CHAPTER FIVE

ANALYSIS AND RESULTS

SECTION ONE: ANALYSIS:

To create and sustain an effective knowledge economy, countries must put in place appropriate arrangements to grow, become competitive, and increase welfare. This process initially means understanding their relative strengths and weaknesses and then acting on them to develop appropriate policies and investments to give direction to their ambition, as well as devising mechanisms to monitor progress against the goals set.

5.1 Benchmarking Analysis:

The benchmarking process is aiming at answering the following seven research questions:

Q1. What is the status of quality government institutions and economic incentives as a factor of knowledge economy development in Sudan?
Q2. What is the status of training support as a factor of knowledge economy development in Sudan?
Q3. What is the status of education as a factor of knowledge economy development in Sudan?
Q4. What is the status of research & development, and innovation as a factor of knowledge economy development in Sudan?
Q5. What is the status of information and communication technologies as a factor of knowledge economy development in Sudan?
Q6. What is the status of information and communication technologies' infrastructure as a factor of knowledge economy development in Sudan?
Q7: What is the level of readiness of Sudanese economy to turn into a knowledge-based economy

We have utilized the Knowledge assessment methodology (KAM) which is very suitable in case where the main purpose is to identify the problems and opportunities. The KAM does not provide solutions to the problems nor does it show how the opportunities are enhanced.

5.1.1 Knowledge Assessment Methodology (KAM):

As we mentioned earlier in this chapter the Knowledge Assessment Methodology (KAM), Developed by the World Bank Institute, the KAM is a user-friendly interactive Internet-based tool that provides a basic assessment of countries' and regions' readiness for the knowledge economy.

KAM utilizes indicators, scorecards and indexes that represent the knowledge economy readiness and compares a given country with its neighbors, regions, and competitors or even with selected leading countries. In this thesis KAM was applied to compare Sudan's knowledge economy readiness with the relevant benchmarking group and countries from the middle lower income groups (see appendix).

Benchmarking is important in measuring outcomes (but not causation) of policies. It allows comparisons between countries and indicates how well countries are doing compared with others in terms of their adaptation, mastery and development of different indicators.

5.2 The Steps of the Benchmarking Process:

Step 1: We identified the benchmarking group: the lower middle income countries-Arab Countries only

Step 2: We identified the relevant indicators: 18 indicators

Step 3: We performed the normalization procedure

Step 4: We utilized the knowledge economy scorecard: we benchmarked Sudan with only two countries every time:

Sudan with: Egypt and Algeria

Sudan with Morocco and Syria

Sudan with Yemen and /Mauritania

Step 5: We used the knowledge economy index

5.3 Sudan Knowledge Economy Index:

This section presents Knowledge Economy Index (KEI) rankings 2012 for Sudan extracted from the World Bank's Knowledge Assessment Methodology (KAM). Knowledge Economy Index (KEI) is an aggregate index representing a country's overall preparedness to compete in the Knowledge Economy (KE)

The KEI is constructed as the simple average of four sub-indexes, which represents the four pillars of the knowledge economy: economic performance; economic incentive and institutional regime, education, the innovation system and ICT.

Each of the pillar sub-indexes are in turn based on four indicators that proxy the performance of the pillar. 12 knowledge indicators have been used to compile the four pillars of the KEI

Table 5.1 presents Sudan's performance on the aggregate KEI and KI performance and rank during 1995-2012:

Table 5.1 Sudan KEI and KE rank (1995-2012)

Sudan	1995			2000			2012		
	Rank	KEI	KI	Rank	KEI	KI	Rank	KEI	KI
	138	2.08	2.54	1.35	1.35	1.62	137	1.48	1.82

Source: KAM World Bank 2012

Table 5.1 provides Sudan's knowledge competitiveness as *slightly improved* over the past 17 years, with the ranking rising from 138 in 1995 to 137 in the current 2012 rankings. The KEI and KI have declined from 2.08 and 2.54 in 1995 to 1.48 and 1.82 in 2000 respectively. Knowledge index consists of knowledge economy index (KEI) {is also called economics and institutions regime and knowledge index) and (KI) (consists of education index, innovation index and ICT index)

The KAM Knowledge Index (KI) measures a country's ability to generate, adopt and diffuse knowledge. This is an indication of overall **potential** of knowledge development in a given country. Methodologically, the KI is the simple average of the normalized performance scores of a country or region on the key variables in three Knowledge Economy pillars – education and human resources, the innovation system and information and communication technology (ICT) (World Bank: 2012)

5.4 Sudan Knowledge Economy Pillars:

We have mentioned in the theoretical framework (chapter two) that there are four pillars for knowledge economy. The following pillars are four critical requisites for a country to be able to fully participate in the knowledge economy (World Bank: KAM):

1. ***Education & Training***: An educated and skilled population is needed to create, share and use knowledge.

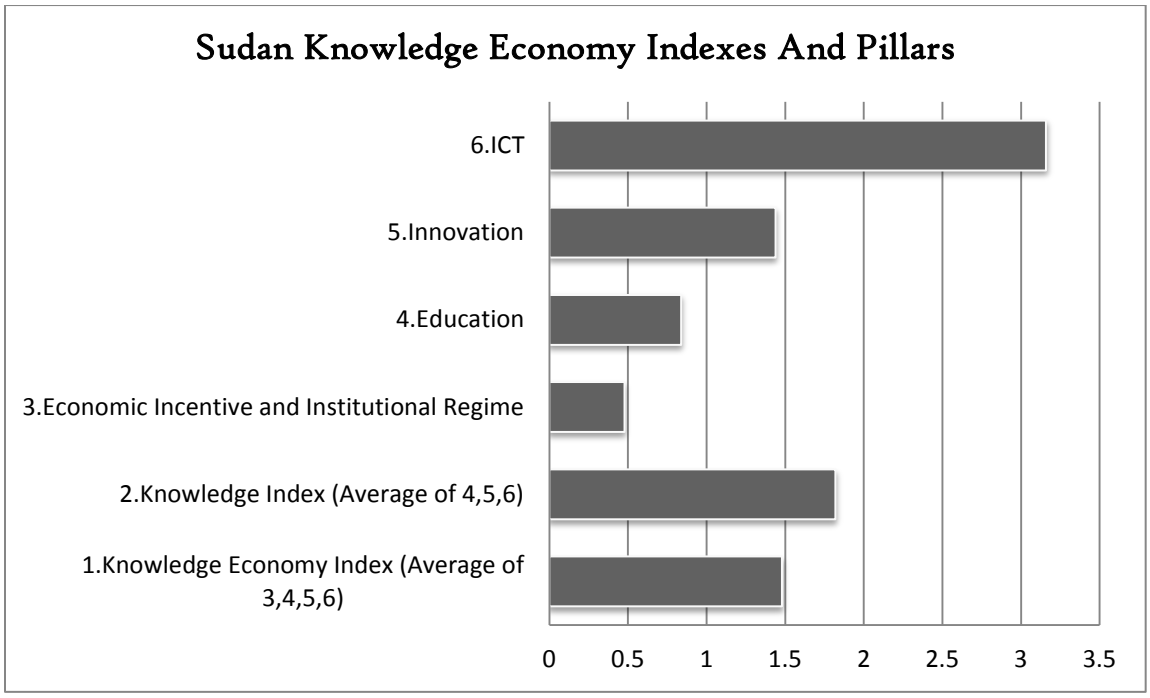
2. **I*nformation Infrastructure***: A dynamic information infrastructure-ranging from radio to the internet-is required to facilitate the effective communication, dissemination and processing of information.
3. ***Economic Incentive & Institutional Regime***: A regulatory and economic environment that enables the free flow of knowledge, supports investment in Information and Communications Technology (ICT), and encourages entrepreneurship is central to the knowledge economy.
4. ***Innovation Systems***: A network of research centers, universities, think tanks, private enterprises and community groups is necessary to tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new knowledge.
5. Table 5.2, Figure 5.1 presents Sudan knowledge economy pillars for the period (1995-2012).

Table 5.2 Sudan Knowledge Economy Indexes and Pillars *(weighted by population)*

	Sudan					
	Group: All					
	1995		**2000**		**2012**	
Index	**Index**	**Rank**	**Index**	**Rank**	**Index**	**Rank**
1.Knowledge Economy Index (Average of 3,4,5,6)	2.08	138	1.53	138	1.48	137
2.Knowledge Index (Average of 4,5,6)	2.54	131	1.86	132	1.82	122
3.Economic Incentive and Institutional Regime	0.71	138	0.54	142	0.48	142
4.Education	1.27	127	1.38	124	0.84	133
5.Innovation	2.17	134	2.09	141	1.44	141
6.ICT	5.96	142	2.10	132	4.77	104

Source: KAM 2012

Figure 5.1 Sudan Knowledge Economy Indexes and Pillars (2012)



Source: KAM 2012

Table 5.2 presents Knowledge Economy Index (KEI) and Knowledge Index and the four Pillars indexes rankings for (1995, 2000 and 2012) for Sudan extracted from the World Bank's Knowledge Assessment Methodology (KAM).

Sudan's performance on the aggregate KEI (consisting of four pillars) and on individual indicators is compared with rest of the world (for the periods 1995-2000 and 2012. Sudan's knowledge competitiveness has improved over the 1995-2000 and 2012 years, with the ranking rising from 131th, 132th in 1995 and 2000 respectively to 122nd in the current 2012 rankings.

During the same period Sudan has shown different degrees of progress in KEI pillars: In the pillar of Economic Incentive Regime (EIR) the country

shows a negative progress and ranked 138th, 142nd and 142nd as compared with rest of the world.

In the pillar of Information Communications and Technology (ICT) Sudan demonstrated a significant improvement and ranked at 104th in the world in terms of the ICT pillar ranking. In Education pillar, Sudan's performance is deteriorated with ranks of 127th (1995), 124th (2000) and 131 (2012) is far below and is significantly lagging the other world countries.

In Innovation pillar, Sudan has a weak performance with ranks of 134th, (1995) and 141th (2000 and 2012) remains significantly weak when compared to other world economies.

Sudan's overall development pattern in all four of the knowledge economy pillars therefore does not appear to have changed significantly in terms of the knowledge economy readiness during the past two decades.

5.5 Benchmarking Sudan KEI and KE pillars with lower middle income group:

The World Bank economies divided economies (according to Gross National Income (GNI) per capita) to the following three groups:

1. low income, $1,005 or less;
2. lower middle income, $1,006 - $3,975; (see table 1)
3. upper middle income, $3,976 - $12,275; and
4. High income, $12,276 or more.

Sudan is classified as a lower middle income, ($1006-$3975), based on its GNI (GDP previously) per capita, (see Appendix 1)

In this section we benchmarks Sudan with its comparators from lower middle income group as follows:

For Knowledge economy index and knowledge index and the four pillars:

a. Sudan with Arab countries which belong to lower middle income economies: (Algeria; Egypt, Arab republic; Morocco; Syrian Arab Republic; Yemen, Republic and Mauritania.)

b. Sudan with non Arab African countries which belong to lower middle income economies: (Cape Verde; Angola; Djibouti; Cameron; Lesotho; Zambia; Senegal; Ghana, Namibia.)

c. Sudan with some selected non Arab, non African countries which belong to lower middle income economies: (Lao PDR; Uzbekistan, India, Swaziland; Nicaragua; Honduras; Fiji; Dominican Republic, Guyana, Mongolia; Georgia, Moldova and Macedonia.)

d. Sudan is benchmarked with Arab countries which belong to lower middle income economies: (Algeria; Egypt, Arab republic; Morocco; Syrian Arab Republic; Yemen, Republic and Mauritania.) since they share many aspects of economic structure and environment as Sudan.

e. We disaggregate the pillars into indicators**.**

5.5.1 Benchmarking Sudan KEI and KE pillars with Lower Middle Income economies:

In this section we benchmarks Sudan KEI and KE pillars with all lower middle income economies (see Appendix I). Appendix I show that the region's overall readiness is at low end of the world. As a whole, the lower

middle economies' overall knowledge economy position is not in line with their level of economic development. This can be explained by the weakness in the region's incentives and institutional framework. In the three other pillars, the region is not very far from the global average.

Still there are some countries from the region which has started its turning to be a knowledge based economy. For example, Morocco, for example, during the last decade, has focused its public spending on the creation of knowledge based platforms aiming to accelerate the shift from traditional and industrial economy to more knowledge based one (Driouchi, and Kadiri, 2010).

5.5.2 Benchmarking Sudan KEI and KE pillars with Arab countries from Lower Middle Income economies:

In this section we benchmarks Sudan KEI and KE pillars with six Arab countries from lower middle income economies (Algeria; Egypt, Arab Republic; Morocco; Syrian Arab Republic; Yemen, Republic And Mauritania).

Table 5.3 compares Sudan Knowledge economy index and pillars with its comparators from Arab countries belong to lower middle income group:

Table 5.3 Benchmarking Sudan KEI and KE pillars with Arab countries from Lower Middle Income Economies:

	KEI		Economic Incentive and Institutional Regime		Innovation		Education		ICT	
Country	**2012**	**1995**	**2012**	**1995**	**2012**	**1995**	**2012**	**1995**	**2012**	**1995**
Egypt, Arab Rep.	6.06	7.15	7.02	5.89	6.79	8.22	5.3	6.95	5.11	**7.55**
Algeria	5.84	5.66	3.21	3.1	5.71	5.95	7.64	6.05	6.81	7.55
Morocco	5.55	6.34	7.1	6.89	5.91	7.63	2.57	3.28	6.63	7.55
Syrian Arab Republic	4.17	5.47	2.63	2.74	4.55	5.24	3.9	4.64	5.58	9.26
Yemen, Rep.	2.41	3.71	3.79	3.13	2.71	3.33	1.95	1.78	1.19	6.59
Mauritania	2.33	3.3	2.64	1.9	2.74	3.02	0.87	1.26	3.05	7.04
Sudan	2.14	3.08	0.36	1.32	2.58	3.5	0.86	1.56	4.77	5.96

Source: World bank 2012

Table 5.3 benchmarks Sudan KEI and KE pillars with Arab countries from lower middle income economies (Algeria; Egypt, Arab republic; Morocco; Syrian Arab Republic; Yemen, Republic and Mauritania) belongs to lower middle income economies. The eight countries are ranked according to their KEI. Egypt has the highest KEI with 7.15 and 6.06 while Sudan has the lowest KEI with 3.08, 2.14 during the periods 1995, and 2012 consecutively. All countries have shown a declining in their KEI except of Algeria (KEI (1995) of 5.66 to KEI of 5.84(2012).

There is a significant improvements in ICT pillar in Sudan has jumped from ICT index of 4.77 (1995) to 5.96 (2012).

