A STUDY ON HUMAN CAPITAL INDEX IN CLOSING THE DIGITAL DIVIDE AND RAISING E-GOVERNMENT PERFORMANCE IN MIDDLE EAST COUNTRIES

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A STUDY ON HUMAN CAPITAL INDEX IN CLOSING THE DIGITAL DIVIDE AND RAISING E-GOVERNMENT PERFORMANCE IN MIDDLE EAST COUNTRIES

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This is to certify that we have read this thesis and that in our opinion, it is fully adequate, in scope and quality, as a thesis of the degree Master of Science (M.Sc.) in Mathmatics and Computer Science – Information Technology Program.

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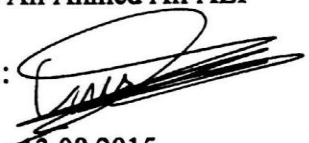
Signature : 

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ABSTRACT

A Study on Human Capital Index in Closing the Digital Divide and Raising E-government Performance in Middle East Countries

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E-government initiatives aim to employ information and communications technology (ICT) to provide better services to citizens and businesses while challenging the digital divide, which leads to closing the divide so as to promote e-government performance. This thesis takes related works already reported in the literature and addresses major factors that played a main role in achieving digitized governments, especially in the Middle East and Arab countries. As the case study, performance indices of Iraq, Bahrain and the KSA from 2002 to 2014 are studied in depth.

The problem has been identified as the steady decline in the Human Capital Index (HCI) in the region. Therefore, the nature of the HCI measurement has been investigated. Major findings demonstrate a relationship between the HCI and ICT skills index of the International Telecommunication Union with a considerable digital divide in ICT skills in the Arab countries in addition to poor performance in the HCI. This finding is also supported by interpreting the differences between the

indices of the HCI versus the telecommunication infrastructure index (TII) and online services index (OSI). This quick tool reveals that a poor HCI prevents these countries from promoting higher ranks. Another finding emerging from the statistics shows that the HCI exhibits unique behavior that differs from the TII and OSI and that it (the HCI) needs more time to improve. It is therefore necessary to focus on investing in HCI and ICT skills and to develop policies and strategies by those governments in charge.

Among the limitations of this thesis are information sources that include only previous studies in addition to websites and in-situ surveys that were not conducted. The legal, economic and cultural aspects of the HCI are not studied. The HCI and ICT skills indices are found to play unique roles in closing the digital divide and this effect can be observed even in rich Arab countries not found in the list of world e-government leaders.

Keywords: E-government, Digital Divide, ICT Skills Index, HCI, Middle East.

ÖZ

Ortadoğu Ülkelerinde Sayısal Uçurumun Kapatılmasında ve E-Devlet Başarımının Yükseltilmesinde Beşeri Sermaye Endeksi Üzerine Çalışma

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Ağustos 2015, 92 sayfa

E-devlet atılımları, bilgi ve iletişim teknolojilerini (BİT) kullanarak vatandaşlara ve iş dünyasına daha iyi hizmetler vermeyi ve sonuç olarak sayısal uçurumu kapatarak e-devlet başarımını yükseltmeyi hedeflemektedir. Bu tez, literature sunulmuş çalışmaları alarak, özellikle Ortadoğu ve Arap ülkelerinde sayısal devlet önünde engel olan ana sorunları hedeflemiştir. Irak, Bahreyn ve Suudi Arabistan devletlerinin 2002-2014 yılları arası başarım endekleri ayrıntılı çalışılmıştır.

Sorun, bölgedeki beşeri sermaye endeksinin (BSE) sürekli düşüşü olarak belirlenmiştir. Bu yüzden, BSE'nin ölçümlenmesi araştırılmıştır. Ana bulgular göstermektedir ki BSE ve ITU'nun BİT beceri endeksinin arasında bir bağ vardır ve Arap ülkelerinde, BİT becerilerinde önemli ölçüde sayısal bir uçurum ve BSE'nde zayıf başarım vardır. Bu bulgu, aynı zamanda BSE'nin iletişim altyapı endeksi (İAE)

ve çevirimiçi hizmetler endeksiye (ÇHE) arasında farkla desteklenmektedir. Bu farklarla, zayıf BSE'nin söz konusu ülkelerin yüksek seyivelere çıkmasını önlediğini açıkça görülmektedir. İstatistiklerden çıkan başka bir bulgu da BSE'nin İAE ve ÇHE'nden farklı olarak kendine özgü tutumu olduğunu ve iyileşmesi için daha çok zamana gereksimi olduğunu göstermiştir. Bu nedenle, devlet yönetimlerinin BSE ve BİT becerileri odaklı kararlar alması ve statejiler geliştirmesi gerekmektedir.

Tezin kısıtlamaları arasında, önceki çalışmalar ve İnternet sayfalarıyla sınırlı bilgi kaynakları sayılabilir. Yerinde bilgi toplama yapılmamıştır. BSE'nin yasal, ekonomik ve kültürel yönleri işlenmemiştir.

BSE'nin ve BİT becerileri endeksi, sayısal uçurumun kapatılmasında kendilerine özgü rolleri vardır ve bu etkileri, dünya e-devlet liderlerinin arasında yer alamayan zengin Arap ülkelerinde de görülmektedir.

Anahtar Sözcükler: E-devlet, Sayısal Uçurum, BİT Beceri Endeksi, BSE, Ortadoğu

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Last but not the least; I dedicate this thesis to the memory of my father. I extend my acknowledgement and heartfelt love to my mother, brothers and sister, for continuous supporting along the period of my study also I would like to dedicate this effort for my wife and my kids. I would like to thank all my friends who stood with me throughout the study period.

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LIST OF ABBREVIATIONS

EGDI	E-Government Development Index
E-Governance	Electronic Governance
E-Government	Electronic Government
G2B	Government-to-Business
G2C	Government-to-Citizen
G2E	Government-to-Employee
G2G	Government-to-Government
GDP	Gross Domestic Product
GNI	Gross National Income
HCI	Human Capital Index
ICT	Information and Communications Technology
IDI	ICT Development Index
IT	Information Technology
ITU	International Telecommunication Union
KSA	Kingdom of Saudi Arabia
ME	Middle East
OECD	Organization for Economic Cooperation and Development
OSI	Online Service Index
TII	Telecommunication Infrastructure Index
UAE	United Arab Emirates
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UK	United Kingdom

CHAPTER 1

INTRODUCTION

Rapid development in the adoption of ICT and increasing its acceptance from citizens, especially good interaction of citizens with e-services which is provided in the business sector, encourages governments to use ICT as a tool to provide better services for their citizens. At the same time, a new problem has emerged known as the digital divide due to a lack of ICT adoption. This causes gaps to occur among the various levels of individuals up to governments and nations. It also impedes the performance of e-government, hence the emergence of a correlation between closing the digital divide on the one hand and raising the performance of e-government on the other hand.

The interesting in this subject due to the following reasons:

When reading many papers and studies in Arabic and English language concerning e-government and the digital divide in Iraq and Middle Eastern countries, it show a lack in studies regarding analyses of the digital divide and of e-government indices. Did not find any study clearly identifying the main factors of the digital divide in the Middle East. There is no identification for weakness of the digital divide in which ICT aspect in access, use or skills. There is an absence of explanations that clarify the relationship between closing the digital divide and increasing e-government performance, including an explanation and interpretation about the Arab countries that have good situations financially and physically.

This thesis explains and interprets e-government indices and ICT development indices regarding access, use and skills that reflect aspects of the digital divide. By Use a different means of analysis which does not depend on index values. Instead,

thesis depends on the average differences and rankings for each index. It has been identified that there are weaknesses in the HCI and ICT Skills Index and demonstrated that there is a relationship between these two indices.

1.1 Purpose and Scope

The main problem that needs to be addressed is determining the weaknesses in aspects of the digital divide, including ICT access, ICT use or ICT skills which have negative effects on e-government performance in ME countries in addition needing to correct the evaluation of e-government indices in order to determine the extent to which the digital divide influences it. There is an error found in the evaluation of e-government indices. The index value alone did not reflect the reality of the strong and weak points. Moreover, the performance levels for each index were compared to other countries of the world.

The purpose of our study is to determine key factors that affect closing the digital divide and improve the performance of e-government by searching for any correlation between e-government indicators and ICT development indicators which reflect aspects of the digital divide and by using the average difference value as a quick tool to evaluate e-government HCI, OSI and TII indices. Additionally, the purpose of the study is to diagnose the weak and strong points in indices performance and to find the challenges that prevent Arab countries from having higher income and good ICT infrastructure and from entering the list of world e-government leaders.

In the scope of the study, our investigation was conducted to determine the weaknesses in the indices that negatively impact on closing the digital divide and e-government performance. By focusing on e-government indices HCI, OSI and TII and ICT development indices, such as the ICT Access Index, ICT Use Index, ICT Skills Index and components of the HCI and ICT Skills Index. Focusing carefully on the HCI after having found unique behavior which differs from OSI and TII. We have concentrated on Middle Eastern countries and take Iraq, Bahrain and the KSA as case studies from 2002 to 2014.

1.2 Research Question

(1) "Can the HCI and ICT skills index play a unique role in closing the digital divide and raise e-government performance in Iraq and Middle Eastern countries?"

(2) "Why are rich Arab countries that have good ICT infrastructure not able to enter the list of world e-government leaders?"

1.3 Outline

The remaining part of this thesis is firstly structured into Chapter 2, which covers an introduction and literature review of e-government and the digital divide. review and discuss their definitions and components. In addition, explain the indicators that reflect their aspects. Moreover, discuss the successful policies adopted in the UK to closing the digital divide, which is digital by default and its effects on the use of e-government services seamlessly as well as the benefits gained through closing the digital divide. By taking three countries as case studies: Iraq, Bahrain and the KSA. Through cover these countries and discuss their strategies and the reality of the achievements, developments and ranked progress from 2002 to 2014.

Chapter 3 analyzes data for three ITU indicators that measure the digital divide: the ICT Access Index, the ICT Use Index and the ICT Skills Index in Middle Eastern countries. Identified the ICT Skills Index as a key factor for the digital divide. An analysis is conducted on the collected data and on extracts from ITU and UN surveys about Middle Eastern countries. Furthermore, a relationship is proved between the HCI and ICT Skills indices through an analysis of their components from 2002 to 2014 in addition to an analysis and discussion of the effects of the HCI on e-government rankings. After analyzing the indices of Arab countries and in our case studies Iraq, Bahrain and KSA, explain and prove that the average difference value is a quick tool to evaluate e-government indices.

Finally in the conclusion chapter, Chapter 4, discuss the results, findings, limitations and future work which has been obtained from the findings in Chapters 2 and 3.

CHAPTER 2

BACKGROUND AND LITERATURE REVIEW

2.1 Background

2.1.1 E-Government

There are several definitions of e-government based on the perspectives of experts, scientists and organizations who define it. They have different perceptions and visions of the reality, function and performance of e-government. Some important definitions can review about it as follows. “E-Government refers to the use by government agencies of information technologies, such as Wide Area Networks, the Internet and mobile computing, which have the ability to transform relations with citizens, businesses, and other arms of government [1].This definition and many others are focused on clarifying the role of the ICT to provide assistance in e-government.

“The use of information and communication technologies, and particularly the Internet, as a tool to achieve better government” [2]. The Organization for Economic Co-operation and Development (OECD) has adopted this definition since 2003. This is similar to the previous definition given at [1]. This definition “The act or process of governing; specifically: authoritative direction or control” [3] is correct. However, it talks in general terms. This definition: “The employment of the Internet and the world-wide-web for delivering government information and services to the citizens” [4] has a narrow vision and limits e-government to the Internet only. The Internet is important and is considered to be a Midfield carrier for service. However, this does not mean ignoring all the other factors.

By looking at the definitions, it’s clear that e-government initiatives are about governments providing services to service consumers. It is possible to classify e-government models based on the nature of the service provider and consumer. Basically, government is the primary service provider. On the consumer side, we may misinterpret that only citizens acquire services. However, business, non-citizen

employees and even government itself can also be service consumers. Based on this fact, we can classify e-government initiatives as follows:

- Government-to-Citizen (G2C) – the interaction between government and citizens to provide information, services, and other functionality to citizens [1] and [5]. For example, taxes, fees paid to government such as for driving licenses [6]**.** There are also electronic service deliveries for exchange of information [1] and [5**]** including citizens sending reports about illegal acts or criticizing a particular government policy and proposing solutions.

- Government-to-Business (G2B) – the interaction between government and business to conduct e-transactions initiatives, such as e-procurement, online service delivery, and exchange of information and commodities.

- Government-to-Employee (G2E) – the interaction between government and employees to manage internal communications and the civil service with employees of government to achieve processing the system and paperless career applications in an e-office. This includes e-office online participation and e-learning.

- Government-to-Government (G2G) – the interaction between government departments or agencies and the collaboration and sharing of information between agencies of government through projects or systems that support this operation [1]. These include exchanging and sharing information and data between the Ministry of Interior and the Ministry of Defense through private government networks.

As can be seen, the interaction between the service provider and the consumer is in both directions; hence, we encounter terms such as C2G and B2G to refer to citizen to government and business to government respectively. We can see that there is a relation between e-government and ICT regarding interaction, conducting business and delivering services as we mention some examples with the services G2C, G2B, G2E and G2G by using ICT. We can also encounter the term “e-governance,” which is frequently mentioned in the literature along with the term “e-government.” E-Governance is the use of ICT in society through different actors to improve the access to information and to build capacity. By looking at these properties, it may be

easily confused with e-government; however, e-governance is more about using ICT from the public sectors, which will improve service delivery and activate participation of citizens in the process of decision-making [7]. Before we proceed with the potential barriers hindering the transformation of processes from paper-based models to electronic channels, we briefly visit e-governance.

E-Governance has a wider concept than e-government. It is related to defining the technologies that impact government's administration and manages its relation with society and public servants. E-governance includes a series of essential steps that direct government agencies in development and administration so as to ensure the achievement of successful delivery and implementation of the services of e-government [8].

Government	**Governance**
Electronic Service Delivery	Electronic Consultation
Electronic Workflow	Electronic Administration & Management
Electronic Voting	Electronic Engagement
Electronic productivity	Networked Societal Guidance

Table 1 E-Government and E-Governance Functions [8]

Table 1 shows the functions of e-government and e-governance that relate to each of them. E-Government is responsible for services and their delivery, workflow, productivity and electronic voting. E-Governance is responsible for Electronic Consultation, Electronic Administration and Management, Electronic Engagement and Networked Societal Guidance.

Barriers

When we look at these service delivery models, we see many actors on the consumer side. For this reason, there is a variety in the consumers; e.g. a business may need to submit its tax file to the related ministry while a citizen would like to inform a local government office about his change of address. Such variety creates a variety of potential problems both in the information structure and in the touch points to

government. The problem grows with privacy and security concerns. Hence, we see that visiting barriers in e-government delivery is a requirement.

There are several barriers and obstacles on the way to implementing e-government initiatives. The main important barriers not limited to, but include:

- Legislative barriers, regarding laws, regulations and directives that relate to the use of electronic services and facilitate their work and publication.

- Administrative barriers related to the absence of suitable business models, the need to develop the skills of staff, repairs related to administrative structuring.

- Technological barriers associated with ICT infrastructure have standards, suitable tools and the ability to develop, deploy and use electronic services[9]**.**

- Confidence, absence of confidence in the electronic government from citizens, which is the main goal of e-government and other beneficiaries, such as business institutions and the public and private sector [10].

- Economic barriers related to limited budgets that cause non-implementation of policies and strategies which are prepared for the development of e-government.

- The digital divide, as explained in (Section 2.1.3).

As we see so far, enabling e-government projects is not an easy or short term task. Considering the flow of information, privacy, security, adoption and similar subjects, countries are spending considerable resources in terms of money, human resources and time. For this reason, there are internationally recognized initiatives to provide road maps to willing countries. The UN and ITU are two popular and widely accepted organizations which publish reports on how each country is performing in this transformation, i.e. transforming paper-based models to electronic government models. Throughout the thesis, we present figures, statistical snapshots and rankings of the countries based on the reports prepared by the UN and ITU. Therefore, it is

beneficial to provide some basic information about these organizations in the next section.

2.1.2 Indices

The International Telecommunication Union is an agency belonging to the United Nations. It specializes in information and communication technologies (ICTs). The main responsibility of the ITU is to allocate satellite orbits, spectrums of global radio and to develop the technical standards for ICTs. The UN has many responsibilities to their member states and to the world. The ITU handles these through its resources. For example, the ITU manages its responsibilities related to emergency services, power networks, water supplies and chains of food distribution. The ITU connects the world seamlessly without any difficulties with ICT environments. The ITU has 193 member states. Its membership is found in both the public and private sectors. In addition, it includes 700 private companies and leading academic institutions [11].

The United Nations produces surveys on e-government every two years. The Economic and Social Affairs Department handles this responsibility. The UN assesses the development status of e-government of the 193 member states. The United Nations has adopted each e-government survey as a comprehensive perspective for e-government development. It depends on the three dimensions, namely online services availability, infrastructure of telecommunication and human capacity. The UN selects indices to reflect these dimensions [12].

The three indices which the UN selects are the TII, OSI and HCI. Each index reflects a particular aspect of the reality of e-government in each country. The UN has adopted indicators and methodologies to calculate those indicators .The final goal is to give an e-government rank for each country .We address each of these indices and what each reflects, their own calculation methodology respectively and their respective components.

2.1.2.1 Telecommunication Infrastructure Index (TII)

According to the 2014 survey, this indicator shows and reflects the situation of the telecommunication infrastructure in each country. The TII measures the reality of telecommunication infrastructure by depending on five indices. Each of these indices

reflects a part of the reality of the infrastructure by following aspects such as mobile, Internet, fixed wireless, fixed telephone and broadband. Specifically, these indices measure the number of mobile subscribers per 100 inhabitants, the estimated number of Internet users per 100 inhabitants, the number of wireless broadband subscriptions per 100 inhabitants, the number of fixed broadband subscriptions per 100 inhabitants and the number of main fixed telephone lines per 100 inhabitants. The TII is calculated arithmetically by taking the average of these five indices. The primary source of the data is the Telecommunication Union in each case.

TII = (number of mobile subscribers per 100 inhabitants

+ estimated Internet users per 100 inhabitants

+ number of wireless broadband subscriptions per 100 inhabitants

+ number of fixed broadband subscriptions per 100 inhabitants

+ number of main fixed telephone lines per 100 inhabitants) /5.

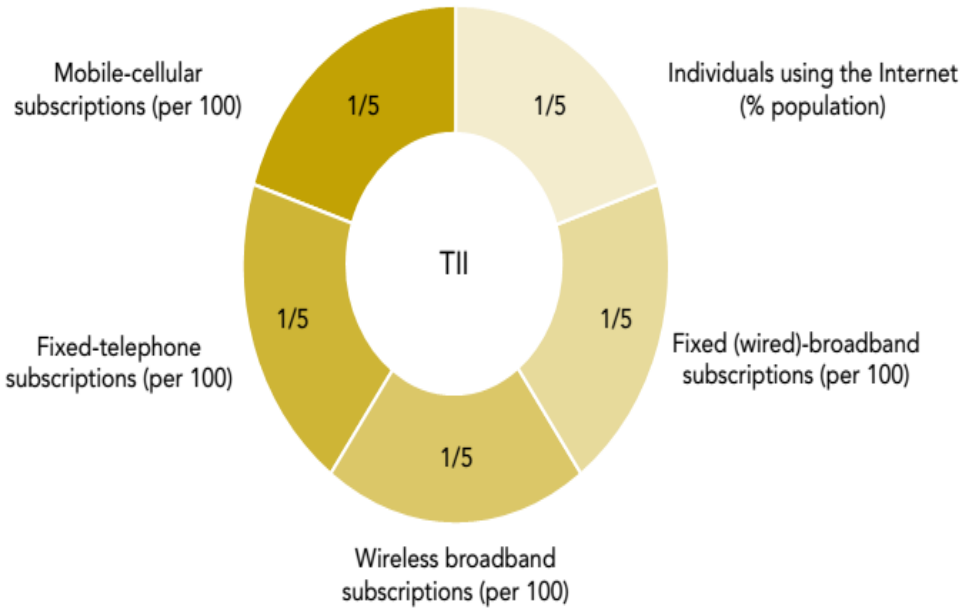


Figure 1 Telecommunication Infrastructure Index (TII) and it's Components [12]

Figure 1 shows the five components of the TII, each of which represents 1/5 of the total account of the TII.

2.1.2.2 Online Service Index (OSI)

According to the 2014 survey, the OSI reflects the reality of online services that are provided by e-government in each country. The method of calculating this index differs from the HCI and TII indicators. Previous indicators rely on statistics and provide a clear number. This indicator is based on a questionnaire in its account. The methodology of measuring Online Service Index values depends on a collected persons group which consists of more than 90 researchers including qualified graduate students and volunteer students in the field of public administration at universities. The job of this team is to evaluate online service. In order to ensure accurate and correct results for evaluation, researchers take training courses to learn how to apply the evaluation. For example, for the evaluation of the electronic service, there are two researchers who evaluate e-services according to existing questions about services. Some of the questions are as follows:

The number of available services that actually worked?

It is easier to use or not?

Researchers collect answers to these questions from the perspective of the citizen and not from the website and portal designer's perspective. Researchers evaluate the national website for each country in the native language of that country by measuring the performance of the national portal, e-services portal and e-participation portal. They test the related websites of the ministries of social services, labor, education, finance, and health. The information and features on the website should be found quickly and intuitively, have ease of use and be available. It should be usable with content readily discoverable by the intended beneficiaries.

We can explain these stages as follows:

- Stage 1 Emerging information services

  Government websites depend on public policy to provide information on regulations, governance, documentation on relevant laws, such as citizens being able to obtain updated information on ministries and national government. Moreover, links should lead to archived information.

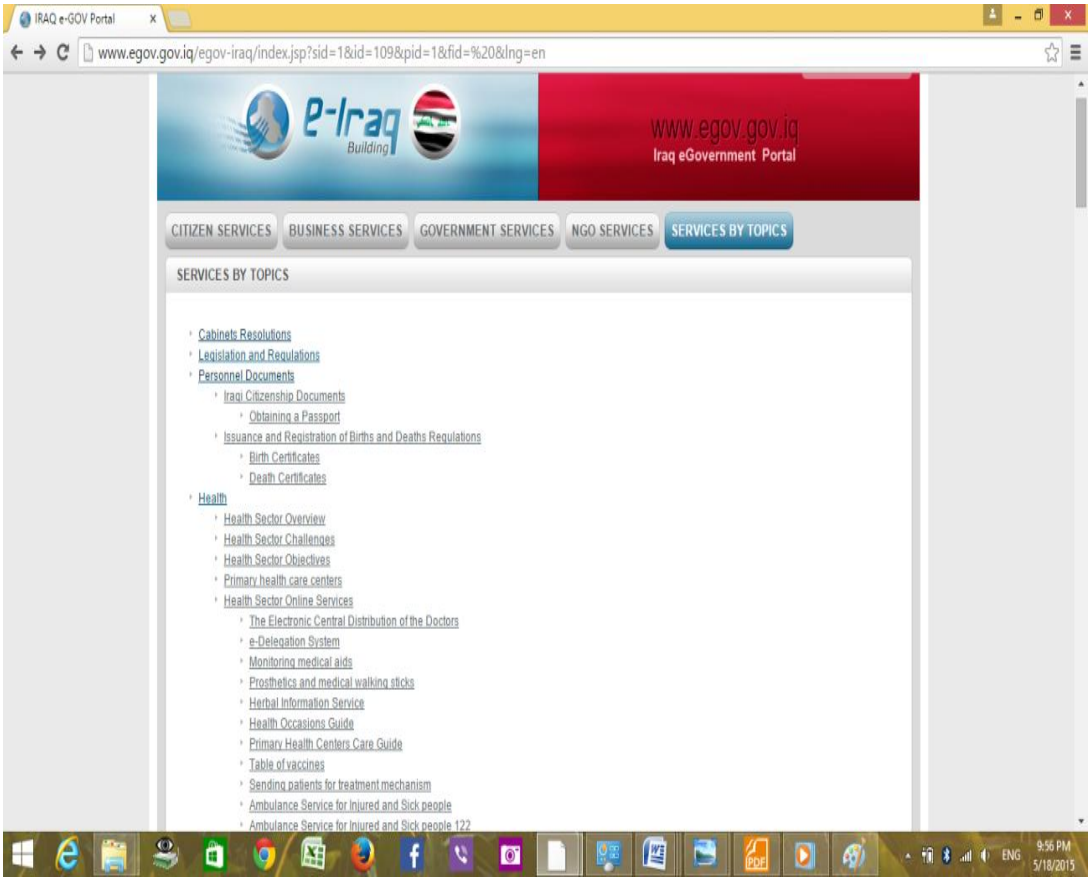


Figure 2 Provision of Laws Documentation by Iraq E-government Portal [13]

Stage 2 Enhanced information services

Government websites deliver enhancements by interactive contact between government and the citizen. This e-communication is either one-way or two-way and includes downloadable forms for government services and applications. Moreover, sites have audio and video capabilities to interact with citizens.

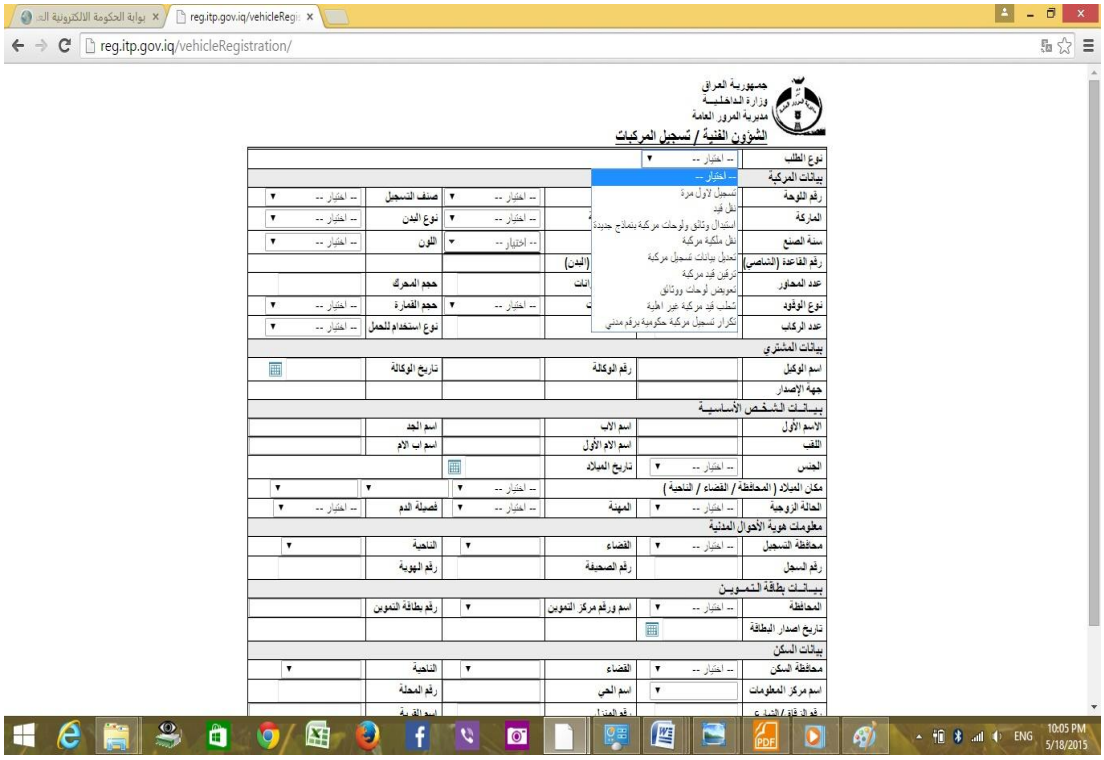


Figure 3 Vehicles Registration in Iraq E-government Portal [14]

- Stage 3 Transactional services

Government websites interact with citizens in two-way communication, including non-financial transactions processes, filing taxes online, applying for licenses and applying for certificates and permits. Financial transactions are handled on a secure network.

