index	11
	Sub-pillar 2.3: National Renewal Capital	**2**
RC1	Researchers	2
RC2	R&D expenditure	5
RC3	scientific & technical journal articles	2
RC4	Patents	2
RC5	Venture capital	9
RC6	S&T parks and Incubators	9
RC7	High Techs exports	9
RC8	Technology absorption	9
RC9	Capital goods export	3
RC10	Entrepreneurial Attitudes	4
RC11	Entrepreneurial Activity	7
	Sub-pillar 2.4: National Social Capital	**12**
SC1	Perception of Happiness	14
SC4	Crime	14
SC6	Political Rights**	6
SC7	Civil liberties**	5
SC8	Women Rights	5
	Sub-pillar 2.5: National Natural Resource	**11**
NNR1	Total freshwater withdrawal	2
NNR2	Crude Oil Production	10
NNR3	Crude Oil exports	11
NNR4	Natural gas marketed production	5
NNR5	Natural gas exports	6
NNR6	Exports of petroleum products	9
NNR7	Value of petroleum exports	-
NNR8	Output of Petroleum Products	5
	Sub-pillar 2.6: National Financial Capital	**11**
NFC1	GDP at PPP per capita	11

Egypt's political status declined from Partly Free to Not Free due to the overthrow of elected president Mohamed Morsi in July 2013, and the increased role of the military in the political process. Islam is the state religion, and most Egyptians are Sunni Muslims. Censorship, both official and self-imposed, is widespread. Freedoms of assembly and association are restricted, but protests have been a key forum for political expression since the 2011 uprising. The 2013 draft constitution represents a modest improvement in women's rights, as it clearly affirms the equality of the sexes. The extent to which this results in practical improvements for women is not yet clear

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Iran

ISEDI	**ICT-based socio-economic development Index**	**7**
IE	**Pillar1: ICT Entities**	**9**
CP	**Pillar 2: Capital Portfolio**	**5**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**8**
IIE1	Fixed telephone subscribtions per 100 inhabitants	1
IIE2	households with computer	10
IIE3	Mobile Cellular subscriptions per 100 inhabitants	13
IIE4	Percentage of households with internet access	12
IIE5	secure internet servers/ million pop	13
IIE6	international Internet bandwidth	13
IIE7	price basket for residential fixed line	1
IIE8	price basket for mobile cellular	7
IIE9	cost of fixed broadband	12
IIE10	cost of mobile-broadband	14
	Sub-pillar 1.2: Provide/Use Entity	**11**
PUE1	percentage of individuals using the internet	9
PUE2	mobile broadband subscriptions per 100 inhabitants	13
PUE3	fixed broadband subscriptions per 100 inhabitants	8
PUE4	business-to-consumer internet use	11
PUE5	use of online public services by citizens	8
PUE6	business-to-business internet use	13
PUE7	facebook penetration rate	8
PUE8	ICT Service Export (% of total service export)	11
PUE9	ICT good import (% of total good import)	4
	Sub-pillar 1.3: Rule/Procedure Entity	**10**
RPE1	laws relating to ICT	9
RPE2	Freedom on the web	16
RPE3	Existence of software copyright law	11
RPE4	Government prioritization of ICT	8
RPE5	Existence of USO policy	6
RPE6	Independence of regulatory	9
	Sub-pillar 1.4: Fund/Innovation Entity	**11**
FIE1	ICT Expenditure As % of GDP	9
FIE2	Telecom Investment	2
FIE3	Level of e-participation development	9
FIE4	Availability of latest ICT technology	12
FIE5	ICT PCT patents, applications/million pop.	15
FIE6	ICT R&D labor force	16
FIE7	Intencity of competition among ICT interprise	12
FIE8	Existance of new organization model	10
	Sub-pillar 2.1: National Human Capital	**2**
HC2	Share of Young People to population (%)	6
HC3	Number of Tertiary Teachers	1
HC5	Adult Literacy Rate	10
HC7	Labor force participation rate, total (% ages 15-64)	13
HC8	Employment to population ratio,+15,total(%)	15
HC9	Labor force, Female(% of total labor force)	9
HC10	Total nobel prizes*	1
HC11	Science and Engineering Enrolment Ratio (%)	1
HC12	Sum of Olampyc Medals*	24
HC13	Brain Drain	12
HC14	Life Expectency	11
HC15	Health Expenditure % of GDP	4
HC16	Physisians per 1000 people	14
HC17	Nurses and midwievs	14

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**14**
PSC1	Doing B business index	14
PSC2	Governance Indicators	13
PSC3	Economic Freedom Index	14
PSC4	Inflation Rate (%)	17
PSC5	GINI index	11
PSC7	Current Account Balance	4
PSC8	Economic growth	16
PSC9	Capital goods gross imports(US$ mil)	17
PSC10	E-government index	9
	Sub-pillar 2.3: National Renewal Capital	**1**
RC1	Researchers	**1**
RC2	R&D expenditure	**2**
RC3	scientific & technical journal articles	1
RC4	Patents	3
RC5	Venture capital	17
RC6	S&T parks and Incubators	1
RC7	High Techs exports	3
RC8	Technology absorption	14
RC9	Capital goods export	13
RC10	Entrepreneurial Attitudes	5
RC11	Entrepreneurial Activity	**1**
	Sub-pillar 2.4: National Social Capital	**13**
SC1	Perception of Happiness	12
SC4	Crime	8
SC6	Political Rights**	6
SC7	Civil liberties**	6
SC8	Women Rights	14
	Sub-pillar 2.5: National Natural Resource	**5**
NNR1	Total freshwater withdrawal	1
NNR2	Crude Oil Production	2
NNR3	Crude Oil exports	4
NNR4	Natural gas marketed production	2
NNR5	Natural gas exports	5
NNR6	Exports of petroleum products	5
NNR7	Value of petroleum exports	5
NNR8	Output of Petroleum Products	2
	Sub-pillar 2.6: National Financial Capital	**9**
NFC1	GDP at PPP per capita	9

Iran is a Theocratic Republic consisting of several interconnected governing bodies, with an Islamic Sharia Law constitution. The chief of state is the Supreme Leader, who is appointed for life by the Assembly of Experts. The Supreme Leader has the final word in all major political, cultural, religious, judiciary, foreign policy and economic decisions. Since 1987, Iran has seen a steady rise of political activism through an increase in the number of political parties and activist groups; however, the country still does not have a free press. The government represses both individual and organized freedom of speech by directly controlling television and radio broadcasting. It has issued gag orders on media coverage of specified events or topics and has successfully blocked broadcasts. The government censors websites by filtering Internet content, based on the assumption that uncensored content contains information of social immorality and defamatory statements about Iran's religious and/or political leadership.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Iraq

ISEDI	**ICT-based socio-economic development Index**	**14**

IE	**Pillar1: ICT Entities**	**16**
CP	**Pillar 2: Capital Portfolio**	**9**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**16**
IIE1	Fixed telephone subscribtions per 100 inhabitants	9
IIE2	households with computer	16
IIE3	Mobile Cellular subscriptions per 100 inhabitants	17
IIE4	Percentage of households with internet access	15
IIE5	secure internet servers/ million pop	14
IIE6	international Internet bandwidth	14
IIE7	price basket for residential fixed line	7
IIE8	price basket for mobile cellular	14
IIE9	cost of fixed broadband	16
IIE10	cost of mobile-broadband	15
	Sub-pillar 1.2: Provide/Use Entity	**14**
PUE1	percentage of individuals using the internet	17
PUE2	mobile broadband subscriptions per 100 inhabitants	14
PUE3	fixed broadband subscriptions per 100 inhabitants	13
PUE4	business-to-consumer internet use	12
PUE5	use of online public services by citizens	15
PUE6	business-to-business internet use	14
PUE7	facebook penetration rate	15
PUE8	ICT Service Export (% of total service export)	8
PUE9	ICT good import (% of total good import)	13
	Sub-pillar 1.3: Rule/Procedure Entity	**13**
RPE1	laws relating to ICT	12
RPE2	Freedom on the web	14
RPE3	Existence of software copyright law	14
RPE4	Government prioritization of ICT	12
RPE5	Existence of USO policy	11
RPE6	Independence of regulatory	13
	Sub-pillar 1.4: Fund/Innovation Entity	**14**
FIE1	ICT Expenditure As % of GDP	16
FIE2	Telecom Investment	16
FIE3	Level of e-participation development	12
FIE4	Availability of latest ICT technology	14
FIE5	ICT PCT patents, applications/million pop.	13
FIE6	ICT R&D labor force	13
FIE7	Intencity of competition among ICT interprise	14
FIE8	Existance of new organization model	13
	Sub-pillar 2.1: National Human Capital	**15**
HC2	Share of Young People to population (%)	17
HC3	Number of Tertiary Teachers	9
HC5	Adult Literacy Rate	13
HC7	Labor force participation rate, total (% ages 15-64)	16
HC8	Employment to population ratio,+15,total(%)	17
HC9	Labor force, Female(% of total labor force)	12
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	9
HC12	Sum of Olampyc Medals*	0
HC13	Brain Drain	3
HC14	Life Expectency	16
HC15	Health Expenditure % of GDP	11
HC16	Physisians per 1000 people	16
HC17	Nurses and midwievs	15