In Education, a pillar which is instrumental for a country's transition to knowledge based environment, Sudan's performance is far below and is significantly lagging the other Arab countries of Lower Middle economies.

In Innovation pillar, Sudan has not improved its overall performance during the twenty years, it still remains significantly weak when compared to other Arab countries of Lower Middle economies and is lagging behind these countries.

As for Economic Incentive and Institutional Regime Sudan has the weakest index among its comparators of Arab countries of Lower Middle economies with indexes of 1.32, 0.36 during the period from 1995 up to 2012.

It can be concluded that Sudan is the least in knowledge economy readiness among Arab countries of *lower middle economies*.

5.5.3 Benchmarking Sudan KEI and KE pillars with non Arab African countries which belong to lower middle income economies*:*

In this section we benchmarks Sudan KEI and KE pillars with nine non Arab African countries from lower middle income economies (Cape Verde; Angola; Djibouti; Cameron; Lesotho; Zambia; Senegal; Ghana, and Namibia).

Table 5.4 benchmarks Sudan Knowledge economy index and pillars with its comparators from Arab countries belong to lower middle income economies: Table 5.4 paints a preliminary picture of Sudan's overall readiness or preparedness for the knowledge economy as compared to non Arab African countries from the group of Lower Middle economies. Table 5.4 shows that Sudan is placed at the lower end of the KEI ranking (the 8^{th}) among this group before Djibouti and Angola as for KEI, and before Angola KE (the 9^{th}). Sudan is still better than the African regional average (KEI of 1.91).

Sudan has a very strong ICT index as compared to this group; in 1995 Sudan ranked the seventh among this group, but in 2012 Sudan (irrespective of the

declining in its ICT index) has become the second strongest country in this group after Namibia.

Sudan shows a backward position compared to this group as for innovation, education and economic incentive and institutional regime.

Table 5.4 **Benchmarking Sudan KEI and KE pillars with non Arab African countries which belong to lower middle income economies**

	KEI		Economic Incentive and Institutional Regime		Innovation		Education		ICT	
Country	**2012**	**1995**	**2012**	**1995**	**2012**	**1995**	**2012**	**1995**	**2012**	**1995**
Namibia	6.14	7.38	9.28	8.1	6.22	6.48	3.94	5.98	5.1	8.94
Cape Verde	5.72	n/a	6.6	6.31	3.03	3.46	5.44	n/a	7.83	7.86
Ghana	4.05	4.63	6.44	4.85	3.66	4.13	3.92	3.56	2.17	5.96
Senegal	3.91	4.8	5.99	4.76	4.13	5.23	1.61	1.55	3.91	7.67
Zambia	3.65	5.46	5.77	6.84	3.39	5.48	2.83	2.85	2.63	6.67
Lesotho	2.68	4.52	3.97	4.17	2.86	4.7	2.22	2.63	1.67	6.59
Cameroon	2.29	3.65	1.43	1.69	4.38	4.58	1.82	2.36	1.52	5.96
Sudan	2.14	3.08	0.36	1.32	2.58	3.5	0.86	1.56	4.77	5.96
Djibouti	1.78	4.57	2.62	5.71	1.9	4.52	0.86	0.36	1.75	7.67
Angola	1.3	2.8	1.77	1.37	1.93	3.49	0.37	0.36	1.12	5.96

Source: World bank 2012

5.5.4 Benchmarking Sudan KEI and KE pillars with non Arab, non African countries which belong to lower middle income economies*:*

In this section we benchmarks Sudan KEI and KE pillars with fourteen non Arab non African countries from lower middle income economies (Lao

PDR; Uzbekistan, India, Swaziland; Nicaragua; Honduras; Fiji; Dominican Republic, Guyana, Mongolia; Georgia, Moldova and Macedonia.)

Table 5.5 compares Sudan Knowledge economy index and pillars with its comparators from Arab countries belong to lower middle income group:

Table 5.5 **benchmarking Sudan KEI and KE pillars with Sudan with non Arab, non African countries which belong to lower middle income group:**

	KEI		Economic Incentive and Institutional Regime		Innovation		Education		ICT	
Country	**recent**	**1995**	**recent**	**1995**	**recent**	**1995**	**recent**	**1995**	**recent**	**1995**
Macedonia, FYR	8.61	7.64	8.32	6.31	8.28	7.25	8.18	6.99	9.67	10
Georgia	7.72	7.41	9.44	2.02	8.47	8.93	6.97	9.16	5.99	9.52
Mongolia	6.59	6.43	6.24	6.22	4.43	5.36	8.48	6.83	7.19	7.31
Guyana	6.55	7.84	3.68	8.25	6.73	7.7	6.97	6.72	8.81	8.69
Dominican Republic	6.44	6.14	5.69	3.94	6.08	4.99	6.07	6.35	7.92	9.29
Fiji	5.91	7.6	2.56	6.6	7.78	6.79	6.89	7.72	6.4	9.29
Honduras	4.69	5.67	4.65	4.98	4.22	6.28	4.91	4.1	4.99	7.31
India	4.6	5.33	5.4	5.27	7.51	5.9	3.17	3.54	2.32	6.59
Swaziland	4.43	6.98	5.13	8.48	5.95	7.2	3.22	5.22	3.43	7.02
Uzbekistan	4.1	6.84	0.81	1.31	4.88	7.26	6.32	9.76	4.4	9.05
Nicaragua	3.78	5.5	5.3	5.44	2.71	3.82	4.85	4.84	2.25	7.91
Lao PDR	2.25	2.78	1.76	0.24	2.79	2.98	2.43	1.96	2	5.96
Sudan	2.14	3.08	0.36	1.32	2.58	3.5	0.86	1.56	4.77	5.96

Source: World Bank 2012

According to the above table Sudan has a lowest KEI among this group. Sudan is at the seventh rank as for ICT, the least in education and innovation and incentives and institutional regime.

5.6 Knowledge Economy Indicators:

We examined eighteen knowledge economy indicators of the knowledge economy pillars to study Sudan's performance of those indicators.

Table 5.6 and Figure 5.2 provides Sudan's performance in eighteen knowledge economy indicators.

Table 5.6 Eighteen Indictors of the Four Knowledge Economy Pillars-Sudan' Performance

	Sudan		**Lower Middle Income**	
	(Group: Africa)		(Group: All)	
Variable	actual	normalized	actual	normalized
Annual GDP Growth (%),	7.8	8.71	6.8	8.4
GDP per Capita (in/nal current $ PPP),	2.210.00	7.67	4.744.00	3.58
GDP (current US$ bill),	54.68	9.03	164.46	6.9
Regulatory Quality,	-1.25	0.97	-0.36	3.25
Rule of Law,	-1.34	0.97	-0.57	3.39
Government Effectiveness,	-1.32	0.97	-0.49	3.32
Press Freedom (1-100),	76	1.94	57.05	3.75
Researchers in R&D / Mil. People,	n/a	n/a	n/a	n/a
Total Expenditure for R&D as % of GDP,	0.29	5	n/a	n/a
S&E Journal Articles / Mil. People,	0.89	1.29	10.95	4.1
Adult Literacy Rate (% age 15 and above),	70.21	5.16	71	1.95
Gross Secondary Enrollment rate,	37.97	6.13	57.95	2.45
Gross Tertiary Enrollment rate,	n/a	n/a	15.7	3.23
Mobile Phones per 1000 People,	360	4.52	560	2.69
Computers per 1000 People,	110	9.03	40	2.33
Internet Users per 1000 People,	100	8.71	100	2.97
ICT Expenditure as % of GDP,	n/a	n/a	6	7.61

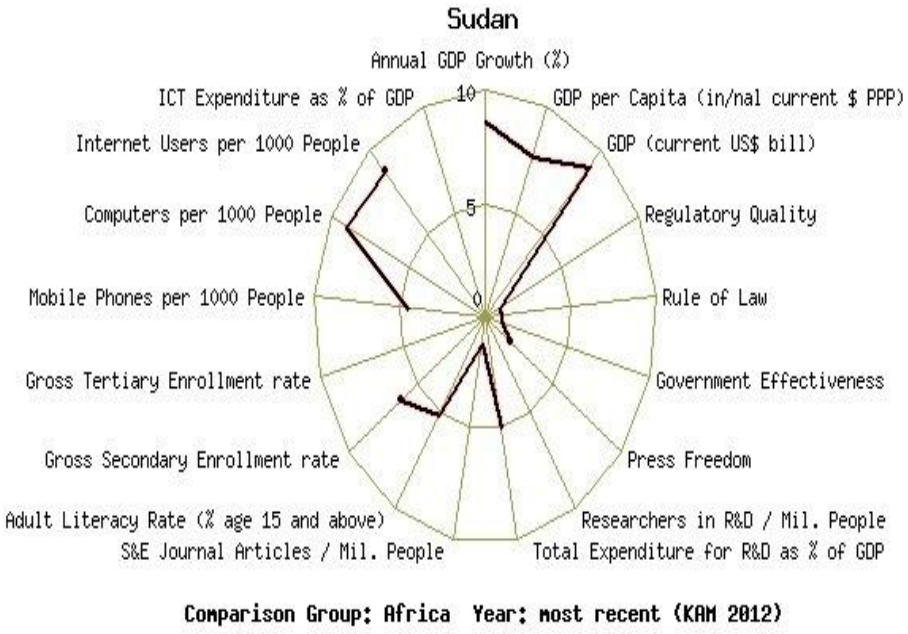
Source: World Bank 2012

Table 5.6 and Figure 5.2 presents the status of Sudan as for the eighteen knowledge economy indicators of the knowledge economy pillars as compared to the rest of lower middle income countries.

As compared to lower middle income countries Sudan has a low performance in the indicators of governance especially Regulatory Quality, Rule of law, government effectiveness and press freedom its normalization fell below the 50th percentile in the governance indicators of the knowledge economy. Sudan has a good position compared to its group in the indicators of economic performance, education, ICT.

We will discuss the performance of Sudan for every separate pillar in the following section:

Figure 5.2 Eighteen Indictors of the Four Knowledge Economy Pillars-Sudan' Performance



Source: KAM 2012

The above graph takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position.

5.7 Economic Performance:

Sudan has been consistently ranked among the bottom performers in international competitiveness rankings. Measured by many indicators related to the knowledge economy, it has been ranked among the least performing countries. In 2012 Sudan has no record in world economic forum's (wef) global competitiveness report.

In the following section we compare Sudan economics' performance with its comparators from Arab countries of the lower middle economies.

The benchmarking exercises offer:

a. Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Algeria and Egypt (Table 5.7, Figure 5.3)
b. Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Morocco and Syria(Table 5.8, Figure 5.4)
c. Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Yemen and Mauritania. (Table 5.9, Figure 5.5)

5.7.1 Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Algeria and Egypt:

In this section we benchmarks Sudan's Knowledge Economy scorecard on Economic Performance with Algeria and Egypt. Three economic performance indicators have been used: annual GDP growth (%), GDP per capita and human development index (The Human Development Index

(HDI) is a comparative measure of life expectancy, literacy, education, standards of living, and quality of life for countries worldwide), countries are ranked as : very high Human Development ; high Human Development; medium human development, low human development (World Bank 2012).

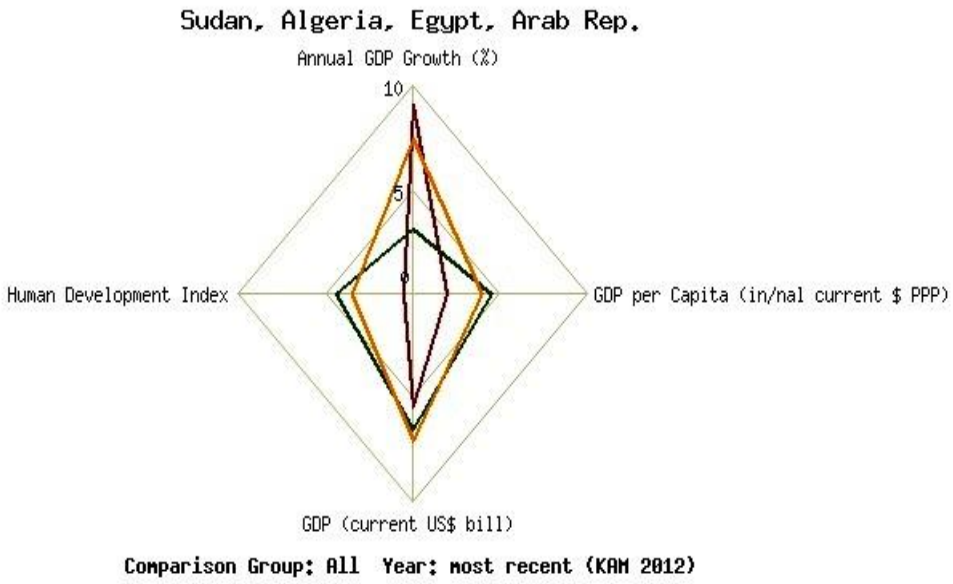
Table 5.7 and figure 5.3 Benchmarks Sudan's Knowledge Economy scorecard on Economic Performance with Algeria and Egypt

Table 5.7 Benchmarking Sudan's Knowledge Economy Scorecard on Economic Performance with Algeria and Egypt,

	Sudan		**Algeria**		**Egypt, Arab Rep.**	
	(Group: All)		(Group: Lower Middle Income)		(Group: All)	
Variable	actual	normalized	actual	normalized	actual	normalized
Annual GDP Growth (%),	7.8	9.1	2.8	1.9	6	7.5
GDP per Capita (in/nal current $ PPP),	2.210.00	1.99	8.172.00	8.81	5.673.00	3.97
Human Development Index,	0.38	0.56	0.68	6.9	0.62	3.54

Source: World Bank 2012

Figure 5.3 Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Algeria and Egypt,



Source: World Bank (2012)

	Sudan		Algeria		Egypt

The above graph takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position. The red color indicates the ranking of **Economic Performance** indicators in Sudan. The green color indicates the ranking of **Economic Performance** indicators in Algeria, while, the yellow color indicates the ranking of **Economic Performance** indicators in Egypt

According to table 5.7 and figure 5.3 compared to Egypt and Algeria Sudan has showed a strong position for its annual GDP growth, in 2012, the Algerian economy grew by 2.5%, up slightly from 2.4% in 2011 while Egypt has a stable economy enjoying continuous growth, averaging 4%–5% in the past quarter-century.

Sudan ranks the last as for GDP per capita and for Human development index.

Algeria and Egypt are classified as medium human development (93 ranking out of 187, Egypt (112 ranking out of 187) ; while Sudan is classified as low human development (171 ranking out of 187) (human Development Index: 2013).