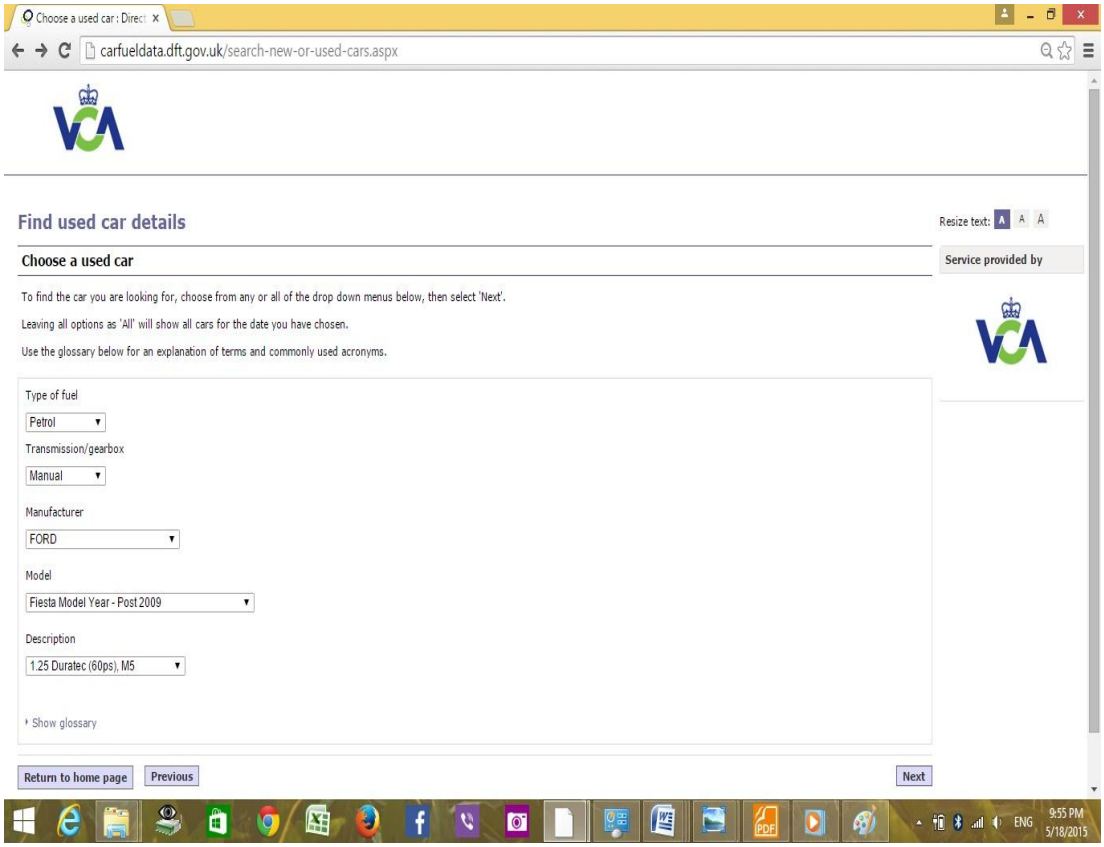


Figure 4 Filing Taxes for Used Cars Online on the UK E-government Portal [15]

- Stage 4 Connected Services

  Rather than service based models, this level offers services in a user-centric manner. The user basically logs on to the e-government website through which he can reach the desired services. More explicitly, the user does not seek a service provider, such as the ministry of health website. Instead, he finds the related service in his customized homepage on the portal. As the service providers, the government agencies are connected to each other electronically, so the information flow is guaranteed between them.

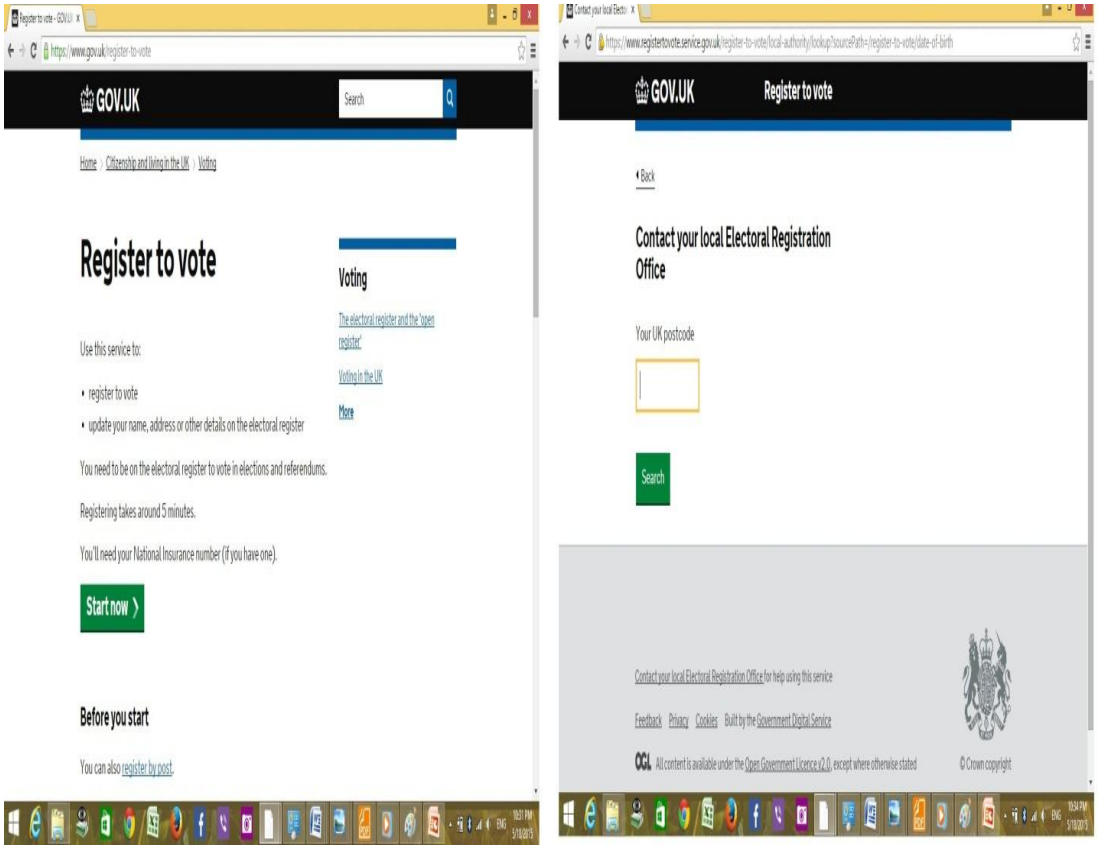


Figure 5 Register to Vote and Voice Contact with the Registration Office on the UK E-government Portal [16]

Additionally, government websites are developing interactions with their citizens. By using Web 2.0, environments are created by governments to activate citizens' roles to be involved in the activities of government. These include citizens' sharing their voice in decision-making.

The online index ranges from 0 to 1 as it is a normalized value. The online index value gives a score to each country ranging from 0 to 153. The highest score of 153 could be given to any country on the list of 193 and so the minimum score is zero.

The mathematics to calculate the OSI for any country is as follows:

Online Service Index (Country "x")

Country "x" score = 114, minimum score = 0, high score = 153

= Country score – minimum score / high score – minimum score

= (114 – 0) / (153 – 0)

= 0.7451 the value of OSI for country "x"

2.1.2.3 Human Capital Index (HCI)

According to the 2014 survey, the HCI reflects the reality of the citizen from the educational side. It plays an important role in raising the rankings of e-governments. We explain this role in (Section 3.3). This index reflects the attention of governments to their citizens and the extent of their interest in them in the field of education. In many cases, acquiring education requires citizens to have a healthy financial situation. This indicator needs a long term investment for its value to rise. The HCI differs from the other indices (OSI and TII) due to this property. For example, the State of Bahrain is rich and has a small area. It has made agreements with the Cisco Company [17]. Bahrain has achieved high progress in its OSI and TII indices. However, Bahrain could not achieve the same progress in its HCI indicator. As explained in (Section 2.2.2.3), the HCI requires more than finances for its development. The HCI needs a long-term policy applied over many years. This policy is related to changes in the reality of education over a whole generation, including literacy and the number of students enrolled in higher education. This type of change cannot be carried out in the short term.

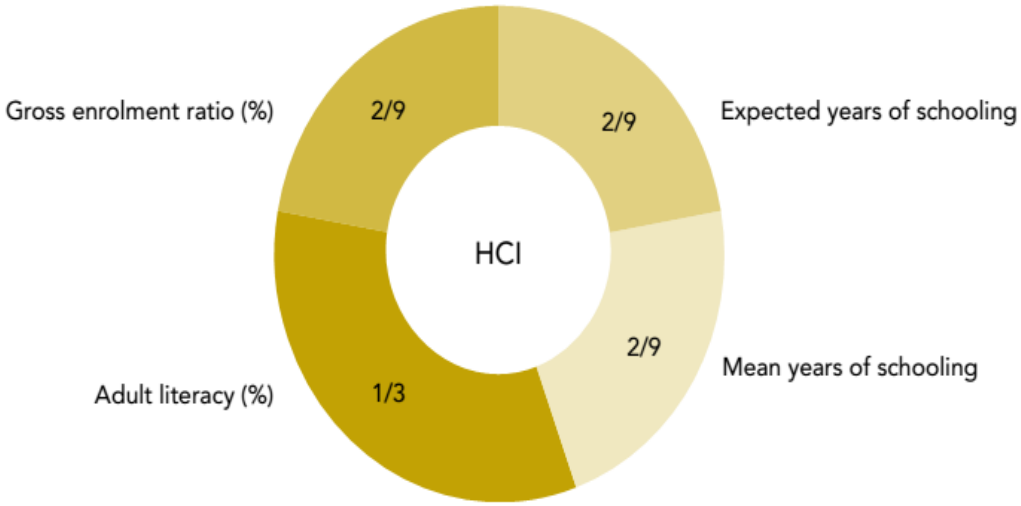


Figure 6 Human Capital Index (HCI) and its Components [12]

- Adult literacy is measured as the percentage of people who have a simple level of reading and writing. Their ages range from 15 years and above. They have the ability to understand, read, and write short simple statements.

- The gross enrolment ratio measures the gross enrolment ratio for all students at the primary, secondary and tertiary levels regardless of age.

- Expected years of schooling is the total number of schooling years a child would spend to finish schooling from primary to secondary to tertiary levels. It starts from the current enrolment ratio age for a child.

- Mean years of schooling (MYS) is the average number of years of education completed by a country's adult population 25 years and older, excluding repeated grades spent at the same level.

Human capital composite value = Adult literacy rate Z-score/3
+ 2 × Gross enrolment ratio Z-score/9
+ 2 × Expected years of schooling Z-score /9
+ 2 × Mean years of schooling Z-score/9

The Z-score is a statistical measurement which calculates the relationship of the mean to the standard deviations in a group of scores [18].

Note: Z-score $=\frac{X-\mu}{\theta}$, X = a raw score before the standardized, μ = population's mean, θ = population's standard deviation [31]

HCI Calculation

The human capital value is calculated with this formula:

Human Capital Index (Country "x") = Country "x" composite value – lowest composite value for all countries / High composite value for all countries – lowest composite value for all countries. For example, if country "x" has the composite value = 0.8438, lowest composite value for all countries = 3.2354, highest = 1.2752, the Human Capital Index normalized value of country "x" would be:

Human Capital Index (Country "x") = [0.8438–(–3.2354)] / [1.2752–(–3.2354)]
= 0.9044

Change of HCI

Components of HCI in past Surveys (2002, 2003, 2004, 2005, 2008, 2010, 2012)	*Components of HCI in 2014 Survey*
Adult literacy	Adult literacy
Gross enrolment ratio	Gross enrolment ratio
-	Expected years of schooling
-	Mean years of schooling

Table 2 HCI and Changes of Its Components From 2002 to 2014 [12]

The HCI through all UN surveys from 2002 to 2012 has only two components, namely the Adult literacy and Gross enrolment ratio. In the 2014 survey, two more components were added: mean years of schooling and expected years.

As we have reviewed the related, the two new components include schooling's expected years and the schooling's mean years. They reflect performance on two sides, government and citizens. They add to HCI elements in order to help the measurement operation of the HCI and help the measurement to be more accurate, realistic and reflect the HCI in more detail. Schooling's expected years reflect the number of years that states produce for their citizens. This classic service differs from one state to another. For example, some states produce 23 years from primary school to higher studies. Moreover, some countries have less than 18 years due to the fact that they do not have higher education, such as South Sudan, except for some higher human studies in some universities. Furthermore, schooling's mean years reflect the level of students' performance through the study of life. For example, adult citizens mean years of schooling's ratio in the UK differ from South Sudan. These two factors enhance the HCI measurement. We believe that the HCI's four components need further additions to reflect the level of the HCI without any error rate. This will be added in the coming years to become five or six components if the UN makes data available regarding the details and reality of education around the world.

2.1.2.4 The E-Government Development Index (EGDI)

The E-Government Development Index (EGDI) is used to measure the capacity and willingness of administrations of countries that use ICT to deliver public services. The number of countries that registered their e-governments in the United Nations is

193 [12]. The classification of these countries and their rankings is important as it reflects the level of the development of any country. Therefore, the EGDI is important since its value represents the ranking of e-government in the world. The EGDI is a compound of three indices which measure online services, telecommunication infrastructure development status and human capital focusing on the human situation in education and other factors. After calculating each of these indices, they are compounded with the EGDI. This formula explains the EGDI mathematically: EGDI = (OSI+ TII+ HCI)/3

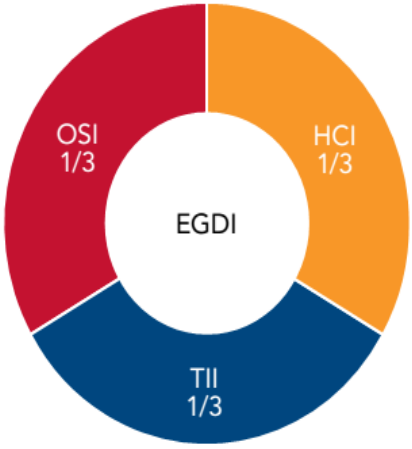


Figure 7 Three Components of the EGDI [12]

Figure 7 shows the EGDI consisting of three indices: the HCI, OSI and TII. Each has the same weighting of 0.33.

Country	Region	2014 EGDI	2014 Rank	2012 Rank	Change in Rank (2012–2014)
Republic of Korea	Asia	0.9462	1	1	-
Australia	Oceania	0.9103	2	12	↑ 10
Singapore	Asia	0.9076	3	10	↑ 7
France	Europe	0.8938	4	6	↑ 2
Netherlands	Europe	0.8897	5	2	↓ 3
Japan	Asia	0.8874	6	18	↑ 12
United States of America	Americas	0.8748	7	5	↓ 2
United Kingdom	Europe	0.8695	8	3	↓ 5
New Zealand	Oceania	0.8644	9	13	↑ 4
Finland	Europe	0.8449	10	9	↓ 1
Canada	Americas	0.8418	11	11	-
Spain	Europe	0.8410	12	23	↑ 11
Norway	Europe	0.8357	13	8	↓ 5
Sweden	Europe	0.8225	14	7	↓ 7
Estonia	Europe	0.8180	15	20	↑ 5
Denmark	Europe	0.8162	16	4	↓ 12
Israel	Asia	0.8162	17	16	↓ 1
Bahrain	Asia	0.8089	18	36	↑ 18
Iceland	Europe	0.7970	19	22	↑ 3
Austria	Europe	0.7912	20	21	↑ 1
Germany	Europe	0.7864	21	17	↓ 4
Ireland	Europe	0.7810	22	34	↑ 12
Italy	Europe	0.7593	23	32	↑ 9
Luxembourg	Europe	0.7591	24	19	↓ 5
Belgium	Europe	0.7564	25	24	↓ 1
Very High EGDI Average		0.8368			
World Average		0.4712			

Table 3 World E-government Leaders [12]

Table 3 shows a list of the 25 countries which are the world leaders of e-government. These countries have EGDI values in the range of 0.75 to 1.00, which is considered to be a very high EGDI. Europe has 16 countries in this list, Asia has 5 countries, and the Americas have 2 countries and Oceania has 2 countries. All of these countries are considered high-income nations. Bahrain has 18; it advanced to the 18 ranking from 2012 to 2014. The Republic of Korea ranked first in 2012 to 2014. Australia ranked second and Singapore third. The average of the EGDI in these 25 countries is 0.8368, which is considered to be very high as the world average is 0.4712.

2.1.2.5 ICT Development Index (IDI)

According to [19]**,** the ICT Development Index (IDI) is similar to the EGDI. Both of these are a composite index and they have three indices. In 2008, the ITU developed the IDI. In 2009, it was first presented in the edition of measuring the Information Society [19] by being used to measure the developments in ICT access, ICT use and ICT skills across countries. The IDI is a compound of three indices: the ICT access index, the ICT use index and the ICT skills index. After calculating each these indices, they are compounded with the IDI.

This formula explains IDI mathematically.

IDI = (0.4 × ICT access index + 0.4 × ICT use index + 0.2 × ICT skills index).

It can be said that IDI is similar to EGDI, both of which have three indices. However, we are not interested in the weight of each index. We are interested in the relationship between the Human Capital Index and the ICT Skills Index.

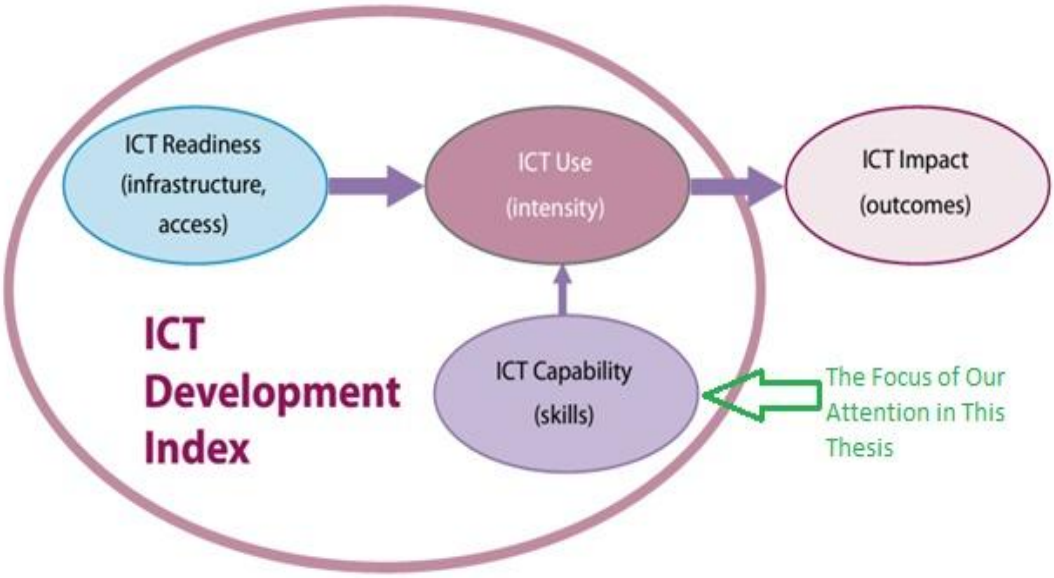


Figure 8 Three Stages in the Evolution towards an Information Society [19]

Figure 8 shows the three stages of IDI: ICT readiness (infrastructure access), ICT use intensity and ICT capability (skill). These stages enter in the operation of evolution to an information society.

- The first stage represents ICT readiness, which shows the level of, and access to, ICTs and networked infrastructure. The Access Index reflects this stage.

- The second stage represents ICT intensity, which shows the level of ICT use in society. The ICT Use Index reflects this stage.

- The third stage represents ICT impact, which shows the outcome of effective and efficient use of ICT. The ICT Skills Index reflects this stage.

We will focus on and highlight ICT skills in our work.

Region	IDI 2012						IDI 2011						Difference 2011-2012		
	Max.	Min.	Range	Average value*	StDev	CV	Max.	Min.	Range	Average value*	StDev	CV	Range	Average value*	CV
Europe	8.45	4.11	4.34	6.73	1.14	16.89	8.41	3.80	4.61	6.51	1.14	17.49	-0.27	0.22	-0.61
CIS	6.19	3.12	3.07	4.95	0.96	19.40	5.94	3.02	2.91	4.65	0.88	18.96	0.16	0.31	0.45
The Americas	7.53	2.54	4.99	4.45	1.33	29.87	7.35	2.39	4.96	4.22	1.26	29.91	0.03	0.22	-0.04
Asia & Pacific	8.57	1.73	6.84	4.37	2.26	51.83	8.51	1.62	6.89	4.20	2.25	53.59	-0.05	0.17	-1.76
Arab States	6.54	1.70	4.84	3.94	1.74	44.08	6.41	1.68	4.74	3.68	1.58	42.82	0.10	0.26	1.25
Africa	4.75	0.99	3.75	2.00	0.94	46.98	4.36	0.93	3.43	1.87	0.85	45.22	0.33	0.13	1.76

Note: * Simple average. StDev: Standard deviation; CV: Coefficient of variation.
Source: ITU.

Table 4 IDI by Region, 2011 and 2012 [19]

Table 4 shows the ICT Development Index (Access, Use, Skills) values for six Categories. The average values for these categories: Europe, CIS, The Americas, Asia and Pacific, Arab States, and Africa are as follows: 6.37, 4.95, 4.45, 4.37, 3.94 and 2.00. The Arab States category is fifth before Africa, which is the last category.

We are interested in the ICT skills index because it measures the skills of ICT and we will focus on it to find a relationship between it and the HCI in (Section 3.3) [19].

ICT Skills Index

According to calculations of the ITU, ICT Skills index or (IDI skills sub-index), its components are

1. Adult literacy rate is the same definition as the HCI in (Section 2.1.2.3).

2. Gross enrolment ratio (secondary and tertiary level) is measured by taking the total number of students who enroll through these two stages [19].

	ICT Skills index	Weight
1	Adult literacy rate	33%
2	gross enrolment ratio(Secondary)	33%
3	gross enrolment ratio(Tertiary)	33%

Table 5 ICT Skills Index Components [19]

The ITU selects these factors to scale ICT skills; in other words, the relationship between the adult literacy rate, secondary gross enrolment ratio, tertiary gross enrolment ratio and ICT skills. Any citizen who does not have literacy cannot or hardy use a computer or the Internet. Any student at secondary school should study a computer course because in nearly every secondary curriculum, there is a computer or ICT course. Any tertiary student will have more developed ICT skills since in scientific studies (such as engineering, science, etc.), ICT skills for students are very good and in non-scientific studies (such as arts, history, etc.). Students need to use computers and the Internet to finish their studies.

2.1.3 Digital Divide

The rapid development in the use of digital technology presented some problems. However, we can say that the digital divide problem is the most important which impedes the performance of e-government. We highlight some definitions of the digital divide, its causes and methods of measurement according to the ITU.

The gap that appears between several levels of individuals, households, businesses and geographic area appears in different economic and social stages with regard to their ICT access and use [20]. The gap appears between those who have access to digital technologies and those who do not [21]. It refers to the disparity in ICT access [22].

All of these definitions focus on ICT access, except for the OECD definition, which focuses on ICT access and use. However, saying that the digital divide is limited only to the availability of ICT infrastructure and the lack of ICT access or use is open to discussion.

We need to think of the ability to access ICT and the inability to use ICT or its use without the existence of required skills. Moreover, the digital divide is a changeable problem. Perhaps the causes will change or the levels of appearance will change depending on any technological development, social, economic or even political problems. Even appearing levels can be changed. We can determine the individual as the lowest level and government as the highest level. However, levels among them may vary depending on the evolution, such as that which previously appeared in a social media cluster and in e-business. As we reviewed, we can define the digital divide as follow

The gap can occur among various levels of individuals up to governments and nations because of the lack of ICT access, ICT use and ICT skills.

The 2014 UN survey has demonstrated that access to ICT infrastructure is primarily an issue of the digital divide. However, we should give attention to the access and use of ICT. According to the ITU, we can understand the digital divide by distinguishing ICT access, ICT use and ICT skills between countries and grouping those with the same characteristics. The ITU wants to measure the ICT developments for countries. At the same time, they want to evaluate and track the digital divide around the world. The ITU produces the IDI index to measure and track the digital divide [19], as explained in (Section 3.1).

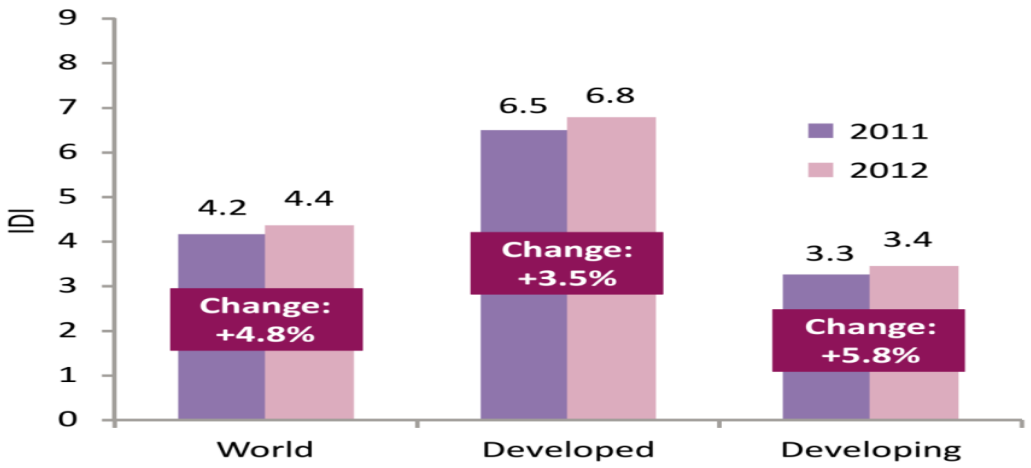


Figure 9 IDI, World and by Level of Development [19]

Figure 10 shows the average of IDI value and growing changes from 2011 to 2012 around the world in developed and developing countries. It shows the divide between the developing and developed countries. In 2012, the average of the IDI value for developed countries was 6.8, which is more than twice the average IDI value for developing countries, which was 3.4. We can see that a gap shows clearly between developed and developing countries. This gap reflects the digital divide. The growing change in the IDI value for developing countries is growing faster at a rate of 5.8 percent, while developed countries have a rate of 3.5 percent.