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**15**
PSC1	Doing B business index	17
PSC2	Governance Indicators	15
PSC3	Economic Freedom Index	15
PSC4	Inflation Rate (%)	11
PSC5	GINI index	16
PSC7	Current Account Balance	17
PSC8	Economic growth	10
PSC9	Capital goods gross imports(US$ mil)	13
PSC10	E-government index	15
	Sub-pillar 2.3: National Renewal Capital	**17**
RC1	Researchers	6
RC2	R&D expenditure	16
RC3	scientific & technical journal articles	14
RC4	Patents	15
RC5	Venture capital	11
RC6	S&T parks and Incubators	16
RC7	High Techs exports	15
RC8	Technology absorption	15
RC9	Capital goods export	12
RC10	Entrepreneurial Attitudes	17
RC11	Entrepreneurial Activity	**10**
	Sub-pillar 2.4: National Social Capital	**16**
SC1	Perception of Happiness	17
SC4	Crime	16
SC6	Political Rights**	7
SC7	Civil liberties**	7
SC8	Women Rights	15
	Sub-pillar 2.5: National Natural Resource	**6**
NNR1	Total freshwater withdrawal	3
NNR2	Crude Oil Production	4
NNR3	Crude Oil exports	3
NNR4	Natural gas marketed production	13
NNR5	Natural gas exports	-
NNR6	Exports of petroleum products	3
NNR7	Value of petroleum exports	6
NNR8	Output of Petroleum Products	4
	Sub-pillar 2.6: National Financial Capital	**10**
NFC1	GDP at PPP per capita	10

Although **Iraq** conducts meaningful elections, the operation of democracy in Iraq remains seriously impaired by sectarian and insurgent violence, widespread corruption, and the state's limited administrative capacity. Political violence in Iraq increased sharply during 2013. The vast majority of attacks were attributed to the Islamic State in Iraq (formerly Al Qaeda in Iraq), which in July announced a merger with jihadist groups in Syria and rebranded itself the Islamic State in Iraq and Greater Syria (ISIS). Freedom of the media is limited in practice by the threat of violence. As a result, self-censorship is widespread. Media freedom has also been eroded by the state's ability to justify silencing dissenting views in the media. Despite Iraq's turmoil, successive governments have been able to improve the telecom sector and the information society, as well as involve the private sector through the creation of the regulatory environment which is represented by the Communications and Media Commission, which resulted in a boom in the mobile services.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Jordan

ISEDI	**ICT-based socio-economic development Index**	**10**
IE	**Pillar1: ICT Entities**	**8**
CP	**Pillar 2: Capital Portfolio**	**14**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**9**
IIE1	Fixed telephone subscribtions per 100 inhabitants	16
IIE2	households with computer	8
IIE3	Mobile Cellular subscriptions per 100 inhabitants	6
IIE4	Percentage of households with internet access	7
IIE5	secure internet servers/ million pop	7
IIE6	international Internet bandwidth	10
IIE7	price basket for residential fixed line	17
IIE8	price basket for mobile cellular	8
IIE9	cost of fixed broadband	14
IIE10	cost of mobile-broadband	10
	Sub-pillar 1.2: Provide/Use Entity	**9**
PUE1	percentage of individuals using the internet	11
PUE2	mobile broadband subscriptions per 100 inhabitants	9
PUE3	fixed broadband subscriptions per 100 inhabitants	10
PUE4	business-to-consumer internet use	3
PUE5	use of online public services by citizens	11
PUE6	business-to-business internet use	5
PUE7	facebook penetration rate	3
PUE8	ICT Service Export (% of total service export)	17
PUE9	ICT good import (% of total good import)	7
	Sub-pillar 1.3: Rule/Procedure Entity	**6**
RPE1	laws relating to ICT	6
RPE2	Freedom on the web	5
RPE3	Existence of software copyright law	6
RPE4	Government prioritization of ICT	6
RPE5	Existence of USO policy	8
RPE6	Independence of regulatory	7
	Sub-pillar 1.4: Fund/Innovation Entity	**8**
FIE1	ICT Expenditure As % of GDP	3
FIE2	Telecom Investment	12
FIE3	Level of e-participation development	11
FIE4	Availability of latest ICT technology	5
FIE5	ICT PCT patents, applications/million pop.	7
FIE6	ICT R&D labor force	6
FIE7	Intencity of competition among ICT interprise	5
FIE8	Existance of new organization model	5
	Sub-pillar 2.1: National Human Capital	**12**
HC2	Share of Young People to population (%)	14
HC3	Number of Tertiary Teachers	10
HC5	Adult Literacy Rate	2
HC7	Labor force participation rate, total (% ages 15-64)	17
HC8	Employment to population ratio,+15,total(%)	16
HC9	Labor force, Female(% of total labor force)	10
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	17
HC12	Sum of Olampyc Medals*	0
HC13	Brain Drain	9
HC14	Life Expectency	12
HC15	Health Expenditure % of GDP	1
HC16	Physisians per 1000 people	4
HC17	Nurses and midwievs	6

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**9**
PSC1	Doing B business index	9
PSC2	Governance Indicators	6
PSC3	Economic Freedom Index	4
PSC4	Inflation Rate (%)	10
PSC5	GINI index	7
PSC7	Current Account Balance	11
PSC8	Economic growth	11
PSC9	Capital goods gross imports(US$ mil)	10
PSC10	E-government index	8
	Sub-pillar 2.3: National Renewal Capital	**5**
RC1	Researchers	8
RC2	R&D expenditure	6
RC3	scientific & technical journal articles	7
RC4	Patents	10
RC5	Venture capital	12
RC6	S&T parks and Incubators	5
RC7	High Techs exports	5
RC8	Technology absorption	4
RC9	Capital goods export	2
RC10	Entrepreneurial Attitudes	13
RC11	Entrepreneurial Activity	13
	Sub-pillar 2.4: National Social Capital	**5**
SC1	Perception of Happiness	7
SC4	Crime	3
SC6	Political Rights**	6
SC7	Civil liberties**	5
SC8	Women Rights	6
	Sub-pillar 2.5: National Natural Resource	**14**
NNR1	Total freshwater withdrawal	14
NNR2	Crude Oil Production	-
NNR3	Crude Oil exports	-
NNR4	Natural gas marketed production	-
NNR5	Natural gas exports	-
NNR6	Exports of petroleum products	-
NNR7	Value of petroleum exports	-
NNR8	Output of Petroleum Products	-
	Sub-pillar 2.6: National Financial Capital	**12**
NFC1	GDP at PPP per capita	12

Jordan is a constitutional monarchy. Since gaining independence from British rule in 1946, Jordan was primarily ruled by King Hussein (1953-99). In 1989, parliamentary elections were reinstated and since then a gradual economic and political liberalization has developed. Jordan is not classified as an oil producing country, and much of its ICT infrastructure development was developed due to the Foreign Direct Investment (FDI). It holds no exceptional economic weaknesses or strengths, but does have relative strengths in terms of a very low rate of corruption, strong property rights, and low tax rates on individual and corporate income