5.7.2 Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Morocco and Syria:

In this section we benchmarks Sudan's Knowledge Economy scorecard on Economic Performance with Morocco and Syria.

Morocco's economy is considered a relatively liberal economy governed by the law of supply and demand. Since 1993, the country has followed a policy of privatization of certain economic sectors which used to be in the hands of the government. Morocco has become a major player in the African economic affairs, and is the 5th African economy by GDP (PPP). The World Economic Forum placed Morocco as the 2nd most competitive economy in North Africa behind Tunisia, in its African Competitiveness Report 2009. Additionally, Morocco was ranked the 1st African country by the Economist Intelligence Unit' quality-of-life index, ahead of South Africa.The **economy of Syria** is based on agriculture, oil, industry and services.

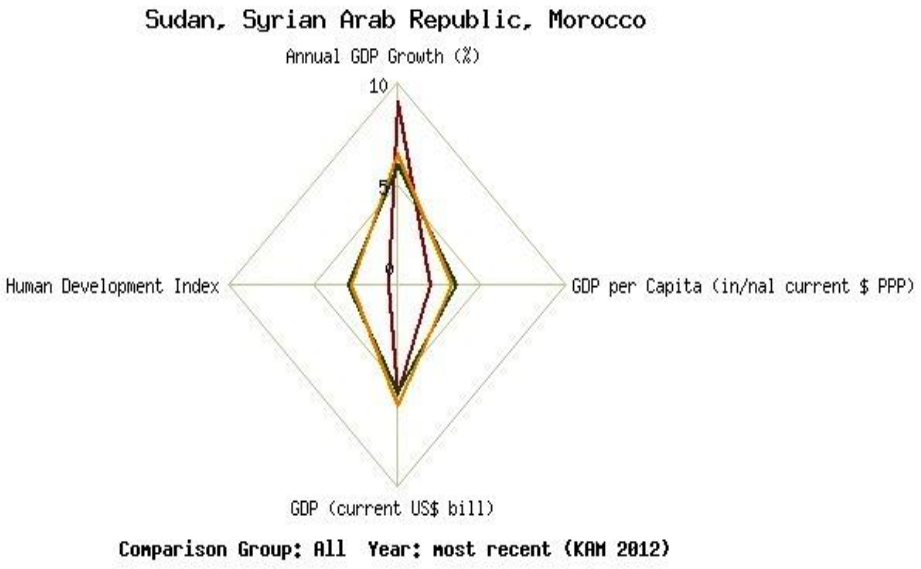
Table 5.8 and Figure 5.4 Benchmarks Sudan's Knowledge Economy scorecard on Economic Performance with Syria and Morocco

Table 5.8 Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Morocco and Syria

Variable	Sudan (Group: All)		Syria (Group: All)		Morocco (Group: All)	
	actual	normalized	actual	normalized	actual	normalized
Annual GDP Growth (%),	7.8	9.1	4.6	5.97	5	6.6
GDP per Capita (in/nal current $ PPP	2.210.00	1.99	4.730.00	3.55	4.494.00	3.26
Human Development Index,	0.38	0.56	0.59	2.99	0.57	2.78

Source: World Bank 2012

Figure 5.4 Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Morocco and Syria



Source: World Bank (2012)

	Sudan		Morocco		Syria

The above graph takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position. The red color indicates the ranking of **Economic Performance** indicators in Sudan. The green color indicates the ranking of **Economic Performance** indicators in Morocco, while, the yellow color indicates the ranking of **Economic Performance** indicators in Syria.

According to table 5.8 and fig. 5.4 compared to Morocco and Syria Sudan has showed a strong position for its annual GDP growth, while it ranks the last as for GDP per capita and for Human development index.

Morocco (rank: 130 out of 187) and Syria (rank are classified as medium human development according to the Human development Index.

5.7.3 Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Yemen and Mauritania*:*

In this section we benchmarks Sudan's Knowledge Economy scorecard on Economic Performance with Yemen and Mauritania.

Yemen is a low income country that is highly dependent on declining oil resources for revenue. Petroleum accounts for roughly 25% of GDP and 70% of government revenue.

Mauritania's economy is sharply divided between a traditional agricultural sector and a modern mining industry that was developed in the 1960s. About half of the country's workers depend on either raising crops or pasturing livestock for their livelihood and are unaffected by the mining industry.

Table 5.9 and figure 5.5 Benchmarks Sudan's Knowledge Economy scorecard on Economic Performance with Yemen and Mauritania. It shows the strong position for Sudan annual GDP growth as compared to the two countries; while it ranks the middle as for GDP per capita and the last for Human development index. Sudan, Yemen and Mauritania have been classified as having low human development index.

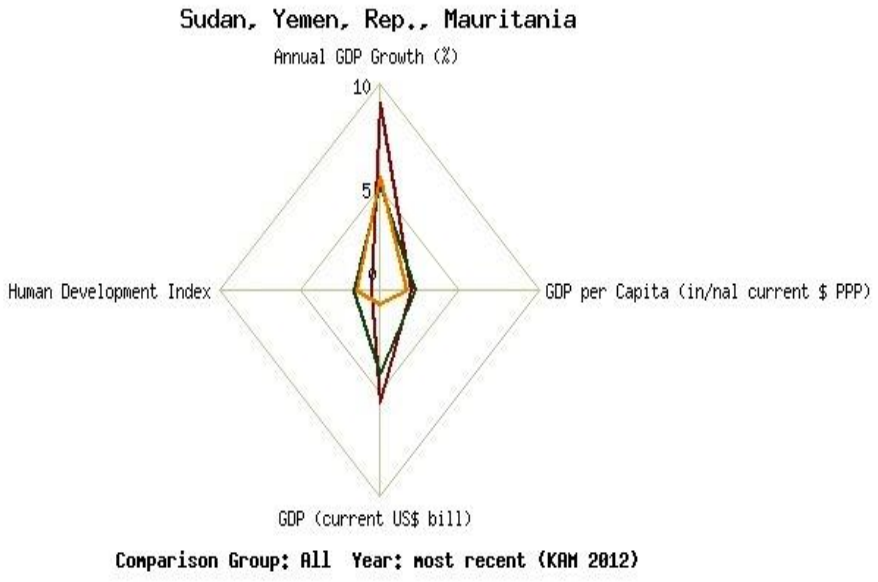
Table 5.9 Benchmarking Sudan Economic Performance with Yemen and Mauritania

	Sudan		**Yemen,**		**Mauritania**	
	(Group: All)		(Group: All)		(Group: All)	
Variable	actual	normalized	actual	normalized	actual	normalized
Annual GDP Growth (%),	7.8	9.1	4	5.14	4.2	5.56
GDP per Capita (in/nal current $ PPP),	2.210.00	1.99	2.470.00	2.27	1.929.00	1.7
Human Development Index,	0.38	0.56	0.44	1.74	0.43	1.53

Source: World Bank 2012

Figure 5.5 takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position. The red color indicates the ranking of **Economic Performance** indicators in Sudan. The green color indicates the ranking of **Economic Performance** indicators in Yemen, while, the yellow color indicates the ranking of **Economic Performance** indicators in Mauritania.

Figure 5.5 Benchmarking Sudan's Knowledge Economy scorecard on Economic Performance with Yemen and Mauritania



	Sudan		Yemen		Mauritania

5.8 Quality Government Institutions and Economic Incentives:

5.8.1 Governance:

To analyses the benefits from investments in education, ICT and research and development we must have an economic incentives and institutional framework. The main components of this framework may include elements as macroeconomic and political stability, good incentives for doing business for both national and foreign companies, air competition and regulatory policies that are conductive to entrepreneurship and risk taking. It may also

include the capacity of the government to formulate and implement sound policies effectively; it also includes respect of citizens and the institutions that govern economic and social interactions among them.

Governance can be broadly defined as the set of traditions and institutions by which authority in a country is exercised. This includes the process, by which governments are selected, monitored and replaced

The benchmarking exercises offer:

d. Benchmarking Sudan's Knowledge Economy scorecard on Governance with Algeria and Egypt (Table 5.10)
e. Benchmarking Sudan's Knowledge Economy scorecard on Governance with Morocco and Syria(Table 5.11)
f. Benchmarking Sudan's Knowledge Economy scorecard on Governance with Yemen and Mauritania. (Table 5.12)

5.8.2 Benchmarking Sudan's Knowledge Economy scorecard on Governance with Algeria and Egypt:

In this section we benchmarks Sudan's Knowledge Economy scorecard on Governance with Algeria and Egypt.

Table 5.10 Benchmarking Sudan's Knowledge Economy Scorecard on Governance with Algeria and Egypt,

	Sudan		**Algeria**		**Egypt, Arab Rep.**	
	(Group: All)		(Group: All)		(Group: All)	
Variable	actual	normalized	actual	normalized	actual	normalized
Regulatory Quality,	-1.25	0.62	-0.94	1.37	-0.14	4.32
Rule of Law,	-1.34	0.34	-0.73	2.6	-0.03	5.75
Government Effectiveness,	-1.32	0.34	-0.59	3.15	-0.3	3.97

Source: KAM 2012

According to table 5.10 Sudan's Knowledge Economy scorecard on Governance is compared to Algeria and Egypt. Sudan has ranked the last and has showed a weak position for its regulatory quality, rule of law and government effectiveness. Irrespective of different ranks between the three countries but all of the three countries are characterized by a relatively closed political system which does not allow for meaningful popular participation. The citizens of the three countries under investigation, lack means to engage with the government and hold it accountable. In addition, accountability mechanisms among the main institutions of government are generally weakly developed and the executive dominates other branches of government.

5.8.3 Benchmarking Sudan's Knowledge Economy scorecard on Governance with Morocco and Syria:

In this section we benchmarks Sudan's Knowledge Economy scorecard on Governance with Morocco and Syria .Table 5.11 presents the results of the benchmarking process.

Table 5.11 Benchmarking Sudan's Knowledge Economy Scorecard on Governance with Morocco and Syria

	Sudan		**Morocco**		**Syrian Arab Republic**	
	(Group: All)		(Group: All)		(Group: All)	
Variable	actual	normalized	actual	normalized	actual	normalized
Regulatory Quality,	-1.25	0.62	-0.01	4.73	-1.07	0.89
Rule of Law,	-1.34	0.34	-0.16	5.34	-0.47	3.97
Government Effectiveness,	-1.32	0.34	-0.16	5.34	-0.61	3.08

Source: KAM 2012

According to table 5.11 Sudan's Knowledge Economy scorecard on Governance compared to Morocco and Syria; Sudan ranked the last and has showed a weak position for its regulatory quality, rule of law and government effectiveness. But still the three countries share the problems of extremely under-developed public accountability systems and uneven enforcement of existing anticorruption laws, Morocco blends a powerful monarchy and weak political institutions with a rather free civil society and media. In Morocco, the governance system is characterized by a dominant executive in the form of the King, whose powers are not controlled by the parliament or other public institutions in any substantial manner.

5.8.4 Benchmarking Sudan's Knowledge Economy scorecard on Governance with Yemen and Mauritania*:*

In this section we benchmarks Sudan's Knowledge Economy scorecard on Governance with Yemen and Mauritania. Table 5.12 presents the results of the benchmarking process.

Table 5.12 Benchmarking Sudan's Knowledge Economy Scorecard on Governance with Yemen and Mauritania

	Sudan		**Yemen, Rep.**		**Mauritania**	
	(Group: All)		**(Group: All)**		**(Group: All)**	
Variable	actual	normalized	actual	normalized	actual	normalized
Regulatory Quality,	-1.25	0.62	-0.6	2.12	-0.66	1.92
Rule of Law,	-1.34	0.34	-1.15	1.1	-0.84	1.99
Government Effectiveness,	-1.32	0.34	-1.12	0.68	-0.9	1.64

Source: KAM 2012

According to table 5.12 Sudan Knowledge Economy scorecard on Governance compared to Yemen and Mauritania; Sudan ranked the last and has showed a weak position for its regulatory quality, rule of law and government effectiveness.

Figures 5.6-5.7-5.8 summarizes the data from the Worldwide Governance Indicators (WGI) project for Sudan for three governance indicators:

Government Effectiveness, Regulatory Quality, and the Rule of Law, the three figures emphases our low ranking as for governance indicators, where our percentile rank is below the 10th for all three variables.

Figure 5.6 Sudan, 1996-2012: Government Effectiveness

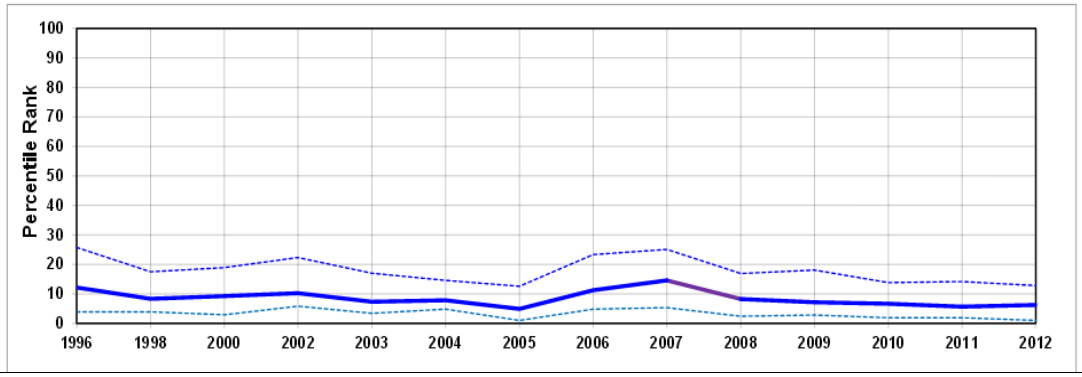


Figure 5.7 Sudan, 1996-2012: Regulatory Quality

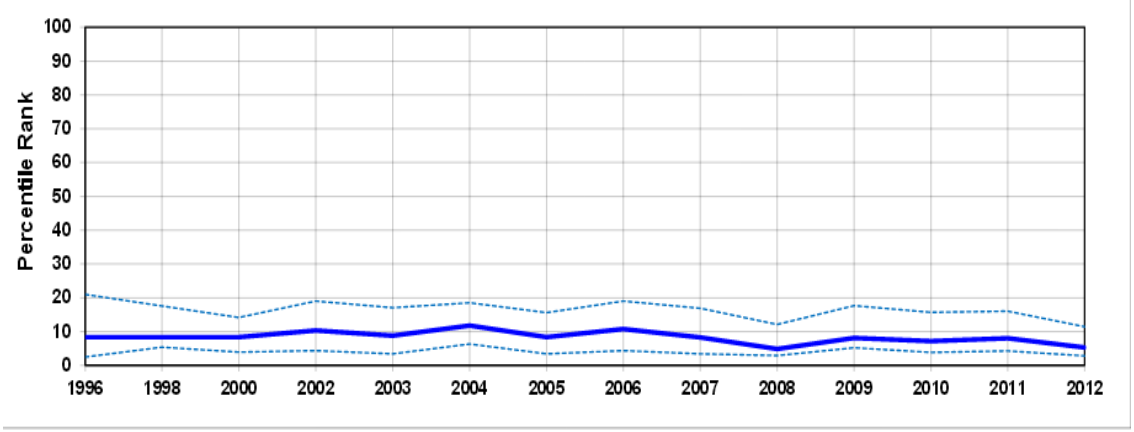
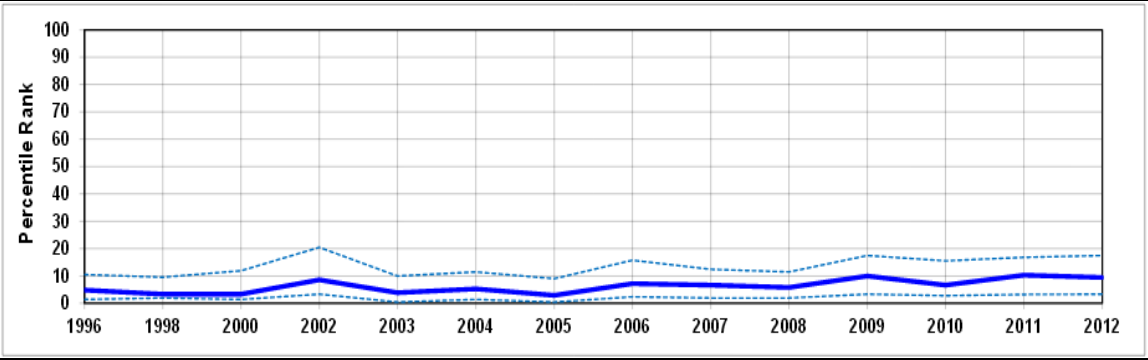


