IASP International Association of Science Parks and Areas of Innovation

35th IASP World Conference
on Science Parks and Areas of Innovation 2018
Isfahan, Iran

The Symbiosis in OIC Member States to Achieve Knowledge-Based Economy: The role of Network of Networks

Parallel session 2:

Global alliances for internationalization

Authors:

R. Ramazani Khorshid Doust
M. Motaghitalab
M. Saberi Motlagh

Hosted by:

ISFAHAN SCIENCE & TECHNOLOGY TOWN (ISTT)

ISBN: 978-84-09-17612-0

The Symbiosis in OIC Member States to Achieve Knowledge-Based Economy: The role of Network of Networks

R. Ramazani Khorshid Doust, M. Motaghitalab*[1], M. Saberi Motlagh

Executive Summary
This study has focused on Technomart as an important current issue in the science and technology ecosystem. Promoting Technomart among the OIC Member States is a proper step towards more integration and competitive strength. Based on World Bank, Knowledge Economy Index is an aggregated criterion for evaluating countries. KEI is based on summing up the normalized scores of four attributes of the countries. As an alternative, nine attributes have been introduced to measure the position of the OIC Member States to promote Technomart i.e., Multi-Attribute Utility Theory (MAUT) has been applied instead of simple summing up. This study has ranked the OIC countries as pioneer and intermediate in a certain area relating to Technomart. Finally, the obtained results showed that none of the OIC countries is pioneer in all competencies. That is, even the pioneer countries in some areas need the help of others to promote their abilities in Technomart.

1- INTRODUCTION

The Organization of Islamic Cooperation (OIC) was founded in 1969 among the Islamic Countries. It aimed to enhance comprehensive cooperation and unity among the Islamic governments. OIC is an inter-governmental group of fifty-seven countries. The more feasible initiation was to improve economic cooperation. Thus, a set of measures were undertaken for this cause. In 1976, the establishment of the Islamic Chamber of Commerce and Industry (ICCI), as an organ of OIC, was projected and finally shaped in 1978. The ICCI assists the private sector of the member countries in a broad area such as trade and its requirements such as information, insurance, investment and so on. This effort resulted in the Trade Preferential System (TPS) agreement among the member states in the late 1990s to be actualizes in 2009. This was a great step with tremendous potential towards economic integration of Islamic Countries. OIC has 57 Member Countries with a population of over 1.6 billion, possessing near 20 percent of the territories of the world enriched with natural and human resources. Islamic Countries have remarkable socioeconomic potentials. They have near 70 percent of the global oil, 40 percent of the world export, and a total Gross Domestic Product at Purchasing Power Parity of US$ 18,600 billion. The population of OIC Member Countries (1.6 billion) is more than China (1.36 billion). The GDP of OIC Member Countries (US$ 18,600 billion, PPP) is equal to USA (US$ 18,560 billion). Also the Muslims have a strategic geographical position in the world with more than 50 percent of the discovered world oil reserves, in addition to a great amount of mines and natural and agricultural resources. However, the share of OIC members of the world economy, especially in Hi-Technology is negligible.

With all the previous measures and existing potentials, the Islamic nations are far behind the developed world. During 2000-2014, the unemployment rate in OIC countries was 7.8 - 9.1 percent; in fact 73.7 million young people were unemployed in 2014[2]. This was significantly more than the average unemployment rates of the world and non-OIC developing countries. The socioeconomic indices and rankings of OIC, as the proxy representative of the Islamic world, depicts the urgent need for improvement in both OIC and its member state economy and social conditions which requires great decisive moves and efforts. The great merit of OIC Member Countries is their economic diversity. Countries with similar economic situation fail to properly function in an economic union. On the contrary, countries with different economic conditions may function as complementary partners in a union. On the other hand, OIC Member Countries are on a broad economic spectrum, from less developed to newly industrial semi-developed. In such context, some countries may play the role of pioneer and pivot in some aspect or field and is capable to assist others. This assistance is not

* Corresponding Author
[1] m_mottaghi@gstp.ir
[2] OIC Economic Outlook (2015), pp. 12.

unilateral, the pioneer country in one field may receive help from other Member Countries in a different field or aspect. These enable the Muslims to alleviate the existing complex unbalanced and less development problems. The key point is that economic integration is a process. It may start as preferential trade agreement that results in economic unification. This process is complex and requires a set of efforts and coordination such as rules and regulation change, fixed exchange rates and a joint regulatory for harmonization.