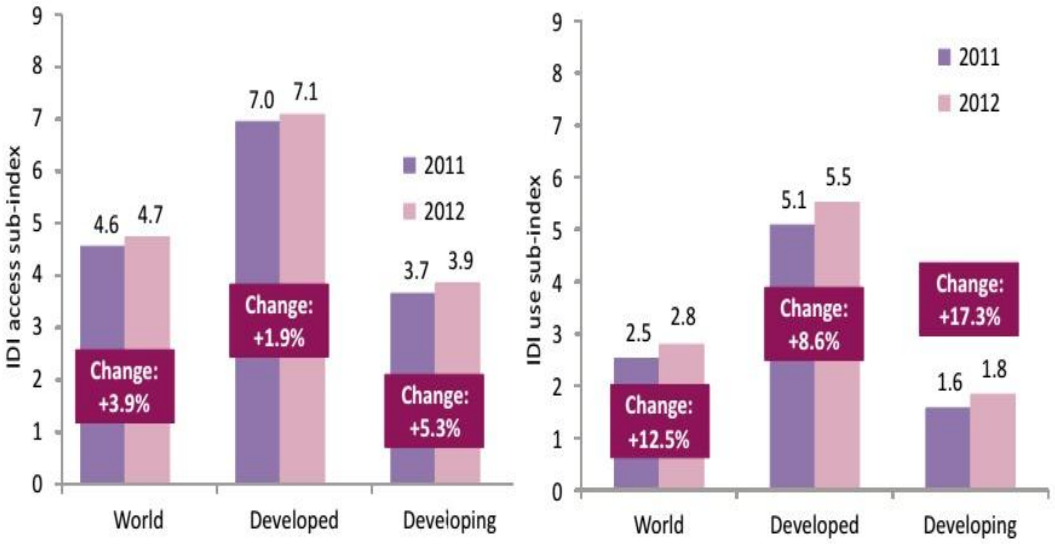


Figure 10 IDI access sub-index and IDI use sub-index, world and by level of development [19]

Figure 10 shows the IDI access and IDI use changes ratio from 2011 to 2012 around the world in both developed countries and developing countries. It shows a divide in the access and use of ICT between developing and developed countries and the world. The left chart shows in 2012 that the average of the IDI access value for developed countries is 7.1, while for developing countries, it is 3.9 and for the world, it is 4.7. This clearly shows the digital divide in aspects of access. However, there is a faster growing change in developing countries with a value of 5.3 percent, while there is less growing change in developed countries.

On the other hand, the right chart shows in 2012 that the average of the IDI use value for developed countries is 5.5 and for developing countries it is 1.8 and for the world it is 2.8. The using digital divide appears clearly. However, there is faster growing change in developing countries with a value of 17.3 percent, while there is less growing change in developed countries at 8.6 percent.

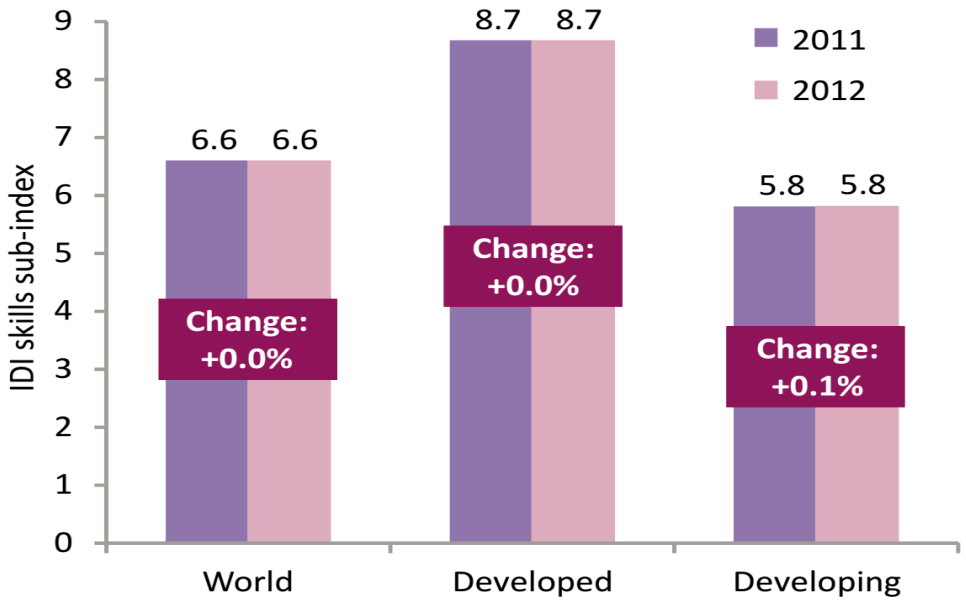


Figure 11 IDI skills sub-index, world and by level of development [19]

Figure 11 shows the average of the IDI skills value and the growing changes from 2011 to 2012 around the world in developed and developing countries. It shows a divide in ICT skills between the developing and developed world. In 2012, the average of the IDI skills value for developed countries is 8.7, for developing countries, it is 5.8, and for the world, it is 6.6. On the other hand, we can see there is no noticeable change in the growth of developing countries, which is 0.1 percent,

while there is no change in growth in developed countries, which is zero percent. There is different behavior compared with the remaining indicators which use the ICT index and ICT access index, where there is a small change in growth. This behavior is somewhat similar to the behavior of HCI. In order to make a tangible change, it is necessary to research the relation between the Human Capital Index and the ICT Skill Index in (Section 3.2).

We can see that IDI, with its three components of access, use and skills, measures the divide and reflect the ICT development situation in every country. IDI skills give the developed countries the advantage to be in the top ICT world leaders as there is difficulty to make positive changes to it for developed countries. This digital divide that shows through ICT development index has a negative effect on the development of countries. The question remains as to how to overcome this divide without knowing the reasons for it. Knowing the causes helps to diagnose and resolve the problem. We endeavored to collect the reasons in a simplified manner without going into the complexities. We can review the reasons for the digital divide as follows:

- High cost of access, which is shown in the developing countries. The economic side is adversely affected. For example, they are not able to offer free or low-cost Internet services to make access easier [12].

- Political barriers; countries should develop a policy to address the problem of the digital divide. Long-term policies take into account and connect modern techniques with education and help citizens to acquire this new technology. The policy should be implemented according to the steps carried out in a specific timetable, such as the digital by default policy in the UK, the aim of which is to provide e-services to all UK citizens easily. This policy is committed to a timetable. (Section 2.2.1)

- On the physical side, there is non-availability of access to ICTs. This can be in terms of availability of broadband, Internet connections, computers, mobile devices, smart phones and in general all communication infrastructure access. Wide geographical areas in some countries impede the deployment of telecommunications networks in addition to the lack of investment by the public and private sector.

- Disparity in technology access between developed and developing countries directly affect the use of technology. For example, the percentage of individuals who use the Internet in developed countries is far higher than the percentage of individuals in developing countries. The digital divides shows this clearly. The figure below illustrates the difference in the use of the Internet, through the selection of sample countries from both developing and developed countries [19].

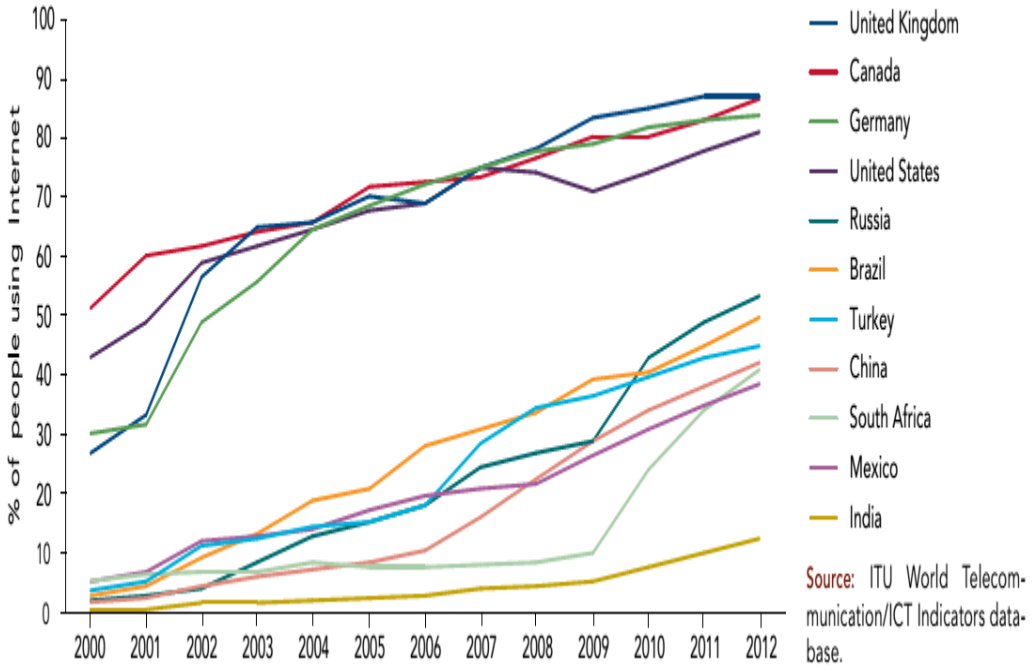


Figure 12 Changes in Percentage of People Using the Internet, Selected Countries [19]

- Educational disparity – according to the 2014 UN survey, there is a clear relationship between education, literacy and ICT skills. Education is the main factor and determinant of the intensity of Internet use. This gives the developed countries that have good human resources the advantage to remain advanced far ahead of the others. For example, if a person has a Bachelor degree or higher, the probability of increasing Internet use per day in Europe is 2.4 times and in Republic of Korea 3.6 times.

- Language and content barriers – after access to technology, there are other barriers. If the citizen logs in to the Internet and cannot understand the

content, the question remains as to what is the purpose of making ICT infrastructure available to all as logging into the Internet and participating in it determines participation in society and the economy [12].

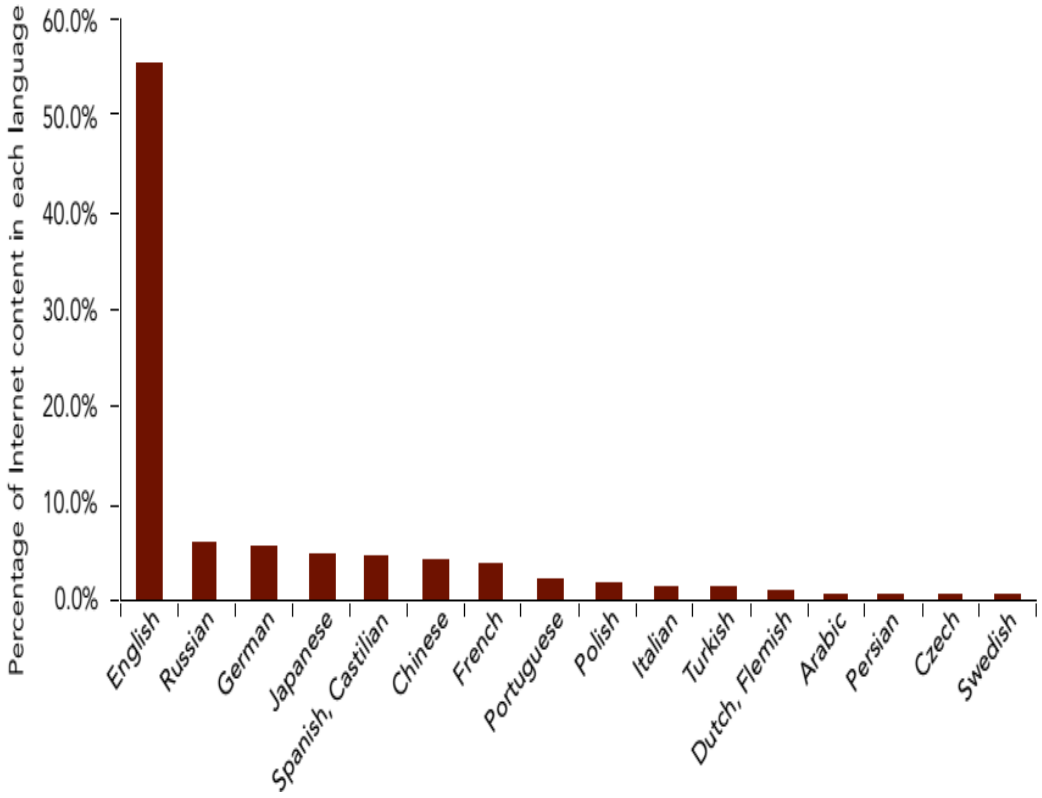


Figure 13 Lack of Content in Own Language as a Barrier to Accessibility, Selected Countries [12]

Figure 13 shows the percentage of Internet content in each language in 2013. The English language ranks first with 56 percent. The Russian and German languages are in second place with 6 percent. French, Spanish and Chinese are third with 4 percent, followed by the Portuguese language with 2 percent and the Arabic language with 1 percent.

- With regard to the gender barrier, there is a gap in access to technology, especially the Internet, as shown within the same country, the same group and the same family. It is shown by gender such that access to the Internet between women and men differs, as shown in Figure 14.

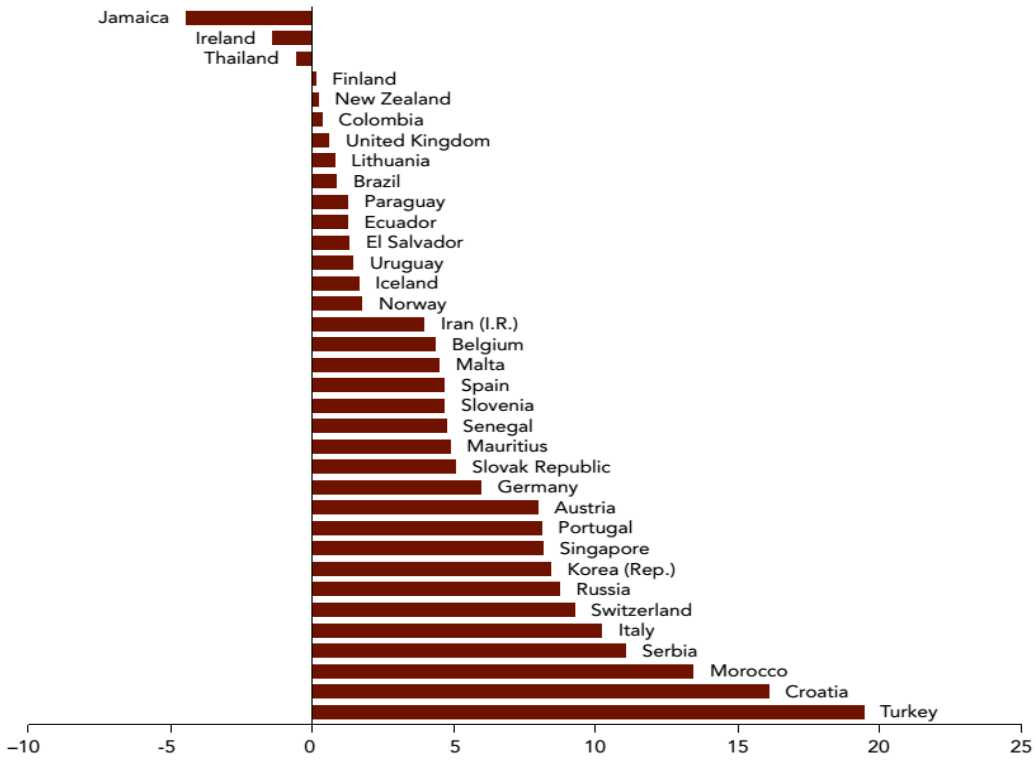


Figure 14 Disparity in Use of the Internet between Men and Women [12]

Figure 14 shows that if the country has a value close to zero, the gender ratio of use of the Internet between men and women is roughly equal and close to a 50%-50% distribution. Finland, New Zealand and Colombia are the countries whose values are closest to zero. On the other hand, in Turkey, Croatia and Morocco, men use the Internet more than women. Turkey is the highest country at 18 percent. Finally, men have higher Internet usage than women with the exception of three countries, namely Jamaica, Thailand and Ireland.

There is a correlation between the digital divide on the one hand and the level of performance of e-governments on the other hand. We can see the similarity in behavior between the HCI and IDI skills indices. In (Section 3.2), we search to find any relationship between the HCI and IDI skills, the effect of one on the other, and the effect of both on the digital divide and e-government performance.

2.2 Literature Review

2.2.1 Digital by Default

The UK Government wants to close the digital divide for using e-services in e-government by offering applications digitally by default. They decided to be direct and user friendly to achieve their goal instead of using any complicated plans, thereby leading to developing and finishing in the long-term future.

The UK government decided to offer good digital services so that people would prefer to implement the deal on the Internet instead of the phone, mail or through personal contact. Through the production of electronic services to citizens, this service should be easier to use so that it can be applied from the first time. Moreover, it also meets the needs of the citizen. Thus, it has been suggested for the standards and criteria for the design of digital services. The designers of the e-service in e-government must be committed to these standards and criteria [23].

As reported in study [24], published in 2012, the Government Digital Strategy of the UK has demonstrated that all services provided by central government departments in all UK ministries will transform to digital by default. They will provide public services digitally by default. Every e-service will follow the guidance of this strategy in terms of standards, designs and code. All directives are available from the official UK government website https://www.gov.uk/ document, figures and YouTube. The Government Digital Service [24], which belongs to the UK Cabinet Office, is responsible for the implementation of digital by default and is supported by the Government Communication Network. Digital by default was published in the UK government at end of 2012.

The conclusions of this study were that in 2012, the UK Cabinet Office adopted the digital by default strategy for e-government. All e-services should be standardized in standards, designs and code. Government digital services and network government communication networks are responsible for implementation.

According to the study in [25]**,** the digital services that are produced by e-government (both new and redesigned services) should be able to interact between each other and with the user (citizen) at the same time. This has to be developed

easily without major change in the main program structure or environment. It should make people feel good and satisfied through doing digital services to handle transactions online. Digital teams who are responsible for designing digital services must follow a service manual for digital by default for designing.

The service manual is considered to be a reference for service managers and digital delivery teams across government. A service manual consists of a set of standards and is a design manual. Firstly, it contains digital by default service standards and a set of criteria that digital teams should follow to produce the required services at high quality. A digital team should know and understand these standards carefully before starting to build digital services. Secondly, a government service design manual is a set of guidance and advice that should be learned and explained to teams across government. It clearly shows how to design and build digital services step by step. The service manual gives direction to digital teams to meet the criteria and standards through designing an operation. Government digital services will not be allowed to appear on the gov.uk domain if it is not compatible with the standards and criteria of digital by default. A service manual offers guides and resources for all concerned and involved in building e-services on all levels, including service managers, content designers, developers, researchers, web operators, performance analysts, chief technology officers and technical architects.

The UK government offers open e-services to meet the needs of citizens. These are frequently-used services by citizens, including birth certificates and passport applications. This produces e-services that meet the needs of citizens and have a special and high quality called digital by default.

There are 24 criteria which should be adopted by the designers of digital by default services. The first criterion is to understand the needs of users. 82% of the population is online in the UK. They expect good e-services with high quality to meet their needs. If those e-services are complex or perhaps even not clear, they will prefer personal contact, mail or other alternatives. The digital team that results from the cooperation between each government department, government digital service and network government communication network that are responsible for the design of digital service must be multidisciplinary to be able to implement tasks of design, construction and operation of the service to the fullest. A service must be managed

by designers with experience and high skill with high scalability in decision-making and an adoption model to analyze the success of the service and to know what is expected from a service.

Comparison the results after execution with expected results. The results are taken from user feedback. An analysis should done on user feedback and take this feedback results to add features and functions on next phase of development. Create a service simple and intuitive enough to make users succeed from first time, without any help. Make sure that the team has the technical ability and flexibility to modernize and improve the service on a frequent basis. Digital service should be compatible with most hardware for example, computer mobile tablet and else .on other side compatible with software which represents by operating systems and application that works on above hardware .Digital service should be able to evaluate constantly. Test should apply in an environment similar to the live version on all common browsers and devices .Develop a plan after digital service work to scale the usability and to get feedback from users constantly. Setting criteria for the degree of satisfaction of users via digital services. Setting a criteria for the completion rates across digital and assistance digital services. Make a plan (with supporting evidence) to achieve a low cost per transaction through digital services .Test the service from beginning to end with the minister whom responsible for that.

The conclusion of the study is service manual offer direction and resources to digital teams responsible for designing the digital service. The service manual is followed by all concerned and is involved in building e-services at all levels. Thus, there are service managers, content designers, designers, developers, user researchers, web operations, performance analysts, chief technology officers and technical architects. All new or redesigned services should have the ability to develop easily without major change. Government digital services will not be allowed to appear on the gov.uk domain if it is not compatible with the standards and criteria of digital by default. There are 24 criteria that should be adopted by the designers of digital by default services. These criteria determine the specifications of service, designers, designing and meeting the needs of users. After fulfilling these criteria by digital services, we will have a final result, which is a digital by default service.

As we have reviewed the related, this strategy of digital by default starts by identifying the target, which provides standardized electronic services known as digital by default. Identified government departments responsible for implementation include the Government Digital Service and network Government Communication. Identified areas of implementation for government ministries and the public sector. Identified standards in detail and the necessary steps for building these services. Supplied workers to build the service of all documents, instructions and details through the official website.

2.2.2 E-Government Cases From the Middle East (ME)

We selected three countries, Iraq, Bahrain and the KSA, as case studies for the following reasons: Iraq is a country of researchers. The aim is to evaluate the strengths and weaknesses of the Iraq e-government and the causes of the digital divide. We selected Bahrain because of its successful experience in e-government and its first-place ranking in e-government in the Middle East. The KSA has conditions similar to Iraq. It has a population of 28 million, its area is not small and it has average performance in e-government.

2.2.2.1 Iraq

From the year 2003 until the time of writing this thesis, Iraqi e-government has made some achievements and a sufficiently large change. In 2011, the foundation stone was placed in electronic government. The portal opened, the strategy for development of e-governance was in place and the communication interface standardized.

Iraq

Website	National Portal
Region	Asia
Sub-Region	Western Asia
Income *	Upper middle income
Income Value	5,870 USD, GNI per capita
Population	30,962,380
E-Government Development Index	0.3141 Rank 134 of 193
E-Participation Index	0.1373 Rank 152 of 193

* Income data refer to World Bank classification

Figure 15 Iraq E-government Information in 2014 [26]

Figure 15 shows Iraq e-government information for 2014. The Iraq region in Asia and the sub-region is western Asia is upper middle income with value estimated at 5,870 USD. The population of Iraq is 30,962,380 and its rank in the E-Government Development Index is 134 of 193 countries.

Survey Year	E-Government Rank	EGDI	E-Participation Index	OSI	HCI	TII
2003	174	0	0	0	0.93	0.01578
2005	118	0.3334	0	0.0538	0.93	0.01636
2008	151	0.269	0.20454	0.1070	0.6922	0.01274
2010	136	0.29957	0.04285	0.1523	0.69556	0.05522
2012	137	0.34093	0.1053	0.2875	0.61509	0.12014
2014	134	0.31414	0.13725	0.1968	0.5283	0.21727

Table 6 Iraq E-government Rank and Indicators From 2003 to 2014

Table 6 above is an extract from the UN's reports on e-government initiatives of the countries [12], [27], [28], [29], [30] and [31]. It shows the Iraq e-government situation as indicators and ranks. We can notice from the indicator values that there are developments in e-government performance and there is no stability. The Human Capital Index in the last decade has unhealthy results such that it is falling from 0.93 in 2003 to 0.5283 in 2014. However, the Telecommunication Infrastructure Index has good results such that it rises from 0.01578 in 2003 to 0.21727 in 2014. The Online Service Index has ascending performance until 2012. The E-Participation Index in 2003 and 2005 has zero value and from 2010 to 2014, there are rises in performance from 0.04285 to 0.13725. The rank of Iraq from 2003 to 2008 has unstable results, but from 2010 to 2014, there are stable results.

As we have reviewed the related, development and improvement in Iraq e-government is insufficient to advance in rank while all countries are working continuously to improve their ranks.

Therefore, an indicator's value of e-government does not only refer to a pure field that it represents. It also refers to a competitive advantage. For example, the Online Service Index does not only refer to development performance in Online Service. Iraq received a score of 0.287 in the 2012 UN survey Online Service Index and there is some improvement until 2014. However, in 2014, the UN survey gave Iraq a low score of 0.196 in the Online Service Index due to other countries taking more steps in their development operation.

Survey year	**2014**	**2012**	**2010**	**2008**	**2005**	**2003**
Iraq Rank	134	137	136	151	118	174

Table 7 Iraq E-government Rank From 2003-2014

Table 7 depends on the data in reports [12], [27], [28], [29], [30] and [31]. It shows Iraq's rank in 2003 at 174 as there was a simple start in e-government in this year. From 2003 to 2005, there are high developments in e-government performance for which Iraq received the best ranking of 118 in the last decade. From 2005 to 2008, the rank decreased to 151. During this period, Iraq witnessed a bad security situation.

From 2010 to 2014, there are close e-government performances of 136, 137 and134 appearing in the rankings.

Strategy Goals for the E-Governance Development in Iraq

Study [32] stated that in 2012, the General Secretariat of the Cabinet decided to approve the study submitted by the Ministry of Science and Technology – National Committee e-Governance. The study is a National strategic policies and Iraqi e-governance work plan for 2012-2015. As explained by the National Strategy of Iraq [33], there are goals of a strategy to develop e-governance in Iraq.

- Increased interaction between government and citizens through the introduction of good e-services. These services should be easy to use, simple and designed to be implemented from first use. Removing complex barriers for using e-services helps to increase interaction and vice versa.

- Publishing e-government services in all regions of Iraq. E-government leaders should have creative thinking to make access to e-services possible for citizens in different places. They should ensure that all citizens have access to e-services by opening e-government centers and making e-services easy to use.

- Focus on the use of ICT techniques to increase the efficacy of public institutions. ICT infrastructure networks and computers make the work easier. It helps to contact every citizen throughout the country, better than personal contacts.

- Take advantage of the development of e-government performance to achieve economic growth through e-commerce support and management of e-business.

- Reduce the digital divide between layers of society, individuals, businesses and the state of Iraq and developed countries.

E-Governance Work Plan in Iraq

As mentioned previously, the strategy goals for e-governance in 2012 General Secretariat of the Cabinet are approval on Iraqi e-Governance work Plan from 2012-2015. Below are the main paragraphs of the work plan that have been working since 2012 in Iraq. Note that the responsibility for the implementation belongs to the Ministry of Science and Technology – National Committee e-Governance.

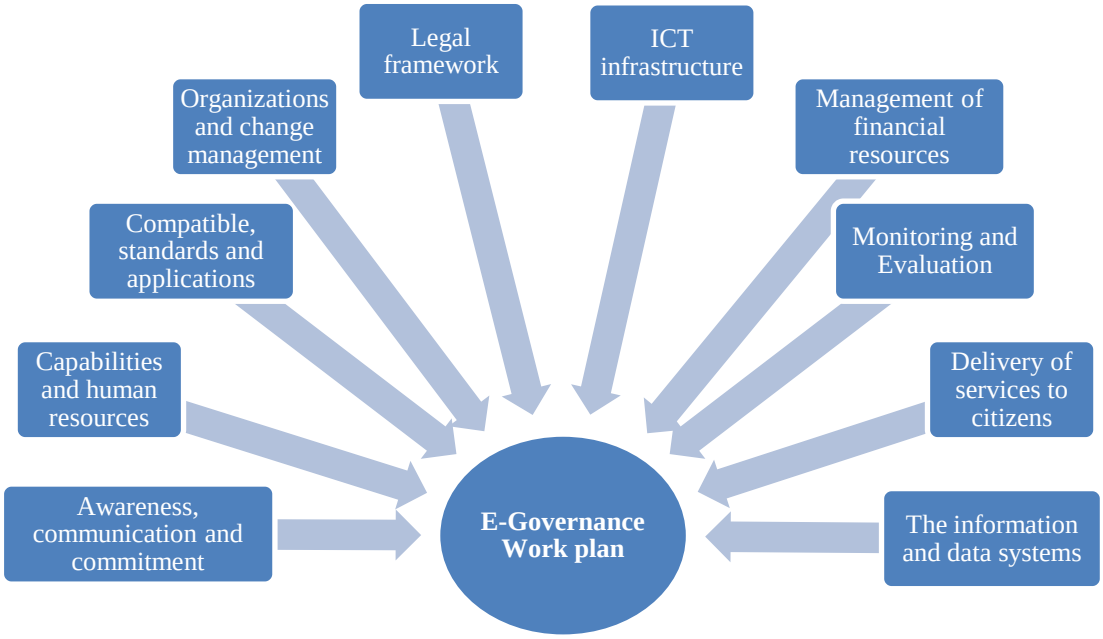


Figure 16 Elements of E-Governance Work Plan in Iraq [33]

Figure 16 shows the ten elements of the E-Governance Work plan in Iraq starting with the first elements of awareness, communication and commitment and ending with the last element of information and data systems.