Figure 5.8 Sudan, 1996-2012 Rule of Law



Source: *worldwide governance indicators*

5.9 Education and Training Support:

Education is a major component of well-being and is used in the measure of economic development and quality of life, which is a key factor determining whether a country is a developed, developing, or underdeveloped nation. Education is the key element of a knowledge-based, innovation-driven economy. It affects both the supply of innovation and the demand for it. Human capital and skilled labor are complementary to technological advances: new technologies cannot be adopted in production without sufficient workforce training and education. On the other hand, the demand side also is important. Innovations may not take place due to a lack of demanding customers and consumers.

The United Nations publishes a Human Development Index every year, which consists of the Life Expectancy Index, Education index, and Income index. The **Education Index** is calculated from the *Mean years of schooling index* and the *Expected years of schooling index*. Table 5.13 compares Sudan with its Arab comparators of lower middle income economies as for the education index; Sudan has the lowest rank in the list (161 from 183 in the world). This backward status in Sudan can be due to the inefficiency in the

educational system. Efficiency enhancers, such as higher education**,** like its primary-level one, appear to be misaligned with the requirements of a competitive economy. There is a pressing need to revisit the mathematics and science curricula, improve the quality of management and internet access in schools and invest in high quality, specialized training of staff at the business levels.

Table 5.13 UN Education index for Arab countries (Lower Middle Income Economies)

The country	UN Education index	International rank
Syria	0.76	124
Algeria	0.71	129
Egypt	0.62	136
Yemen	0.597	153
Morocco	0.590	155
Mauritania	0.55	160
Sudan	0.52	161

Source: BTI 2012

In the following section we compare Sudan's Education with its comparators from Arab countries of the lower middle economies. Four variables are used: adult literacy rate (% age 15 and above), Gross Secondary Enrollment rate, Gross Tertiary Enrollment rate and Public Spending on Education as % of GDP.

The benchmarking exercises offer:

a. Benchmarking Sudan's Knowledge Economy scorecard on Education with Algeria and Egypt (Table 5.14)
b. Benchmarking Sudan's Knowledge Economy scorecard on Education with Morocco and Syria(Table 5.15)

c. Benchmarking Sudan's Knowledge Economy scorecard on Education with Yemen and Mauritania. (Table 5.16)

5.19.1 Benchmarking Sudan knowledge economy's scorecard on Education with Algeria and Egypt:

In this section we benchmarks Sudan's Knowledge Economy scorecard on education with Algeria and Egypt. Table 5.14 presents the results of the benchmarking process.

Table 5.14 Benchmarking Sudan knowledge economy's scorecard on Education with Algeria and Egypt:

	Sudan		**Algeria**		**Egypt, Arab Rep.**	
	(Group: Lower Middle Income)		(Group: Lower Middle Income)		(Group: Lower Middle Income)	
Variable	actual	normalized	actual	normalized	actual	normalized
Adult Literacy Rate (% age 15 and above),	70.21	2.14	72.65	3.1	66.37	1.43
Gross Secondary Enrollment rate,	37.97	1.43	96.48	9.52	67.2	4.76
Gross Tertiary Enrollment rate	n/a	n/a	30.62	7.11	28.45	6.58
Public Spending on Education as % of GDP,	n/a	n/a	4	4.83	4	4.83

Source: *World Bank 2012*

According to table 5.14 Sudan Knowledge Economy scorecards on Education is compared to Algeria and Egypt; Sudan ranked the second as for Adult Literacy Rate (% age 15 and above), the last as for Gross Secondary Enrollment rate, we were unable to normalize the Gross Tertiary Enrollment rate and Public Spending on Education as % of GDP, because of the lack of information.

5.9.2 Benchmarking Sudan's Knowledge Economy scorecard on Education with Morocco and Syria*:*

In this section we benchmarks Sudan's Knowledge Economy scorecard on education with Morocco and Syria. Table 5.15 presents the results of the benchmarking process.

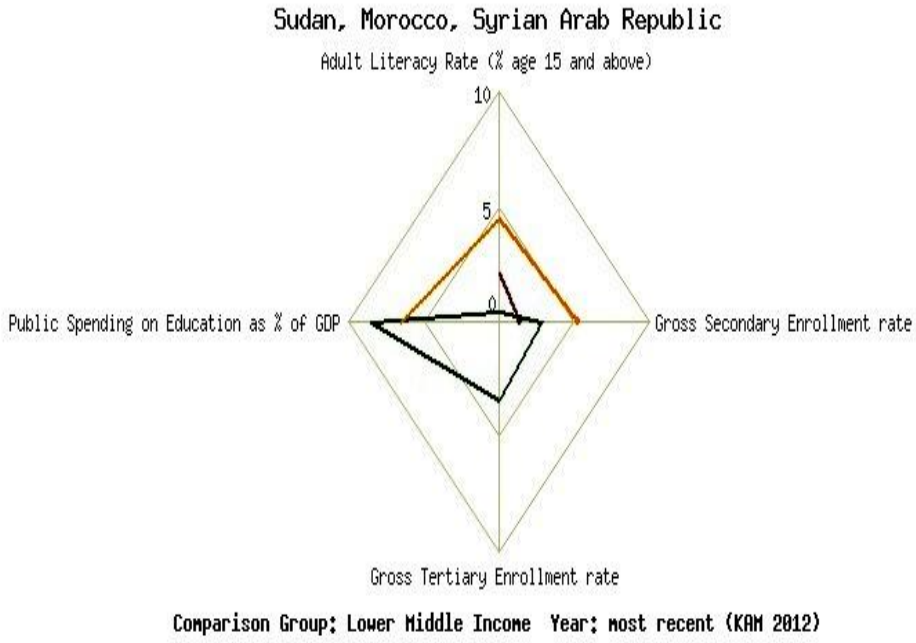
Table 5.15 Benchmarking Sudan's Knowledge Economy scorecard on Education with Morocco and Syria

	Sudan		**Morocco**		**Syrian**	
	(Group: Lower Middle Income)		(Group: Lower Middle Income)		(Group: Lower Middle Income)	
Variable	actual	normalized	actual	normalized	actual	normalized
Adult Literacy Rate (% age 15 and above),	70.21	2.14	56.08	0.48	84.19	4.52
Gross Secondary Enrollment rate,	37.97	1.43	55.85	2.86	74.74	5.24
Gross Tertiary Enrollment rate,	n/a	n/a	12.88	3.42	n/a	n/a
Public Spending on Education as % of GDP,	n/a	n/a	6	8.62	5	6.55

Source: World Bank 2012

According to Table 5.15 Fig. 5.9 where Sudan Knowledge Economy scorecards on Education is compared to Morocco and Syria; Sudan ranks the second as for Adult Literacy Rate (% age 15 and above) and has a better position than Morocco, the last as for Gross Secondary Enrollment rate, we were unable to normalize the Gross Tertiary Enrollment rate and Public Spending on Education as % of GDP, because of the lack of information.

Figure 5.9 Benchmarking Sudan's Knowledge Economy Scorecard on Education with Morocco and Syria



Source: World Bank 2012

	Sudan		Morocco		Syria

5.9.3 Benchmarking Sudan's Knowledge Economy Scorecard on Education with Yemen and Mauritania*:*

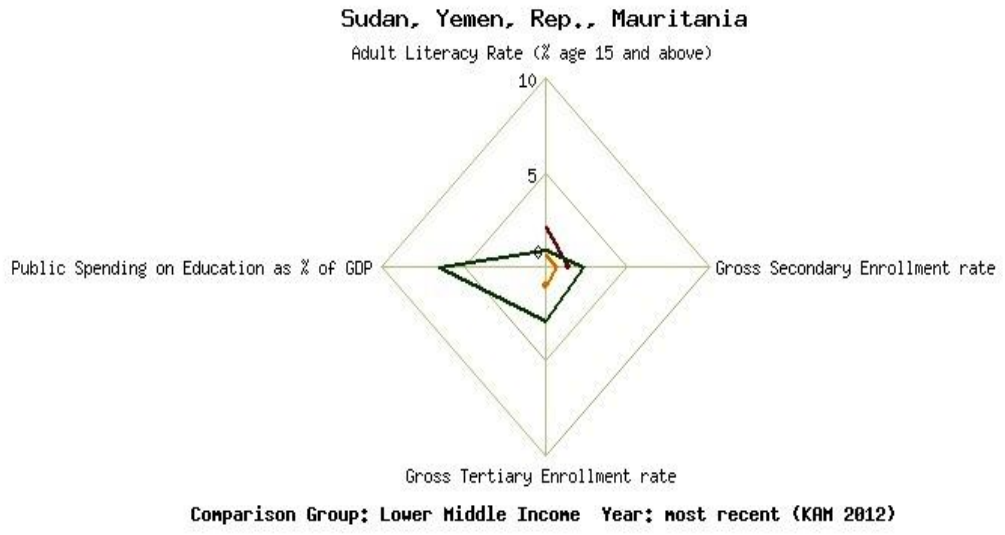
In this section we benchmarks Sudan's Knowledge Economy scorecard on education with Yemen and Mauritania. Table 5.15 presents the results of the benchmarking process. Sudan ranks the first as for Adult Literacy Rate (% age 15 and above), the second as for Gross Secondary Enrollment rate after Yemen.

Table 5.16 Benchmarking Sudan's Knowledge Economy scorecard on Education with Yemen and Mauritania

Variable	Sudan (Group: Lower Middle Income)		Yemen, Rep. (Group: Lower Middle Income)		Mauritania (Group: Lower Middle Income)	
	actual	normalized	actual	normalized	actual	normalized
Adult Literacy Rate (% age 15 and above),	70.21	2.14	62.39	0.95	57.45	0.71
Gross Secondary Enrollment rate,	37.97	1.43	45.61	2.38	24.46	0.71
Gross Tertiary Enrollment rate,	n/a	n/a	10.23	2.89	3.81	1.05
Public Spending on Education as % of GDP,	n/a	n/a	5	6.55	3.81	1.05

Source: World bank 2012

Figure 5.10 Benchmarking Sudan's Knowledge Economy scorecard on Education with Yemen and Mauritania



Source: World Bank 2012

	Sudan		Yemen		Mauritania

5.10 Research and Development:

No country can compete without a deep understanding and vision of the role of R&D for long term economic and social well-being and a strategy to harness that potential for its people. The aim of Scientific Research is the generation of new scientific knowledge as well as the correction and integration of previous knowledge, either immediately applicable or not. The roots of scientific research can be traced as far back as the ancient times, boomed during the renaissance period but the massive and systematic engagement in Research and Development (R&D) activities, not only in Academia but also in Enterprises, is only a recent phenomenon of the 20th century.

5.10.1 Sudan Innovation Status:

Innovation is conceptualized as the creation and distribution of new ideas, transformation of new ideas into commercial value and the development of new products and processes.

The Global Innovation Index elements of the national economy that enable innovative activities: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication. Two output pillars capture actual evidence of innovation outputs: (6) Knowledge and technology outputs and (7) Creative outputs.

The Global Innovation Index includes two sub-indices: the Innovation Input Sub-Index and the Innovation Output Sub-Index. The first sub-index is based on five pillars: Institutions, Human capital and research,

Infrastructure, Market sophistication, and Business sophistication. The second sub-index is based on two pillars: Knowledge and technology outputs and Creative outputs. Each pillar is divided into sub-pillars and each sub-pillar is composed of individual indicators

According to the Global Innovation Index 2013: Sudan has a very low ranks with a rank of 141; compared to its comparators in middle income group, with a rank of 35; compared to sub-Saharan countries with a rank of 32 and an *efficiency* rate of 0.49 with a rank of 138.

Tables 5.17 and 5.18 presents the strength and weaknesses of Sudan's innovation Status according to some selected innovation input sub-index and selected innovation output sub-index.

Table 5.17 Strength of Sudan's Innovation Status (Economy's best percent ranks):

Strength		
Pillar	***Sub Pillars***	***Percent Rank***
Business environment		37.5
	Ease of starting a business	28.3
	Ease of resolving insolvency	45.3
	Ease of paying taxes	42.5
Human capital and research		62.4
	Education	94.2
	Pupil-teacher ratio, secondary	38.2
	Gross capital formation	24.2
Ecological sustainability		29.9
	GDP per unit of energy use	38.7
	Microfinance institutions' gross loan portfolio	23.3
	Market access for non-agricultural exports	82.2

	High-tech imports	47.5
	Foreign direct investment net inflows	51.7
Knowledge and technology outputs		37.5
	Knowledge diffusion	79.2
	Royalties and license fees receipts (% service exports)	69.0
	Communications, computer and information services exports, %	94.1
	Foreign direct investment net outflows	38.2

Source: (Global Innovation Index 2013)

The above Table 5.17 reveals that innovation which due to human capital and research has the highest best percent rank (62.4 percent) followed by Knowledge and technology outputs (37.5 percent), and the ones due to Ecological sustainability has the lowest best percent ranks (29.9 percent).