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Kuwait

ISEDI	**ICT-based socio-economic development Index**	**4**
IE	**Pillar1: ICT Entities**	**6**
CP	**Pillar 2: Capital Portfolio**	**4**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**3**
IIE1	Fixed telephone subscribtions per 100 inhabitants	6
IIE2	households with computer	4
IIE3	Mobile Cellular subscriptions per 100 inhabitants	4
IIE4	Percentage of households with internet access	4
IIE5	secure internet servers/ million pop	2
IIE6	international Internet bandwidth	16
IIE7	price basket for residential fixed line	5
IIE8	price basket for mobile cellular	4
IIE9	cost of fixed broadband	1
IIE10	cost of mobile-broadband	2
	Sub-pillar 1.2: Provide/Use Entity	**3**
PUE1	percentage of individuals using the internet	4
PUE2	mobile broadband subscriptions per 100 inhabitants	3
PUE3	fixed broadband subscriptions per 100 inhabitants	5
PUE4	business-to-consumer internet use	4
PUE5	use of online public services by citizens	7
PUE6	business-to-business internet use	6
PUE7	facebook penetration rate	2
PUE8	ICT Service Export (% of total service export)	3
PUE9	ICT good import (% of total good import)	6
	Sub-pillar 1.3: Rule/Procedure Entity	**9**
RPE1	laws relating to ICT	10
RPE2	Freedom on the web	10
RPE3	Existence of software copyright law	7
RPE4	Government prioritization of ICT	10
RPE5	Existence of USO policy	9
RPE6	Independence of regulatory	6
	Sub-pillar 1.4: Fund/Innovation Entity	**12**
FIE1	ICT Expenditure As % of GDP	12
FIE2	Telecom Investment	8
FIE3	Level of e-participation development	10
FIE4	Availability of latest ICT technology	9
FIE5	ICT PCT patents, applications/million pop.	10
FIE6	ICT R&D labor force	12
FIE7	Intencity of competition among ICT interprise	10
FIE8	Existance of new organization model	11
	Sub-pillar 2.1: National Human Capital	**5**
HC2	Share of Young People to population (%)	5
HC3	Number of Tertiary Teachers	15
HC5	Adult Literacy Rate	4
HC7	Labor force participation rate, total (% ages 15-64)	4
HC8	Employment to population ratio,+15,total(%)	3
HC9	Labor force, Female(% of total labor force)	7
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	6
HC12	Sum of Olampyc Medals*	2
HC13	Brain Drain	7
HC14	Life Expectency	10
HC15	Health Expenditure % of GDP	16
HC16	Physisians per 1000 people	8
HC17	Nurses and midwievs	3

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**4**
PSC1	Doing B business index	7
PSC2	Governance Indicators	4
PSC3	Economic Freedom Index	6
PSC4	Inflation Rate (%)	4
PSC5	GINI index	4
PSC7	Current Account Balance	1
PSC8	Economic growth	2
PSC9	Capital goods gross imports(US$ mil)	7
PSC10	E-government index	5
	Sub-pillar 2.3: National Renewal Capital	**11**
RC1	Researchers	12
RC2	R&D expenditure	10
RC3	scientific & technical journal articles	10
RC4	Patents	8
RC5	Venture capital	7
RC6	S&T parks and Incubators	17
RC7	High Techs exports	11
RC8	Technology absorption	6
RC9	Capital goods export	5
RC10	Entrepreneurial Attitudes	2
RC11	Entrepreneurial Activity	4
	Sub-pillar 2.4: National Social Capital	**7**
SC1	Perception of Happiness	4
SC4	Crime	11
SC6	Political Rights**	5
SC7	Civil liberties**	5
SC8	Women Rights	7
	Sub-pillar 2.5: National Natural Resource	**4**
NNR1	Total freshwater withdrawal	15
NNR2	Crude Oil Production	3
NNR3	Crude Oil exports	5
NNR4	Natural gas marketed production	9
NNR5	Natural gas exports	-
NNR6	Exports of petroleum products	2
NNR7	Value of petroleum exports	4
NNR8	Output of Petroleum Products	3
	Sub-pillar 2.6: National Financial Capital	**2**
NFC1	GDP at PPP per capita	2

Kuwait is a constitutional monarchy with an Amir as chief of state and Prime Minister as head of government. Even though formal political parties are forbidden, political gatherings are not considered unlawful. The government of Kuwait allows for some open debate on politics in the press but because it restricts freedom of assembly, public gatherings require approval. Major newspapers are privately owned, foreign broadcasts are available, and Kuwait has allowed private television channels to be transmitted. There is a civil law system for public matters, but Islamic Law dominates family and personal matters.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Lebanon

ISEDI	**ICT-based socio-economic development Index**	**8**

IE	**Pillar1: ICT Entities**	**7**
CP	**Pillar 2: Capital Portfolio**	**12**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
Sub-pillar 1.1: ICT Infrastructure Entity		**7**
IIE1	Fixed telephone subscribtions per 100 inhabitants	5
IIE2	households with computer	5
IIE3	Mobile Cellular subscriptions per 100 inhabitants	12
IIE4	Percentage of households with internet access	6
IIE5	secure internet servers/ million pop	6
IIE6	international Internet bandwidth	4
IIE7	price basket for residential fixed line	14
IIE8	price basket for mobile cellular	9
IIE9	cost of fixed broadband	7
IIE10	cost of mobile-broadband	13
Sub-pillar 1.2: Provide/Use Entity		**6**
PUE1	percentage of individuals using the internet	5
PUE2	mobile broadband subscriptions per 100 inhabitants	8
PUE3	fixed broadband subscriptions per 100 inhabitants	2
PUE4	business-to-consumer internet use	14
PUE5	use of online public services by citizens	9
PUE6	business-to-business internet use	12
PUE7	facebook penetration rate	5
PUE8	ICT Service Export (% of total service export)	2
PUE9	ICT good import (% of total good import)	15
Sub-pillar 1.3: Rule/Procedure Entity		**14**
RPE1	laws relating to ICT	16
RPE2	Freedom on the web	3
RPE3	Existence of software copyright law	13
RPE4	Government prioritization of ICT	17
RPE5	Existence of USO policy	17
RPE6	Independence of regulatory	16
Sub-pillar 1.4: Fund/Innovation Entity		**7**
FIE1	ICT Expenditure As % of GDP	13
FIE2	Telecom Investment	4
FIE3	Level of e-participation development	7
FIE4	Availability of latest ICT technology	10
FIE5	ICT PCT patents, applications/million pop.	3
FIE6	ICT R&D labor force	2
FIE7	Intencity of competition among ICT interprise	6
FIE8	Existance of new organization model	14
Sub-pillar 2.1: National Human Capital		**7**
HC2	Share of Young People to population (%)	7
HC3	Number of Tertiary Teachers	4
HC5	Adult Literacy Rate	6
HC7	Labor force participation rate, total (% ages 15-64)	10
HC8	Employment to population ratio,+15,total(%)	10
HC9	Labor force, Female(% of total labor force)	6
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	8
HC12	Sum of Olampyc Medals*	0
HC13	Brain Drain	14
HC14	Life Expectency	3
HC15	Health Expenditure % of GDP	2
HC16	Physisians per 1000 people	2
HC17	Nurses and midwievs	10

Code	Individual indicators	Rank
Sub-pillar 2.2: National Process & Structural Capital		**12**
PSC1	Doing B business index	11
PSC2	Governance Indicators	10
PSC3	Economic Freedom Index	8
PSC4	Inflation Rate (%)	9
PSC5	GINI index	10
PSC7	Current Account Balance	14
PSC8	Economic growth	14
PSC9	Capital goods gross imports(US$ mil)	16
PSC10	E-government index	7
Sub-pillar 2.3: National Renewal Capital		**8**
RC1	Researchers	10
RC2	R&D expenditure	8
RC3	scientific & technical journal articles	9
RC4	Patents	13
RC5	Venture capital	14
RC6	S&T parks and Incubators	13
RC7	High Techs exports	6
RC8	Technology absorption	10
RC9	Capital goods export	1
RC10	Entrepreneurial Attitudes	12
RC11	Entrepreneurial Activity	8
Sub-pillar 2.4: National Social Capital		**8**
SC1	Perception of Happiness	2
SC4	Crime	2
SC6	Political Rights**	5
SC7	Civil liberties**	4
SC8	Women Rights	4
Sub-pillar 2.5: National Natural Resource		**14**
NNR1	Total freshwater withdrawal	12
NNR2	Crude Oil Production	-
NNR3	Crude Oil exports	-
NNR4	Natural gas marketed production	-
NNR5	Natural gas exports	-
NNR6	Exports of petroleum products	-
NNR7	Value of petroleum exports	-
NNR8	Output of Petroleum Products	-
Sub-pillar 2.6: National Financial Capital		**8**
NFC1	GDP at PPP per capita	8

Lebanon is a secular republic governed by a unicameral National Assembly or Majlis Alnuwab. The chief of state is the President and the head of government is the Prime Minister, who are elected and serve four-year terms. The legal system in Lebanon is independent of the government and is a mixture of Ottoman law, Canon law, Napoleonic code, and Civil law. There is no judicial review of legislative acts. The government of Lebanon does not officially acknowledge Islamic Law. Political parties are legal and there are many active political parties, including socialist parties, democratic parties and religious parties such as Hezbollah. There is a partly free press in Lebanon and freedom of association and assembly is allowed, with some restriction on freedom of expression concerning political criticism. Most of the media are owned by political elites; however, independently operated television and radio stations do exist. Several conflicts contributed to the destruction of Lebanon's infrastructure, including the 15-year civil war in Lebanon (1976-1991), the involvement of Syria in Lebanon's internal affairs and the Israeli and Lebanese war (2006).