- Awareness, communication and commitment ensure that there is awareness by political leaders and citizens of the importance of implementation of e-government in addition to the existence of ongoing communication between concerned personnel to transform from traditional services to the provision of e-government services and the commitments of involved persons that work in

e-government with specific program work according to steady steps and a specific timetable for the development of e-government.

- Capabilities and human resources include the necessary skills that are needed for workers in the field of e-government. This also includes putting programs for digital literacy among the citizens, coordination with the Ministry of Education to teach students the required skills and teaching ICT skills in the curricula of elementary, middle and high schools in conformity with students' ability to learn and their ages.

- Compatible standards and applications. In 2012, fixed criteria for the establishment of networks in the Iraqi ministries were agreed upon; this included the standardization of data and information exchange between government websites.

  As explained by study [33], the Iraqi government has held a partnership with the United Nations Development Program. A high-level meeting chaired by the Minister of Science and Technology in Erbil, in January 2011, determined the direction for the development of the framework of a conversational interface for the government, on which it has been agreed to fix the criteria in National Institutions.

- Organizations and change management. The challenge is making major changes in the context of the work through a transition from paper-based business to electronic automation and e-government. The study stated that this change is an urgent necessity and should benefit from the successful experiences of e-government in the leading countries.

- Legal framework. Laws should be updated to protect the privacy of information and data. Criminal laws should clearly deal with cyber-crime and the protection of electronic content ownership.

  So far, there is no cyber-crime law in Iraq. There is no agreement on the law in the Council of Representatives because of media pressure that objected to the method of determining and dealing with the type of crime and the final punishment for the Iraqi judiciary to deal with these crimes according to the

penal law of 1969 or publications law of 1968, which is for newspapers and magazines [35].

- ICT infrastructure. A national policy must prepare to support ICT and obtain assistance from the private sector. The study suggested following successful models from countries that have complete ICT infrastructures.

- Management of financial resources. This is the determination of the necessary financial issues for finishing infrastructure, managing and training people and building electronic services. Every ministry must be involved in their own budgets pertaining to e-government.

- Monitoring and Evaluation. Update data and create questionnaires for citizens, the business sector and employers and submit periodic reports. Cooperation with the United Nations by continuously sending data of e-government.

- Delivery of services to citizens. For ease of access and use of e-services, one must first create e-service centers in most cities in Iraq, and take advantage of the widespread use of mobile phones and the possibility of using mobile Internet to download e-services. Adoption of open a data policy.

- Information and data systems should transform the internal workings of the ministry first from paper work to automation work. Automation work means using ICT in the works. For example, using a computer to store data instead of traditional records, using e-mail over networks instead of traditional mail. Secondly from automation work to e-government.

Study [36] showed an improvement in the communications sector in Iraq since 2004. Entering the mobile phone networks in service in Iraq and increasing the number of landline subscribers from 794,198 to 2.8 million in June 2005. The number of Internet subscribers more than doubled and the number of mobile phone subscribers jumped from 488,966 to 2.5 million. Mobile phone networks are operating in major urban areas.

The National Development Strategy (2007-2010) has identified the procedures required for the advancement of activities of the telecommunications sector. The procedures are rebuilt and expand the current PBX and local distribution networks, increase the intensity of the telephone service and create a modern, integrated communications network to meet the needs of e-government.

2.2.2.2 Kingdom of Saudi Arabia (KSA)

From the year 2003 until now, the KSA e-government achieved continuous success and positive change every time the UN survey was published. However, that progress was made on the e-government level to reach the middle 36 within a decade. The KSA is facing challenges to achieve better ranks and enter the list of the top twenty e-government leaders.

Saudi Arabia

Website	National Portal
Region	Asia
Sub-Region	Western Asia
Income *	High income
Income Value	21,210 USD, GNI per capita
Population	27,258,387
E-Government Development Index	0.6900 Rank 36 of 193
E-Participation Index	0.5686 Rank 51 of 193

* Income data refer to World Bank classification

Figure 17 KSA E-government Information in 2014 [26]

Figure 17 above shows KSA e-government information for 2014. The KSA region is in Asia and the sub-region is Western Asia. Its income is high income with a value estimated at 21,210 USD. The population of the KSA is 27,258,387 and its rank in the E-Government Development Index is 36 of 193 countries.

Survey Year	2014	2012	2010	2008	2005	2003
KSA Rank	36	41	58	70	80	105

Table 8 Saudi Arabia E-Government Rank from 2003 to 2014

Table 8 depends on data in reports [12], [27], [28], [29], [30] and [31]. It shows ranking changes for the KSA. There are constant successful steps for e-government starting from 2003 to 2014 in the KSA. We see ascending performance in the E-Government Rank through the last decade. In 2003, the rank was 105 and there was a normal start compared with other Middle Eastern countries in e-government in this year. From 2003 to 2005, the rank increased 25 steps from 105 to 80, in 2008 it increased 10 steps, in 2010 similarly there were 12 incremental steps, and in 2012, 17 incremental steps. From 2012 to 2014, the rank increased by 5 steps from 41 to 36. The research to date in the Middle East in general, especially the KSA, has tended to focus on challenges and obstacles facing the implementation of e-government. A study [37] explaining the implementation of e-government in the KSA discusses the challenges and obstacles that affect the improvements in the electronic services provided, as shown in the table below.

Rank	CHALLENGES
1	IT Infrastructural weakness
2	Lack of knowledge about the e-government program
3	Lack of security and privacy of information
4	Lack of qualified personnel and training courses
5	Culture differences
6	Leaders and management support
7	Lack of policy and regulation for e-usage
8	Lack of partnership and collaboration
9	Lack of strategic plans
10	Resistance to change to e-systems
11	Shortage of financial resources

Table 9 KSA E-government Challenges [37]

Table 9 shows the statistics about challenges in KSA e-government and their ranks.

Historical events about e- government in KSA are mentioned. In 1998, the KSA initiated an e-government program. The period between 2005 and 2008 witnessed the achievement of important steps in its implementation. In 2005, the Government Program (YESSER) started. The program was managed by three finance ministries, the MCIT ministry and the governor of the CIT commission [38]. In 2010, it enabled citizens in Saudi Arabia to take advantage of the e-government program by using e-services widely.

Moreover, the study [37] has showed a successful adoption of ICT in the KSA after addressing the problems. The adoption of ICT as the foundation for the successful implementation of e-government was demonstrated in addition to the facilitation of the interaction and communication between business and citizens and the Saudi government and talks about the benefits of electronic services for individuals in the KSA .By removing citizens who worry about wasting their time, the stress and tension of clerks disappears. Electronic services with constant quality would be available seven days a week and twenty four hour per day. As explained by researchers, there is a vast area in the KSA. The total area of the KSA amounts to 2.15 million square kilometers and is the largest country on the Arabian Peninsula [39]. Due to difficulties accessing the city center, e-services were introduced. It has been become easier for citizens to access services by using the Internet in contrast to the previous suffering due to long distances and the difficulty of access, effort and time wasting. In addition, it provided e-services that will help employees in the KSA government who produce traditional services by reducing pressure and the problems that result from face-to-face contact with citizens.

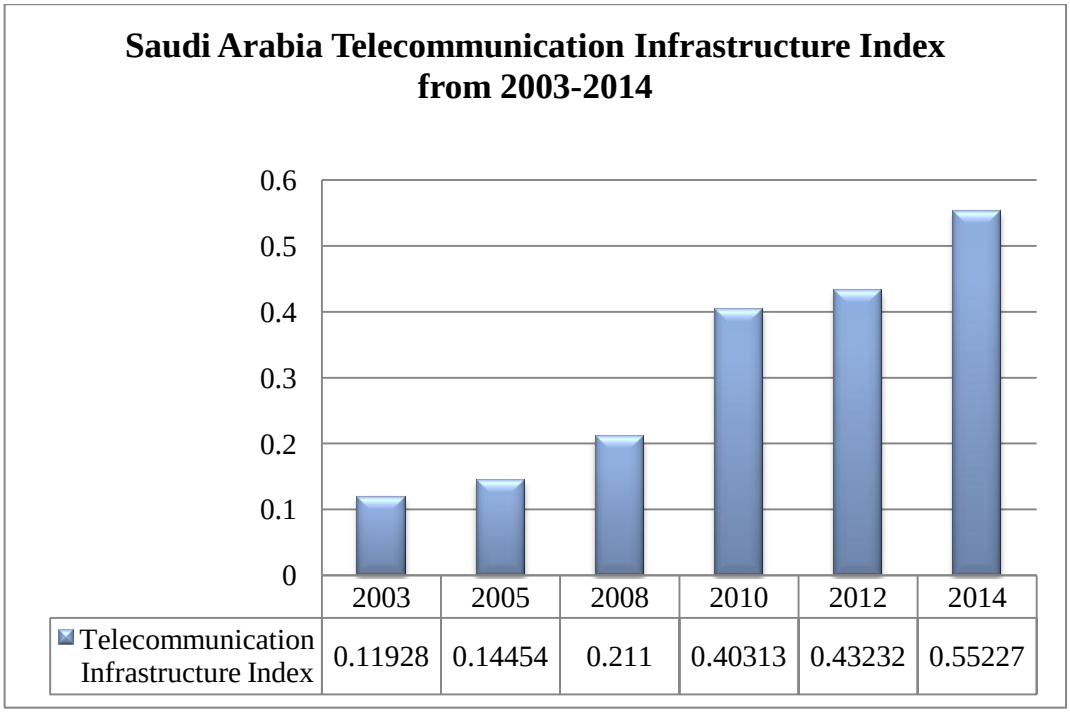


Figure 18 KSA Telecommunication Infrastructure Index from 2003-2014

Figure 18 depends on data in reports [12], [27], [28], [29], [30] and [31]. It shows the TII development in the KSA. It is clear that there is ascending performance and continuous improvement in the communication field starting in 2003 with a 0.11928 TII value and increasing through the last decade until 2014 with a 0.55227 TII value. A study has recommended cooperation between the public and private sector and the government.

As reported in study [40], the KSA government introduced a program known as Yesser. This program aims at the development of the national strategy and includes an implementation plan, the first of which was to be implemented between 2006 and 2010 and the second to be implemented between 2010 and 2016. Each plan works according to the same steps limited with final dates. A program for directing leaders of e-government follows specific steps which start with strategic objectives for the implementation of e-government in the KSA.

- Provide initial high services (150 services) electronically at a sophisticated level.

- Provide services that are integrated and simplified for the user and at a high level of security.

- Access to electronic services for all at anytime from anywhere inside and outside the Kingdom.
- Achieve a level of use of e-government services by 75% of users.
- Achieve 80% satisfaction for users of e-services.

From the above steps, the level of efficiency and effectiveness in the public sector will increase. The program contains operational plan projects that focus on three categories, which include infrastructure projects such as the construction of private networks between government locations, e-services projects such as building new and renewing e-services for citizens, and national applications projects such as e-elections.

2.2.2.3 Bahrain

In 2003, the Bahrain e-government started strongly with a rank of 46. It fell within the list of twenty e-government leaders in 2010 and 2014. Bahrain is a very rich country with a small area and a population not exceeding 1.25 million. It has built ICT infrastructure and deployed the Internet and computers at subsidized prices for citizens. In the near and far future, Bahrain is expected to remain in the top 20 e-governments unless major changes occur in the state of Bahrain or in the manner e-governments are evaluated.

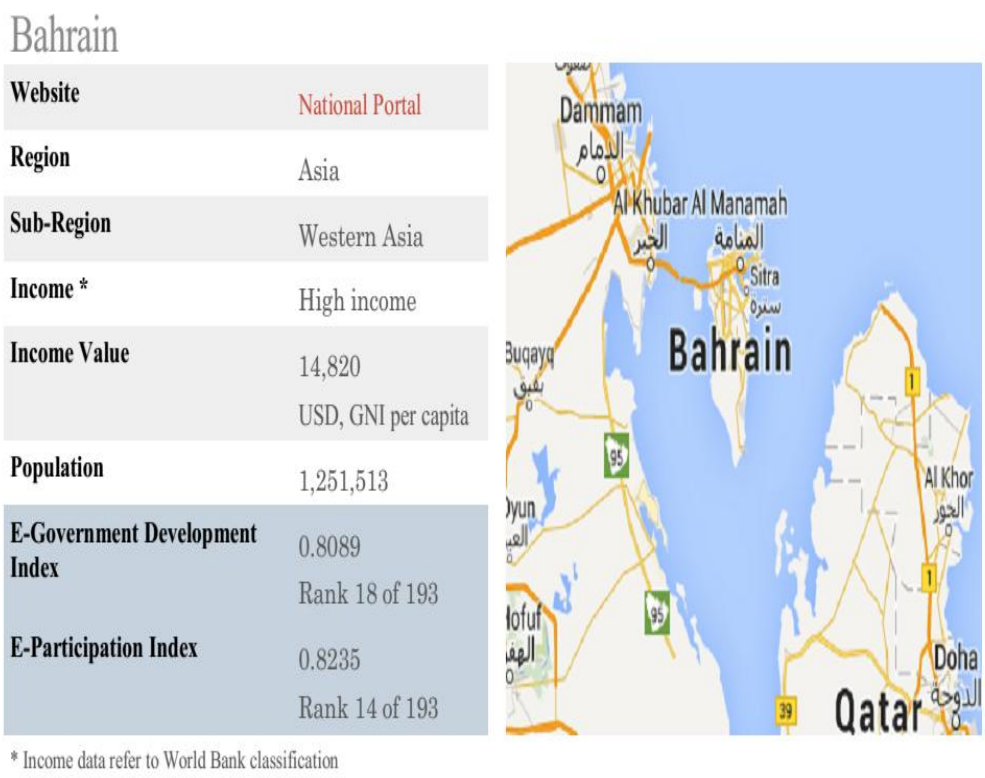


Figure 19 Bahrain E-government Information in 2014 [26]

Figure 19 above shows Bahrain e-government information for 2014. The Bahrain region is in Asia and the sub-region is Western Asia. Bahrain's income is high at a value estimated to be 14,820 USD. The population of Bahrain is 1,251,513 and it ranks in the E-Government Development Index at 18 of 193 countries.

Survey year	2014	2012	2010	2008	2005	2003
Bahrain Rank	18	36	13	42	53	46

Table 10 Bahrain E-Government Rank from 2003 to 2014

Table 10 depends on data extracted from UN reports on e-government initiatives of the countries [12], [27], [28], [29], [30] and [31]. It shows ranking changes for Bahrain such that in 2003 it was 46, which was a strong start in e-government in this year. From 2003 to 2005, the rank decreased 7 steps from 46 to 53. In 2010, there is high development in e-government performance with Iraq ranking best at 13 in the

last decade. From 2010 to 2012, the rank decreased 23 steps from 13 to 36. In 2014, Bahrain comes back strongly with a ranking of 18.

Study [41] has demonstrated that Bahrain achieved first place among the Arab States and the Middle East and 14th place in the e-participation index. It achieved advanced centers in the United Nations Public Service Awards in 2014, where national call centers achieved first place in West Asia, first place in the Middle East and third place in Asia and thirteenth globally, according to the results of the United Nations report for e-government in 2010.

Study [42] mentions that in 2013, statistics showed that there is high satisfaction for e-government services in Bahrain. The study stated that citizens, residents and both aspects of the business sector (commerce and industry) were happy with e-government performance.

Study [43] explains that on October 11, 2002 an agreement was made between the Bahrain Telecommunications Company «Batelco» and Cisco Systems, American International. The agreement was estimated to cost several million dollars to build an ICT infrastructure starting with a Metro Ethernet system provided by Cisco. The agreement is the beginning of the contribution of Cisco's technology to the e-government project in Bahrain.

Study [44] mentions that Bahrain has started building an ICT infrastructure. The first objective is to connect state departments. This ICT infrastructure would provide service at high quality through local networks. At the same time, the Internet service in Bahrain would have high quality at low-cost for the citizen.

Bahrain established a high-quality government data network among all its ministries, including more than 200 government sites. These ministries' sites exchange information, conduct video conferences and take advantage of other multimedia services that are provided through the data network.

In addition, study [17] has been cleared that Zagel project responsible about management electronic Mailings through e-government in Bahrain. It provides multiple levels of security systems, which guarantees the confidentiality of mail according to the nature of the document sent to the user with the possibility of

continuous monitoring of correspondence. Information about mailing is saved through advanced electronic archiving. The Zagel project electronic mailings won first place in the United Nations Public Service Award in 2012 for the category of "advanced knowledge management in government." For example, the Council of Ministers and the Supreme Judicial Council connect online with the communication channel for the exchange of files such as doc, mp4, mp3 and jpg. The channel is difficult to penetrate from outside its closed channel, and from inside, only authorized people can access it and log in to it.

The leaders of the Bahrain e-government focused on four major channels that offer and provide electronic services. These four channels are the portal site, gateway mobile phone, the classic phone center and centers for public services.

2.2.3 Benefits Gained Through Closing the Digital Divide

Closing the digital divide has broad benefits in terms of time, effort, accuracy and so on. These benefits appear in many areas in society. However, there are direct effects on the social and economic side. We can know the benefits gained by closing the digital divide through what transpires in the literature review [45], [46] and [47].

2.2.3.1. Economy

The benefit of the contribution of the Internet to GDP has other advantages in terms of the financial return gained from citizens using the Internet service. This is represented by opening new digital markets to developing countries through the Internet. E-business will be active and competitive between the traditional market and the digital market, which will serve the economies of developing countries and create new jobs, provide low cost products and services and transform business from the domestic level to the global level.

As reported in [45] there are some statistical facts about financial returns that the government gained in the UK. There are works that show considerable savings in transaction costs with closing the digital gap. The numbers vary between £3.30 and £12 per transaction in the UK in 2009. This amounts to £22 billion per year. Households in the UK can save about £560 per year by shopping and paying bills online. The conclusions of this study are that the UK government saves about £8 per

transaction if we turn citizens from offline to online. The total gain for the economy is estimated to be £22 billion.

In the same manner, study [24] considers the relationship between the contributions of the Internet to GDP as economic benefits, according to the study produced by the McKinsey Global Institute in 2011. According to this study, in the G8 countries (France, United Kingdom, Germany, Italy, the Russian Federation, Canada, United States and Japan plus South Korea, Sweden, Brazil, China and India), the Internet's contribution to GDP was estimated at 3.4%. The report mentions that developing countries should take closing the digital divide seriously in order to be able to obtain economic benefits and achieve an economic future for their countries. The conclusion of this study states that developing countries can benefit economically and survive in the future through the adoption of the Internet's contribution to GDP and at the same time, the digital divide can close. Furthermore, the Internet's highest contribution to GDP refers to a healthy economy and vice versa. Developing countries should consider the digital divide issue not only from a technical perspective but as a necessity for current economic profit gains and for economic survival in the future.

As we have reviewed the related, transforming transactions onto online services reduces transaction costs both to the citizen and to the government. This leads to saving money by eliminating long queues at government offices; hence, clerks are not assigned to perform transactions that can be conducted through websites. On the citizen side, citizens can perform such transactions not necessarily from a government office and not necessarily during work hours or on work days. This also saves them travel costs and travel time. This economic benefit is more considerable with government to business transactions.

Study [47] discusses social and economic benefits and the possibility of increased economic competitiveness for countries by bridging the digital divide. This should increase investment in the adoption of ICT, especially for developing countries in order to enable the survival of a country economically. The study proposes a framework for a digital effectiveness model to apply in developing countries. It is aimed at the optimal use of technological capabilities in a normal environment. The researcher states that after the correction is applied to the model, a country would

acquire the best economic returns. The model is a set of relations between the units representing ICT technology and knowledge management and culture, which produce digital effectiveness that leads to closing the digital divide, increases economic returns and raises the government's performance of countries.

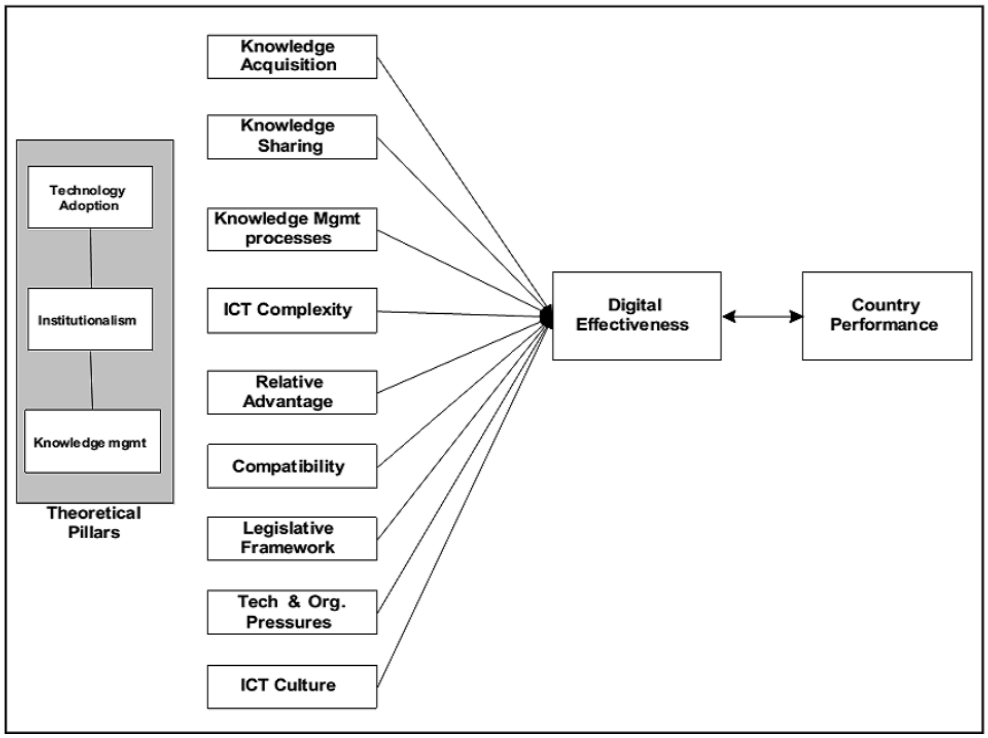


Figure 20 Digital Effectiveness Models [47]

The conclusions of this study propose steps that depend on digital effectiveness, which at its core is the best investment for the available technological capabilities and adoption of ICT to reduce the digital divide and obtain the best returns from social and economic benefits. The policy maker in developing countries should focus on expanding their investments in ICT adoption and a digital effectiveness framework that can help them if they follow these steps.

As we have reviewed the related, the study shows that there are social and economic benefits of increasing investment in the adoption of ICT. The proposal is scientifically acceptable theoretically as it bridges the digital divide through its reliance on ICT. However, the main weakness of this study is shown in terms of practice. The proposal for the study is a framework of a digital efficiency model that was not proved to be successful in practice and has not been adopted in any country. The model does not give any details that show the implementation of the commands

for leaders, specialists and staff. Moreover, it did not give any precise guidance on how to deal with, and to acquire, benefits. It only discussed how best to use the ICT technology in the environment. Furthermore, it produced only linking technology and a knowledge management environment and a culture in the context of digital effectiveness.

2.2.3.2 Trust

Transforming transactions onto online services makes it easy to provide a service to the citizen via e-government. The transition online leads to increased confidence and trust of the citizen and the citizen's satisfaction with the government since the dual relationship between the citizen and the government is the responsibility of the citizen to the government and the duties of the government of the services provided.

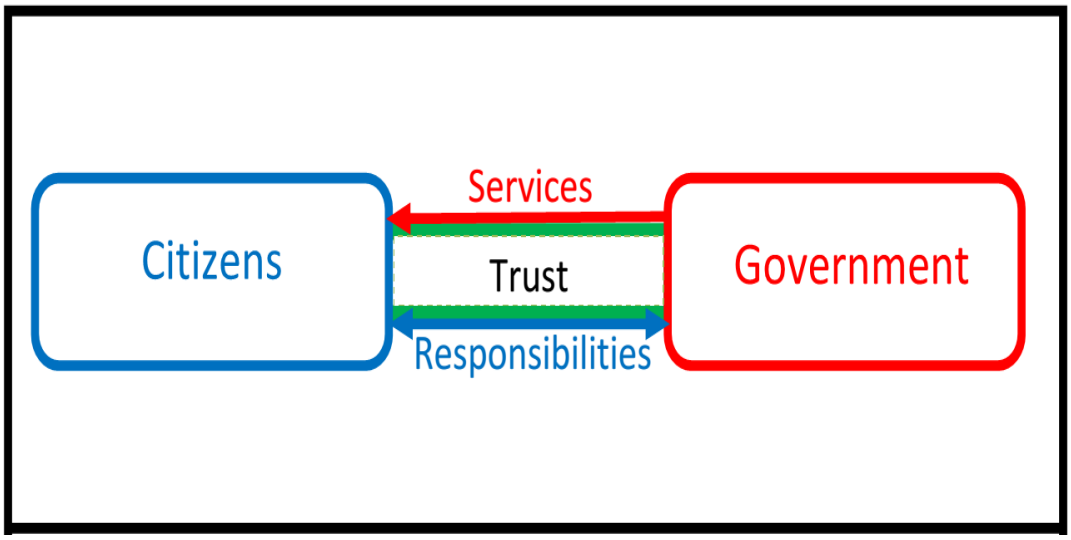


Figure 21 Trust Channel

Figure 21 above represents the relationship between the citizen and the government. The red arrow represents the connection between government and citizen with services provided by the government to the citizen. The stream from government to the citizen on the other hand, is represented by the blue arrow, which is the connection between the citizen and government with the responsibilities of the citizen to the government and vice versa.

Both are the responsibilities and services that represent a frame of the relationship between the citizen and the government. Both create channels of confidence and both maintain and expand it.

While surveying the related literature, we see that many papers report on economic benefits (Section 2.2.3.1) to our knowledge. However, the benefits of closing the digital gap are not limited to saving money. For instance, offering services online or on the web avoids human-to-human interaction. This reduces the emotional element of clerks and citizens when performing transactions. Additionally, performing transactions in a digitized manner automatically archives records; hence, they are recorded and they can be investigated when necessary. As surveyed in this section, there is literature supporting the fact that transparency improves trust between the government and the service consumer.

2.3 Discussion

The digital services that may be designed by companies belong either to the government sector or private sector. Digital Services are completed by different executives and different designers who have different perspectives and are without a pre-defined vision. This leads to the production of digital services which have differing performance and uneven quality, and in many respects, the ease of use and execution time or ability to develop in the future. Moreover, a digital service which is designed this way would suffer with continuous changes of hardware and software in the future in addition to questions about the life cycle of this digital service.

Digital by default makes digital services unified in the method of analysis, design and implementation. This turns into a scientific concept and is an important element taken into account in any policy and strategy for e-government. It is considered to be high value in the perspective of officials who want to develop the performance of digital services that are provided to citizens. The European Union has suggested that member states follow the UK's experience by using digital by default. The different countries which have applied digital by default include Australia [48]. Some European countries that have advanced locations in e-government EGDI applied digital by default, such as that which has been adopted in Netherlands [12].

This offers a realistic solution to the problems of designing digital services as a model and it provides clear steps to the design and prototype product and afterwards to the final digital service product. Digital by default gained its power fully from the adoption of scientific software engineering bases that were required in designing software due to lack of finishing time or because of losing a clear future vision that was required for digital service in addition to a lack of staff with sufficient multidisciplinary experience.