Table 5.18 Weaknesses of Sudan's Innovation Status (Economy's worst percent ranks):

Weaknesses		
Pillar	***Sub Pillars***	***Percent Rank***
Political environment		0.0
	Political stability and absence of violence/terrorism	0.7
	Government effectiveness	0.7
Research and development (R&D)		0.0
	Logistics performance	0.7
	Venture capital deals	0.0
Business Sophistication		1.4
	GMAT test takers	0.7
Innovation linkages		0.0

	Joint venture/strategic alliance deals	0.0
	Patent families filed in at least three offices	0.0
	Communications, computer and information services imports, %	0.0
	National office resident patent applications	1.7
	Patent Cooperation Treaty resident applications	0.0
Creative outputs		0.0
	Intangible assets	0.0
	Madrid system trademark registrations by country of origin	0.0
	Creative goods and services	1.4

Source: (Global Innovation Index 2013)

It is very clear from the above table that most of the weakness indicators have (0 percent)

Table 5.19 Figure 5.11 depicts Sudan's Knowledge Economy scorecard on the innovation, selected Variables, most Recent Period.

We can observe from the above table that four indicators lack information *(*Science and Engineering Enrolment Ratio (%), Science Enrolment Ratio (%), Availability of Venture Capital (1-7), *and* Private Sector Spending on R&D). the strong variables for innovation according to the table are High-Tech Exports as % of Manuf. Exports followed by foreign development investments inflows as a percent of gross domestic product with normalized rates of 9.54 and 7.5 consecutively while the weakest variables are S&E Journal Articles / Mil. People and Manuf. Trade as % of GDP: with normalization of 0.90 and 0.54 consecutively.

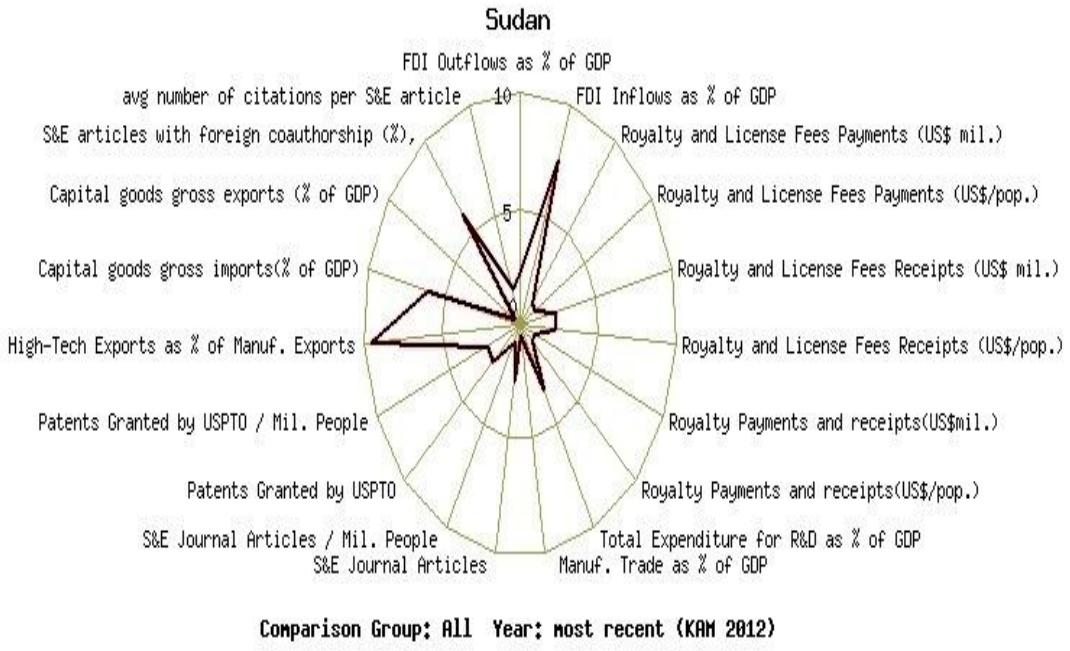
For the variable of avg number of citations per S&E article Sudan is normalized to 1.67 compared to middle lower income countries (normalized to 4.55) this indicates the weakness status of Sudan as far as this variable is concerned.

Table 5.19 Sudan's Knowledge Economy Scorecard on the Innovation, selected Variables, most Recent Period

	actual	***normalized***
FDI Inflows as % of GDP,	7.03	7.50
Royalty Payments and receipts (US$/pop.)	0.00	1.04
Total Expenditure for R&D as % of GDP	0.29	3.17
Manuf. Trade as % of GDP	13.82	0.54
S&E Journal Articles	35.87	2.48
S&E Journal Articles / Mil. People	0.89	0.90
Patents Granted by USPTO	0.00	2.40
High-Tech Exports as % of Manuf. Exports	34.00	9.54
avg number of citations per S&E article	1.02	1.67

Source: World Bank 2012

Figure 5.11 Sudan's Knowledge Economy scorecard on the innovation, selected Variables, most Recent Period



Source: World Bank 2012

5.10.2 Benchmarking Sudan's Knowledge Economy scorecard on research and development:

In the following section we compare Sudan's research and development with its comparators from Arab countries of the lower middle economies. The following table: table 5.20 presents the global innovation index (GII) and ranking for Sudan and its comparators of Arab countries (lower middle income). Sudan rank 141 (from 142) in its innovation index globally, it has the lowest innovation index compared to Arab countries of the lower middle income economies

Table 5.20 The Global Innovation Index and Ranking for Sudan and Its Comparators of Arab Countries (lower middle income)

Country	The Global Innovation Index	Rank
Morocco	30.7	88
Egypt	27.9	103
Algeria	24.4	124
Syria	23.1	132
Yemen	19.2	139
Sudan	16.8	141
Mauritania	n.a	n.a

Source: global innovation index: 2012

The benchmarking exercises offer:

d. Benchmarking Sudan's Knowledge Economy scorecard on research and development with Algeria and Egypt (Table 5.21-Figure 5.12)

e. Benchmarking Sudan's Knowledge Economy scorecard on research and development with Morocco and Syria(Table 5.22- Figure 5.13)
f. Benchmarking Sudan's Knowledge Economy scorecard on research and development with Yemen and Mauritania. (Table 5.23 -Figure 5.14)

5.10.3 Benchmarking Sudan's Knowledge Economy Scorecard on Research and Development with Algeria and Egypt:

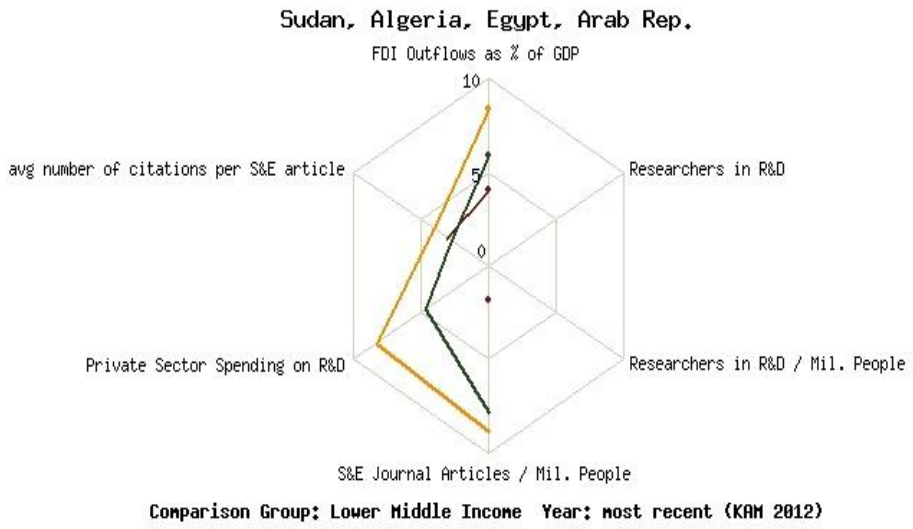
In this section we benchmarks Sudan's Knowledge Economy scorecard research and development with Algeria and Egypt. Table 5.21 presents the results of the benchmarking process.

Table 5.21 Benchmarking Sudan's Knowledge Economy Scorecard on Research and Development with Algeria and Egypt:

	Sudan		**Algeria**		**Egypt, Arab Rep.**	
	(Group: Lower Middle Income)		(Group: Lower Middle Income)		(Group: Lower Middle Income)	
Variable	actual	normalized	actual	normalized	actual	normalized
FDI Outflows as % of GDP,	0.07	4.05	0.17	5.95	0.45	8.38
S&E Journal Articles / Mil. People	0.89	1.9	14.2	7.86	24.16	8.81
Private Sector Spending on R&D	n/a	n/a	0.99	2.86	3	8.33
public Sector Spending on R&D	1.02	3.1	0.99	2.86	1.15	4.05

Source: World Bank 2012

Figure 5.12 Benchmarking Sudan's Knowledge Economy scorecard on Research and Development with Algeria and Egypt



Source: World Bank 2012

	Sudan		**Algeria**		**Egypt**

The above graph takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position. The red color indicates the ranking of **Research and Development** indicators in Sudan. The green color indicates the ranking of **Research and Development** indicators in Algeria, while, the yellow color indicates the ranking of **Research and Development** indicators in Egypt

Foreign direct investment (FDI) has been widely accepted as a major engine of growth in many countries, especially for the developing economies. Governments of developing countries try to create investment-friendly environments in order to attract FDI inflows. With these inflows, the host countries expect to receive not only capital but also technology and management know-how, and finally to attain higher level of development (Borensztein et al., 1998; Kohpaiboon, 2003; JyunYiand Chih-Chiang, 2008; Pradhan, 2009).

Foreign Direct Investment (FDI) has become a very important source of external financing for Sudan, and an important source of foreign exchange to support the country's recent current account deficits. Net FDI and portfolio inflows hit [US] $3.5 billion in 2006, largely because of foreign entrants in the Telecommunications and banking sectors, in addition to FDI supporting foreign operators in the oil sector. However, net inflows subsequently declined, and are projected to be $2.4 billion for 2009, which is one-third less in relation to the peak in 2006. In addition, there is general concern that such flows are unlikely to be sustained without discovery of new oil sources or renewed privatization (World Bank report 2009)

According to Table 5.21 and Figure 5.12; Sudan has the lowest ranks as for foreign and direct investments (FDI) Outflows as % of GDP and science and engineering (S&E) Journal Articles / Mil. People. Sudan shows a better position than Algeria in the average number of citations per science and engineering (S&E) article.

5.10.4 Benchmarking Sudan's Knowledge Economy Scorecard on Research and Development with Morocco and Syria:

In this section we benchmarks Sudan's Knowledge Economy scorecard on research and development with Morocco and Syria. Table 5. 22 & Figure 5.13 presents the results of the benchmarking process.

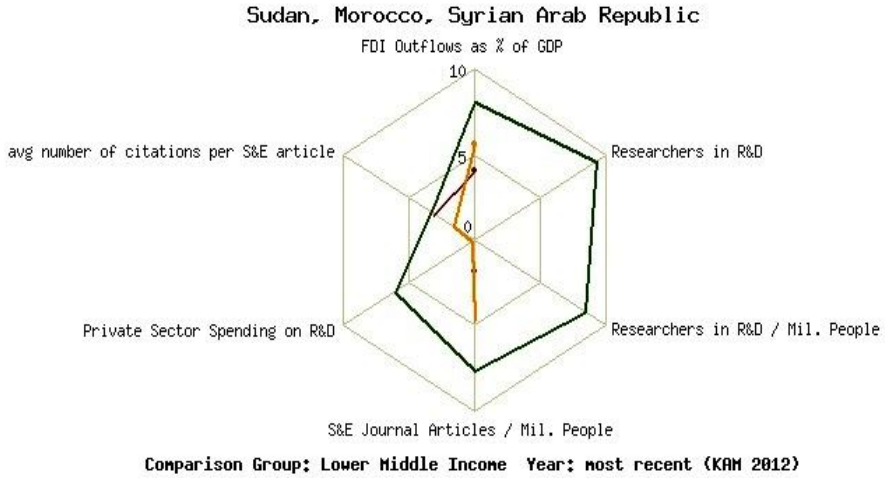
According to Table 5.22 and Figure 5.13; Sudan has the lowest ranks as for foreign and direct investments (FDI) Outflows as % of GDP and science and engineering (S&E) Journal Articles / Mil. People. Sudan shows a better position in the average number of citations per science and engineering (S&E) article.

Table 5.22 Benchmarking Sudan's Knowledge Economy Scorecard on Research and Development with Morocco and Syria

	Sudan		**Morocco**		**Syrian**	
	(Group: Lower Middle Income)		(Group: Lower Middle Income)		(Group: Lower Middle Income)	
Variable	actual	normalized	actual	normalized	actual	normalized
FDI Outflows as % of GDP,	0.07	4.05	0.43	8.11	0.16	5.68
Researchers in R&D,	n/a	n/a	3.00	9.23	n/a	n/a
Researchers in R&D / Mil. People,	n/a	n/a	799	8.46	n/a	n/a
S&E Journal Articles / Mil. People,	0.89	1.9	12.13	7.62	3.96	4.76
Private Sector Spending on R&D	n/a	n/a	2.7	6.11	2	0.28
avg number of citations per S&E article,	1.02	3.1	1.06	3.33	0.81	1.67

Source: World Bank 2012

Figure 5.13 Benchmarking Sudan's Knowledge Economy Scorecard on Research and Development with Morocco and Syria



Source: World Bank 2012

	Sudan		Morocco		Syria

The above graph takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position. The red color indicates the ranking of **Research and Development** indicators in Sudan. The green color indicates the ranking of **Research and Development** indicators in Morocco, while, the yellow color indicates the ranking of **Research and Development** indicators in Syria.

5.10.5 Benchmarking Sudan's Knowledge Economy Scorecard on Research and Development with Yemen and Mauritania:

In this section we benchmarks Sudan's Knowledge Economy scorecard on research and development with Yemen and Mauritania. Table 5. 23 & Figure 5.14 presents the results of the benchmarking process.