Trade of Hi-Technology among the OIC members is a crucial topic for their technologic development. The concepts of "Technology" and "Market" encompass a very broad range of meanings and examples. Also, OIC members are in a widespread socio-economical spectrum. The interface of these broad and diversified fields results in a very complex subject. Therefore, a thorough approach to include this widespread diversity is needed. This approach should preferably be based on systemic modeling. Typologically speaking, "Technomart" is a "Special Common Market". It concentrates on common market for Hi-Tech commodities and services. Establishing an "OIC Technomart" requires reviewing the previous efforts and existing drives and barriers on the pace of decisions and actions to establish a common market among its members. The Member Countries -as the main components of OIC, might be grouped due to various sets of their attributes. Some of the OIC members have more potential in some areas and less in others. Theoretically, these differences are not opportunities to provide a proper context for close cooperation among the members. On the other hand, the OIC members can shape some complementary sets that are able to compensate the shortcomings of each other for achieving certain goals and purposes.

To promote the interactions among Islamic Countries, a comprehensive model is in urgent need. The model should indicate the positions of members in the process of Technomart Promotion. The TP is a multi-inter-disciplinary and multi-facet. In addition, in each OIC member country, TP is inter-departmental in nature. Therefore, general indices such as Knowledge Economy Index (KEI) and Knowledge Index (KI) are very general and cannot tackle the complexity and ad hoc nature of the TP. It is worthwhile to note that the factors which make KEI along with some other factors will help for the cause of TP.

This study is focused on a novel approach based on "system approach" to find a model system for Technomart in OIC Member Countries.

2- METHODOLGY

The meta-factors are the cornerstone of the TP, such as the socio-economic situation, human resources, research and development and so on. Therefore, the competencies of the TP as attributes of each OIC Member Country are needed. For this purpose, grouping and multi-attribute modeling based on data gathering, and innovative design model were applied and OIC Member Countries are grouped based on 9 meta-factors. Then the ability of the countries is depicted according to each meta-factor. As a result, the countries are grouped as "pioneers", "intermediate" and "followers", depending on their status in 9 areas. Finally, to enhance a feasible "Technomart Promotion" (TP) in OIC, the multi-level processes of TP have been designed in three levels.

3- Result and Discussion

3-1- Education and Human Resource

In table 1, the OIC Member Countries education indices are shown. Saudi Arabia, Iran and Turkey with both significant population and economy are among the top 20 countries and also Kazakhstan is the pioneer.

Table 1- Education Index in OIC Member Countries[3]

Rank	Country	Education Index	Rank	Country	Education Index
1	Kazakhstan	6.91	22	Indonesia	3.20
2	Bahrain	6.78	23	Syrian	2.40
3	Azerbaijan	5.95	24	Morocco	2.07
4	UAE	5.80	25	Bangladesh	1.75
5	Saudi Arabia	5.65	26	Guinea	1.75
6	Uzbekistan	5.65	27	Nigeria	1.62
7	Jordan	5.55	28	Yemen	1.62
8	Lebanon	5.51	29	Pakistan	1.44
9	Guyana	5.43	30	Cameroon	1.39
10	Kyrgyz Rep	5.32	31	Senegal	1.32
11	Algeria	5.27	32	Benin	1.10
12	Oman	5.23	33	Uganda	1.09
13	Malaysia	5.22	34	Mali	1.05
14	Albania	4.81	35	Cote d'Ivoire	0.91
15	Tajikistan	4.66	36	Sudan	0.84
16	Iran	4.61	37	Djibouti	0.73
17	Tunisia	4.55	38	Mauritania	0.71
18	Turkey	4.11	39	Sierra Leone	0.57
19	Kuwait	3.70	40	Burkina Faso	0.28
20	Qatar	3.41	41	Mozambique	0.17
21	Egypt	3.37			

3-2- Quality of Management Education

The quality of management education (QME) also plays a crucial role for development in general and for TP in specific. According to the reported results, Qatar, Lebanon and Tunisia are the pioneer countries, Iran and Indonesia with both significant population and economy are the 6th and 8th respectively[4].