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Libya

ISEDI	**ICT-based socio-economic development Index**	**15**

IE	**Pillar1: ICT Entities**	**14**
CP	**Pillar 2: Capital Portfolio**	**10**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**15**
IIE1	Fixed telephone subscribtions per 100 inhabitants	13
IIE2	households with computer	15
IIE3	Mobile Cellular subscriptions per 100 inhabitants	15
IIE4	Percentage of households with internet access	13
IIE5	secure internet servers/ million pop	12
IIE6	international Internet bandwidth	17
IIE7	price basket for residential fixed line	8
IIE8	price basket for mobile cellular	13
IIE9	cost of fixed broadband	11
IIE10	cost of mobile-broadband	8
	Sub-pillar 1.2: Provide/Use Entity	**16**
PUE1	percentage of individuals using the internet	16
PUE2	mobile broadband subscriptions per 100 inhabitants	15
PUE3	fixed broadband subscriptions per 100 inhabitants	15
PUE4	business-to-consumer internet use	15
PUE5	use of online public services by citizens	16
PUE6	business-to-business internet use	15
PUE7	facebook penetration rate	16
PUE8	ICT Service Export (% of total service export)	13
PUE9	ICT good import (% of total good import)	9
	Sub-pillar 1.3: Rule/Procedure Entity	**12**
RPE1	laws relating to ICT	13
RPE2	Freedom on the web	4
RPE3	Existence of software copyright law	12
RPE4	Government prioritization of ICT	13
RPE5	Existence of USO policy	10
RPE6	Independence of regulatory	12
	Sub-pillar 1.4: Fund/Innovation Entity	**13**
FIE1	ICT Expenditure As % of GDP	11
FIE2	Telecom Investment	6
FIE3	Level of e-participation development	15
FIE4	Availability of latest ICT technology	13
FIE5	ICT PCT patents, applications/million pop.	11
FIE6	ICT R&D labor force	11
FIE7	Intencity of competition among ICT interprise	13
FIE8	Existance of new organization model	12
	Sub-pillar 2.1: National Human Capital	**11**
HC2	Share of Young People to population (%)	12
HC3	Number of Tertiary Teachers	17
HC5	Adult Literacy Rate	7
HC7	Labor force participation rate, total (% ages 15-64)	6
HC8	Employment to population ratio,+15,total(%)	7
HC9	Labor force, Female(% of total labor force)	1
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	13
HC12	Sum of Olampyc Medals*	0
HC13	Brain Drain	17
HC14	Life Expectency	7
HC15	Health Expenditure % of GDP	9
HC16	Physisians per 1000 people	7
HC17	Nurses and midwievs	2

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**13**
PSC1	Doing B business index	**16**
PSC2	Governance Indicators	**16**
PSC3	Economic Freedom Index	**16**
PSC4	Inflation Rate (%)	**12**
PSC5	GINI index	**15**
PSC7	Current Account Balance	**5**
PSC8	Economic growth	**13**
PSC9	Capital goods gross imports(US$ mil)	**12**
PSC10	E-government index	**16**
	Sub-pillar 2.3: National Renewal Capital	**15**
RC1	Researchers	16
RC2	R&D expenditure	13
RC3	scientific & technical journal articles	17
RC4	Patents	17
RC5	Venture capital	13
RC6	S&T parks and Incubators	14
RC7	High Techs exports	16
RC8	Technology absorption	13
RC9	Capital goods export	10
RC10	Entrepreneurial Attitudes	16
RC11	Entrepreneurial Activity	16
	Sub-pillar 2.4: National Social Capital	**15**
SC1	Perception of Happiness	13
SC4	Crime	15
SC6	Political Rights**	7
SC7	Civil liberties**	6
SC8	Women Rights	10
	Sub-pillar 2.5: National Natural Resource	**9**
NNR1	Total freshwater withdrawal	8
NNR2	Crude Oil Production	6
NNR3	Crude Oil exports	6
NNR4	Natural gas marketed production	8
NNR5	Natural gas exports	8
NNR6	Exports of petroleum products	10
NNR7	Value of petroleum exports	7
NNR8	Output of Petroleum Products	8
	Sub-pillar 2.6: National Financial Capital	**7**
NFC1	GDP at PPP per capita	7

Libya has a Unitary provisional parliamentary republic (in dispute). The new Libyan government—composed of the legislative assembly, or General National Congress (GNC), and a cabinet headed by Prime Minister- failed to establish security and the rule of law. About 97% of the population in Libya are Muslims, most of whom belong to the Sunni branch. Although the overthrow of longtime leader Mu'ammar al-Qadhafi led to a dramatic opening in the political and media environments in 2011, conditions for press freedom in Libya deteriorated in 2013. The telecommunications infrastructure inherited from the previous regime has yet to be refurbished, and internet users struggle to secure a reliable, high-speed connection.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Morocco

ISEDI	**ICT-based socio-economic development Index**	**13**
IE	**Pillar1: ICT Entities**	**12**
CP	**Pillar 2: Capital Portfolio**	**15**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**11**
IIE1	Fixed telephone subscribtions per 100 inhabitants	14
IIE2	households with computer	9
IIE3	Mobile Cellular subscriptions per 100 inhabitants	9
IIE4	Percentage of households with internet access	9
IIE5	secure internet servers/ million pop	10
IIE6	international Internet bandwidth	7
IIE7	price basket for residential fixed line	10
IIE8	price basket for mobile cellular	16
IIE9	cost of fixed broadband	13
IIE10	cost of mobile-broadband	17
	Sub-pillar 1.2: Provide/Use Entity	**12**
PUE1	percentage of individuals using the internet	8
PUE2	mobile broadband subscriptions per 100 inhabitants	10
PUE3	fixed broadband subscriptions per 100 inhabitants	14
PUE4	business-to-consumer internet use	8
PUE5	use of online public services by citizens	13
PUE6	business-to-business internet use	8
PUE7	facebook penetration rate	12
PUE8	ICT Service Export (% of total service export)	5
PUE9	ICT good import (% of total good import)	10
	Sub-pillar 1.3: Rule/Procedure Entity	**7**
RPE1	laws relating to ICT	8
RPE2	Freedom on the web	2
RPE3	Existence of software copyright law	9
RPE4	Government prioritization of ICT	7
RPE5	Existence of USO policy	7
RPE6	Independence of regulatory	11
	Sub-pillar 1.4: Fund/Innovation Entity	**10**
FIE1	ICT Expenditure As % of GDP	1
FIE2	Telecom Investment	7
FIE3	Level of e-participation development	16
FIE4	Availability of latest ICT technology	7
FIE5	ICT PCT patents, applications/million pop.	12
FIE6	ICT R&D labor force	17
FIE7	Intencity of competition among ICT interprise	8
FIE8	Existance of new organization model	8
	Sub-pillar 2.1: National Human Capital	**9**
HC2	Share of Young People to population (%)	11
HC3	Number of Tertiary Teachers	5
HC5	Adult Literacy Rate	16
HC7	Labor force participation rate, total (% ages 15-64)	9
HC8	Employment to population ratio,+15,total(%)	8
HC9	Labor force, Female(% of total labor force)	2
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	3
HC12	Sum of Olampyc Medals*	11
HC13	Brain Drain	11
HC14	Life Expectency	15
HC15	Health Expenditure % of GDP	5
HC16	Physisians per 1000 people	15
HC17	Nurses and midwievs	16

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**7**
PSC1	Doing B business index	8
PSC2	Governance Indicators	9
PSC3	Economic Freedom Index	9
PSC4	Inflation Rate (%)	3
PSC5	GINI index	3
PSC7	Current Account Balance	16
PSC8	Economic growth	6
PSC9	Capital goods gross imports(US$ mil)	6
PSC10	E-government index	12
	Sub-pillar 2.3: National Renewal Capital	**4**
RC1	Researchers	3
RC2	R&D expenditure	3
RC3	scientific & technical journal articles	6
RC4	Patents	5
RC5	Venture capital	10
RC6	S&T parks and Incubators	4
RC7	High Techs exports	1
RC8	Technology absorption	11
RC9	Capital goods export	15
RC10	Entrepreneurial Attitudes	6
RC11	Entrepreneurial Activity	2
	Sub-pillar 2.4: National Social Capital	**3**
SC1	Perception of Happiness	10
SC4	Crime	1
SC6	Political Rights*	5
SC7	Civil liberties*	4
SC8	Women Rights	3
	Sub-pillar 2.5: National Natural Resource	**14**
NNR1	Total freshwater withdrawal	6
NNR2	Crude Oil Production	-
NNR3	Crude Oil exports	-
NNR4	Natural gas marketed production	-
NNR5	Natural gas exports	-
NNR6	Exports of petroleum products	-
NNR7	Value of petroleum exports	-
NNR8	Output of Petroleum Products	-
	Sub-pillar 2.6: National Financial Capital	**15**
NFC1	GDP at PPP per capita	15