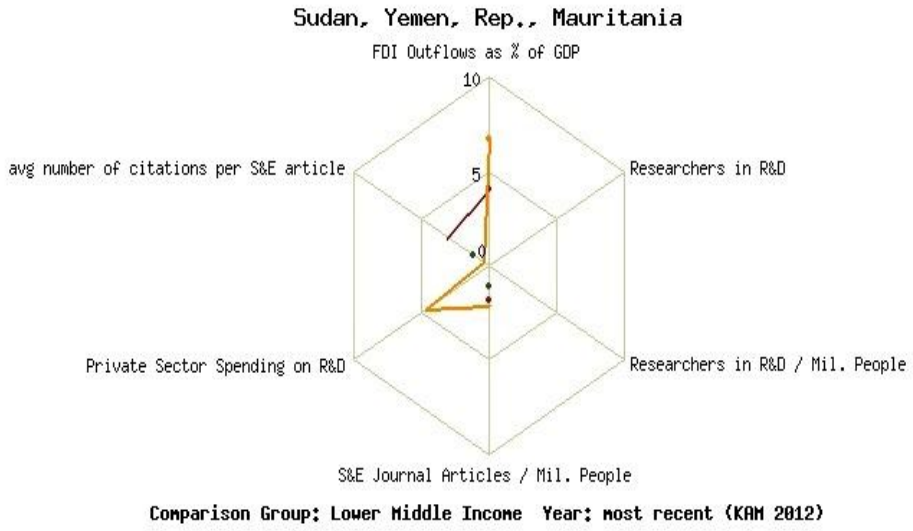
Sudan has the lowest ranks as for foreign and direct investments (FDI) Outflows as % of GDP and science and engineering (S&E) Journal Articles / Mil. People. Sudan shows a second better position in the average number of citations per science and engineering (S&E) article.

Table 5.23 Benchmarking Sudan's Knowledge Economy Scorecard on Research and Development with Yemen and Mauritania

	Sudan		**Yemen, Rep.**		**Mauritania**	
	(Group: Lower Middle Income)		(Group: Lower Middle Income)		(Group: Lower Middle Income)	
Variable	actual	normalized	actual	normalized	actual	normalized
FDI Outflows as % of GDP,	0.07	4.05	n/a	n/a	0.19	6.76
S&E Journal Articles / Mil. People,	0.89	1.9	0.82	1.19	1.06	2.14
Private Sector Spending on R&D	n/a	n/a	n/a	n/a	2.6	4.72
avg number of citations per S&E article,	1.02	3.1	0.74	1.19	0.64	0.48

Source: World Bank 2012

Figure 5.14 Benchmarking Sudan's Knowledge Economy Scorecard on Research and Development with Yemen and Mauritania



Source: World Bank 2012

	Sudan		Yemen		Mauritania

The above graph takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position. The red color indicates the ranking of **Research and Development** indicators in Sudan. The green color indicates the ranking of **Research and Development**

indicators in Yemen, while, the yellow color indicates the ranking of **Research and Development** indicators in Mauritania.

5.11 Information Communication Technology (ICT) in Sudan:

Regarding *information infrastructure,* Sudan has made impressive advances in ICTs due to considerable improvements in telephones (fixed plus mobile, in which Sudan has experienced a boom in mobile telephony), computer penetration, and, most laudably, Internet users. Even though Sudan has made a several-fold improvement in its information infrastructure penetration ratios in *absolute* terms in the past few years, it has fallen behind in *relative* terms, because the world on average has moved faster and improved much more significantly. The contrast is made even more striking by *overlaying* Sudan's most recent performance with those of its two closest competitors, Middle Lower income countries have made much greater leaps in enhancing their information infrastructures, as evidenced by the variables for telephones, computers, and the Internet; they have also improved on the other pillars.

Table 5.24 – Figure 5.15 depicts Sudan's Knowledge Economy scorecard on information and communications technologies, for selected variables.

Sudan has a weak expenditure on ICT, and weak availability of e-government services. The only strong normalized factor is the availability of computer per 1000 people.

This means that Sudan's progress in ICT development has, to say the least, been disappointing despite some positive developments in recent years. Sudan has managed to export on a comparable basis between US $ 150 to $200 million (World Bank reports: 2012). While it produces around 5500 IT graduates per year, except for a few leading institutions, they are of poor

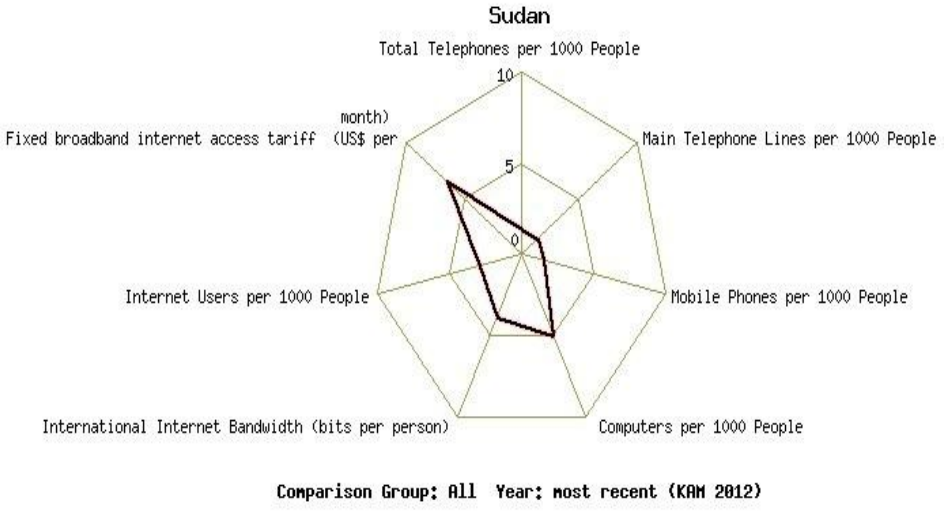
quality. A large number of the few high quality graduates find it much more attractive to seek employment overseas rather than within Sudan despite the relatively high salaries offered to such graduates by domestic companies.

Table 5.24 Sudan's Knowledge Economy Scorecard on Information and Communications Technologies, Selected Variables: 2012

Variable	Sudan (Group: All) actual	Sudan (Group: All) normalized
Total Telephones per 1000 People,	370	1.45
Main Telephone Lines per 1000 People,	10	1.44
Mobile Phones per 1000 People,	360	1.52
Computers per 1000 People,	110	5.07
International Internet Bandwidth (bits per person),	322	3.94
Internet Users per 1000 People, 2	100	2.97
Fixed broadband internet access tariff (US$ per month),	23	6.57

Source: World Bank 2012

Fig 5.15 Sudan's Knowledge Economy Scorecard on Information and Communications Technologies, Selected Variables: 2012



Source: World Bank 2012

5.11.1 Sudan's ICT development Index:

Sudan's ICT development Index has changed from the rank of 131 in 2007 to the rank of 120 in 2012 which means that there is a remarkable development in ICT field in Sudan. the **ICT Development Index** (**IDI**) *(ICT Development Index: 2012)* is an index published by the United Nations International Telecommunication Union based on internationally agreed information and communication technologies (ICT) indicators. This makes it a valuable tool for benchmarking the most important indicators for measuring the information society. The IDI is a standard tool that governments, operators, development agencies, researchers and others can use to measure the digital divide and compare ICT performance within and across countries. The ICT Development Index is based on 11 ICT indicators, grouped in three clusters: access, use and skills.

5.11.2 Sudan's Digital Access Index:

The DAI reflects the ability of each country's population to take advantage of internet communication technologies on changing weather patterns, current events, disasters and early warning systems, as well as general information on agriculture and markets to facilitate adaptation. Digital access is also important during all phases of disaster response. It is a composite score of eight variables describing availability of infrastructure, affordability of access, educational level, quality of information and communication technology services, and Internet usage. The DAI also provides a transparent and globally measurable way of tracking progress towards improving access to ICTs. Digital Access Index is developed by the International Telecommunication Union. Table 5.25 compares Sudan to its

comparators as for Digital access using The Digital Access Index (DAI). Sudan is classified as a low access country and it has the lowest digital access index as compared with its comparators Arab countries of the lower middle economies.

Table 5.25 Benchmarking Sudan with Its Comparators Arab Countries of the Lower Middle Economies as For Digital Access Index - DAI

Country	***DAI***	***Access Classification***
Egypt	0.40	*Medium Access*
Algeria	***0.37***	*Medium Access*
Morocco	***o.33***	*Medium Access*
Syria	0.28	*Low access*
Yemen	0.18	*Low access*
Mauritania	0.14	*Low access*
Sudan	0.13	*Low access*

Source: Internet World Stat

5.11.3 Benchmarking Sudan's Knowledge Economy scorecard on ICT with its comparators from Arab countries of the lower middle economies:

In the following section we compare Sudan's ICT with its comparators from Arab countries of the lower middle economies. Four variables are used: Total Telephones per 1000 People, Computers per 1000 People, Internet Users per 1000 People, and ICT Expenditure as % of GDP.

The benchmarking exercises offer:

g. Benchmarking Sudan's Knowledge Economy scorecard on ICT with Algeria and Egypt (Table 5.26-Figure 5.16)
h. Benchmarking Sudan's Knowledge Economy scorecard on ICT with Morocco and Syria(Table 5.7 –Figure 5.17)

i. Benchmarking Sudan's Knowledge Economy scorecard on ICT with Yemen and Mauritania. (Table 5.28-figure 5.18)

5.11.4 Benchmarking Sudan's Knowledge Economy Scorecard on ICT with Algeria and Egypt:

In this section we benchmarks Sudan's Knowledge Economy scorecard on information and telecommunication with Algeria and Egypt.

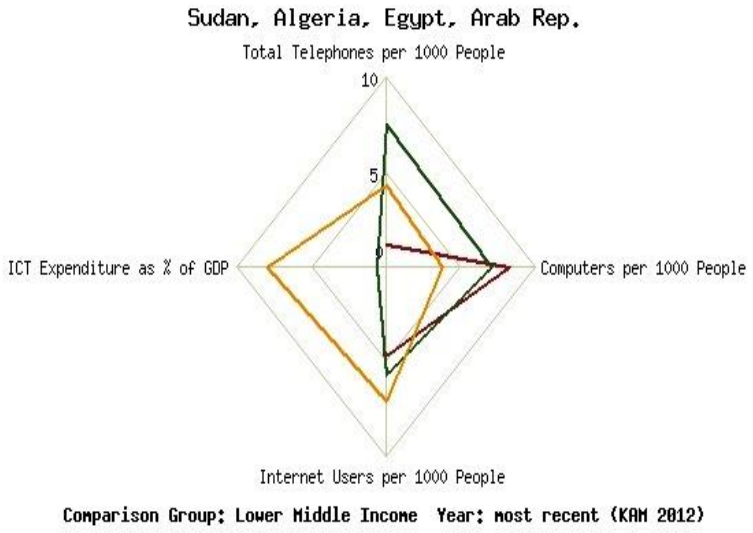
Sudan current level of internet users per 1000 people is the lowest as compared to Egypt and Algeria, the availability of telephones per 1000 people is also very limited if compared to those two countries. No information is provided as for ICT Expenditure as % of GDP. Sudan level of availability of computers per 1000 people is the first among the two countries.

Table 5.26 Benchmarking Sudan's Knowledge Economy Scorecard on ICT with Algeria and Egypt:

	Sudan		**Algeria**		**Egypt, Arab Rep.**	
	(Group: Lower Middle Income)		(Group: Lower Middle Income)		(Group: Lower Middle Income)	
Variable	actual	normalized	actual	normalized	actual	normalized
Total Telephones per 1000 People,	370	1.22	1.010.00	7.56	790	4.39
Computers per 1000 People,	110	8.33	100	7.14	40	3.81
Internet Users per 1000 People,	100	4.76	130	5.71	200	7.14
ICT Expenditure as % of GDP,	n/a	n/a	2	0.67	6	8

Source: World Bank 2012

Figure 5.16 Benchmarking Sudan's Knowledge Economy Scorecard on ICT with Algeria and Egypt:



Source: World Bank 2012

	Sudan		Egypt		Algeria

The above graph takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position. The red color indicates the ranking of **ICT** indicators in Sudan. The green color indicates the ranking of **ICT** indicators in Egypt, while, the yellow color indicates the ranking of **ICT** indicators in Algeria.

5.11.5 Benchmarking Sudan's Knowledge Economy scorecard on ICT with Morocco and Syria:

In this section we benchmarks Sudan's Knowledge Economy scorecard on information and telecommunication with Morocco and Syria.

Sudan current level of internet users per 1000 people is the lowest as compared to Morocco and Syria, the availability of telephones per 1000 people is also very limited if compared to those two countries. No information is provided as for ICT Expenditure as % of GDP. Sudan level of availability of computers per 1000 people is the first among the two countries.

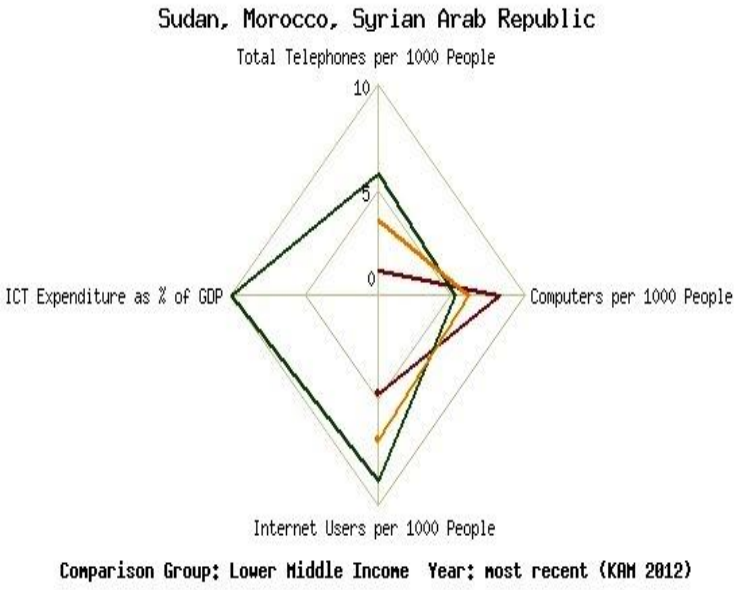
Table 5. 27 & Figure 5.17 presents the results of the benchmarking process.