This problem was solved by digital by default by considering that staff should be multidisciplinary as the requirements of the standards. The service manual will help digital teams. The presence of the service manual as a cornerstone of the head of digital teams and to digital team members gives a holistic view of the entire work. On the other hand, it gives a general understanding of what is happening through designing the operation. Simultaneously, each designer would understand the nature

of his work as a functional unit in a larger system. All in all, the UK provided successful e-services which need the minimum requirement of ICT skills. It is an effective way to raise the performance of e-government and close the digital divide.

Iraqi e-government has five strategic goals, and the ten elements of the work plan [32] and [33] discuss governance, not government. The main weakness of the strategy and work plan is discussed in general. These are only recommendations and there is no law in force to implement it as it is not clear and there is no detailed explanation of how to implement them. To illustrate, the work plan only mentions an open data policy without any explanation. Moreover, the work plan mentioned should benefit from the successful experiences of e-government. However, it did not name any country such as South Korea or the UK. There is no specific time for the implementation of each level. The strategic goals and work plan seem correct and logical. However, there is no interaction with the reality of Iraq. The main limitation is caused by an unclear evaluation of the ICT infrastructure. Moreover, it lacks a measure of willingness of the involved ministries that produce electronic services in addition to there being a lack of updated statistics regarding the Internet and computer usage between citizens. All in all, if we could not achieve success in e-government, the question remains regarding how to achieve success in e-governance which requires central management for ICT, more control for e-services that provide and standardize functional units in state institutions.

Iraqi e-government has three different performance indicators: HCI, TII and OSI. The TII and OSI have healthy performance. They have increased in value in the last decade as there is financial support for the ICT infrastructure and for portals design. On the other hand, the Human Capital Index in the last decade has shown unhealthy results in descending away from 0.93 in 2003 to 0.5283 in 2014 [12]and [27]. The strategy and work plan in 2012 did not address the problem of a decreasing HCI.

An important issue emerging from these findings is that e-government performance will not achieve further advancement in the future due to the HCI decrease referring to a lower rank to e-government and a decline in the level of education and ICT skill, thereby weakening the citizen’s capacity to use e-services.

In the KSA, progress has been made in e-government in the last decade from a 105 rank value to 36 [12]. The KSA achieved continuous success and positive change every time the UN survey was published. TII and OSI help the KSA to raise its rank. However, HCI has a negative impact on the KSA rank with the HCI having a rank of 71, while the KSA e-government rank is 36.This achievement will be difficult in the near future for KSA e-government. The HCI requires many years of work to change it. We will endeavor to find an answer in detail to this question in Chapter 3. The study [37] has stated that there is a successful adoption of ICT in the KSA after addressing the problems. After our analysis of the OSI and TII performance during the last decade, we find it to be correct.

In 2014, Bahrain entered the list of twenty-five e-government leaders with an 18 rank value [12]. In short, the reasons for this are due to the fact that it is a small country with a high income, has a small area, and the population is 1.25 million [26]. The turning point in the development of e-government was in 2002 with an agreement made between the Bahrain Telecommunications Company «Batelco» and Cisco Systems, American International. The agreement was estimated to cost several million dollars to build ICT infrastructure starting with a Metro Ethernet system provided by Cisco [43]. The agreement is the beginning of the contribution of Cisco technology in the e-government project in Bahrain. It has a high TII and OSI. However, the HCI rank of 58 could not see advantages from it in order to raise its e-government rank.

The literature review about the benefits gained through closing the digital divide [45], [46] and [47] mentioned the benefits of closing the digital divide visibly and concretely on both the economic and social sides, even including the benefits of confidence-building between the government and the citizen through the closing. However, they did not identify the main goal for closing, the greatest benefit and most importantly to our knowledge, which is helping governments to survive in the future. This represents an invisible benefit.

CHAPTER 3

THE ROLE OF HUMAN CAPITAL INDEX AND ICT SKILLS INDEX

The ITU adopted three indicators to measure the digital divide: the ICT Access Index, the ICT Use Index and the ICT Skills Index (Section 2.1.3). In this chapter, we explain the impact of these indices on the digital divide in Middle Eastern countries. The UN considers the financial and physical factors to be the main reasons for the digital divide [12]. However, there are countries in the Middle East with high income and excellent ICT infrastructure, such as Qatar. The UAE and KSA suffer from the digital divide. We identify that these countries did not suffer from a gap in access and use of ICT according to the good rank that they have in the ICT Access Index and ICT Use Index (see Tables 11 and 12). Nevertheless, they have low rankings in ICT Skills (see Table 13), which is reflective of a gap in this aspect. These digital divides in ICT skills make these countries unable to enter the list of 25 world e-government leaders. Even Bahrain, entered this list with difficulty after spending millions of dollars in its agreement with Cisco to build ICT infrastructure and provide electronic services [43]. Bahrain is still suffering from the digital divide. We highlight ICT Skills as a major cause of the digital divide in Middle Eastern countries and we address those Arab countries which have weak points in ICT Skills.

Measuring the digital divide by ITU shows the situation of Arab countries, such as the UAE, Bahrain, Qatar and the KSA. Iraq is not put in the list as related data could not be collected (See Tables 11, 12 and 13). By studying the indices of measuring the digital divide, namely the ICT Access Index, ICT Use Index and ICT Skills Index, we endeavor to find the common aspects between them and the e-government indices: HCI, OSI and TII. Moreover, we explain that the HCI has a negative effect on e-governments in the Middle East. Hence, the ICT skills index has the same effect as the HCI. Furthermore, we find the relation between the HCI and ICT Skills Index and prove that the HCI contains ICT Skills. We produce the average difference value for e-government indices as a quick tool to measure the weak and strong points in the performance of each index. We enhance our finding by taking three countries, namely Iraq (Fig. 33), the KSA (Fig. 35) and Bahrain (Fig. 37) to analyze and track the behavior of their indices from 2003 to 2014. We also address the fact that the HCI on e-government has a more unique and different effect than TII and OSI. The

average difference value of each index reflects another aspect which the index value did not show.

3.1 Digital divide measurement

ITU measure the digital divide by using the ICT Access Index, ICT Use Index and ICT Skills Index. First index is ICT Access.

Economy	Rank 2012	Access 2012	Rank 2011	Access 2011
Hong Kong, China	1	9.18	1	9.13
Luxembourg	2	8.93	2	8.72
Iceland	3	8.77	3	8.71
Switzerland	4	8.73	4	8.61
Germany	5	8.51	5	8.48
United Kingdom	6	8.46	7	8.30
Sweden	7	8.37	6	8.36
Singapore	8	8.31	9	8.21
Netherlands	9	8.28	8	8.23
Malta	10	8.28	11	8.16
Korea (Rep.)	11	8.28	10	8.19
Denmark	12	8.18	12	8.14
Austria	13	7.96	15	7.74
France	14	7.95	14	7.77
Macao, China	15	7.93	13	7.91
Japan	16	7.73	17	7.64
Norway	17	7.72	16	7.70
New Zealand	18	7.69	22	7.49
Belgium	19	7.67	18	7.58
Finland	20	7.66	20	7.55
Canada	21	7.65	19	7.58
Australia	22	7.64	21	7.55
Ireland	23	7.59	23	7.49
Israel	24	7.57	24	7.38
United Arab Emirates	25	7.31	35	6.73
Barbados	26	7.29	28	7.03
Estonia	27	7.27	29	7.00
Bahrain	28	7.25	34	6.82
United States	29	7.24	26	7.12
Slovenia	30	7.23	25	7.17
Italy	31	7.15	27	7.08
Qatar	32	7.10	32	6.88
Spain	33	7.05	30	6.99
Antigua & Barbuda	34	7.03	31	6.94
Portugal	35	7.00	33	6.83
Saudi Arabia	36	6.76	38	6.58
Russian Federation	37	6.73	39	6.53
Greece	38	6.69	36	6.58
Croatia	39	6.66	37	6.58
Czech Republic	40	6.60	40	6.49
Kazakhstan	41	6.60	47	6.14
Brunei Darussalam	42	6.55	42	6.35
Lithuania	43	6.47	41	6.44
Poland	44	6.46	43	6.32
Hungary	45	6.46	44	6.30
Cyprus	46	6.45	45	6.29
Belarus	47	6.41	53	6.01
Uruguay	48	6.38	49	6.06
Bulgaria	49	6.33	50	6.04
Slovakia	50	6.28	48	6.13
Latvia	51	6.25	52	6.02
St. Vincent and the Gr.	52	6.12	51	6.02
Seychelles	53	6.10	57	5.49
Malaysia	54	6.09	54	5.76
Lebanon	55	6.04	64	5.34
Argentina	56	5.88	56	5.59
Serbia	57	5.82	46	6.24
Romania	58	5.81	55	5.61
Moldova	59	5.81	60	5.45
Oman	60	5.74	61	5.42
Trinidad & Tobago	61	5.67	58	5.46
Chile	62	5.65	62	5.40
TFYR Macedonia	63	5.65	59	5.45
Maldives	64	5.62	63	5.38
Costa Rica	65	5.53	69	4.95
Panama	66	5.51	66	5.06
Brazil	67	5.49	65	5.18
Ukraine	68	5.27	71	4.88
Saint Lucia	69	5.20	67	5.04
Azerbaijan	70	5.17	72	4.84
Mauritius	71	5.17	70	4.91
Turkey	72	5.11	68	5.01
Georgia	73	5.06	74	4.65
Jordan	74	4.95	76	4.53
Suriname	75	4.90	73	4.79
Bosnia and Herzegovina	76	4.83	75	4.58
Iran (I.R.)	77	4.68	77	4.53
Morocco	78	4.67	78	4.39
Armenia	79	4.52	79	4.23
China	80	4.36	82	4.04
Colombia	81	4.35	84	3.99
Ecuador	82	4.34	81	4.05
Egypt	83	4.20	83	4.00
Syria	84	4.20	80	4.12
South Africa	85	4.14	88	3.90
Venezuela	86	4.13	87	3.91
Mexico	87	4.11	85	3.93
Mongolia	88	4.04	95	3.69
Viet Nam	89	4.04	89	3.87
Thailand	90	4.00	92	3.77
Tunisia	91	3.95	90	3.79
El Salvador	92	3.95	91	3.78
Jamaica	93	3.93	86	3.91
Fiji	94	3.86	93	3.76
Peru	95	3.85	94	3.74
Albania	96	3.73	96	3.53
Gabon	97	3.67	102	3.30
Indonesia	98	3.62	100	3.35
Paraguay	99	3.60	98	3.45
Algeria	100	3.60	99	3.43
Botswana	101	3.58	97	3.46
Cape Verde	102	3.46	101	3.32
Philippines	103	3.41	106	3.19
Sri Lanka	104	3.36	105	3.21
Dominican Rep.	105	3.35	103	3.30
Bolivia	106	3.27	108	3.06
Tonga	107	3.25	104	3.23
Guyana	108	3.18	109	3.01
Cambodia	109	3.14	112	2.72
Namibia	110	3.09	110	2.87
Honduras	111	3.05	107	3.11
Nicaragua	112	2.99	111	2.74
Kenya	113	2.73	123	2.35
Bhutan	114	2.68	116	2.46
Sudan	115	2.62	120	2.37
Senegal	116	2.59	121	2.37
Côte d'Ivoire	117	2.58	113	2.48
Mauritania	118	2.58	119	2.41
Pakistan	119	2.56	115	2.47
Zimbabwe	120	2.54	126	2.19
Lao P.D.R.	121	2.53	122	2.36
India	122	2.50	114	2.47
Mali	123	2.44	127	2.18
Swaziland	124	2.43	117	2.46
Gambia	125	2.42	125	2.26
Ghana	126	2.40	128	2.15
Uzbekistan	127	2.38	118	2.44
Benin	128	2.36	124	2.27
Lesotho	129	2.26	130	2.01
Zambia	130	2.12	133	1.89
Djibouti	131	2.11	129	2.08
Yemen	132	2.09	134	1.86
Bangladesh	133	2.03	138	1.81
Solomon Islands	134	2.02	131	1.97
Nigeria	135	1.99	136	1.85
Congo	136	1.99	135	1.85
Rwanda	137	1.96	141	1.78
Uganda	138	1.95	132	1.93
Cameroon	139	1.87	143	1.72
Tanzania	140	1.87	139	1.79
Burkina Faso	141	1.87	142	1.76
Comoros	142	1.87	137	1.82
Angola	143	1.83	140	1.78
Liberia	144	1.80	148	1.54
Malawi	145	1.72	144	1.72
Guinea	146	1.71	145	1.65
Mozambique	147	1.69	146	1.60
Niger	148	1.65	149	1.54
Ethiopia	149	1.64	147	1.60
Myanmar	150	1.62	150	1.53
Guinea-Bissau	151	1.49	154	1.32
Madagascar	152	1.48	151	1.48
Cuba	153	1.45	152	1.38
Chad	154	1.40	155	1.23
Congo (Dem. Rep.)	155	1.33	153	1.32
Eritrea	156	1.23	156	1.12
Central African Rep.	157	1.12	157	1.12

Table 11 ICT Access Index (IDI Access Sub-Index), 2011 and 2012 [19]

Table 11 shows ICT Access Index values of 157 countries cross the world. This index reflects the digital divide in ICT access. The Arab countries UAE, Bahrain, Qatar and KSA have good rankings: 25, 28, 32 and 36. They rank higher than China, many European countries and South American countries. It is a clear that these Arabic countries did not have a clear digital divide in the ICT Access aspect. Iraq is not in the list as related data could not be collected.

Economy	Rank 2012	Use 2012	Rank 2011	Use 2011
Sweden	1	8.25	2	8.16
Korea (Rep.)	2	8.22	1	8.17
Denmark	3	8.15	3	7.78
Norway	4	8.05	4	7.67
Finland	5	8.05	5	7.51
Japan	6	7.51	6	7.49
Iceland	7	7.50	10	6.96
Australia	8	7.46	12	6.66
Netherlands	9	7.32	9	6.99
Luxembourg	10	7.29	8	7.07
Singapore	11	7.25	7	7.12
United Kingdom	12	7.19	13	6.46
Macao, China	13	6.88	11	6.71
United States	14	6.76	14	6.43
New Zealand	15	6.72	17	6.09
Hong Kong, China	16	6.62	18	6.02
France	17	6.60	16	6.11
Switzerland	18	6.54	15	6.24
Estonia	19	6.52	24	5.45
Canada	20	6.38	19	5.84
Ireland	21	6.08	20	5.81
Germany	22	6.05	21	5.76
Malta	23	6.04	25	5.17
Austria	24	5.97	23	5.56
Israel	25	5.86	27	5.02
Qatar	26	5.79	22	5.70
Belgium	27	5.75	26	5.07
Spain	28	5.52	29	4.96
Latvia	29	5.45	30	4.78
United Arab Emirates	30	5.18	40	3.93
Czech Republic	31	5.17	28	5.02
Barbados	32	5.00	44	3.64
Croatia	33	4.99	32	4.63
Slovenia	34	4.94	33	4.61
Italy	35	4.89	34	4.60
Poland	36	4.84	31	4.75
Slovakia	37	4.79	35	4.42
Bahrain	38	4.75	41	3.92
Greece	39	4.65	36	4.17
Hungary	40	4.48	37	4.17
Portugal	41	4.45	39	4.00
Russian Federation	42	4.34	42	3.91
Cyprus	43	4.23	38	4.00
Bulgaria	44	4.20	45	3.64
Belarus	45	4.13	52	3.17
Oman	46	4.07	54	2.99
Uruguay	47	3.84	51	3.19
Antigua & Barbuda	48	3.77	43	3.76
Lithuania	49	3.76	46	3.58
Azerbaijan	50	3.72	53	3.07
Kazakhstan	51	3.71	47	3.37
TFYR Macedonia	52	3.67	49	3.22
Chile	53	3.67	55	2.98
Saudi Arabia	54	3.67	48	3.28
Lebanon	55	3.54	63	2.37
Serbia	56	3.52	50	3.20
Brazil	57	3.41	59	2.69
Romania	58	3.34	58	2.78
Bosnia and Herzegovina	59	3.19	56	2.90
Argentina	60	3.16	60	2.69
Malaysia	61	3.11	57	2.85
Costa Rica	62	3.06	68	2.24
Trinidad & Tobago	63	2.83	61	2.56
Georgia	64	2.82	64	2.35
Albania	65	2.71	74	2.15
China	66	2.70	69	2.24
Mauritius	67	2.69	76	2.12
Turkey	68	2.63	66	2.30
Armenia	69	2.60	70	2.21
Brunei Darussalam	70	2.53	62	2.39
Seychelles	71	2.52	71	2.18
Egypt	72	2.51	67	2.25
Panama	73	2.46	65	2.34
Saint Lucia	74	2.39	72	2.17
South Africa	75	2.35	81	1.89
Maldives	76	2.32	77	2.02
Morocco	77	2.28	75	2.13
St. Vincent and the Gr.	78	2.27	73	2.15
Dominican Rep.	79	2.27	84	1.77
Moldova	80	2.27	80	1.94
Colombia	81	2.26	82	1.86
Mexico	82	2.23	79	1.97
Viet Nam	83	2.22	78	2.01
Ecuador	84	2.22	87	1.63
Cape Verde	85	2.12	93	1.39
Venezuela	86	2.00	83	1.82
Fiji	87	1.99	88	1.60
Uzbekistan	88	1.95	86	1.65
Jordan	89	1.92	89	1.55
Jamaica	90	1.84	90	1.51
Tunisia	91	1.82	85	1.67
Ukraine	92	1.76	91	1.49
Nigeria	93	1.72	95	1.29
Ghana	94	1.71	96	1.25
Mongolia	95	1.64	100	1.17
Indonesia	96	1.64	98	1.21
Peru	97	1.63	92	1.47
Zimbabwe	98	1.59	105	1.03
Namibia	99	1.55	102	1.14
Suriname	100	1.49	94	1.33
Philippines	101	1.46	99	1.18
Bolivia	102	1.42	103	1.13
Guyana	103	1.36	97	1.21
Sudan	104	1.26	101	1.16
El Salvador	105	1.25	108	0.93
Tonga	106	1.24	109	0.90
Thailand	107	1.23	104	1.10
Paraguay	108	1.17	106	1.02
Kenya	109	1.15	107	0.95
Iran (I.R.)	110	1.14	110	0.85
Swaziland	111	1.11	118	0.65
Bhutan	112	1.05	111	0.83
Botswana	113	1.00	114	0.70
Syria	114	0.97	112	0.81
Sri Lanka	115	0.87	116	0.67
Cuba	116	0.86	113	0.78
Honduras	117	0.81	117	0.66
Senegal	118	0.80	115	0.68
Uganda	119	0.75	121	0.53
Algeria	120	0.68	119	0.62
India	121	0.65	124	0.46
Angola	122	0.62	120	0.55
Yemen	123	0.62	122	0.52
Nicaragua	124	0.58	123	0.46
Tanzania	125	0.49	126	0.44
Lesotho	126	0.48	125	0.45
Zambia	127	0.48	127	0.40
Solomon Islands	128	0.47	130	0.35
Lao P.D.R.	129	0.46	129	0.36
Gambia	130	0.46	128	0.38
Cambodia	131	0.41	139	0.19
Pakistan	132	0.38	131	0.34
Rwanda	133	0.38	135	0.27
Djibouti	134	0.37	133	0.30
Mauritania	135	0.32	132	0.33
Gabon	136	0.30	134	0.28
Congo	137	0.28	137	0.20
Malawi	138	0.26	136	0.21
Bangladesh	139	0.24	138	0.20
Mozambique	140	0.23	141	0.18
Comoros	141	0.20	140	0.18
Cameroon	142	0.19	142	0.17
Benin	143	0.14	143	0.13
Burkina Faso	144	0.13	144	0.10
Liberia	145	0.13	145	0.10
Central African Rep.	146	0.10	149	0.07
Guinea-Bissau	147	0.10	146	0.09
Mali	148	0.10	148	0.08
Côte d'Ivoire	149	0.09	147	0.09
Chad	150	0.08	150	0.07
Madagascar	151	0.07	151	0.07
Niger	152	0.07	152	0.06
Ethiopia	153	0.07	153	0.05
Congo (Dem. Rep.)	154	0.06	155	0.04
Guinea	155	0.05	154	0.04
Myanmar	156	0.04	156	0.03
Eritrea	157	0.03	157	0.02

Table 12 ICT Use Index (IDI Use Sub-Index), 2011 and 2012 [19]

Table 12 shows ICT Use Index values of 157 countries. The Arab countries Qatar, UAE, Bahrain, and the KSA have good rankings: 26, 30, 38 and 54. It does not have a clear gap. However, their values in the ICT Access Index are better than the ICT Use Index.

Economy	Rank 2012	Skills 2012	Rank 2011	Skills 2011
Korea (Rep.)	1	9.86	1	9.86
Finland	2	9.80	2	9.80
United States	3	9.65	3	9.65
Greece	4	9.55	4	9.55
Belarus	5	9.48	5	9.48
Slovenia	6	9.44	6	9.44
New Zealand	7	9.38	7	9.38
Spain	8	9.34	8	9.34
Australia	9	9.29	9	9.29
Iceland	10	9.24	10	9.24
Ukraine	11	9.17	11	9.17
Norway	12	9.10	12	9.10
Denmark	13	9.08	13	9.08
Cuba	14	9.00	14	9.00
Sweden	15	9.00	15	9.00
Belgium	16	8.98	16	8.98
Poland	17	8.96	17	8.96
Lithuania	18	8.92	18	8.92
Austria	19	8.92	19	8.92
Ireland	20	8.89	20	8.89
Canada	21	8.85	21	8.85
Netherlands	22	8.80	22	8.80
Russian Federation	23	8.80	23	8.80
Estonia	24	8.79	24	8.79
Italy	25	8.79	25	8.79
Argentina	26	8.75	26	8.75
Israel	27	8.71	27	8.71
Portugal	28	8.69	28	8.69
Barbados	29	8.69	29	8.69
Chile	30	8.64	30	8.64
Macao, China	31	8.63	31	8.63
Hungary	32	8.62	32	8.62
United Kingdom	33	8.62	33	8.62
Japan	34	8.62	34	8.62
Venezuela	35	8.56	35	8.56
France	36	8.55	36	8.55
Czech Republic	37	8.48	37	8.48
Romania	38	8.45	38	8.45
Latvia	39	8.42	39	8.42
Uruguay	40	8.38	40	8.38
Switzerland	41	8.37	41	8.37
Croatia	42	8.28	42	8.28
Fiji	43	8.24	43	8.24
Mongolia	44	8.23	44	8.23
Germany	45	8.17	45	8.17
Slovakia	46	8.13	46	8.13
Bulgaria	47	8.13	47	8.13
Kazakhstan	48	8.09	49	8.00
Armenia	49	8.01	48	8.01
Serbia	50	7.99	50	7.99
Hong Kong, China	51	7.98	51	7.98
Costa Rica	52	7.97	52	7.97
Cyprus	53	7.94	53	7.94
Colombia	54	7.79	54	7.79
Turkey	55	7.71	55	7.71
Lebanon	56	7.68	56	7.68
Albania	57	7.65	57	7.65
Saudi Arabia	58	7.60	58	7.60
Malta	59	7.58	59	7.58
Moldova	60	7.53	60	7.53
Bosnia and Herzegovina	61	7.51	61	7.51
Bahrain	62	7.47	62	7.47
Peru	63	7.45	63	7.45
Jordan	64	7.35	64	7.35
TFYR Macedonia	65	7.31	66	7.31
Iran (I.R.)	66	7.30	67	7.30
Ecuador	67	7.29	68	7.29
Azerbaijan	68	7.28	69	7.28
Thailand	69	7.26	65	7.34
St. Vincent and the Gr.	70	7.23	70	7.23
Luxembourg	71	7.23	71	7.23
Brazil	72	7.19	72	7.19
Georgia	73	7.19	73	7.19
Oman	74	7.18	74	7.18
Tonga	75	7.17	75	7.17
Brunei Darussalam	76	7.16	76	7.16
Singapore	77	7.12	77	7.12
Antigua & Barbuda	78	7.11	78	7.11
Panama	79	7.11	79	7.11

Economy	Rank 2012	Skills 2012	Rank 2011	Skills 2011
Mexico	80	7.09	80	7.09
United Arab Emirates	81	7.08	81	7.08
Mauritius	82	7.07	82	7.07
Bolivia	83	7.02	83	7.02
Saint Lucia	84	6.98	84	6.98
Tunisia	85	6.95	85	6.95
Philippines	86	6.94	86	6.94
Uzbekistan	87	6.94	87	6.94
Qatar	88	6.92	88	6.92
Jamaica	89	6.85	89	6.85
Sri Lanka	90	6.84	90	6.84
Algeria	91	6.82	91	6.82
Malaysia	92	6.81	92	6.81
China	93	6.77	93	6.77
Maldives	94	6.77	94	6.77
South Africa	95	6.75	95	6.75
Dominican Rep.	96	6.67	96	6.67
Trinidad & Tobago	97	6.67	97	6.67
Indonesia	98	6.61	98	6.61
Paraguay	99	6.54	99	6.54
Cape Verde	100	6.50	100	6.50
Viet Nam	101	6.49	101	6.49
Seychelles	102	6.47	102	6.47
Suriname	103	6.40	103	6.40
Guyana	104	6.34	104	6.34
Honduras	105	5.99	105	5.99
El Salvador	106	5.88	106	5.88
Botswana	107	5.82	107	5.82
Egypt	108	5.80	109	5.74
Syria	109	5.77	108	5.77
Nicaragua	110	5.56	110	5.56
Myanmar	111	5.39	111	5.39
Gabon	112	5.13	112	5.13
Swaziland	113	5.12	113	5.12
Morocco	114	5.03	115	4.93
Namibia	115	4.98	114	4.98
Solomon Islands	116	4.88	116	4.88
India	117	4.79	117	4.79
Ghana	118	4.76	118	4.72
Bhutan	119	4.56	123	4.38
Kenya	120	4.54	119	4.54
Lao P.D.R.	121	4.53	120	4.53
Cameroon	122	4.50	121	4.50
Cambodia	123	4.42	122	4.42
Comoros	124	4.38	124	4.38
Zimbabwe	125	4.35	125	4.35
Lesotho	126	4.28	126	4.28
Bangladesh	127	4.10	127	4.10
Yemen	128	4.04	128	4.04
Djibouti	129	3.90	131	3.80
Sudan	130	3.88	129	3.88
Congo (Dem. Rep.)	131	3.80	130	3.80
Congo	132	3.78	132	3.78
Uganda	133	3.69	133	3.69
Zambia	134	3.64	134	3.64
Gambia	135	3.64	135	3.64
Rwanda	136	3.61	136	3.61
Tanzania	137	3.56	140	3.38
Nigeria	138	3.51	137	3.51
Angola	139	3.51	138	3.51
Eritrea	140	3.46	139	3.46
Senegal	141	3.32	141	3.32
Madagascar	142	3.32	142	3.32
Pakistan	143	3.27	143	3.27
Malawi	144	3.21	144	3.21
Côte d'Ivoire	145	3.16	145	3.16
Guinea-Bissau	146	3.13	146	3.13
Liberia	147	3.07	147	3.07
Benin	148	3.02	148	3.02
Mauritania	149	3.01	149	3.01
Ethiopia	150	2.80	150	2.80
Mozambique	151	2.71	151	2.73
Guinea	152	2.64	153	2.61
Mali	153	2.63	152	2.63
Central African Rep.	154	2.59	154	2.59
Chad	155	2.10	155	2.10
Burkina Faso	156	1.91	156	1.84
Niger	157	1.51	157	1.49

Table 13 ICT Skills Index (IDI Skills Sub-Index), 2011 and 2012 [19]

Table 13 shows a list of 157 countries across the world. These countries have ICT Skills Index values that range from 9.86 to 1.49. The Republic of Korea ranks first, followed by Finland in second place and the United States ranking third. The Arab countries KSA, Bahrain UAE and Qatar respectively rank as follows: 58, 62, 81 and 88. The Arab State countries are considered to be above the medium and below of it. The results of the ICT Access Index and ICT Use Index are better than the ICT Skills Index. These countries have a clear digital divide in the skills of ICT. The figure below explains the situation of ICT Skills of the Arab States.