Morocco is a constitutional Monarchy with an elected parliament. Morocco's predominant religion is Islam. The state dominates the broadcast media, but people have access to foreign satellite television channels. The authorities occasionally disrupt websites and internet platforms, while bloggers and other internet users are sometimes arrested for posting content that offends the monarchy.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Oman

ISEDI	**ICT-based socio-economic development Index**	**6**
IE	**Pillar1: ICT Entities**	**5**
CP	**Pillar 2: Capital Portfolio**	**7**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
Sub-pillar 1.1: ICT Infrastructure Entity		**6**
IIE1	Fixed telephone subscribtions per 100 inhabitants	10
IIE2	households with computer	7
IIE3	Mobile Cellular subscriptions per 100 inhabitants	2
IIE4	Percentage of households with internet access	8
IIE5	secure internet servers/ million pop	5
IIE6	international Internet bandwidth	8
IIE7	price basket for residential fixed line	9
IIE8	price basket for mobile cellular	3
IIE9	cost of fixed broadband	4
IIE10	cost of mobile-broadband	4
Sub-pillar 1.2: Provide/Use Entity		**7**
PUE1	percentage of individuals using the internet	6
PUE2	mobile broadband subscriptions per 100 inhabitants	2
PUE3	fixed broadband subscriptions per 100 inhabitants	12
PUE4	business-to-consumer internet use	9
PUE5	use of online public services by citizens	5
PUE6	business-to-business internet use	7
PUE7	facebook penetration rate	10
PUE8	ICT Service Export (% of total service export)	4
PUE9	ICT good import (% of total good import)	14
Sub-pillar 1.3: Rule/Procedure Entity		**3**
RPE1	laws relating to ICT	5
RPE2	Freedom on the web	6
RPE3	Existence of software copyright law	2
RPE4	Government prioritization of ICT	5
RPE5	Existence of USO policy	1
RPE6	Independence of regulatory	5
Sub-pillar 1.4: Fund/Innovation Entity		**6**
FIE1	ICT Expenditure As % of GDP	10
FIE2	Telecom Investment	5
FIE3	Level of e-participation development	6
FIE4	Availability of latest ICT technology	6
FIE5	ICT PCT patents, applications/million pop.	8
FIE6	ICT R&D labor force	4
FIE7	Intencity of competition among ICT interprise	7
FIE8	Existance of new organization model	6
Sub-pillar 2.1: National Human Capital		**10**
HC2	Share of Young People to population (%)	4
HC3	Number of Tertiary Teachers	13
HC5	Adult Literacy Rate	9
HC7	Labor force participation rate, total (% ages 15-64)	5
HC8	Employment to population ratio,+15,total(%)	5
HC9	Labor force, Female(% of total labor force)	14
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	11
HC12	Sum of Olampyc Medals*	0
HC13	Brain Drain	6
HC14	Life Expectency	4
HC15	Health Expenditure % of GDP	15
HC16	Physisians per 1000 people	5
HC17	Nurses and midwievs	4

Code	Individual indicators	Rank
Sub-pillar 2.2: National Process & Structural Capital		**5**
PSC1	Doing B business index	5
PSC2	Governance Indicators	3
PSC3	Economic Freedom Index	5
PSC4	Inflation Rate (%)	2
PSC5	GINI index	8
PSC7	Current Account Balance	9
PSC8	Economic growth	4
PSC9	Capital goods gross imports(US$ mil)	9
PSC10	E-government index	6
Sub-pillar 2.3: National Renewal Capital		**10**
RC1	Researchers	9
RC2	R&D expenditure	9
RC3	scientific & technical journal articles	11
RC4	Patents	16
RC5	Venture capital	2
RC6	S&T parks and Incubators	10
RC7	High Techs exports	4
RC8	Technology absorption	8
RC9	Capital goods export	9
RC10	Entrepreneurial Attitudes	10
RC11	Entrepreneurial Activity	12
Sub-pillar 2.4: National Social Capital		**4**
SC1	Perception of Happiness	2
SC4	Crime	7
SC6	Political Rights**	6
SC7	Civil liberties**	5
SC8	Women Rights	13
Sub-pillar 2.5: National Natural Resource		**10**
NNR1	Total freshwater withdrawal	13
NNR2	Crude Oil Production	8
NNR3	Crude Oil exports	8
NNR4	Natural gas marketed production	7
NNR5	Natural gas exports	4
NNR6	Exports of petroleum products	-
NNR7	Value of petroleum exports	-
NNR8	Output of Petroleum Products	-
Sub-pillar 2.6: National Financial Capital		**5**
NFC1	GDP at PPP per capita	5

Oman is an absolute monarchy. Formal political parties are not allowed in Oman. The legal system is based on both English common law and Islamic law. Freedom of expression is allowed but there are laws prohibiting criticism of the Sultan. Omanis have access to the Internet, but it is censored by the government for political and pornographic content.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Qatar

ISEDI	**ICT-based socio-economic development Index**	**1**

IE	**Pillar1: ICT Entities**	**2**
CP	**Pillar 2: Capital Portfolio**	**1**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
Sub-pillar 1.1: ICT Infrastructure Entity		**1**
IIE1	Fixed telephone subscribtions per 100 inhabitants	7
IIE2	households with computer	2
IIE3	Mobile Cellular subscriptions per 100 inhabitants	7
IIE4	Percentage of households with internet access	1
IIE5	secure internet servers/ million pop	3
IIE6	international Internet bandwidth	3
IIE7	price basket for residential fixed line	2
IIE8	price basket for mobile cellular	1
IIE9	cost of fixed broadband	2
IIE10	cost of mobile-broadband	1
Sub-pillar 1.2: Provide/Use Entity		**2**
PUE1	percentage of individuals using the internet	3
PUE2	mobile broadband subscriptions per 100 inhabitants	1
PUE3	fixed broadband subscriptions per 100 inhabitants	4
PUE4	business-to-consumer internet use	2
PUE5	use of online public services by citizens	4
PUE6	business-to-business internet use	1
PUE7	facebook penetration rate	4
PUE8	ICT Service Export (% of total service export)	7
PUE9	ICT good import (% of total good import)	5
Sub-pillar 1.3: Rule/Procedure Entity		**1**
RPE1	laws relating to ICT	1
RPE2	Freedom on the web	8
RPE3	Existence of software copyright law	1
RPE4	Government prioritization of ICT	1
RPE5	Existence of USO policy	2
RPE6	Independence of regulatory	1
Sub-pillar 1.4: Fund/Innovation Entity		**3**
FIE1	ICT Expenditure As % of GDP	8
FIE2	Telecom Investment	11
FIE3	Level of e-participation development	4
FIE4	Availability of latest ICT technology	3
FIE5	ICT PCT patents, applications/million pop.	4
FIE6	ICT R&D labor force	5
FIE7	Intencity of competition among ICT interprise	2
FIE8	Existance of new organization model	1
Sub-pillar 2.1: National Human Capital		**1**
HC2	Share of Young People to population (%)	1
HC3	Number of Tertiary Teachers	16
HC5	Adult Literacy Rate	1
HC7	Labor force participation rate, total (% ages 15-64)	1
HC8	Employment to population ratio,+15,total(%)	1
HC9	Labor force, Female(% of total labor force)	17
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	2
HC12	Sum of Olampyc Medals*	3
HC13	Brain Drain	1
HC14	Life Expectency	1
HC15	Health Expenditure % of GDP	17
HC16	Physisians per 1000 people	1
HC17	Nurses and midwievs	1