Table 5.27 Benchmarking Sudan's Knowledge Economy Scorecard on ICT with Morocco and Syria:

	Sudan		**Morocco**		**Syrian Arab Republic**	
	(Group: Lower Middle Income)		(Group: Lower Middle Income)		(Group: Lower Middle Income)	
Variable	actual	normalized	actual	normalized	actual	normalized
Total Telephones per 1000 People	370	1.22	900	5.85	640	3.66
Computers per 1000 People	110	8.33	60	5.24	90	6.19
Internet Users per 1000 People,	100	4.76	320	8.81	190	6.9
ICT Expenditure as % of GDP	n/a	n/a	12	10	n/a	n/a

Source: World Bank 2012

Figure 5.17 Benchmarking Sudan's Knowledge Economy Scorecard on ICT with Morocco and Syria:



Source: World Bank 2012

	Sudan		Morocco		Syria

The above graph takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position. The red color indicates the ranking of **ICT** indicators in Sudan. The green color indicates the ranking of **ICT** indicators in Morocco, while, the yellow color indicates the ranking of **ICT** indicators in Syria.

5.11.6 Benchmarking Sudan's Knowledge Economy scorecard on ICT with Yemen and Mauritania:

In this section we benchmarks Sudan's Knowledge Economy scorecard on information and telecommunication with Yemen and Mauritania.

Table 5. 28 & Figure 5.18 presents the results of the benchmarking process**.**

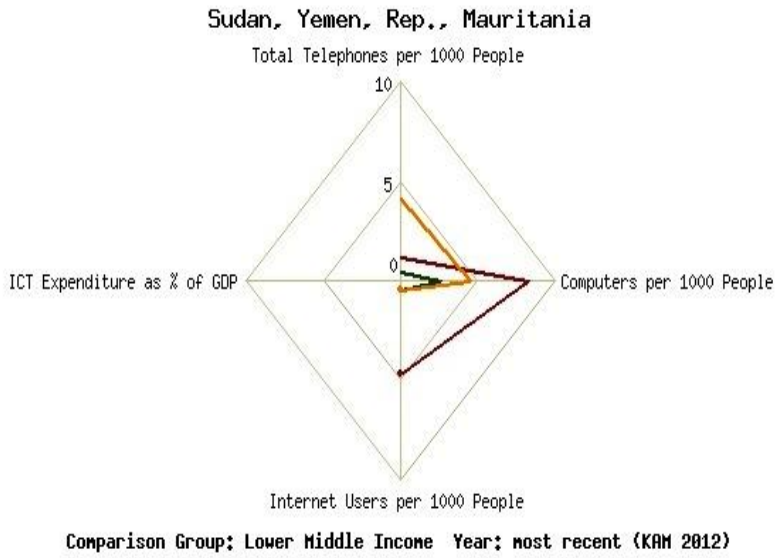
Sudan current level of internet users per 1000 people and the availability of telephones per 1000 people is the second as compared to Yemen and Mauritania. No information is provided as for ICT Expenditure as % of GDP. Sudan level of availability of computers per 1000 people is the first among the two countries.

Table 5. 28 Benchmarking Sudan's Knowledge Economy Scorecard on ICT with Yemen and Mauritania:

	Sudan		**Yemen, Rep.**		**Mauritania**	
	(Group: Lower Middle Income)		(Group: Lower Middle Income)		(Group: Lower Middle Income)	
Variable	actual	normalized	actual	normalized	actual	normalized
Total Telephones per 1000 People,	370	1.22	210	0.49	680	4.2
Computers per 1000 People,	110	8.33	30	2.62	50	4.5
Internet Users per 1000 People,	100	4.76	20	0.48	20	0.5
ICT Expenditure as % of GDP,	n/a	n/a	n/a	n/a	n/a	n/a

Source: World Bank 2012

Figure 5. 18 Benchmarking Sudan's Knowledge Economy Scorecard on ICT with Yemen and Mauritania:



Source: World Bank 2012

	Sudan		Yemen		Mauritania

The above graph takes its shape from the total number of variables under analysis, it employs deciles to show the ranking of every variable, from zero to less than 50% the variable range from very weak to weak, while, at five (50%-the median) the variable has a moderate standard or position, above 5-to-10 (50%-100%) the variable shows a strong position. The red color indicates the ranking of **ICT** indicators in Sudan. The green color indicates the ranking of **ICT** indicators in Yemen, while, the yellow color indicates the ranking of **ICT** indicators in Mauritania.

5.12 E-government in Sudan:

E-government encompasses the capacity and the willingness of the public sector to deploy ICT for improving knowledge and information in the service of the citizen. Capacity espouses financial, infrastructural, human capital, regulatory, administrative and systemic capability of the state. The willingness, on part of the government, to provide information and knowledge for the empowerment of the citizen is a testament to the government's commitment. *(United Nations e-government development index 2012)*

E-Government Development is a function of not only a country's state of readiness but also its technological and telecommunication infrastructure and the level of its human resource development, among other factors, and at a minimum should be based on the level of all three. E-government initiatives, however, sophisticated are unlikely to contribute significantly to development if they reach only the privileged few. *(United Nations e-government development index 2012)*

5.12.1 E-Government Spearheading K-Economy:

E-Government:

a. *Brings knowledge closer to people*
b. *Allows easier communication between peoples*
c. *Improve efficiency of knowledge transaction*
d. *Enhance efficiency of government services*
e. *Develop resources to improve society's learning capacity*

5.12.2 Benchmarking Sudan's E Government Development Index with Its Comparators from Arab Countries of the Lower Middle Economies*:*

In the following section 5.14 we benchmarks Sudan's e government development index with its comparators from Arab countries of the lower middle economies. This can be seen from Table 5.29

Table 5.29 Benchmarking Sudan's E Government Development Index with Its Comparators (Arab Countries of the Lower Middle Economies)

Country	*Index*	*Rank*		*Rank change*
		2012	*2010*	
Morocco	0.4209	120	126	+6
Syria	0.3705	128	133	+5
Algeria	0.3608	132	131	-1
Egypt	0.4611	107	86	-21
Sudan	0.2610	165	154	-11
Yemen	0.2472	167	164	-3
Mauritania	0.1996	181	157	-24

Source: United Nations e-government development index 2012

Table 5.29 Benchmarks Sudan's e government development index with its comparators from Arab countries of the lower middle economies and world E-Government development ranking in the years 2010 and 2012 Sudan index in the year of 2010 was 0.2610 and the world ranking 154. In the year of 2012 the index was 0.2542 and world ranking 165.

According to its comparators Sudan is in the fifth rank after Morocco, Syria, Algeria and Egypt. According to these figures it seem clear that Sudan has not move ahead while some countries in the same region has increased their Government value such as Algeria and Morocco.

The weaknesses in Sudan readiness which impeded the implementation of E-Government includes:

a. Cultural diverse and fragmentations among the citizens (language, religious, etc…)

b. Political instability

c. The embargo and sanction on Sudan since 1996 particularly the technological sanction led to the country isolation and has great impact on influencing the country ICT and its projects development which e Government is one of them.

d. Lack of ICT skills and well-trained staff which lead to the creation of the change resistance.

PART TWO: THE DESCRIPTIVE ANALYSIS:

5.13 The Descriptive Analysis:

5.13.1 General information:

Part one of the descriptive analysis was specified to collect general information about the business enterprises under study. About 137 (43%) of the total sample under study are branches of large corporations. 112 (35%) are newly established. About 54 (17%) are international ventures; about 38 (12%) has headquarters outside Sudan.

Table 5.30 describes the responses about the legal status of the sample under study.

Table 5.30: Legal Status of the Respondents

Legal status	***Frequency***	***Valid percentage***
Sole proprietorship	86	26.9%
partnership	131	40.9%
Corporation privately-held	103	32.2%
Total	**320**	**100%**

Source: the researcher

From the above table we can observe that partnership dominates the legal status of the sample under study 131(40.9 percent compared to the other legal forms of business. The corporations privately owned constitute the second largest legal form of business with 32.2 percent. A privately held company or close corporation is a business company owned either by non-governmental organizations or by a relatively small number of shareholders or company members which does not offer or trade its company stock

(shares) to the general public on the stock market exchanges, but rather the company's stock is offered, owned and traded or exchanged privately. More ambiguous terms for a privately held company are unquoted company and unlisted company (http://en.wikipedia.org/wiki/Privately_held_company).

This dominance of the partnership and corporations privately owned (73.1 percent) over the Sole proprietorship (26.9 percent) is very important for developing knowledge based economies, because those types of enterprises require large capital and investments to be established which make them a solid background for fostering innovations, research and developments.

The results of the basic economic activity of the sample under study are summarized in the following **Table** (**5.31**)

Table 5.31: Basic Types of Activities of the Respondents:

Activity	***Frequency***	***Valid Percents***
Finance	76	23.8
Consultancy	68	21.3
Tourism	43	13.4
Communications	18	5.6
Education	20	6.3
Health	27	8.4
Others	68	21.3
Total	**320**	**100%**

Source: The Researcher

We have asked the companies about the service activities they provide? The companies which provide financial services (Banks and others) are the largest in the sample with 23.8 percent, followed by ones which provide

consultancy services (law, engineering, feasibility studies…etc) with 21.3 percent. The third largest sector is tourism (restaurants and hotels are the main activities) with 13.4 percent. Education is the fourth portion with 6.3 percent (respondents are from private universities, colleges, and other educational institutions). Followed by health related activities with 8.4 percent (respondents are from private hospitals, clinics, and pharmacies, and pharmaceutical industry). Respondents from the Communications sector (telecommunication companies, ICT technologies and related service providers) constitutes with 5.6 per cent. Others constitute a considerable portion with 21.3 percent (mainly insurance companies, labour recruitment, Technical services, Marketing services, and Compute services)

We can observe the dominance of service activities in Finance, consultancy education, tourism, and health. This can show a positive trend towards generating knowledge based activities.

The next question was: describe the end users for the services provided by your company.

Table 5.32: End-Users of Services Provided by the Sample Companies:

Activity	***Frequency***	***Valid Percents***
Direct users	205	64.1
companies	115	35.9
Total	320	100

Source: The Researcher

Direct users are the largest portion of end users for the services provided by the companies under study with 64.1 percent, while 35.9 are business –end

users. The latter includes what is known as business outsourcing. Manufacturing firms sometimes buy (or outsource) R&D by spinning off their laboratories into a separate corporate entity or by choosing to purchase R&D services from another private firm. Governments sometimes choose to "buy" rather than "make" R&D.

Table 5.33: Markets for the Services Provided by the Sample Companies*:*

Activity	***Frequency***	***Valid Percents***
Local	189	59.1
International	131	40.9
Total	320	100

Source: The Researcher

Most of the respondents sell their services in the local market with a 59.1 percent; while 40.9 percent sell their services have global users (mainly universities, hospitals, training centres). The globalization of economic activity is an accomplished fact and will continue to dominate the course of economic development for the foreseeable future. The overall growth of the economy will be driven by the production of economically valuable new ideas; those persons, companies and places that are most proficient in generating and applying new ideas will prosper; those that do not will struggle economically.

5.14 The Factor Component Analysis:

We believe that the private sector is at the forefront of wealth creation and employment generation. So will it be in the new economy. As Sudan's main wealth creator and job generator, private business enterprises will form the bedrock of a knowledge driven economy. It is therefore the government's paramount role and responsibility to enable the right macro-economic conditions to make them prosper. This negates the current practice in the country where perception of the public is that the government has to do everything by itself, including the creation of jobs.

Factor Analysis is the method of analyzing the correlations among variables was started by forming the two main groups of variables:

1. The knowledge economy inputs or the four knowledge economy drivers "mentioned in the theoretical part of the thesis".
2. The knowledge economy outputs which can be seen through better productivity and knowledge acquisition.

The researcher is faced with the problem of which variables to choose and why. In order to determine the key factors which leads to the diffusion of knowledge economy in Sudan, the researcher has used the factor component analysis method. This method distills the Knowledge economy variables into a smaller set of "factors." This method also used to classify these factors according to their importance depending on their loading values.

We have mentioned in previous chapters that the questionnaire consists of four parts each treating the four economy pillars (knowledge economy inputs (independent variables) and knowledge economy outcomes/outputs (dependent variables). The analytical tools used were descriptive statistics

and inferential statistics. The analysis technique used in this research was the factor analysis. The method of analyzing the correlations among variables was started by forming the two main groups of variables: The knowledge economy inputs and the knowledge economy outputs

In order to decide on the factor analysis and to evaluate the adequacy of the factor for the factor analysis and the strength of the relation between the items we used Kaiser-Olkin Measure of sampling adequacy.

We found that the KMO is 0.592 (higher than 0.5) which means that the factor analysis is an appropriate method (since the higher the factor weight the more representative is the factor).

We have run a principal component factor for 76 items of knowledge economy inputs, we employed the criteria of factor selection when Eigenvalues are larger than 1. Only 15 variables have Eigenvalues that greater than 1.00

These factors represented an explained variance 174 of 77.5 per cent {see Appendix (II); which is considered a significant and acceptable percent.

In social sciences 50 per cent of total variance is considered satisfactory. (Tabachnick and Fidell, 2001).

The factor analysis solution extracted factors according to their importance:

First: Knowledge Input Factors:

- The first factor Governance and regulatory regime contained 6 items;
- The second factor Training Support (6 ***items***)
- The third factor Education (6 ***items***);
- The fourth factor Local R&D capabilities (6 ***items***);
- The fifth factor 6 items ICT status (5 ***items***)
- The sixth factor ICT infrastructure and services in Sudan (5 ***items***).

Second: Knowledge Output Factors:

1. Factor 1: Productivity (performance) **(7 *items*)**
2. Factor 2: knowledge acquisition (performance) **(3 *items*)**

More importantly, all extracted items were loaded significantly and heavily on these six factors that ranked in order of the strongest factor loadings. Since there is more than one item in each factor, we used the surrogate factors as common statistical practice in such kind of studies.

The following surrogate factors were used to describe the six factor solution:

5.15 Knowledge Economy Inputs:

5.15.1 Factor 1: Governance and Regulatory Regime: Hypothesis 1:

Table 5.38: The Reliability Test of the Composite Scales of the Extracted Six Items of **Factor 1: Governance and Regulatory Regime**

Knowledge input factor	**Extracted items**	***Mode***	***Median***	***Factor loading***	***No. of items***	***Cronbach's alpha***
Governance and regulatory regime	*Ministry of Finance and National Economy*	**2**	2	0.678	**6 items**	**0.776**
	Sudanese Chamber of Commerce	2	2	0.677		
	Ministry of Industry	4	3	0.653		
	The Central Bank of Sudan	2	2	0.615		
	Khartoum Municipality	2	2	0.575		
	The commercial law	3	3	0.531		

Source: The Researcher

**Scale in the questionnaire survey is: 1 = very good, 2 = good, 3 = neutral, 4 = bad, 5 = very bad.*

Our results in this factor represented a high relevance in explaining and enhancing knowledge outcome in Sudan which emphasizes our earlier ideas that the governmental system in Sudan is irrelevant to the knowledge economy needs. We have loaded significantly and extracted heavily six items of the governance items indicating their high importance and ranking to the factor of Education. The reliability test of the composite scales produced an acceptable value as the Cronbach alpha was 0.776 with mode and median of 2 (4 out of 6). But this result also contradicts the general results we have reached in the benchmarking analysis which showed weak status of governance and regulatory regimes in Sudan, and that governance and regulatory regimes constitutes a great obstacle in enhancing knowledge-based economy in Sudan.