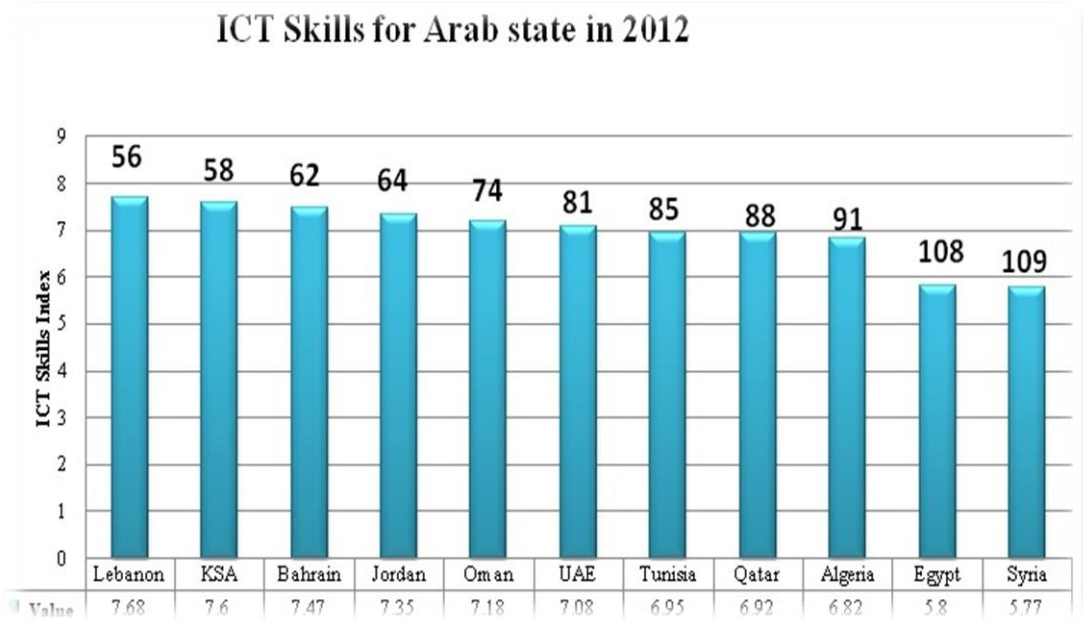


Figure 22 ICT Skills Index Ranking and Index Value for Arab States

Figure 22, which depends on data extracted from study [19], shows 11 countries, the first being Lebanon with a rank of 56, the KSA is second with a rank of 58 and Bahrain third with a rank of 62. The last country in this list is Syria with a rank of 109. We can say that the Arab states have a clear weakness in the ICT Skills Index. For example, Bahrain has 18 ranks in e-government and has high rankings in the OSI, TII, ICT Access Index and ICT Use Index. However, it has 62 ranks in the ICT Skills Index. Even the KSA, UAE and Qatar are in the same situation. Similarly, these countries have low rankings in the HCI.

When countries such as the KSA, UAE, Bahrain and Qatar have good ranking in all indicators, at the same time, they have bad rankings in two indices, namely the HCI

and ICT Skills Indices. This common case should be addressed. Therefore, we researched the relation between the HCI and ICT Skills Index.

3.2 The Relation between HCI and ICT Skills

The HCI and ICT Skills Index have similar results in the Arab countries such that both are ranked low. The HCI has a low value compared with the OSI and TII. On the other hand, the ICT Skills Index has a low value compared with the ICT Access Index and ICT Use Index. We want to determine the common elements between them, the nature of the relation and the percentages.

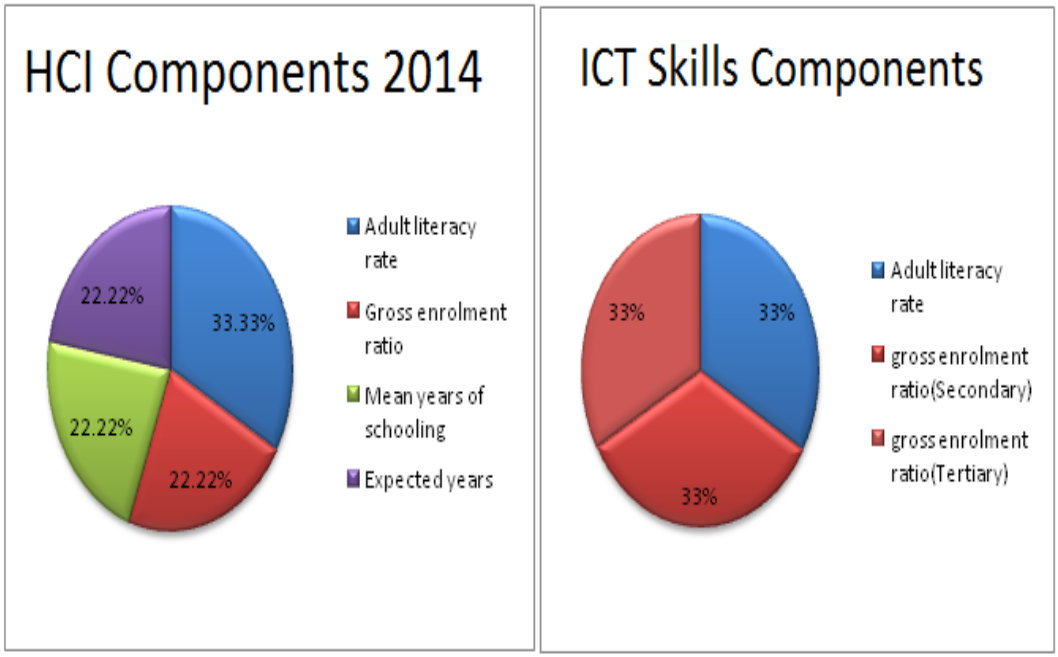


Figure 23 Components of HCI and ICT Skills

Figure 23 above depends on data extracted from [19] and [20] and shows the components of the HCI and ICT Skills Index. We showed the weight for each component to make our calculations easier. We notice that the blue area in both figures is identical with the adult literacy rate. The red area in the HCI represents the gross enrolment ratio in the HCI for primary, secondary and tertiary levels. On the other hand, the red area in the ICT Skills components represents the gross enrolment ratio for secondary and tertiary levels. We will separate the different components in each to determine the common elements, as follows:

HCI Human Capital Index 2014		Weight	ICT Skills (IDI skills sub-index)	Weight
1	**Adult literacy rate**	33%	Adult literacy rate	33%
2	**Gross enrolment ratio (primary, secondary, tertiary)**	22%	gross enrolment ratio(Secondary)	33%
			gross enrolment ratio(Tertiary)	33%
3	**Mean years of schooling**	22%		
4	**Expected years**	22%		

Table 14 Comparison 1 between Components of HCI 2014 and ICT Skills Index

Table 14 depends on data extracted from [19] and [20]

1. Adult literacy rate has the same weight of 33%.

2. Gross enrolment ratios are measured as the combined primary, secondary and tertiary gross enrolment ratio of the total number of students enrolled in these three elements. The weight is 22%.

    - If we assume that each gross enrolment ratio for primary, secondary and tertiary has the same weight,

    Primary gross enrolment ratio = gross enrolment ratios / 3

    =22/3 =7.33

    7.33% is the weight of each element (primary, secondary and tertiary), therefore, the summation of all = 22%.

HCI Human Capital Index 2014		Weight	ICT Skills (IDI skills sub-index)	Weight
1	**Adult literacy rate**	33%	Adult literacy rate	33%
2	**Gross enrolment ratio (Secondary)**	7.33%	Gross enrolment ratio (Secondary)	33%
	Gross enrolment ratio (Tertiary)	7.33%		
	Gross enrolment ratio (Primary)	7.33%	Gross enrolment ratio(Tertiary)	33%
3	**Mean years of schooling**	22%		
4	**Expected years**	22%		

Table 15 Comparison 2 between Components of HCI 2014 and ICT Skills Index

If we want to calculate the gross enrolment ratios without the primary gross enrolment ratio, we apply this formula:

(Primary, Secondary, Tertiary) gross enrolment ratios – (primary) gross enrolment ratio

22 – 7.33 = 14.66

14.66 is the weight of (secondary, tertiary) gross enrolment ratios.

The formula is correct, but the result not 100% correct.

Because the HCI did not give equal weight to (primary, secondary, tertiary) in the gross enrolment ratios, they calculate the total number of students enrolled at the primary, secondary and tertiary levels. Moreover, the number of student enrolments in *primary* should be different from *secondary* and *tertiary* and different from one country to another.

HCI Human Capital Index		Weight		ICT Skills (IDI skills sub-index)	Weight
1	**Adult literacy rate**	33%	47.66%	Adult literacy rate	100%
2	**Gross enrolment ratio (Secondary)**	14.66%		Gross enrolment ratio (Secondary)	
	Gross enrolment ratio (Tertiary)			Gross enrolment ratio (Tertiary)	
	Gross enrolment ratio (primary)	7.33%			
3	**Mean years of schooling**	22%			
4	**Expected years**	22%			

Table 16 Comparison 3 between Components of HCI 2014 and ICT Skills Index

ICT skills index ratio in HCI = Adult literacy rate + [(primary, secondary, tertiary) gross enrolment ratios – Primary gross enrolment ratio]

= 33 + 22 – 7.33

= 33 + 14.66

= 47.66

ICT Skills Index weight in the HCI is 47.6%

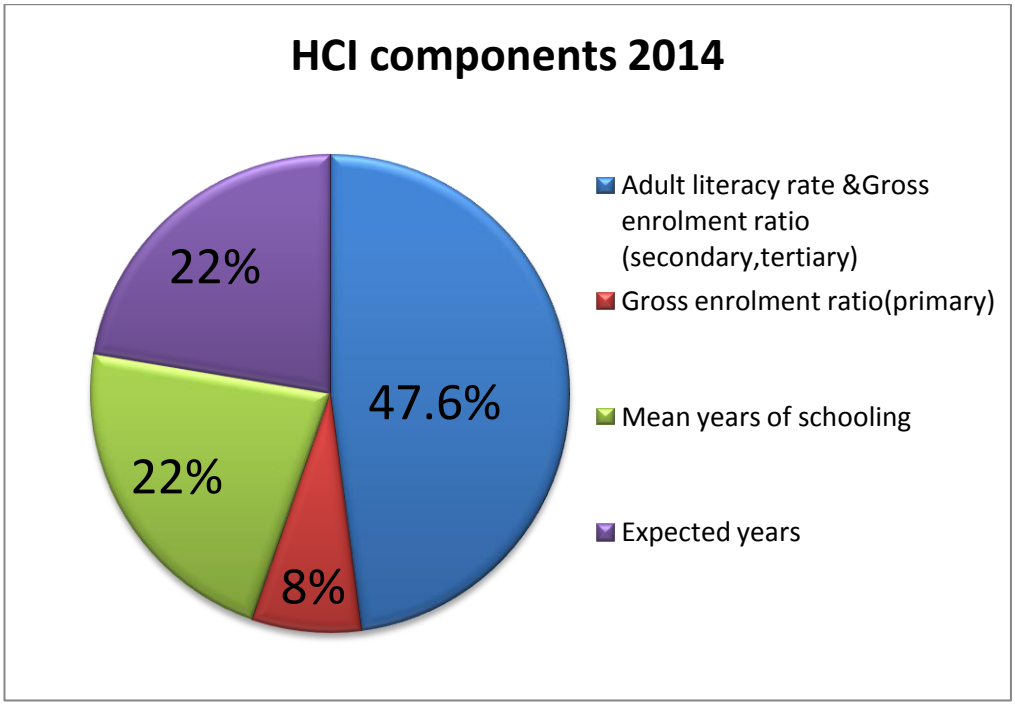


Figure 24 ICT Skills Components in HCI

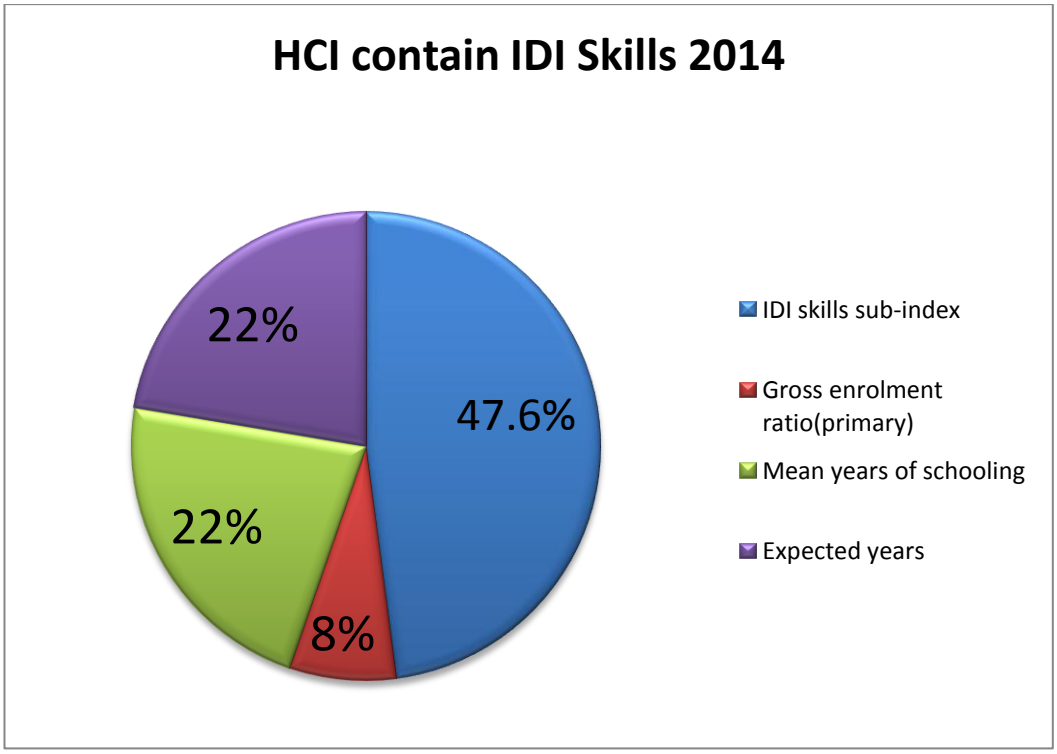


Figure 25 HCI Containing IDI Skills 2014

Figure 25 shows in blue how the ICT Skill components are contained in the HCI. These components are adult literacy rate and gross enrolment ratio (secondary,

tertiary). **Figure 25** considers the final figure that shows the relation is the HCI containing the ICT Skills Index. Weight of this container is 47.66.

The relation between ICT Skills and the HCI 2002-2012

In the same way, we can calculate the HCI and ICT Skills Indices using all UN surveys, namely those from 2002, 2003, 2004, 2005, 2008, 2010 and 2012, for addition to the HCI. Table17 below explains this:

HCI Human Capital Index from 2002 to 2012		**Weight**	**ICT Skills (IDI skills sub-index)**	**Weight**
1	**Adult literacy rate**	66.66%	Adult literacy rate	33%
2	**Gross enrolment ratio (primary, secondary, tertiary)**	33.33%	Gross enrolment ratio (Secondary)	33%
			Gross enrolment ratio (Tertiary)	33%

Table 17 Comparison 4 between Components of HCI 2002 - 2012 and ICT Skills Index

If we give primary, secondary and tertiary in the gross enrolment ratio the same weight, the relation would be

HCI Human Capital Index from 2002 to 2012		Weight		ICT Skills (IDI skills sub-index)	Weight
1	**Adult literacy rate**	66%	89%	Adult literacy rate	100%
2	**Gross enrolment ratio (Secondary)**	11%		Gross enrolment ratio (Secondary)	
	Gross enrolment ratio (Tertiary)	11%		Gross enrolment ratio (Tertiary)	
	Gross enrolment ratio (primary)	11%			

Table 18 Comparison 5 between Components of HCI 2002 - 2012 and ICT Skills Index

HCI containing IDI Skills from 2002 to 2012

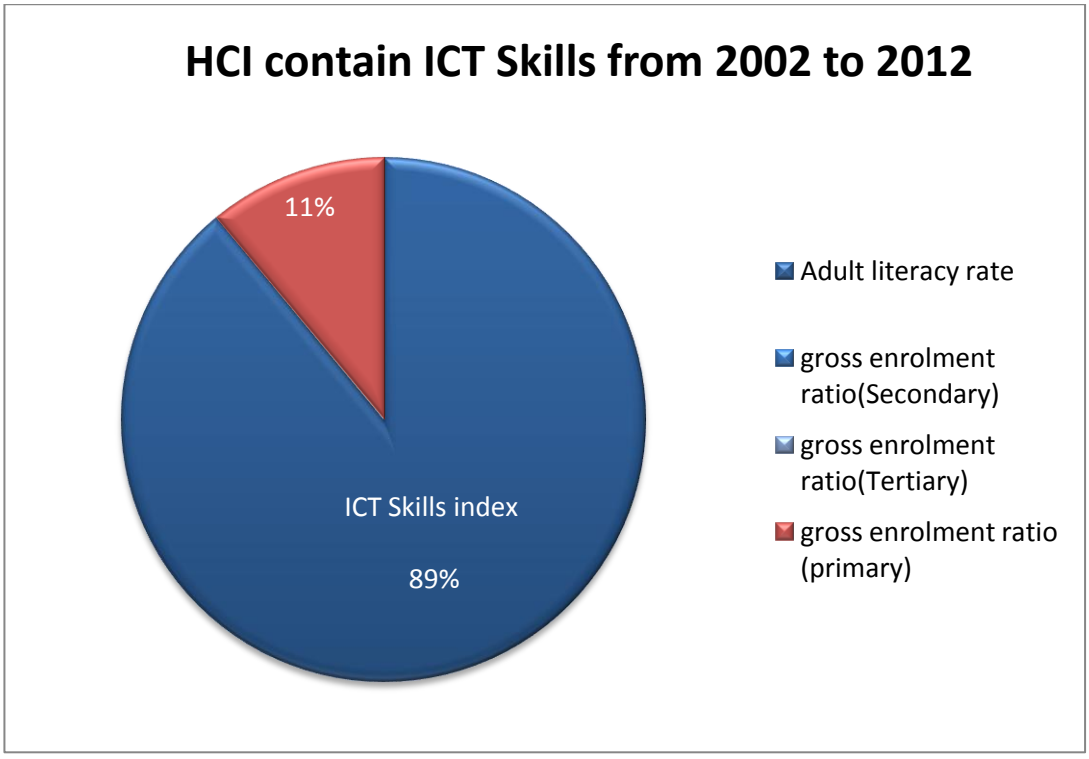


Figure 26 HCI Containing IDI Skills from 2012 to 2104

3.3 Effects of HCI on E-Government Rankings in 2014

The effects of the three indices, HCI, TII and OSI, can be seen in the figure below. We can analyze the behavior of each index by examining its curve.

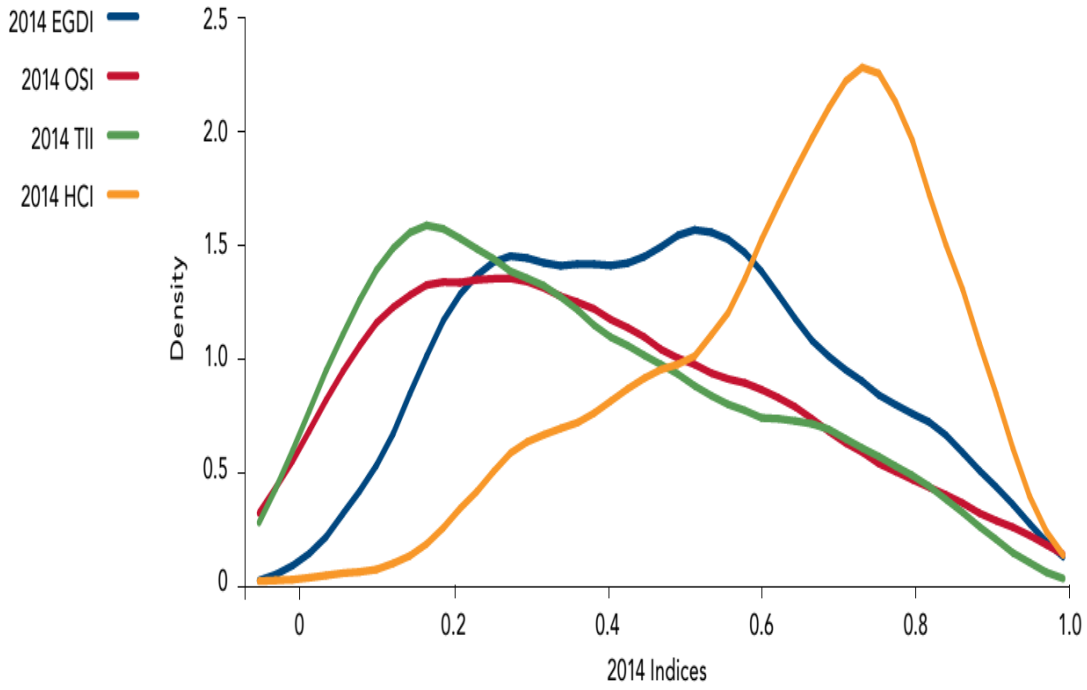


Figure 27 Distributions of EGDI and its Three Components [12]

According to [12], and according to the interpretation for Figure 27, disparities appear in the EGDI levels among human capital resources, online services and infrastructure in several regions. If we compare the three components of the EGDI, we can see that human capital has higher scores than two other components. The Telecommunication Infrastructure Index (TII) has the lowest score and its drags down the overall EGDI. The Online Service Index (OSI) score is under the average value. In general, the countries focus on their investment in human capital and do not give the same focus to ICT infrastructure.

Note: The x-axis represents the values of the four indices, namely EGDI, HCI, OSI and TII, the value from 0 to 1. The y-axis represents the distribution densities of countries, which is the number of countries for each of the four indices. It shows that every index has its own behavior through the distribution density. For example, the HCI has a low distribution density of countries, when its value ranges from 0 to 0.5;

simultaneously the HCI has a high distribution density of countries when its value reaches 7.7. The intersection of these axes represents the values of the indices for HCI, OSI, TII and EGDI with their distribution densities through the countries. This leads to generate four curves. Every curve has two characters: an index value and its distribution density through countries.

As we reviewed, we can obtain other results from the figure above.

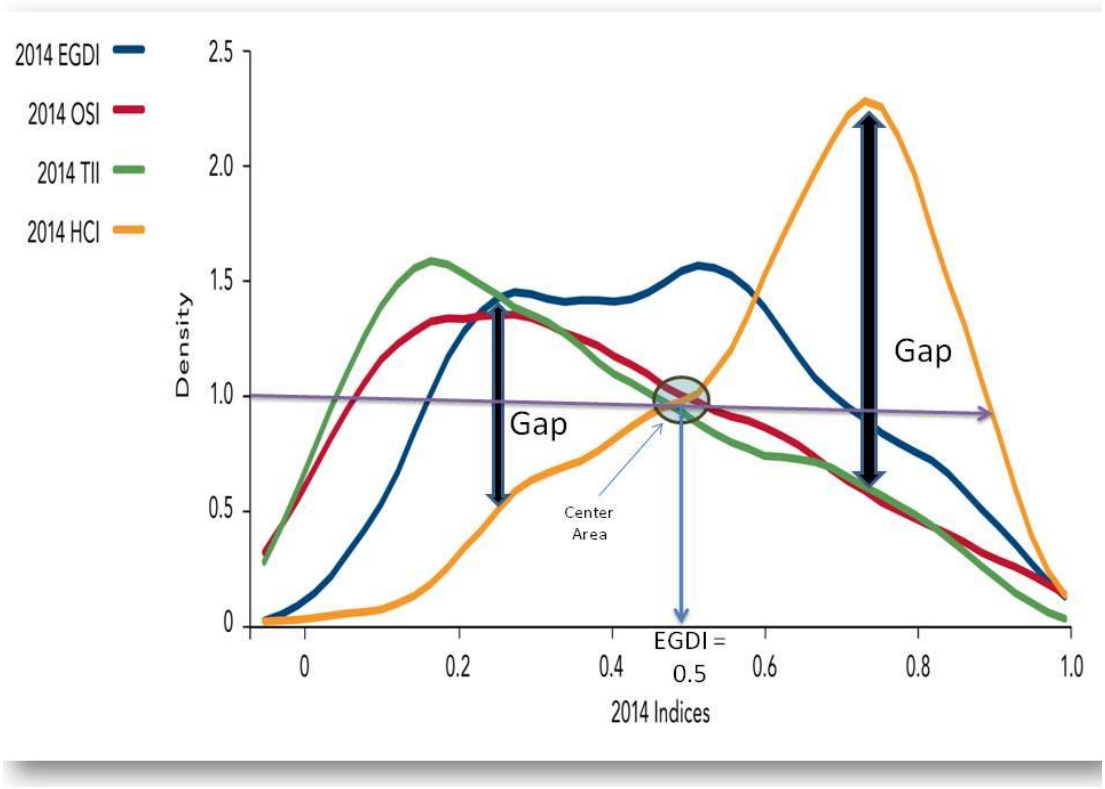


Figure 28 Distributions of EGDI and its three Components, After Analysis

As shown in Figure 28, we can notice from two indices (OSI and TII) that their curves have a closer behavior. Both are similar in their starting to reach their high point, followed by their curves decreasing. The HCI curve starts from 0 to 0.5, which is the center area. In this range, the HCI curves less than the OSI and TII curves. The area in which the values of all three indices approach one another is known as the center area. The HCI curve after the center area jumps in comparison to the OSI and TII. A gap shows between HCI and other two indices OSI, TII, before center area and after it. In particular, this gap clearly shows that the HCI plays the main role in increasing and decreasing e-government rankings. The countries with decreasing

HCIs have EGDIs lower than 0.5. Moreover, countries with EGDIs equal to approximately 0.5 were affected neither negatively nor positively. On the other hand, the HCI increased the EGDI value for countries with an EGDI greater than 0.5.

All in all, HCI is the index which has the greatest impact on e-government rankings. The HCI shows the divide between countries. The 2014 UN survey mentions a positive side for the HCI in raising EGDI. It did not mention the negative side or its effect on large numbers of e-government countries. The survey stated that countries focus on their investment in the HCI and ignore other indices. The figure shows that many e-government countries have better OSI and TII behavior than HCI behavior. Moreover, the HCI required higher than normal investment in budgets and infrastructure. Countries are required to have stable systems, long-term policies and a long, rich tradition of higher education, such as those from the list below of 25 World e-government leaders in HCI. Most of these countries are from Europe, except New Zealand, Australia and we have two countries from North America, USA and Canada, and two countries from Asia, Republic of South Korea and Japan.

We can see both positive and negative direct effects of the HCI on e-government rankings. The list below for e-government countries according to HCI rank enhances their argument.