3-3- Research and Development (R&D)

The researchers per million people in OIC and the world are shown in figure 1. The gap between OIC and the world average is remarkable. The shortcoming is huge when compared to the developed countries such as Korean Republic or Finland. This cavity indicates the urgent need to improve the scientific human resource in the Islamic countries.

3 World Bank (2016), https://data.worldbank.org/topic/education.

4 Yokhaneh M. and Baghoumian R, (2014). Study on the Impact of the Quality of Management Education on the New Economy-Knowledge: Evidence from Members of OIC Countries. *Management Science Letters*, 4 (8), 1655–1660.

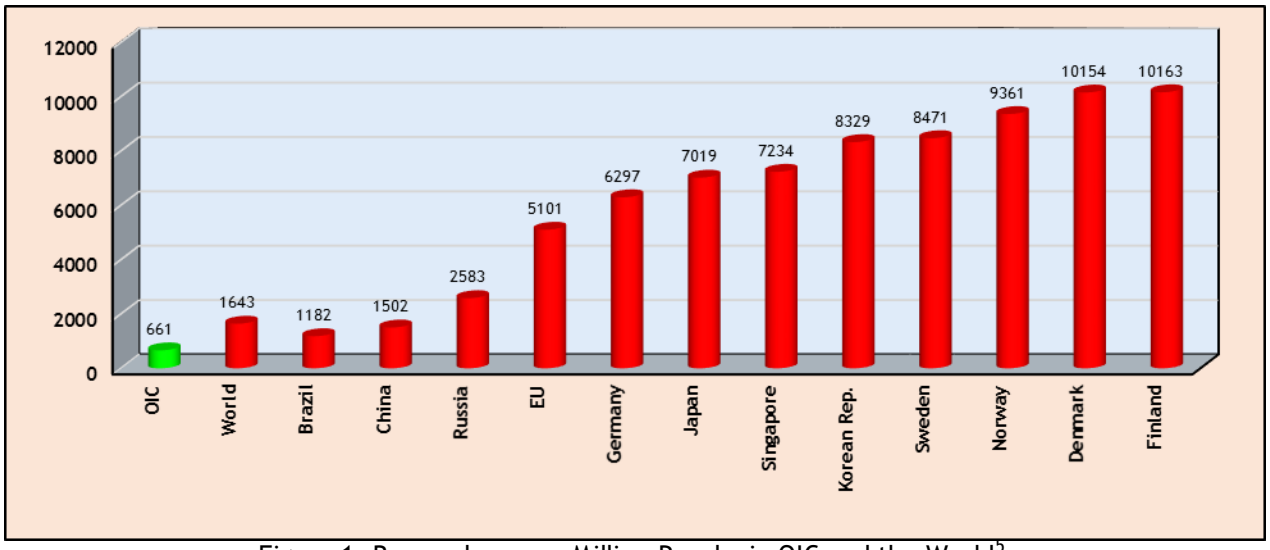

Figure 1- Researchers per Million People in OIC and the World[5]

Expenditure on R&D is a main index for knowledge economy. R&D intensity of a firm is the R&D expenditures divided by the total sales of the firm. For countries "gross domestic expenditure on R&D" (GERD) is used. GERD of top 20 OIC Member Countries and some developed countries, and the R&D expenditures per Capita of top 20 OIC Member are shown in Figures 2 and 3 respectively. In developed countries, between 2.05 to 4.29 percent of their GDP is spent on R&D. In OIC countries, Malaysia spent 1.26 percent for R&D in 2014. Since the GDP in the OIC countries is much less than the developed countries, this shortcoming is disastrous. As a result, OIC with 23 percent of the world population spends 2.9 percent of the world R&D expenditures.