5.15.2 Factor 2: Training Support- Hypothesis 2:

Table 5.36: The Reliability Test of the Composite Scales of the Extracted Six Items of **Factor 2 Training Support .**

Knowledge input factor	**Extracted items**	***Mode***	***Median***	***Factor loading***	***Number of items***	***Cronbach's alpha***
Training support	Training programs	3	3.00	0.829	**6 items**	0.899
	Training expertise	3	3.00	0.766		
	the government's coordination regarding my organization's training needs	3	3.00	0.743		

	Financial support	2	3.00	0.710		
	the government's coordination regarding my organization's technical education needs	3	3.00	0.680		
	the government's coordination regarding my organization's educational needs	3	2.00	0.679		

Source: The Researcher

**Scale in the questionnaire survey is: 1 = very good, 2 = good, 3 = neutral, 4 = bad, 5 = very bad.*

To analyze the significance of the training support we were extracted six items. The Cronbach's alpha for the six items is (0.899) which is a significant alpha. The frequent mode and the median are similar equal 3 for 5 items from 6 items. Based upon the above results Training is a weak factor in creating knowledge based economy in Sudan. This can be due to the separation of training from education. And the lack of awareness about the importance of training for Tomorrow needs, that people should get knowledge for future usage.

5.15.3 Factor 3: Education- Hypothesis 3

Table 5.37: The Reliability Test of the Composite Scales of the Extracted Six Items of **Factor 3 Education**

Knowledge input factor	**Extracted items**	***Mode***	***Median***	***Factor loading***	***Number of items***	***Cronbach's alpha***
General education	Private general education	3	2	0.678	**6 items**	**0.820**
	Public general education	3	3	0.677		
	Public tertiary education	4	3	0.653		
	Technical education	3	3	0.615		
	Vocational training	3	3	0.575		
	Private tertiary education	3	3	0.531		

Source: The Researcher

**Scale in the questionnaire survey is: 1 = very good, 2 = good, 3 = neutral, 4 = bad, 5 = very bad.*

Our results in this factor represented no relevance to the knowledge outcome in Sudan, which emphasizes our earlier ideas that the educational system in Sudan is irrelevant to the local market needs. We have loaded significantly and extracted heavily six items because of their high importance and ranking to the factor of Education. The reliability test of the composite scales produced an acceptable value as the Cronbach alpha was 0.820 with frequent mode and median of 3 (5 out of 6).

.5.15.4 Factor 4: Local Research and Development Capabilities- Hypothesis 4

Table 5.35: The Reliability Test of the Composite Scales of the Extracted Eight Items of **Factor 5: Local R&D Capabilities**

Knowledge input factor	**Extracted items**	***Mode***	***Median***	***Factor loading***	***Number of items***	***Cronbach's alpha***
Local R&D capabilities	Government laws and regulations in support of R&D in your organisation	5	4	0.829	**8 items**	0.902
	Availability of local researchers	5	2	0.766		
	Collaboration with the government in terms of your R&D needs	3	4	0.743		
	Government financial incentives for your organization's R&D	2	4	0.710		
	Collaboration with local academic community	5	4	0.680		
	Collaboration with international research centres	5	4	0.679		
	Universities research centre capabilities	5	3	0.640		
	Availability of expatriate researchers	2	2.00	0.634		

Source: The Researcher

**Scale in the questionnaire survey is: 1 = very good, 2 = good, 3 = neutral, 4 = bad, 5 = very bad.*

The eight items used to test the significance of local research and development for creating knowledge economy in business organizations as a large government stakeholder. Our results of loading showed an acceptable degree of reliability since the Cronbach alpha was 0.902. While the frequent mode was 5 (5 out of 8 items) while the frequent median is 4 (5 out of 8 items), this result contradicts the notions that local research and development environment contributes to innovation and the development of new products, new processes and new knowledge. Our results strength the benchmarking analysis we have carried in the previous part of analysis which showed that Sudan has a low research and development readiness in general.

5.15.5 Factor 5: ICT Status: Hypothesis 5:

Table 5.39: The Reliability Test of the Composite Scales of the Extracted Five Items of **ICT status**

Knowledge input factor	**Extracted items**	***Mode***	***Median***	***Factor loading***	***Number of items***	***Cronbach's alpha***
ICT status	Organizational ICT awareness	2	2	0.678	5items	0.859
	Expertise	3	3			
	Usage	3	2			
	Technical management	4	2			
	Training	3	3			

Source: The Researcher

**Scale in the questionnaire survey is: 1 = very good, 2 = good, 3 = neutral, 4 = bad, 5 = very bad.*

Our results in this factor depicted its neutrality as for explaining and enhancing knowledge outcome in Sudan this can be explained by the fact that ICT status is an internal matter where service companies have some control in engineering a competitive advantage adds to this there is no company in today's world affords to be left out of the information technology system where competitive edges and new knowledge could be facilitated and used.

We have loaded significantly and extracted and loaded significantly heavily five ICT-related items of the governance items indicating their high importance and ranking. The reliability test of the composite scales produced an acceptable value as the Cronbach alpha was 0.859 with a frequent mode of 3 (3 out of 5) while the frequent median was 2 (3 out of 5). Which indicates its good and neutral relevance to the knowledge outcome as mentioned earlier in this section.

Table 5.34: Factor 6: The Reliability Test of the Composite Scales of the Extracted Twelve Items of **ICT Infrastructure and Services in Sudan**-hypothesis 6:

Knowledge input factor	**Extracted items**	***Mode***	***Median***	***Factor loading***	***Number of items***	***Cronbach's alpha***
ICT infrastructure and services in Sudan	Local system solutions	4	3.00	0.829	**12 items**	0.905
	Technical expertise	3	3.00	0.766		
	Service being provided	3	3.00	0.743		
	ICT infrastructure	2	3.00	0.710		
	Internet service	4	3.00	0.680		
	ICT public awareness	4	3.00	0.679		

	Mobile telephone service	2	3.00	0.640		
	Telephone service	2	2.00	0.634		
	ICT legislation	4	3.00	0.593		
	Evaluation of the overall ICT telecommunication services in Sudan	2	2.00	0.554		
	Competition between local ICT companies	4	3.00	0.527		
	Fees	4	4.00	0.520		

Source: The Researcher

** Scale in the questionnaire survey is: 1 = very good, 2 = good, 3 = neutral, 4 = bad, 5 = very bad.*

Twelve items constitutes ICT components and services were used and loaded significantly representing its importance and priority ranking. The reliability test of the composite scales of all twelve items reveals a significant Cronbach's alpha of 0.905. The mode of most of these items (6 out of 12) was 4 and the median was 3, this result indicates dissatisfaction with the ICT infrastructure and services in Sudan. What we have observed during the conduct of the questionnaire that ICT is very important for most of the business organizations under study especially universities and banks and this reflected in the knowledge outcome in the form of better productivity and knowledge acquisition. These pessimistic results about the role of ICT in knowledge economy in Sudan can be due to the lack of real competition between local ICT providers, poor public awareness of full benefits of ICTs, high costs and poor services provided by local ICT companies.

5.16 Knowledge Outcome Factors*:*

Scale in the questionnaire survey is:

1 - very good 2 - good 3 - neutral 4 - bad 5 - very bad

Hypothesis 7 will be tested by testing the following knowledge outpus according to importance and priority:

1. **Factor 1:** Productivity (Performance)
2. **Factor 2:** Knowledge Acquisition

5.16 .1 Knowledge Outcome Factors: Factor 1: Productivity (Performance)

Table 5.40 The Reliability Test of the Composite Scales of the Extracted seven Items of Knowledge Economy Output: **Factor 1: Productivity (performance)**

Knowledge output factor	**Extracted items**	***Mode***	***Median***	***Factor loading***	***Number of items***	***Cronbach's alpha***
Productivity	Improvement of productivity	**2**	2	0.868	**7items**	0.892
	Improvement of an existing product, process or service	**2**	3	0.857		
	Improvement of profitability	**3**	2	0.920		
	Increase in sales or revenues	**4**	3	0.811		
	Improved understanding of new market needs and trends	**2**	2	0.769		
	Development of a new product, process, or service	**2**	2	0.781		
	Generation of new jobs and employment	**3**	3	0.773		

Source: The Researcher

**Scale in the questionnaire survey is: 1 = very good, 2 = good, 3 = neutral, 4 = bad, 5 = very bad.*

We have loaded heavily and significantly the 7 items of knowledge outcome: factor 1: *productivity*. The reliability test of the composite scales of all of seven items revealed a significant Cronbach's alpha of 0.892. The mode of most of these items was 2 (4 out of 7) and median was 2 as (4 out of 7 items) indicating a good relationship between the knowledge input factors and productivity level.

5.16.2 Factor 2: Knowledge acquisition

Table 5.41 The Reliability Test of the Composite Scales of the Extracted three Items of Knowledge Economy Output: **Factor 2: Knowledge Acquisition**

Knowledge output factor	**Extracted items**	***Mode***	***Median***	***Factor loading***	***Number of items***	***Cronbach's alpha***
Knowledge acquisition	Attention to better quality	2	2	0.868	**3 items**	0.823
	Improvement of management and employee skills and know how	2	2			
	Acquisition of external knowledge through online information sources, fairs, exhibition, market scanning, consultants, and other external sources	2	2			

Source: The Researcher

**Scale in the questionnaire survey is: 1 = very good, 2 = good, 3 = neutral, 4 = bad, 5 = very bad.*

As far as the knowledge acquisition as the second knowledge outcome factor, 3 items extracted to form this factor that has loaded significantly indicating its importance and priority ranking. The reliability test showed a significant Cronbach alpha of 0.823 indicating its appropriateness for this factor analysis. Further, the frequent mode of these three items was 2 (3 out of 3 items) and similar result of the median indicating its relevance to the knowledge input factors. These results reflect a good relationship between knowledge acquisition and knowledge input factors. This can be due to many factors as: the availability of internet connections in most of the companies under study, besides most of those companies are internal ICT utilizers. In addition to the existence of knowledgeable workers where the majority of them are university graduates who have the ability to acquire knowledge.

5.17 The Correlation Analysis: Pearson Correlation:

Knowledge Input Factors and Knowledge Output Factors:

1. local R&D capabilities and ***productivity*** with a correlation coefficient of 0. 0.231 significant at 0.01 level (2-tailed);
2. Training support and knowledge acquisition with a correlation coefficient of 0.295 significant at .02 level (2-tailed).
3. ICT status and knowledge acquisition with a correlation coefficient of 0.167 significant at 0.05 level (2-tailed); and
4. Local R&D capabilities and ***knowledge acquisition*** with a correlation coefficient of 0.110 which has no significance.

*The rest of the eight correlations indicated very insignificant correlations with coefficient values below the 0.10.

These results confirm the benchmarking result which showed low readiness of Sudan to be a knowledge-based economy:

economic performance: As for economic performance; Sudan ranks the first among its comparators of Arab countries from the lower middle income groups with 7.8 Annual GDP Growth (%), but he ranks the fifth among its comparators of Arab countries from the lower middle income group (Mauritania is the last) as for GDP per Capita (1.99). Sudan ranks the last among its comparators of Arab countries from the lower middle income group as for Human Development Index (0.56).

As far as ***governance*** Sudan ranks the last, among its comparators of Arab countries from the lower middle income groups as for regulatory quality; rule of law and government effectiveness.

The determinant of Sudan's future economic well-being will be its success in stimulating business to do more R&D, promoting innovation and a culture of entrepreneurship amongst researchers and fostering effective linkages between enterprise and academia.

The same can be reported about the benchmarking process of Sudan's Knowledge Economy scorecard on ***education*** with its comparators of Arab countries (Lower Middle Income Economies) has revealed the weakness status of Sudan in this variable.

The benchmarking process of Sudan's Knowledge Economy scorecard on ***research and development*** with its comparators of Arab countries (Lower Middle Income Economies) has revealed the weakness status of Sudan in this variable. This can be due to the fact that Sudan lacks the potential to achieve a step change in the performance of R&D over the period to 2012 and beyond. It has a weak enterprise base which lacks the potential to increase its R&D capability and absorptive capacity. It also has lacks a growing public research base. The benchmarking process of Sudan's Knowledge Economy scorecard on ICT with its comparators of Arab

countries (Lower Middle Income Economies) has revealed a relatively better status of Sudan in this variable.

As compared to lower middle income countries; Sudan ranks For KEI the 40^{th} in the region (the total number of countries is 42); while for KE Sudan ranks the 37^{th} in the region. For the pillars of economic incentives and regime; innovation; education; and ICT Sudan ranks the (42^{th}), 40^{th}; 39^{th} and the 24^{th} respectively; as compared to lower middle income countries.

This supports our hypotheses (H1, H2, H3, H4,) Sudan has a very weak rank compared to its group of lower middle income countries in KEI, KI, pillars (Research and development; economic incentives and regime; innovation and education), ICT relative to other pillars is a strong factor in creating the knowledge based economy in Sudan (H5and H6)

As for Sudan Knowledge Economy Readiness: we can conclude that Sudan has a weak knowledge economy readiness compared to all lower middle economies. This supports our hypothesis (H7)

Challenge facing Sudan to be a knowledge-based economy: based on the above results we can conclude that the most important challenge facing Sudan to be a knowledge-based economy is that its current knowledge economy model cannot be sustained or transformed into knowledge-based economy. This can be due to many obstacles we have observed during the conduct of this thesis: first of all; Sudanese government lacks the encouraging initiatives which lead to the needed diversification in economics. Lack of appropriate commercial laws which attract and protect the foreign direct investments; besides the lack of legal protection of intellectual property rights. The low and incompatible standards of education and training, lacks of long-run plans to stimulate the education and training outcomes. There is no coordination between the vocational training system

and the skills required by a competitive private sector. The very important challenge facing knowledge-based economy is that higher education in Sudan is less of an elite enterprise. Most students in territory education can complete a four-year degree, but they are unable to get higher degrees. Achieving this goal will require both more effective education of disadvantaged groups and social policies to enable them to pay the costs of higher learning. Globalization is another challenge for Sudanese companies; this is a driver that pushes companies to locate – R&D facilities in particular – elsewhere than in the home country.