Code	Individual indicators	Rank
Sub-pillar 2.2: National Process & Structural Capital		**3**
PSC1	Doing B business index	3
PSC2	Governance Indicators	1
PSC3	Economic Freedom Index	3
PSC4	Inflation Rate (%)	5
PSC5	GINI index	2
PSC7	Current Account Balance	3
PSC8	Economic growth	1
PSC9	Capital goods gross imports(US$ mil)	5
PSC10	E-government index	4
Sub-pillar 2.3: National Renewal Capital		**6**
RC1	Researchers	5
RC2	R&D expenditure	7
RC3	scientific & technical journal articles	12
RC4	Patents	11
RC5	Venture capital	1
RC6	S&T parks and Incubators	8
RC7	High Techs exports	17
RC8	Technology absorption	2
RC9	Capital goods export	4
RC10	Entrepreneurial Attitudes	1
RC11	Entrepreneurial Activity	5
Sub-pillar 2.4: National Social Capital		**2**
SC1	Perception of Happiness	3
SC4	Crime	6
SC6	Political Rights**	6
SC7	Civil liberties**	5
SC8	Women Rights	12
Sub-pillar 2.5: National Natural Resource		**2**
NNR1	Total freshwater withdrawal	17
NNR2	Crude Oil Production	9
NNR3	Crude Oil exports	9
NNR4	Natural gas marketed production	1
NNR5	Natural gas exports	1
NNR6	Exports of petroleum products	4
NNR7	Value of petroleum exports	3
NNR8	Output of Petroleum Products	9
Sub-pillar 2.6: National Financial Capital		**1**
NFC1	GDP at PPP per capita	1

Qatar is a hereditary monarchy ruled by an Amir, the Chief of State in conjunction with a unicameral Advisory Council or *Majlis al-Shura* composed of a Prime Minister and 35 appointed members. Although there is a system of legislative election, none has been held since 1970. The legal system is controlled by the Amir under a recently established civil law.

Islamic law dominates family and personal matters. There are no political parties but Qatar is home to various press agencies including the controversial Al-Jazeera News Network. Al-Jazeera hosts a web site that generates more than a million hits per day (Alterman, 2005). In 2005, Qatar adopted a new constitution, which allows for freedom of expression. The government has refrained from overt censorship; however, print and broadcast media content is influenced by the state. Internet content is censored for pornographic or politically sensitive material.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Saudi Arabia

ISEDI	**ICT-based socio-economic development Index**	**3**
IE	**Pillar1: ICT Entities**	**3**
CP	**Pillar 2: Capital Portfolio**	**3**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**5**
IIE1	Fixed telephone subscribtions per 100 inhabitants	8
IIE2	households with computer	6
IIE3	Mobile Cellular subscriptions per 100 inhabitants	1
IIE4	Percentage of households with internet access	5
IIE5	secure internet servers/ million pop	8
IIE6	international Internet bandwidth	2
IIE7	price basket for residential fixed line	11
IIE8	price basket for mobile cellular	5
IIE9	cost of fixed broadband	8
IIE10	cost of mobile-broadband	6
	Sub-pillar 1.2: Provide/Use Entity	**5**
PUE1	percentage of individuals using the internet	7
PUE2	mobile broadband subscriptions per 100 inhabitants	5
PUE3	fixed broadband subscriptions per 100 inhabitants	6
PUE4	business-to-consumer internet use	5
PUE5	use of online public services by citizens	3
PUE6	business-to-business internet use	3
PUE7	facebook penetration rate	9
PUE8	ICT Service Export (% of total service export)	14
PUE9	ICT good import (% of total good import)	1
	Sub-pillar 1.3: Rule/Procedure Entity	**4**
RPE1	laws relating to ICT	3
RPE2	Freedom on the web	11
RPE3	Existence of software copyright law	5
RPE4	Government prioritization of ICT	4
RPE5	Existence of USO policy	4
RPE6	Independence of regulatory	3
	Sub-pillar 1.4: Fund/Innovation Entity	**2**
FIE1	ICT Expenditure As % of GDP	6
FIE2	Telecom Investment	1
FIE3	Level of e-participation development	5
FIE4	Availability of latest ICT technology	4
FIE5	ICT PCT patents, applications/million pop.	2
FIE6	ICT R&D labor force	7
FIE7	Intencity of competition among ICT interprise	3
FIE8	Existance of new organization model	3
	Sub-pillar 2.1: National Human Capital	**13**
HC2	Share of Young People to population (%)	10
HC3	Number of Tertiary Teachers	3
HC5	Adult Literacy Rate	8
HC7	Labor force participation rate, total (% ages 15-64)	7
HC8	Employment to population ratio,+15,total(%)	6
HC9	Labor force, Female(% of total labor force)	16
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	4
HC12	Sum of Olampyc Medals*	3
HC13	Brain Drain	5
HC14	Life Expectency	6
HC15	Health Expenditure % of GDP	13
HC16	Physisians per 1000 people	13
HC17	Nurses and midwievs	11

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**2**
PSC1	Doing B business index	1
PSC2	Governance Indicators	8
PSC3	Economic Freedom Index	7
PSC4	Inflation Rate (%)	8
PSC5	GINI index	6
PSC7	Current Account Balance	2
PSC8	Economic growth	3
PSC9	Capital goods gross imports(US$ mil)	1
PSC10	E-government index	3
	Sub-pillar 2.3: National Renewal Capital	**7**
RC1	Researchers	17
RC2	R&D expenditure	11
RC3	scientific & technical journal articles	3
RC4	Patents	1
RC5	Venture capital	3
RC6	S&T parks and Incubators	3
RC7	High Techs exports	10
RC8	Technology absorption	3
RC9	Capital goods export	6
RC10	Entrepreneurial Attitudes	3
RC11	Entrepreneurial Activity	17
	Sub-pillar 2.4: National Social Capital	**11**
SC1	Perception of Happiness	5
SC4	Crime	10
SC6	Political Rights**	7
SC7	Civil liberties**	7
SC8	Women Rights	17
	Sub-pillar 2.5: National Natural Resource	**1**
NNR1	Total freshwater withdrawal	4
NNR2	Crude Oil Production	1
NNR3	Crude Oil exports	1
NNR4	Natural gas marketed production	3
NNR5	Natural gas exports	7
NNR6	Exports of petroleum products	1
NNR7	Value of petroleum exports	1
NNR8	Output of Petroleum Products	1
	Sub-pillar 2.6: National Financial Capital	**4**
NFC1	GDP at PPP per capita	4

Saudi Arabia is a constitutional monarchy governed according to Islamic Shari'a law. The chief of state is the King while the head of government is the Prime Minister. The government exercises tight control over state media content and has taken stringent measures against the media for publishing information considered morally or politically offensive. It has been reported that camera cell phones are banned (Shihri, 2004). Although there are no political parties or free press in Saudi Arabia, there is much political activity by Islamic groups.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Syria

ISEDI	**ICT-based socio-economic development Index**	**16**
IE	**Pillar1: ICT Entities**	**15**
CP	**Pillar 2: Capital Portfolio**	**17**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**13**
IIE1	Fixed telephone subscribtions per 100 inhabitants	4
IIE2	households with computer	14
IIE3	Mobile Cellular subscriptions per 100 inhabitants	14
IIE4	Percentage of households with internet access	10
IIE5	secure internet servers/ million pop	16
IIE6	international Internet bandwidth	12
IIE7	price basket for residential fixed line	6
IIE8	price basket for mobile cellular	15
IIE9	cost of fixed broadband	15
IIE10	cost of mobile-broadband	16
	Sub-pillar 1.2: Provide/Use Entity	**17**
PUE1	percentage of individuals using the internet	13
PUE2	mobile broadband subscriptions per 100 inhabitants	12
PUE3	fixed broadband subscriptions per 100 inhabitants	16
PUE4	business-to-consumer internet use	16
PUE5	use of online public services by citizens	17
PUE6	business-to-business internet use	17
PUE7	facebook penetration rate	11
PUE8	ICT Service Export (% of total service export)	15
PUE9	ICT good import (% of total good import)	16
	Sub-pillar 1.3: Rule/Procedure Entity	**15**
RPE1	laws relating to ICT	17
RPE2	Freedom on the web	15
RPE3	Existence of software copyright law	15
RPE4	Government prioritization of ICT	15
RPE5	Existence of USO policy	13
RPE6	Independence of regulatory	14
	Sub-pillar 1.4: Fund/Innovation Entity	**17**
FIE1	ICT Expenditure As % of GDP	15
FIE2	Telecom Investment	15
FIE3	Level of e-participation development	13
FIE4	Availability of latest ICT technology	17
FIE5	ICT PCT patents, applications/million pop.	16
FIE6	ICT R&D labor force	15
FIE7	Intencity of competition among ICT interprise	16
FIE8	Existance of new organization model	16
	Sub-pillar 2.1: National Human Capital	**16**
HC2	Share of Young People to population (%)	15
HC3	Number of Tertiary Teachers	8
HC5	Adult Literacy Rate	11
HC7	Labor force participation rate, total (% ages 15-64)	15
HC8	Employment to population ratio,+15,total(%)	13
HC9	Labor force, Female(% of total labor force)	15
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	7
HC12	Sum of Olampyc Medals*	1
HC13	Brain Drain	15
HC14	Life Expectency	9
HC15	Health Expenditure % of GDP	12
HC16	Physisians per 1000 people	9
HC17	Nurses and midwievs	13