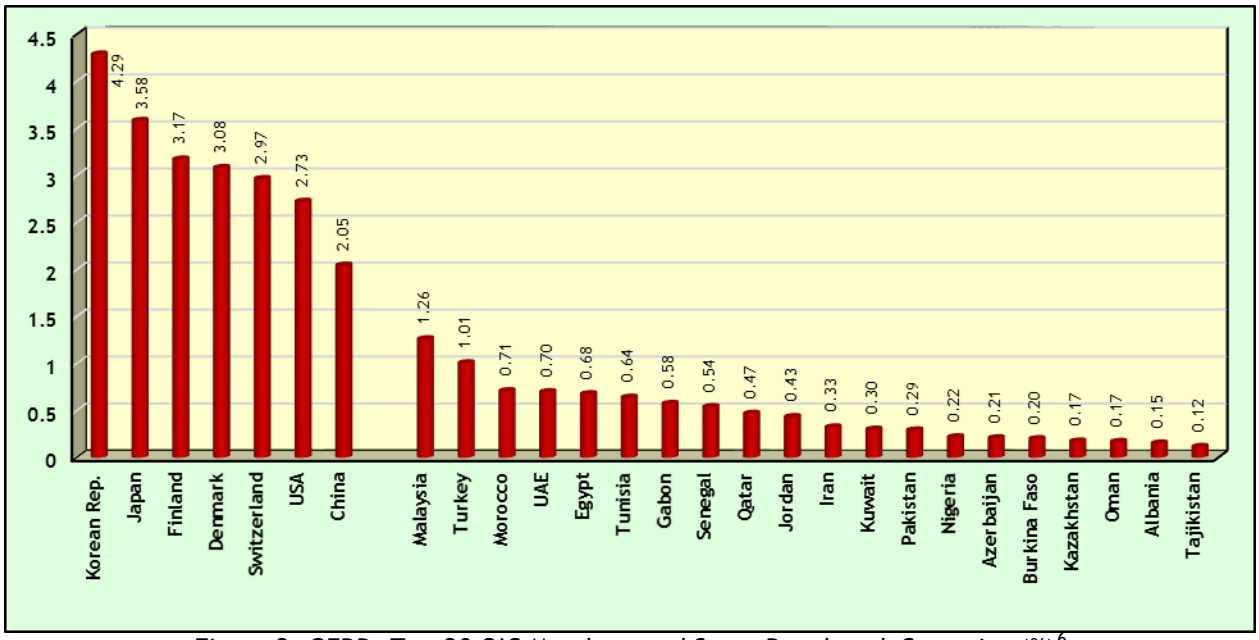

Figure 2- GERD, Top 20 OIC Members and Some Developed Countries (%)[6]

The other index which indicates R&D situation is R&D expenditures per capita, shown in Figure 5. Only four countries, i.e., United Arab Emirates, Malaysia, Kuwait and Turkey had the highest rank.

[5] UNESCO, UIS Data Centre, (2016), http://data.uis.unesco.org/.
[6] UNESCO, UIS Data Centre, (2016), http://data.uis.unesco.org/.

Tunisia, Egypt and Oman also spent more than the average of OIC ($66.7). Iran with $54.3 is near to the OIC average. Unfortunately, more than 47 countries have very weak conditions and result in a huge gap in innovation and competition in the world.