HCI Rank	**EGDI Rank**	**Country Name**	**EGDI**	**HCI**		**HCI Rank**	**EGDI Rank**	**Country Name**	**EGDI**	**HCI**
1	9	New Zealand	0.864	1		**101**	130	Micronesia	0.333	0.702
2	2	Australia	0.910	0.997		**102**	137	Tuvalu	0.30	0.702
3	22	Ireland	0.781	0.961		**103**	142	Marshall Islands	0.285	0.700
4	7	USA	0.874	0.939		**104**	91	Trinidad & Tobago	0.493	0.694
5	13	Norway	0.835	0.938		**105**	76	Mauritius	0.533	0.688
6	1	N. Korea	0.946	0.927		**106**	105	Iran	0.450	0.688

7	5	Netherland	0.889	0.922		**107**	94	Maldives	0.481	0.686
8	19	Iceland	0.797	0.917		**108**	132	Kiribati	0.320	0.681
9	12	Spain	0.840	0.915		**109**	106	Indonesia	0.448	0.678
10	16	Denmark	0.816	0.913		**110**	115	Suriname	0.404	0.674
11	41	Slovenia	0.650	0.907		**111**	70	China	0.545	0.673
12	10	Finland	0.844	0.903		**112**	75	Tunisia	0.538	0.671
13	11	Canada	0.841	0.895		**113**	110	Dominica	0.433	0.670
14	25	Belgium	0.756	0.893		**114**	122	Paraguay	0.374	0.67
15	15	Estonia	0.817	0.888		**115**	131	Gabon	0.324	0.667
16	59	Barbados	0.593	0.886		**116**	44	Qatar	0.636	0.667
17	21	Germany	0.786	0.886		**117**	32	UAE	0.713	0.665
18	55	Belarus	0.605	0.886		**118**	102	Thailand	0.463	0.66
19	4	France	0.893	0.881		**119**	107	Dominican	0.448	0.663
20	14	Sweden	0.822	0.880		**120**	48	Oman	0.627	0.662
21	53	Czech Republic	0.606	0.875		**121**	112	Botswana	0.419	0.655
22	34	Greece	0.711	0.874		**122**	136	Algeria	0.310	0.654
23	39	Hungary	0.663	0.866		**123**	88	El Salvador	0.498	0.641
24	20	Austria	0.791	0.866		**124**	124	Guyana	0.369	0.630
25	6	Japan	0.887	0.861		**125**	114	Honduras	0.408	0.628
26	28	Kazakhstan	0.728	0.861		**126**	138	Swaziland	0.305	0.62
27	87	Ukraine	0.503	0.861		**127**	99	Viet Nam	0.470	0.614
28	8	UK and N. Ireland	0.869	0.857		**128**	127	Cape Verde	0.355	0.603

29	46	Argentina	0.630	0.857		**129**	120	Belize	0.377	0.601
30	30	Switzerland	0.726	0.856		**130**	80	Egypt	0.512	0.591
31	29	Lithuania	0.727	0.855		**131**	135	Syrian	0.313	0.583
32	23	Italy	0.759	0.855		**132**	159	Vanuatu	0.257	0.573
33	17	Israel	0.816	0.854		**133**	117	Namibia	0.387	0.569
34	3	Singapore	0.907	0.851		**134**	147	Nicaragua	0.275	0.563
35	116	Cuba	0.391	0.849		**135**	145	Nauru	0.277	0.561
36	42	Poland	0.648	0.839		**136**	123	Ghana	0.373	0.561
37	27	Russian Federation	0.729	0.838		**137**	119	Kenya	0.380	0.555
38	35	Liechtenstein	0.698	0.836		**138**	126	Zimbabwe	0.358	0.544
39	62	San Marino	0.582	0.835		**139**	144	Cameroon	0.278	0.542
40	85	Fiji	0.504	0.832		**140**	162	Togo	0.244	0.540
41	98	Tonga	0.470	0.830		**141**	172	Burundi	0.192	0.539
42	31	Latvia	0.717	0.828		**142**	168	Equatorial Guinea	0.226	0.528
43	45	Montenegro	0.634	0.827		**143**	175	Myanmar	0.186	0.528
44	51	Slovakia	0.614	0.826		**144**	134	Iraq	0.314	0.528
45	33	Chile	0.712	0.823		**145**	133	Guatemala	0.316	0.527
46	37	Portugal	0.689	0.822		**146**	156	Uganda	0.259	0.527
47	78	Grenada	0.521	0.816		**147**	160	Congo	0.256	0.523
48	26	Uruguay	0.741	0.814		**148**	139	Cambodia	0.299	0.518

49	64	Romania	0.563	0.81		**149**	169	Sao Tome	0.221	0.517
50	149	Democratic Korea	0.275	0.807		**150**	153	Lesotho	0.262	0.513
51	108	Palau	0.44	0.799		**151**	140	Angola	0.297	0.494
52	73	Bulgaria	0.542	0.796		**152**	152	Lao Republic	0.265	0.494
53	38	Monaco	0.671	0.794		**153**	82	Morocco	0.505	0.490
54	47	Croatia	0.628	0.792		**154**	155	Madagascar	0.260	0.488
55	56	Georgia	0.604	0.789		**155**	161	Timor-Leste	0.252	0.483
56	65	Mongolia	0.558	0.788		**156**	125	Rwanda	0.358	0.48
57	40	Malta	0.651	0.785		**157**	166	Malawi	0.232	0.474
58	18	Bahrain	0.808	0.784		**158**	170	Solomon Islands	0.208	0.470
59	24	Luxembourg	0.759	0.783		**159**	118	India	0.383	0.469
60	58	Cyprus	0.595	0.782		**160**	177	Comoros	0.180	0.466
61	121	Libya	0.37	0.782		**161**	163	Zambia	0.238	0.450
62	86	Brunei Darussalam	0.504	0.781		**162**	146	Tanzania	0.276	0.449
63	69	Serbia	0.547	0.779		**163**	143	Bhutan	0.282	0.42
64	67	Venezuela	0.556	0.768		**164**	185	South Sudan	0.141	0.403
65	60	Antigua and Barbuda	0.592	0.766		**165**	182	Guinea-Bissau	0.160	0.386
66	61	Armenia	0.589	0.766		**166**	148	Bangladesh	0.275	0.386

67	54	Costa Rica	0.606	0.758		**167**	183	Congo	0.155	0.384
68	111	Samoa	0.420	0.749		**168**	150	Yemen	0.271	0.38
69	68	Azerbaijan	0.547	0.748		**169**	141	Nigeria	0.292	0.381
70	128	Turkmenistan	0.351	0.748		**170**	165	Nepal	0.234	0.377
71	36	Saudi Arabia	0.690	0.746		**171**	179	Liberia	0.176	0.375
72	77	Panama	0.524	0.745		**172**	174	Mauritania	0.189	0.358
73	63	Mexico	0.573	0.744		**173**	164	Mozambique	0.238	0.345
74	103	Bolivia	0.456	0.742		**174**	176	Haiti	0.180	0.337
75	101	Kyrgyzstan	0.465	0.741		**175**	158	Pakistan	0.257	0.333
76	74	Sri Lanka	0.541	0.737		**176**	167	Gambia	0.228	0.332
77	89	Lebanon	0.498	0.737		**177**	151	Senegal	0.266	0.328
78	57	Brazil	0.600	0.737		**178**	184	Djibouti	0.145	0.318
79	50	Colombia	0.617	0.734		**179**	187	Central African	0.125	0.309
80	81	Seychelles	0.511	0.731		**180**	154	Sudan	0.260	0.305
81	72	Peru	0.543	0.729		**181**	188	New Guinea	0.120	0.3
82	97	Bosnia and Herzegovina	0.470	0.728		**182**	171	Coe d'Ivoire	0.203	0.299
83	93	South Africa	0.486	0.728		**183**	157	Ethiopia	0.258	0.293
84	90	Saint Kitts and Nevis	0.497	0.727		**184**	180	Benin	0.168	0.275

85	43	Andorra	0.642	0.727		**185**	192	Eritrea	0.090	0.272
86	100	Uzbekistan	0.469	0.726		**186**	186	Sierra Leone	0.132	0.269
87	109	Jamaica	0.438	0.726		**187**	173	Afghanistan	0.190	0.241
88	129	Tajikistan	0.339	0.729		**188**	190	Guinea	0.095	0.235
89	79	Jordan	0.516	0.702		**189**	189	Chad	0.107	0.234
90	66	Republic of Moldova	0.557	0.720		**190**	181	Mali	0.163	0.221
91	96	Republic of Macedonia	0.471	0.719		**191**	178	Burkina Faso	0.180	0.157
92	49	Kuwait	0.626	0.719		**192**	191	Niger	0.094	0.119
93	92	Bahamas	0.49	0.713		**193**	193	Somalia	0.013	0
94	71	Turkey	0.544	0.713						
95	104	Saint Lucia	0.452	0.713						
96	52	Malaysia	0.611	0.711						
97	84	Albania	0.504	0.71						
98	113	Saint Vincent and the Grenadines	0.415	0.708						
99	95	Philippines	0.476	0.705						
100	83	Ecuador	0.505	0.703						

Table 19 E-government Rank in HCI

The table above depends on data in [12] and shows e-government ranks in the HCI. We depended on the HCI rank, and not the value, because the rank considers the real scale in order to know the position of a country across the world**.** We can notice that

New Zealand was ranked first, Australia second and Ireland third. Most countries above the medium take advantage of the HCI to raise the EGDI thereby raising their rank. Ukraine has an HCI rank of 27, which helps it to raise their ranking in e-government to reach 87. The Democratic People's Republic of Korea get a big advantage its general e-government rank is 149 however, HCI rank is 50, its mean HCI raise their e-government rank strongly. Cuba has the same advantage general e-government rank is 116 however, HCI rank is 35. Switzerland is a healthy case with their HCI rank and e-government rank being the same at 30. Most countries under the medium have bad effects from HCI in decreasing EGDI and drags down their rank. Such as Turkey has HCI 94 effect to their e-government rank to be 71. The Arab State countries have weak point in HCI value. We will talks about it, Libya gets a big advantage its general e-government rank is 121. However, and HCI rank is 61.This table and figure shows how the HCI is important and how there are countries which need to work on the HCI.

We can see from Figure 28 and Table 19 that the HCI effect is both positive and negative.

Country Name	E-Government Rank	OSI Rank	HCI Rank	TII Rank
Bahrain	18	7	58	26
UAE	32	12	117	43
KSA	36	20	71	52
Qatar	44	38	116	44
Oman	48	26	120	57
Kuwait	49	52	92	45
Tunisia	75	40	112	100
Jordan	79	62	89	99
Egypt	80	51	130	88
Morocco	82	30	153	93
Lebanon	89	97	77	74
Libya	121	183	61	96
Iraq	134	138	144	126
Syrian	135	148	131	129
Algeria	136	168	122	130
Yemen	150	112	168	151

Table 20 E-government Indices Rank for Arab Countries in 2014

Table 20 depends on data extracted from [12] and shows the rankings of the OSI, HCI and TII indices individually for the Arab countries. We can see that the OSI effect is positive in Bahrain, UAE, the KSA and Qatar and, with the exception of Kuwait, most of the countries that have an e-government rank above 89. On the other hand, with the exception of Yemen, the OSI effect is negative on countries that have an e-government rank below 89. The TII effect is negative on countries that have an e-government rank above 49, except for Qatar, which has zero effect. The TII effect is positive on countries that have an e-government rank between 89 and 136. The HCI effect is negative with large values especially on countries that have an e-government rank below 89. The HCI has a strong and bad effect in these countries. The HCI decreases the e-government rank for Bahrain, UAE, the KSA, Qatar, Oman and Iraq. Its bad effects clearly appear with countries ranking above 49 because it is difficult to have a good and close rank in each of the OSI, TII and HCI. All in all, the HCI is the worst-affected index for e-government performance in the Arab countries.

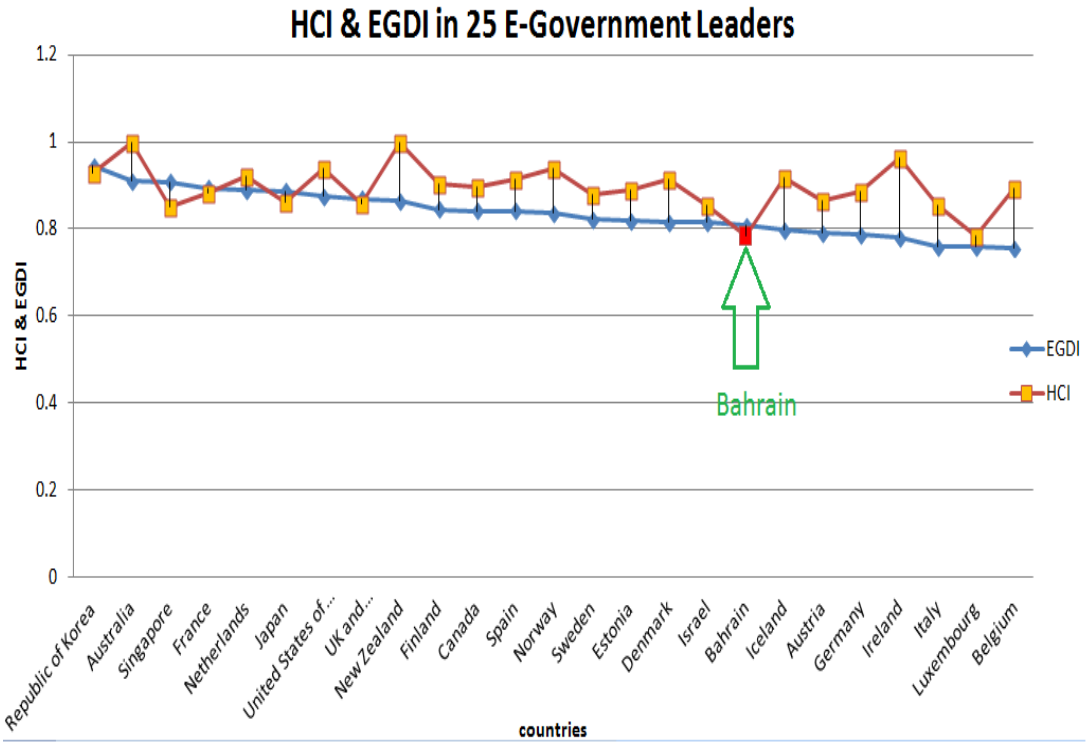
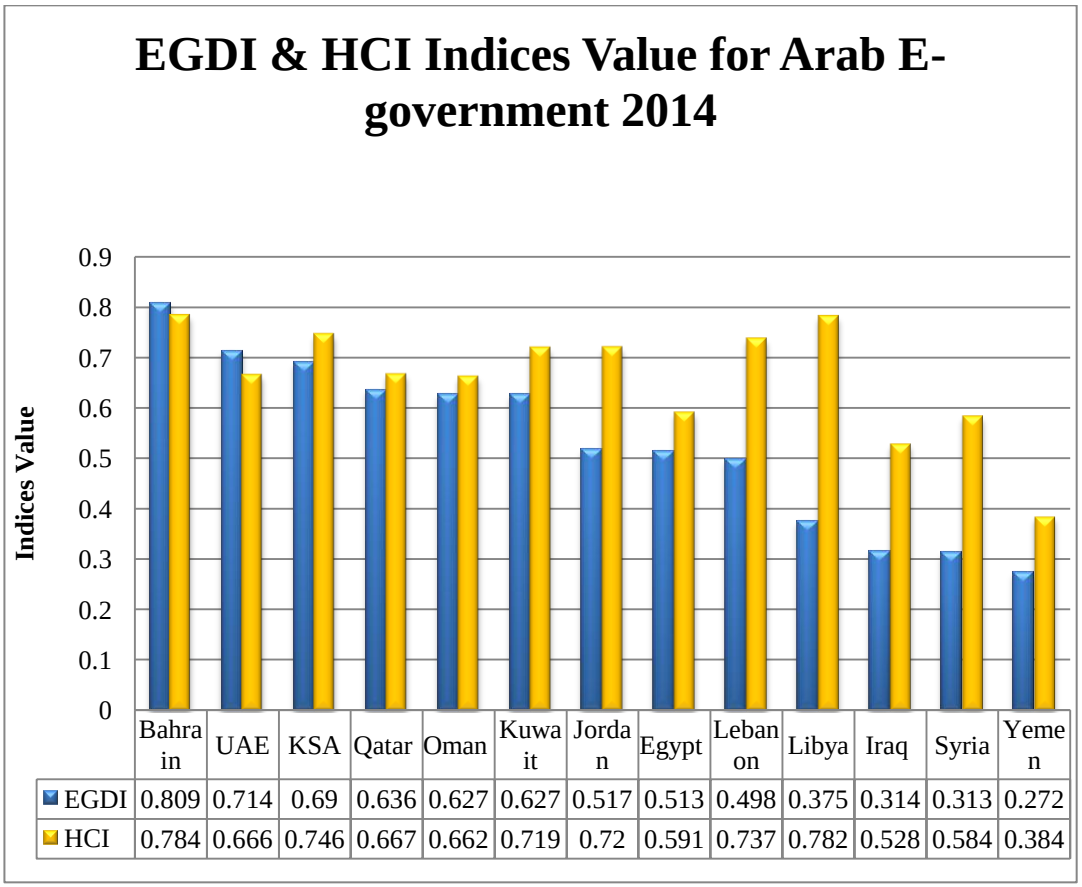


Figure 29 HCI and EGDI for 25 E-government Leaders 2014

Figure 29 depends on data extracted from [12] and shows the effect of the HCI on 25 world leaders in e-government. Most of the countries shown in the figure take advantage of the HCI by raising their EGDI. Bahrain and Singapore did not take any

advantage of the HCI. We can see that Bahrain is in a low position in the HCI compared with others countries.

Figure 30 shows the HCI values for the Arab countries. It shows clearly that the HCI value did not correctly reflect the reality. On the other hand, the HCI rank reflected it correctly.



	Bahrain	UAE	KSA	Qatar	Oman	Kuwait	Jordan	Egypt	Lebanon	Libya	Iraq	Syria	Yemen
EGDI	0.809	0.714	0.69	0.636	0.627	0.627	0.517	0.513	0.498	0.375	0.314	0.313	0.272
HCI	0.784	0.666	0.746	0.667	0.662	0.719	0.72	0.591	0.737	0.782	0.528	0.584	0.384

Figure 30 EGDI Value and HCI Value for Arab Countries 2014

Figure 30 depends on data extracted from [12] and shows a list of the 13 Arab States from the left to far right ordered according to EGDI value. Bahrain has the highest value for an Arab state in terms of EGDI with 0.8088 and an HCI of 0.784. The UAE is in second position Followed by the KSA. Yemen is last in the list. On the other hand, in terms of HCI value, after Bahrain, we have Libya in the second place with a 0.782 value. The HCI value for the Arab states appears to have good performance. There are no large differences between the EGDI and HCI values.

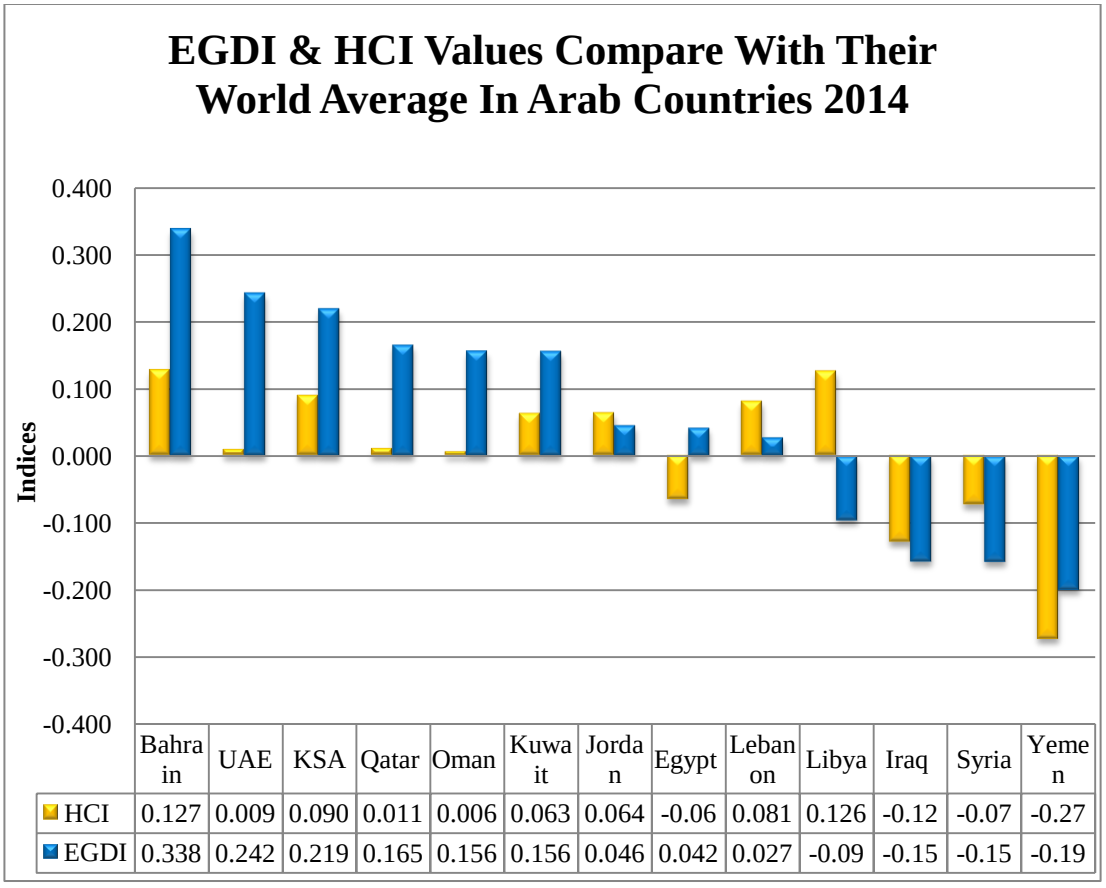
However, if we compare EGDI and HCI values for each of them with the world average, we can see the behavior of each index compared with the world by taking

the values of the differences of EGDI and HCI with the EGDI world average of 0.4712 and the HCI world average of 0.656593.

3.4 Quick Tool to Evaluate Indices

The average difference value is a quick tool to evaluate e-government indices. The behavior of each index is clearly shown this way by comparing it with the world. It measures the weak and strong points in the performance of each index.

How much each index value is above or below the average is shown in Figure 31 below.



	Bahrain	UAE	KSA	Qatar	Oman	Kuwait	Jordan	Egypt	Lebanon	Libya	Iraq	Syria	Yemen
HCI	0.127	0.009	0.090	0.011	0.006	0.063	0.064	-0.06	0.081	0.126	-0.12	-0.07	-0.27
EGDI	0.338	0.242	0.219	0.165	0.156	0.156	0.046	0.042	0.027	-0.09	-0.15	-0.15	-0.19

Figure 31 Values of EGDI and HCI Compared with their Averages in Arab Countries in 2014

Figure 31 depends on data extracted from [12]. It shows how much the EGDI and HCI values are above or below the world average. For example, in 2014 the HCI world average was 0.656593 and for Iraq, the HCI value was 0.5283.

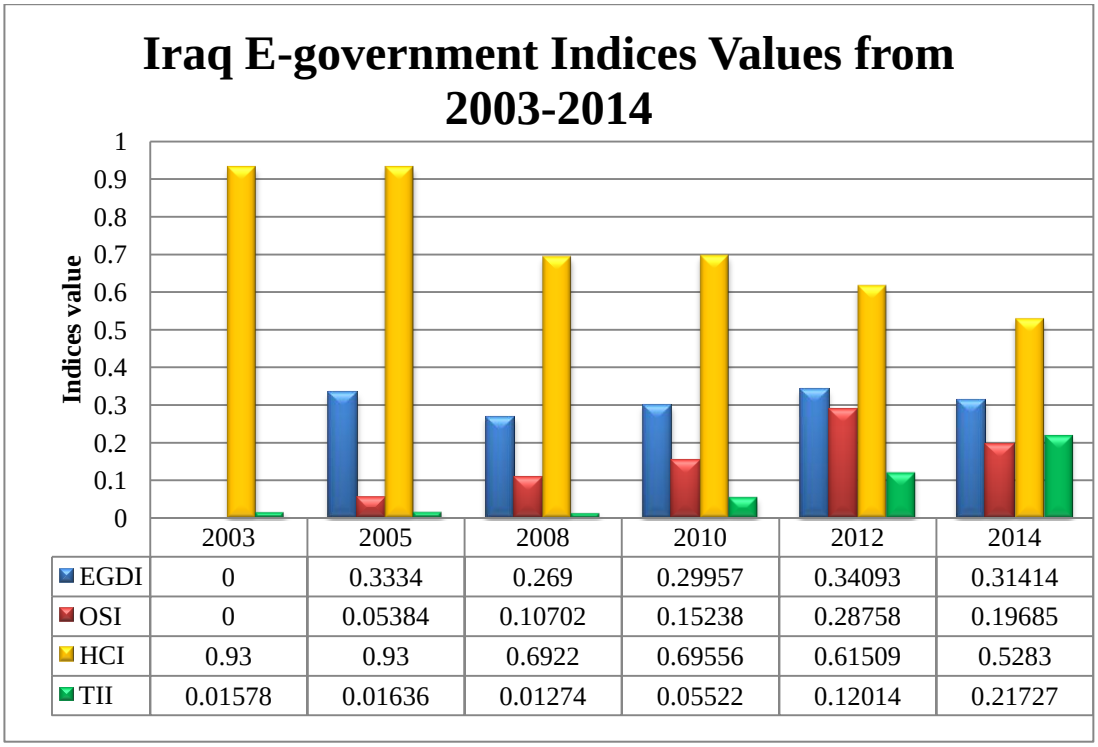
Iraq average difference = HCI value of Iraq – HCI average of the world

= 0.5283 – 0.656593

= –0.128

The list of 13 Arab States from the left to far right is sorted according to EGDI average differences. It shows clear negative performance of the HCI. The value figure did not show this (see figure 30). Bahrain has the higher EGDI and HCI and Yemen the lower. There is a disparity in the EGDI and HCI, which refers to the weakness in the HCI. HCI has an average difference lower than the EGDI average difference in Arab states. It is clear that HCI has a negative impact on the performance of e-government. These countries have HCI values that appear good. However, based on the average differences, the HCI values are insufficient to raise e-government rank.

To sum up, the HCI average differences (see Figure 31) reflect the HCI reality, both the weak points and strong points. It shows the relation between the HCI and the EGDI. The HCI value (see Figure 30) did not reflect this reality. We show this impact of the HCI on 13 Arab countries in 2014. To enhance our finding, we take three countries, namely Iraq, the KSA and Bahrain, and analyze and track the behavior of their indices from 2003 to 2014. We should see that effect of the HCI on e-government differs from the TII and OSI.



	2003	2005	2008	2010	2012	2014
EGDI	0	0.3334	0.269	0.29957	0.34093	0.31414
OSI	0	0.05384	0.10702	0.15238	0.28758	0.19685
HCI	0.93	0.93	0.6922	0.69556	0.61509	0.5283
TII	0.01578	0.01636	0.01274	0.05522	0.12014	0.21727

Figure 32 Iraq E-government Indices Values from 2003 -2014

Figure 32 above extracted from UN reports on e-government initiatives of the countries [12], [27], [28], [29], [30] and [31] shows Iraq's values for its EGDI, OSI, HCI and TII. We can notice that every index value from 2003 to 2014 starts its development progressively from 2003, with the exception of the HCI, the behavior of which is quite different from the remaining indicators, which began with its highest value of 9.3 in 2003 and 2005. After that, the HCI decreased until it reached its value of 0.5283 in 2014. The effects of the HCI on EGDI were negative because it constitutes 33% of the EGDI value. However, the TII and OSI have ascending behavior from 2003 to 2014, with the exception of the OSI value, which decreased in 2014. To sum up, the EGDI has unstable results from 2010 to 2014, the HCI decreased more than 40% from 2003 to 2014 and the HCI is considered to be the main factor that strongly affects the EGDI value.