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**17**
PSC1	Doing B business index	13
PSC2	Governance Indicators	17
PSC3	Economic Freedom Index	17
PSC4	Inflation Rate (%)	16
PSC5	GINI index	17
PSC7	Current Account Balance	12
PSC8	Economic growth	17
PSC9	Capital goods gross imports(US$ mil)	11
PSC10	E-government index	13
	Sub-pillar 2.3: National Renewal Capital	**13**
RC1	Researchers	13
RC2	R&D expenditure	15
RC3	scientific & technical journal articles	13
RC4	Patents	7
RC5	Venture capital	16
RC6	S&T parks and Incubators	7
RC7	High Techs exports	7
RC8	Technology absorption	12
RC9	Capital goods export	17
RC10	Entrepreneurial Attitudes	9
RC11	Entrepreneurial Activity	9
	Sub-pillar 2.4: National Social Capital	**17**
SC1	Perception of Happiness	16
SC4	Crime	17
SC6	Political Rights**	7
SC7	Civil liberties**	7
SC8	Women Rights	8
	Sub-pillar 2.5: National Natural Resource	**12**
NNR1	Total freshwater withdrawal	5
NNR2	Crude Oil Production	11
NNR3	Crude Oil exports	10
NNR4	Natural gas marketed production	11
NNR5	Natural gas exports	-
NNR6	Exports of petroleum products	-
NNR7	Value of petroleum exports	-
NNR8	Output of Petroleum Products	-
	Sub-pillar 2.6: National Financial Capital	**16**
NFC1	GDP at PPP per capita	16

Syria is a semi-presidential republic under an authoritarian military-dominated regime. Their legal system is based on a combination of French and Ottoman civil law and religious law is used in the family court system. The president appoints the vice presidents, prime minister, and deputy prime ministers. The civil war that started in the wake of a peaceful 2011 uprising continued unabated in 2013. By year's end it had produced more than 2 million refugees, 5 million internally displaced persons, and nearly 130,000 fatalities. There are two groups affiliated with Al-Qaeda in Syria: Jabhat al-Nusra (JN) and the Islamic State in Iraq and Greater Syria (ISIS) Freedom of expression is heavily restricted in Syria. Most domestic news outlets are either state controlled or aligned with rebel factions, and access to information is made difficult by both the opposition and regime forces. Freedom of assembly is harshly restricted.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Tunisia

ISEDI	**ICT-based socio-economic development Index**	**12**

IE	**Pillar1: ICT Entities**	**10**
CP	**Pillar 2: Capital Portfolio**	**13**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**10**
IIE1	Fixed telephone subscribtions per 100 inhabitants	11
IIE2	households with computer	13
IIE3	Mobile Cellular subscriptions per 100 inhabitants	8
IIE4	Percentage of households with internet access	14
IIE5	secure internet servers/ million pop	9
IIE6	international Internet bandwidth	5
IIE7	price basket for residential fixed line	16
IIE8	price basket for mobile cellular	11
IIE9	cost of fixed broadband	6
IIE10	cost of mobile-broadband	7
	Sub-pillar 1.2: Provide/Use Entity	**8**
PUE1	percentage of individuals using the internet	12
PUE2	mobile broadband subscriptions per 100 inhabitants	11
PUE3	fixed broadband subscriptions per 100 inhabitants	7
PUE4	business-to-consumer internet use	6
PUE5	use of online public services by citizens	10
PUE6	business-to-business internet use	10
PUE7	facebook penetration rate	6
PUE8	ICT Service Export (% of total service export)	9
PUE9	ICT good import (% of total good import)	2
	Sub-pillar 1.3: Rule/Procedure Entity	**8**
RPE1	laws relating to ICT	11
RPE2	Freedom on the web	1
RPE3	Existence of software copyright law	8
RPE4	Government prioritization of ICT	9
RPE5	Existence of USO policy	12
RPE6	Independence of regulatory	10
	Sub-pillar 1.4: Fund/Innovation Entity	**9**
FIE1	ICT Expenditure As % of GDP	5
FIE2	Telecom Investment	10
FIE3	Level of e-participation development	8
FIE4	Availability of latest ICT technology	8
FIE5	ICT PCT patents, applications/million pop.	5
FIE6	ICT R&D labor force	9
FIE7	Intencity of competition among ICT interprise	9
FIE8	Existance of new organization model	9
	Sub-pillar 2.1: National Human Capital	**8**
HC2	Share of Young People to population (%)	8
HC3	Number of Tertiary Teachers	6
HC5	Adult Literacy Rate	12
HC7	Labor force participation rate, total (% ages 15-64)	11
HC8	Employment to population ratio,+15,total(%)	11
HC9	Labor force, Female(% of total labor force)	3
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	5
HC12	Sum of Olampyc Medals*	0
HC13	Brain Drain	8
HC14	Life Expectency	8
HC15	Health Expenditure % of GDP	3
HC16	Physisians per 1000 people	11
HC17	Nurses and midwievs	9

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**8**
PSC1	Doing B business index	6
PSC2	Governance Indicators	7
PSC3	Economic Freedom Index	10
PSC4	Inflation Rate (%)	13
PSC5	GINI index	9
PSC7	Current Account Balance	10
PSC8	Economic growth	7
PSC9	Capital goods gross imports(US$ mil)	8
PSC10	E-government index	10
	Sub-pillar 2.3: National Renewal Capital	**3**
RC1	Researchers	4
RC2	R&D expenditure	1
RC3	scientific & technical journal articles	4
RC4	Patents	9
RC5	Venture capital	6
RC6	S&T parks and Incubators	6
RC7	High Techs exports	2
RC8	Technology absorption	5
RC9	Capital goods export	14
RC10	Entrepreneurial Attitudes	15
RC11	Entrepreneurial Activity	11
	Sub-pillar 2.4: National Social Capital	**9**
SC1	Perception of Happiness	11
SC4	Crime	9
SC6	Political Rights**	6
SC7	Civil liberties**	5
SC8	Women Rights	1
	Sub-pillar 2.5: National Natural Resource	**14**
NNR1	Total freshwater withdrawal	11
NNR2	Crude Oil Production	-
NNR3	Crude Oil exports	-
NNR4	Natural gas marketed production	12
NNR5	Natural gas exports	-
NNR6	Exports of petroleum products	-
NNR7	Value of petroleum exports	-
NNR8	Output of Petroleum Products	-
	Sub-pillar 2.6: National Financial Capital	**13**
NFC1	GDP at PPP per capita	13

Tunisia is a constitutional republic, with a president serving as head of state, prime minister as head of government, a unicameral parliament and a civil law court system. The majority of Tunisia's population are Muslims. The Tunisian Revolution was an intensive campaign of civil resistance that ultimately leading longtime President Ben Ali to step down in January 2011, after 23 years in power. The Ben Ali regime used an array of legal, penal, and economic measures to silence dissenting voices in the media, and the transitional government in 2011 almost immediately proclaimed freedom of information and expression as a foundational principle for the country. However, the media continued to face a number of obstacles during 2013.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