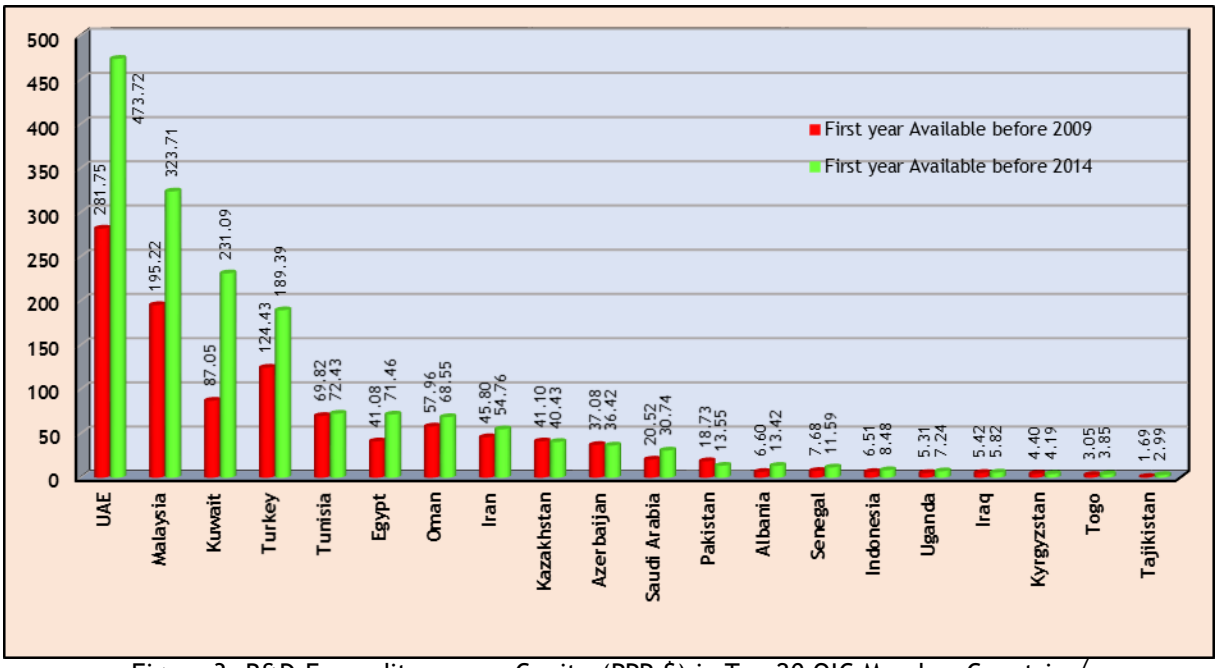

Figure 3- R&D Expenditures per Capita (PPP $) in Top 20 OIC Member Countries[7]

The Government provides a big portion of the costs of R&D in OIC Member Countries. As shown in Figure 4, in 15 countries more than 50 percent of GERD is spent by government. This indicates the weak status of non-governmental sectors in those countries. Malaysian government spent less than 15 percent compared to more than 90 percent in Iraq, Togo, Egypt and Kyrgyzstan, which indicate the unhealthy R&D structure.