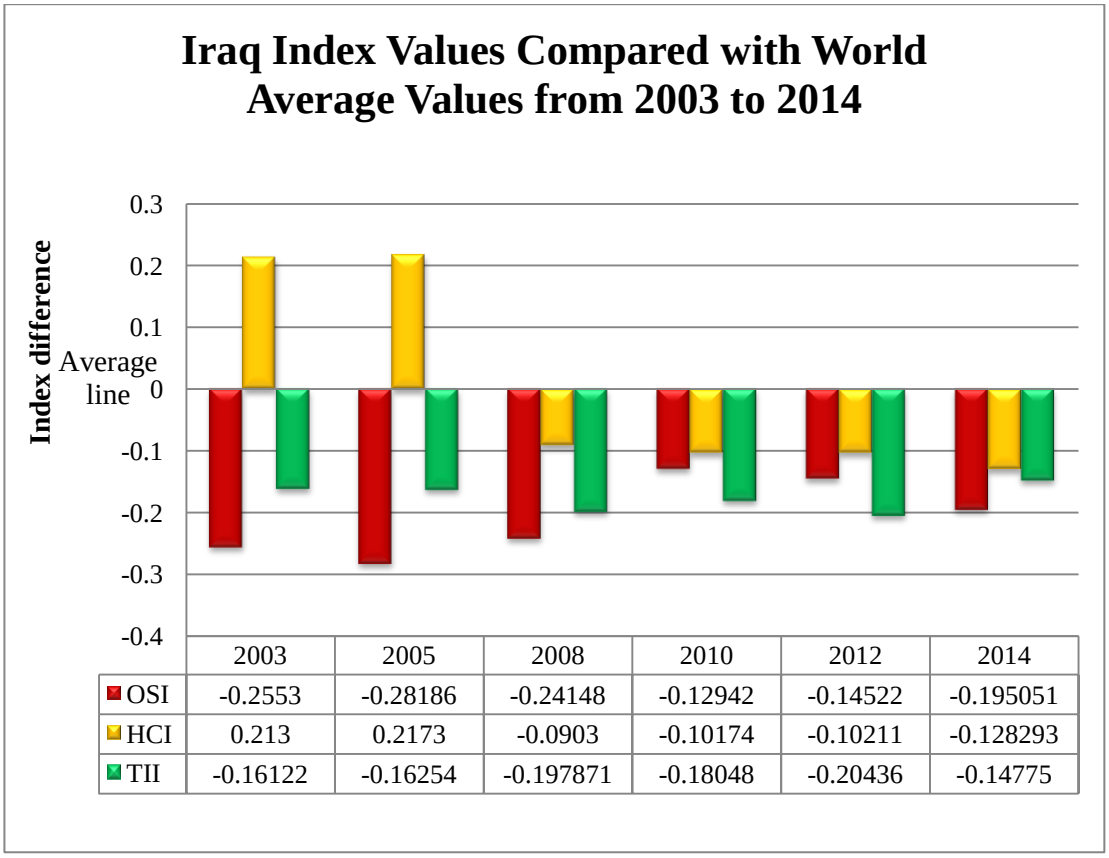
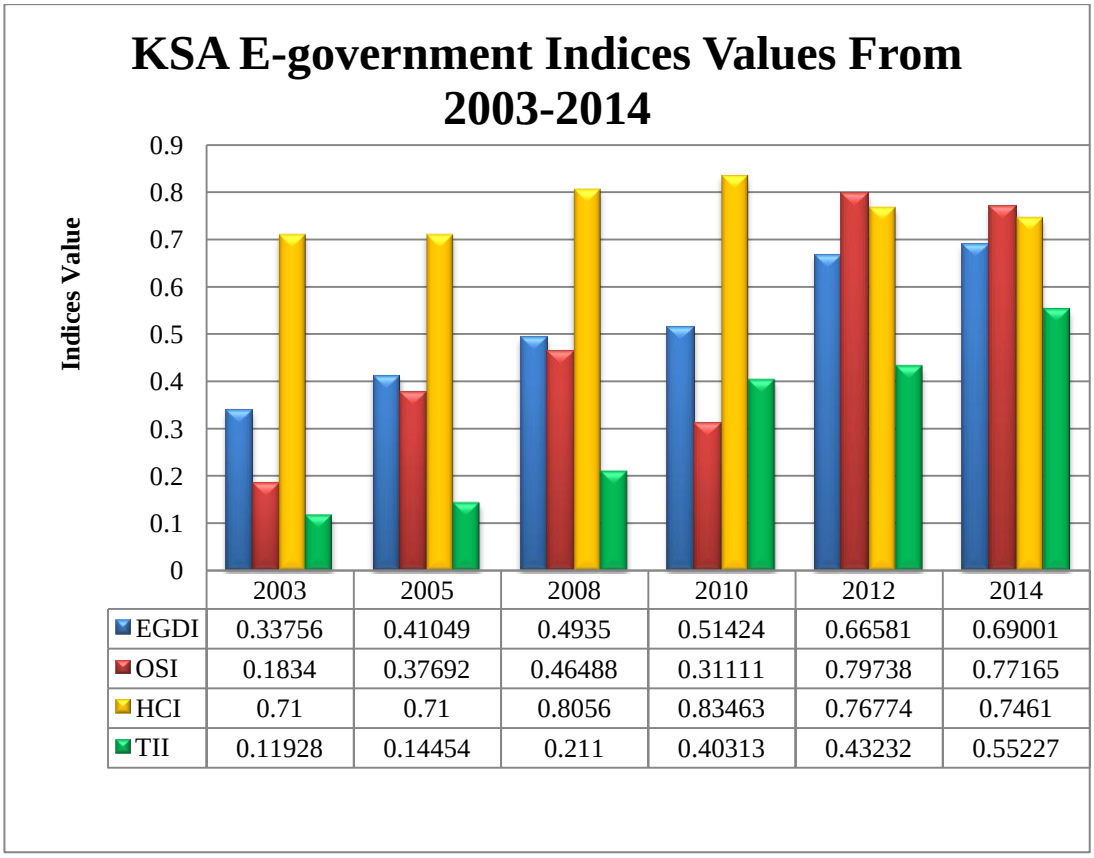


Figure 33 Iraq Index Values Compared with World Average Values from 2003 to 2014

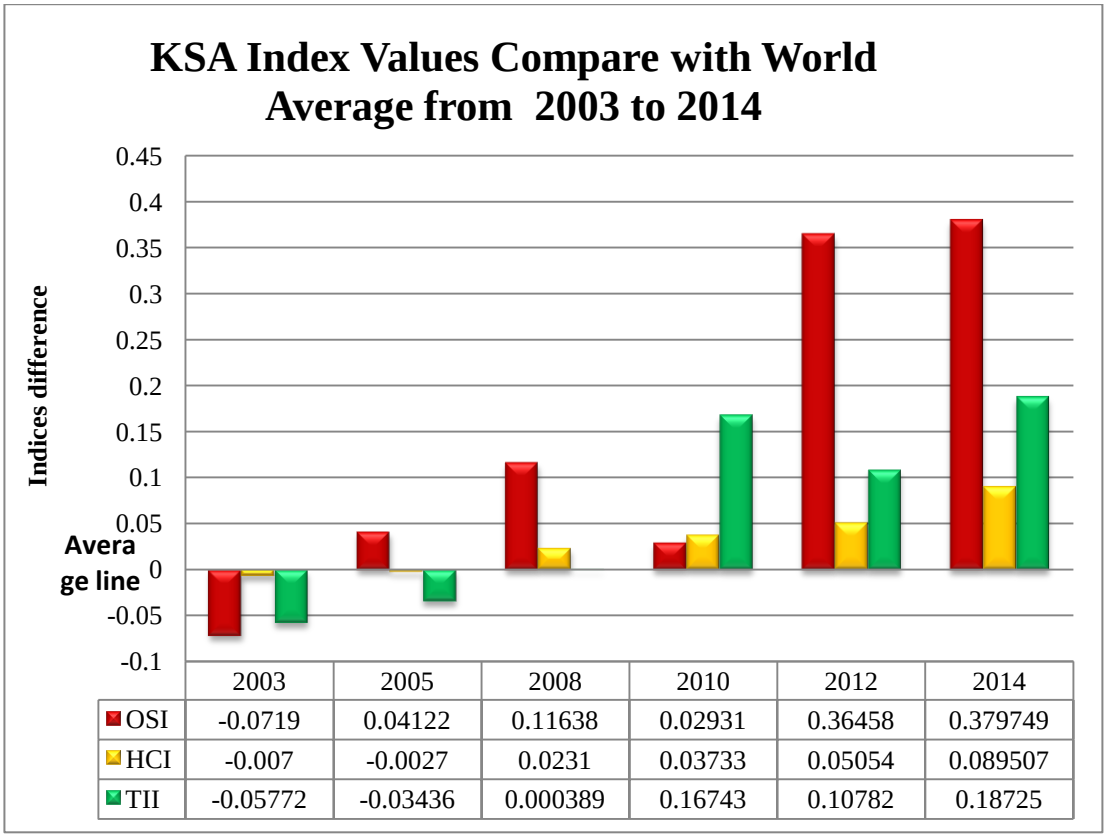
Figure 33 above extracted from UN reports on e-government initiatives of the countries, [12], [27], [28], [29], [30] and [31] shows that Iraq's indices have average difference values below the average line of the world, with the exception of the HCIs in 2003 and 2005. The HCI has the highest result in 2005 with 0.2173 and the lowest result in 2014 with –0.1477. This refers to descending behavior. The OSI has unstable results starting in 2003 with –0.2553 which decreases and increases until 2014 with –0.195. The OSI has the best result in 2010 with –0.129. The TII has unstable results, too. In 2005, it had the lowest result of –0.162. However, in 2014, there was a positive sign, which was the highest result of –0.1477. To sum up, the TII and OSI have average differences in 2014, better than the values in 2003. This refers to the development in TII and OSI. On the other side, there is a serious problem with the HCI regarding its decreasing behavior. Iraq suffers from poor values in all indices. All of these indices are below the average line of the world. It is clear that the HCI is continuously decreasing, while the opposite is true for OSI and TII. In the next decade, the HCI will cause a decrease of e-government rankings.



	2003	2005	2008	2010	2012	2014
EGDI	0.33756	0.41049	0.4935	0.51424	0.66581	0.69001
OSI	0.1834	0.37692	0.46488	0.31111	0.79738	0.77165
HCI	0.71	0.71	0.8056	0.83463	0.76774	0.7461
TII	0.11928	0.14454	0.211	0.40313	0.43232	0.55227

Figure 34 KSA E-government Indices Values from 2003 to 2014

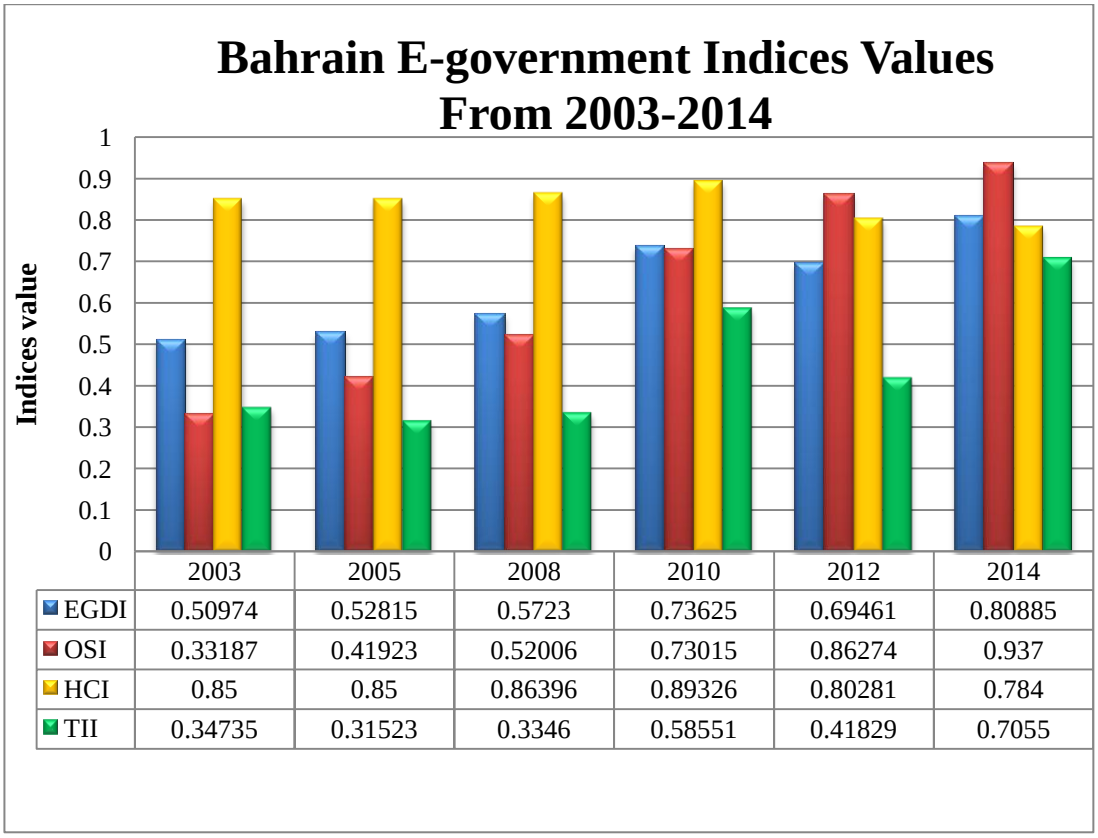
Figure 34 above is an extract from the UN reports on e-government initiatives of the countries [12], [27], [28], [29], [30] and [31], which shows the KSA value of indices for EGDI, OSI, HCI and TII. We can notice that all index values from 2003 to 2014 start to develop progressively and positively. However, the HCI starts to decrease in 2012 with a value of 0.7677 and in 2014 with a value of 0.7461. However, the HCI raised the EGDI value from 2003 to 2010 to a large value. It shows ascending results in e-government values during the last decade. We can notice that the lowest value of all indices appears in 2003. The lowest value of the EGDI was 0.337, the OSI 0.183, the HCI 071 and the TII 0.119. On the other side, the highest valued indices appeared in 2014 with the EGDI scoring at 0.690, the OSI at 0.771 and the TII at 0.55. The exception is the HCI in 2010 appearing at its highest value of 0.834.



	2003	2005	2008	2010	2012	2014
OSI	-0.0719	0.04122	0.11638	0.02931	0.36458	0.379749
HCI	-0.007	-0.0027	0.0231	0.03733	0.05054	0.089507
TII	-0.05772	-0.03436	0.000389	0.16743	0.10782	0.18725

Figure 35 KSA Index Values Compared with World Average from 2003 to 2014

Figure 35 from the above extract from the UN reports on e-government initiatives of the countries [12], [27], [28], [29], [30] and [31] shows that from 2008 to 2014, all KSA indices have an average difference value above the line of the world average. The HCI has a lower average difference compared with other indices. The HCI has healthy behavior in its ascent starting in 2003 at –0.007 until 2014 at 0.089. The TII is rising in value from –0577 in 2003 to 0.187 in 2014. The OSI started in 2003 at –0.0719, which was the lowest and in 2014 it rose to its highest value at 0.379. In 2012 and 2014, we can see that the OSI reached its best result compared with the TII and HCI. To sum up, the average differences of the KSA indices have stable and constant progress through the last decade. There is a clear disparity in the average difference between the HCI, OSI and TII.



	2003	2005	2008	2010	2012	2014
EGDI	0.50974	0.52815	0.5723	0.73625	0.69461	0.80885
OSI	0.33187	0.41923	0.52006	0.73015	0.86274	0.937
HCI	0.85	0.85	0.86396	0.89326	0.80281	0.784
TII	0.34735	0.31523	0.3346	0.58551	0.41829	0.7055

Figure 36 Bahrain E-government Indices Values from 2003 to 2014

Figure 36 from the above extract from the UN reports on e-government initiatives of the countries, [12], [27], [28], [29], [30] and [31], shows that there are ascending results in e-government values through the last decade. The values of Bahrain's indices for EGDI, OSI, HCI and TII show that the HCI has a greater difference than the OSI and TII from 2003 to 2010, which represents the key to raising the EGDI value in that period. However, the HCI having the lowest value at 0.784 appears in 2014 and the highest value of 0.893 appearing in 2010, which refers to a weak point in the HCI. The EGDI and OSI have positive behavior. Their values in 2003 were, for the EGDI 0509 and for the OSI 0.331, which starts rising to 0.8088 for the EGDI and 0.937 for the OSI in 2014. The TII starts in 2003 at 0.347 and it starts decreasing to reach 0.334 in 2008. TII has two strong increases with a value of 0.5855 in 2010 and 0.7055 in 2014.

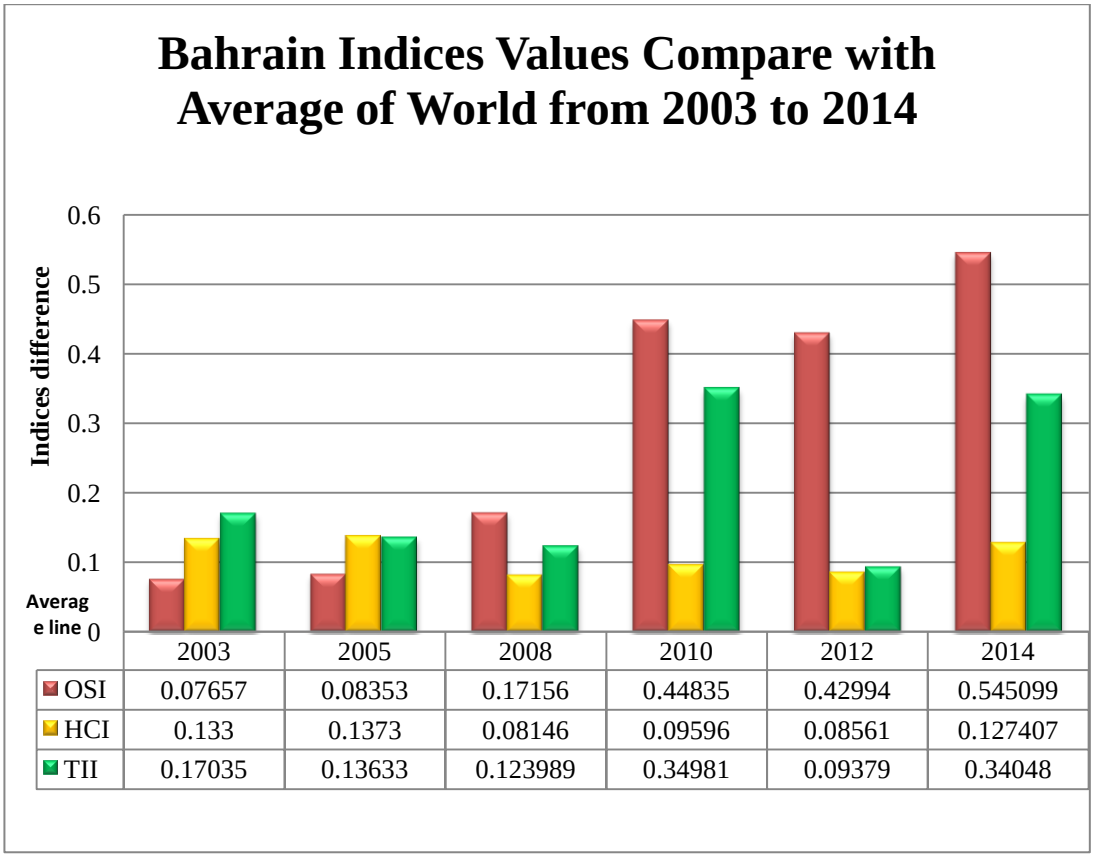


Figure 37 Bahrain Index values compared with World Average from 2003 to 2014

Figure 37 above is an extract from UN reports on e-government initiatives of countries [12], [27], [28], [29], [30] and [31] which shows that from 2003 to 2014, every Bahrain index has an average difference value above the line of the world average. The HCI from 2008 to 2014 has the lowest results compared with the OSI and TII. We can see that the HCI has best result in 2003 and 2005, while the OSI and TII have opposite behavior. The TII has the best result compared with other indices from 2003 with 0.1703 to 2005 with 0.1363. After that, the OSI has the best result from 2008 with 0.1715 to 2014 with 0.545. To sum up, all indices have positive results except for the HCI. There is a clear disparity in the average difference between the HCI, OSI and TII.

CHAPTER 4

CONCLUSION

4.1 Findings

The findings achieved in this study are as follows:

(1) There are many benefits to closing the digital divide.

These benefits occur directly in the economic aspect (Section 2.2.3.1), even in confidence building between the government and the citizen through the closing (Section 2.2.3.2).

(2) Digital by default offers an easy and realistic solution to closing the digital divide.

In designing e-services for e-government, a minimum of ICT skills from users is required. This is an effective way to raise performance of e-government and close the digital divide. It becomes a scientific concept and an important factor to be taken into account in any policy and strategy for e-government (Section 2.2.1).

(3) There is a relation between HCI and the ICT Skills Index.

From 2002 to 2012, the IDI Skills Index constituted a large proportion from the HCI. In 2014, the proportion decreased because of new components added to HCI. The certain relationship from 2002 to 2014 is that the HCI contained IDI Skills (Section 3.2). This explains why Arab countries such as KSA, UAE, Bahrain and Qatar have good rankings in all indicators such as OSI, TII, the ICT Access Index and the ICT Use Index. Simultaneously, they have bad rankings in two indices: the HCI and ICT Skills Index (Sections 3.1) and (Sections 3.3).

(4) Iraq strategy and work plan general discussion

It is only a recommendation that there be no law forced to implement it as it is not clear and there is no detailed explanation about how to implement each point (Section 2.2.2.1).

(5) Iraqi e-government has different performance for the HCI, TII and OSI indicators.

The TII and OSI have healthy performance. Moreover, they have increased their respective values in the last decade due to there being financial support for ICT infrastructure and portals design. On the other hand, the HCI in the last decade has unhealthy results such that we see a drop from 0.93 in 2003 to 0.5283 in 2014 (Section 2.2.2.1).

(6) Iraq e-government performance will not achieve further advancement in the future.

Problems emerged in finding (5). Moreover, a clear digital divide shows itself in a decline of the level of education and ICT skill, thereby weakening the citizen's capacity to use e-services (Section 2.2.2.1). In addition, the HCI has continued to decrease in the last decade; this refers to lower ranks in e-government (Section 3.4).

(7) All Arab countries have a digital divide in aspects of ICT skills and a lower HCI rank.

The value of the ICT Skills Index is lower than the ICT Access Index and the ICT Use Index (Section 3.1). Furthermore, the HCI, which contains ICT skills, has a lower rank compared with the OSI and TII rank in Arab countries. The HCI is the index which has the greatest negative impact on e-government performance of Arab countries (Sections 3.3) and ((Sections 3.4).

(8) Problem diagnosed in finding (7) prevents Arab countries from achieving higher ranks in e-government.

The Arab countries that have higher income and perfect ICT infrastructures are not able to enter the list of the 25 world e-government leaders. A wealthy country can receive a higher rank in good time by making large investments in OSI and TII, as done by Bahrain (Section 2.2.2.3). However, Bahrain cannot do the same for the HCI and it still suffering from the digital divide in ICT skills. It has raised its ICT Access Index and ICT Use Index. Nevertheless, the ICT Skills Index could not rise commensurately (Section 3.1).

(9) The HCI behaves uniquely and differs from TII and OSI.

The HCI has a different distribution density through different countries, which differs from OSI and TII. Moreover, the HCI has an average higher than the TII and OSI average. The HCI affects countries above the average by raising their e-government rank. At the same time, it decreases the rank of most countries below the average. TII and OSI do not have this effect (Section 3.3).

(10) The relationship between the HCI, TII and OSI is open to discussion.

In reference to finding (9), we did not find any relation between them. In Iraq, the KSA and Bahrain, there is a clear disparity in average differences between HCI, OSI and TII. This is a reflection of a performance disparity (Section 3.4).

(11) HCI needs to be long term in order to raise its value.

Raising HCI requires more than normal development on the economic side or investment in infrastructure. A country is required to have a stable system, a long-term policy, and a rich tradition of higher education. The list of 25 World HCI leaders includes countries mostly from Europe, in addition to New Zealand, Australia, USA and Canada and two countries from Asia, namely the Republic of Korea and Japan (Section 3.3).

(12) Average difference value is a quick tool to evaluate e-government indices.

This is a measurement of the weak and strong points in the performances of each index. The behavior of each index is shown clearly in this way by comparing them with world indices. The HCI value did not reflect the reality of performance correctly. On the other hand, the average difference of HCI reflects it correctly (Section 3.4).

4.2 Limitations

The work presented in this thesis has the following limitations:

(1) Personal contact

We were unable to make any personal contact with leaders in Iraq, Bahrain or the UK, namely those who are setting e-government strategies. Nor were we able to make any personal contact with leaders in UK who set the digital by default policy to close digital divide so as to understand the causes and conditions surrounding the work. This limitation relates to findings (2), (4) and (8).

(2) Missing or unreachable data.

Unreachable statistics about HCI components for each country restricted us from exactly determining relative percentages between HCI and the ICT Skills Index. Iraq suffers from a lack of updated statistics about Internet and computer usage by citizens. Even the ITU did not have any information about the ICT situation regarding access, use and skills in Iraq. This limitation relates to findings (7), (8) and (11).

(3) Knowledge was collected from previous studies and websites

We did not collect information directly or make our own statistical survey. We relied upon statistics from the UN and ITU. This limitation relates mostly to findings (1), (3), (5), (6) and (7).

(4) Economic aspect, legal aspect and government policies

We did not address these aspects for countries within the scope of our thesis. A study of these aspects may help us to overcome obstacles that impact on closing the digital divide and increase the performance of e-governments. This limitation indirectly restricts findings (4), (6), (7), (8) and (11).

4.3 Future Studies

To enhance the closing of digital divide and raising e-government performance, some future studies are recommended:

(1) Conducting meetings and surveys

Emerging from the limitations (1) and (3), it is recommended that meetings should be held with e-government leaders and data be collected through semi-structured interviews with key informants. This should show and clear many facts that complement the current thesis.

(2) A comprehensive study on related aspects of state

To overcome limitation (4), all aspects that relate to e-government and the digital divide should be addressed. To obtain a holistic view, we need to help e-government leaders to develop appropriate plans and strategies.

(3) Access data sources

Emerging from limitation (2), it is necessary to cover the missing data of ICT in Iraq. We may attempt to collect dispersed ICT data from government entities. Alternatively, from a sampling of citizens, we may obtain approximate numbers about the adoption of ICT. Moreover, we may contact the UN to obtain permits for access to initial data of HCI components for all countries.

4.4 Conclusion

In the light of findings (3), (5), (6), (7), (8), (10), (11) and (12) within limitations (2), (3) and (4) presented, we conclude that Iraq and Arab countries have special factors that affect closing the digital divide and e-government performance. By using the average difference value as a quick tool to evaluate e-government indices, we diagnosed weaknesses in HCI performance. On the other side, the ICT Skills Index impacted negatively on the digital divide. Hence, the following research questions targeted in the thesis are approached and are found to be encouraging and positive.

(1) “Can the HCI and ICT skills index play a unique role in closing the digital divide and in raising e-government performance in Iraq and Middle Eastern countries?”

(2) “Why are rich Arab countries that have good ICT infrastructure not able to enter the list of the world’s e-government leaders?”

The HCI and ICT skills indices are found to play unique roles in closing the digital divide and in raising e-government performance in Iraq and Middle East countries. In addition, Arab countries have clear digital divide in ICT skills hence they suffer lower HCI ranks. Those two causes prevent Arab countries from achieving higher ranks in e-government performance lists.

Rich Arab countries have good TII however they suffer from poor HCI rank. HCI needs long term to raise its value and requires more than just money; hence, poor HCI prevents these countries from promoting higher ranks and to be able to enter the list of the world's e-government leaders.

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APPENDICES A

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