United Arab Emirates

ISEDI	**ICT-based socio-economic development Index**	**2**
IE	**Pillar1: ICT Entities**	**1**
CP	**Pillar 2: Capital Portfolio**	**2**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**2**
IIE1	Fixed telephone subscribtions per 100 inhabitants	2
IIE2	households with computer	3
IIE3	Mobile Cellular subscriptions per 100 inhabitants	3
IIE4	Percentage of households with internet access	3
IIE5	secure internet servers/ million pop	1
IIE6	international Internet bandwidth	1
IIE7	price basket for residential fixed line	3
IIE8	price basket for mobile cellular	2
IIE9	cost of fixed broadband	3
IIE10	cost of mobile-broadband	5
	Sub-pillar 1.2: Provide/Use Entity	**1**
PUE1	percentage of individuals using the internet	2
PUE2	mobile broadband subscriptions per 100 inhabitants	4
PUE3	fixed broadband subscriptions per 100 inhabitants	3
PUE4	business-to-consumer internet use	1
PUE5	use of online public services by citizens	2
PUE6	business-to-business internet use	2
PUE7	facebook penetration rate	1
PUE8	ICT Service Export (% of total service export)	6
PUE9	ICT good import (% of total good import)	3
	Sub-pillar 1.3: Rule/Procedure Entity	**2**
RPE1	laws relating to ICT	2
RPE2	Freedom on the web	9
RPE3	Existence of software copyright law	3
RPE4	Government prioritization of ICT	2
RPE5	Existence of USO policy	3
RPE6	Independence of regulatory	2
	Sub-pillar 1.4: Fund/Innovation Entity	**1**
FIE1	ICT Expenditure As % of GDP	2
FIE2	Telecom Investment	91
FIE3	Level of e-participation development	91
FIE4	Availability of latest ICT technology	2
FIE5	ICT PCT patents, applications/million pop.	1
FIE6	ICT R&D labor force	1
FIE7	Intencity of competition among ICT interprise	1
FIE8	Existance of new organization model	2
	Sub-pillar 2.1: National Human Capital	**4**
HC2	Share of Young People to population (%)	2
HC3	Number of Tertiary Teachers	14
HC5	Adult Literacy Rate	5
HC7	Labor force participation rate, total (% ages 15-64)	2
HC8	Employment to population ratio,+15,total(%)	2
HC9	Labor force, Female(% of total labor force)	13
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	12
HC12	Sum of Olampyc Medals*	4
HC13	Brain Drain	2
HC14	Life Expectency	2
HC15	Health Expenditure % of GDP	14
HC16	Physisians per 1000 people	6
HC17	Nurses and midwievs	5

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**1**
PSC1	Doing B business index	2
PSC2	Governance Indicators	2
PSC3	Economic Freedom Index	2
PSC4	Inflation Rate (%)	1
PSC5	GINI index	1
PSC7	Current Account Balance	6
PSC8	Economic growth	5
PSC9	Capital goods gross imports(US$ mil)	2
PSC10	E-government index	1
	Sub-pillar 2.3: National Renewal Capital	**9**
RC1	Researchers	7
RC2	R&D expenditure	4
RC3	scientific & technical journal articles	8
RC4	Patents	4
RC5	Venture capital	5
RC6	S&T parks and Incubators	2
RC7	High Techs exports	8
RC8	Technology absorption	1
RC9	Capital goods export	8
RC10	Entrepreneurial Attitudes	11
RC11	Entrepreneurial Activity	14
	Sub-pillar 2.4: National Social Capital	**1**
SC1	Perception of Happiness	1
SC4	Crime	5
SC6	Political Rights*	6
SC7	Civil liberties*	5
SC8	Women Rights	11
	Sub-pillar 2.5: National Natural Resource	**7**
NNR1	Total freshwater withdrawal	9
NNR2	Crude Oil Production	5
NNR3	Crude Oil exports	2
NNR4	Natural gas marketed production	6
NNR5	Natural gas exports	3
NNR6	Exports of petroleum products	8
NNR7	Value of petroleum exports	2
NNR8	Output of Petroleum Products	6
	Sub-pillar 2.6: National Financial Capital	**3**
NFC1	GDP at PPP per capita	3

The **United Arab Emirates** is a federal republic comprised of seven emirates, with an elected President as chief of state and a Prime Minister and Vice President as head of government. The Supreme Council is the highest federal authority of the rulers of the seven emirates. The UAE has a federal court system that includes both secular and Islamic law for civil, criminal, and high courts. There are no political parties in the UAE. The constitution allows freedom of expression; however, there is a proviso law that prohibits pornography as well as criticism and defamation of the state, leadership, and religious issues.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale

Yemen

ISEDI	**ICT-based socio-economic development Index**	**17**
IE	**Pillar1: ICT Entities**	**17**
CP	**Pillar 2: Capital Portfolio**	**16**

The ICT-based socio-economic development (ISED) Composite Index in detail

Code	Individual indicators	Rank
	Sub-pillar 1.1: ICT Infrastructure Entity	**17**
IIE1	Fixed telephone subscribtions per 100 inhabitants	17
IIE2	households with computer	17
IIE3	Mobile Cellular subscriptions per 100 inhabitants	16
IIE4	Percentage of households with internet access	17
IIE5	secure internet servers/ million pop	17
IIE6	international Internet bandwidth	15
IIE7	price basket for residential fixed line	12
IIE8	price basket for mobile cellular	17
IIE9	cost of fixed broadband	17
IIE10	cost of mobile-broadband	11
	Sub-pillar 1.2: Provide/Use Entity	**15**
PUE1	percentage of individuals using the internet	14
PUE2	mobile broadband subscriptions per 100 inhabitants	16
PUE3	fixed broadband subscriptions per 100 inhabitants	17
PUE4	business-to-consumer internet use	13
PUE5	use of online public services by citizens	14
PUE6	business-to-business internet use	9
PUE7	facebook penetration rate	17
PUE8	ICT Service Export (% of total service export)	10
PUE9	ICT good import (% of total good import)	17
	Sub-pillar 1.3: Rule/Procedure Entity	**17**
RPE1	laws relating to ICT	15
RPE2	Freedom on the web	17
RPE3	Existence of software copyright law	16
RPE4	Government prioritization of ICT	16
RPE5	Existence of USO policy	15
RPE6	Independence of regulatory	17
	Sub-pillar 1.4: Fund/Innovation Entity	**15**
FIE1	ICT Expenditure As % of GDP	17
FIE2	Telecom Investment	17
FIE3	Level of e-participation development	17
FIE4	Availability of latest ICT technology	15
FIE5	ICT PCT patents, applications/million pop.	17
FIE6	ICT R&D labor force	14
FIE7	Intencity of competition among ICT interprise	11
FIE8	Existance of new organization model	15
	Sub-pillar 2.1: National Human Capital	**17**
HC2	Share of Young People to population (%)	16
HC3	Number of Tertiary Teachers	11
HC5	Adult Literacy Rate	17
HC7	Labor force participation rate, total (% ages 15-64)	12
HC8	Employment to population ratio,+15,total(%)	12
HC9	Labor force, Female(% of total labor force)	4
HC10	Total nobel prizes*	0
HC11	Science and Engineering Enrolment Ratio (%)	16
HC12	Sum of Olampyc Medals*	0
HC13	Brain Drain	10
HC14	Life Expectency	17
HC15	Health Expenditure % of GDP	6
HC16	Physisians per 1000 people	17
HC2	Share of Young People to population (%)	16

Code	Individual indicators	Rank
	Sub-pillar 2.2: National Process & Structural Capital	**16**
PSC1	Doing B business index	12
PSC2	Governance Indicators	14
PSC3	Economic Freedom Index	11
PSC4	Inflation Rate (%)	15
PSC5	GINI index	13
PSC7	Current Account Balance	13
PSC8	Economic growth	15
PSC9	Capital goods gross imports(US$ mil)	14
PSC10	E-government index	17
	Sub-pillar 2.3: National Renewal Capital	**16**
RC1	Researchers	15
RC2	R&D expenditure	17
RC3	scientific & technical journal articles	16
RC4	Patents	12
RC5	Venture capital	8
RC6	S&T parks and Incubators	11
RC7	High Techs exports	13
RC8	Technology absorption	17
RC9	Capital goods export	16
RC10	Entrepreneurial Attitudes	14
RC11	Entrepreneurial Activity	6
	Sub-pillar 2.4: National Social Capital	**14**
SC1	Perception of Happiness	15
SC4	Crime	13
SC6	Political Rights*	6
SC7	Civil liberties*	6
SC8	Women Rights	16
	Sub-pillar 2.5: National Natural Resource	**13**
NNR1	Total freshwater withdrawal	10
NNR2	Crude Oil Production	13
NNR3	Crude Oil exports	-
NNR4	Natural gas marketed production	-
NNR5	Natural gas exports	-
NNR6	Exports of petroleum products	-
NNR7	Value of petroleum exports	-
NNR8	Output of Petroleum Products	-
	Sub-pillar 2.6: National financial Capital	**17**
NFC1	GDP at PPP per capita	17

Yemen is a republic with a bicameral legislature. The 2011 Yemeni revolution followed other Arab Spring mass protests in early 2011. As a result of the Yemeni revolution, the constitution of Yemen is expected to be rewritten, and then new elections held in 2014. Yemen finalized a freedom of information law in 2012, becoming just the second Arab country, after Jordan, to enact such legislation. Religion in Yemen consists primarily of two principal Islamic religious groups: 60%–65% of the Muslim population is Sunni and over 35%–40% is Shia. Freedom of information advocacy groups praised the law, although the quality of implementation remains unclear.

Note: Indicators fallowed by (*) are employed the value rather than rank
Indicators fallowed by (**) are measured on a 1-to- 7 (worst) scale