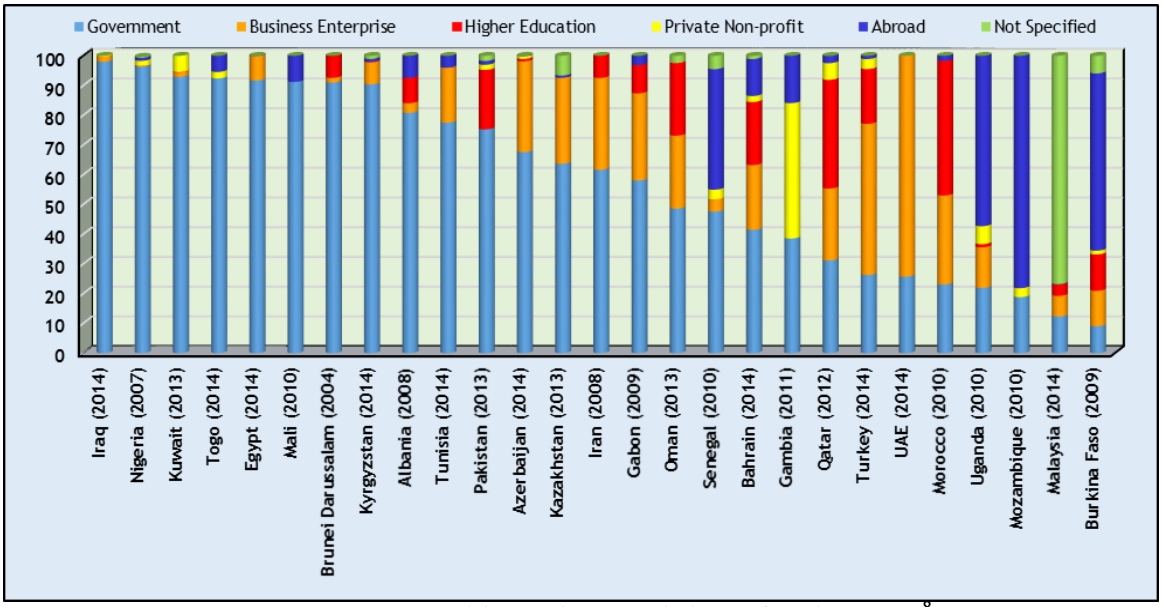

Figure 4- Percent of Spent GERD in OIC Member Countries[8]

[7] UNESCO, UIS Data Centre, (2016), http://data.uis.unesco.org/.
[8] UNESCO, UIS Data Centre, (2016), http://data.uis.unesco.org/.

3-4- Published Articles

OIC Member Countries have published more than 140,497 scholarly papers in journals in 2015. Figure 5 presents the number of articles published by the first 20 countries in OIC. More than 43 percent of these papers were published by Iran (22%) and Turkey (21.5%). Meanwhile Qatar had a relative high rank based per capita publishing and other countries need to be improved.

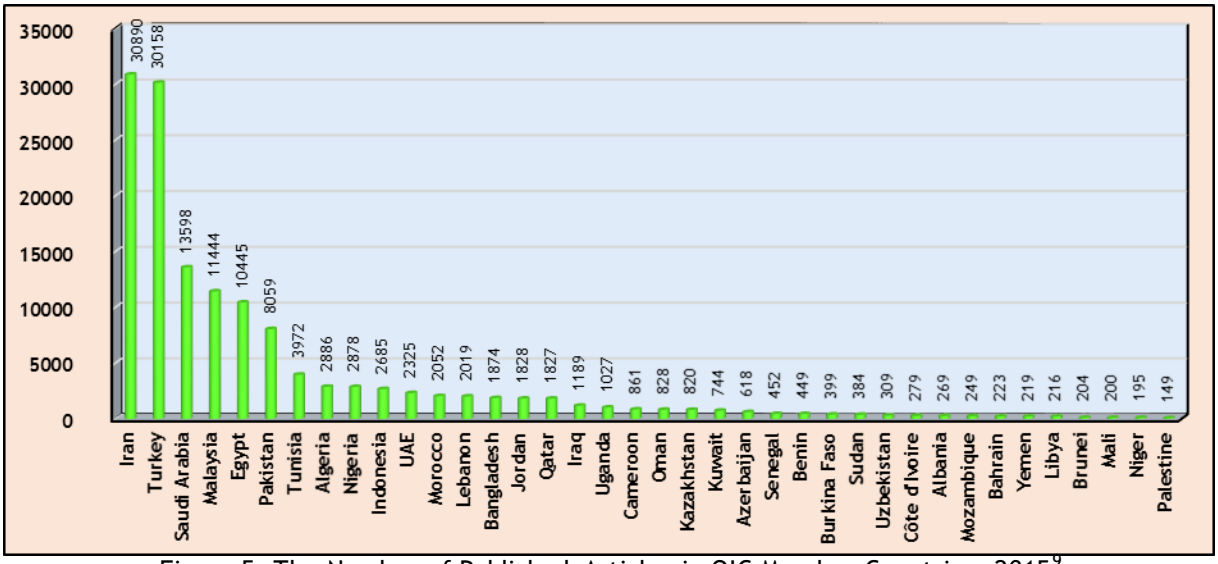

Figure 5- The Number of Published Articles in OIC Member Countries, 2015[9]

OIC with 1.7 billion populations has a scientific production near Germany (104185) with 80 million at the same year. That is, based on per capita estimation of scientific production, OIC is more than 15 times less productive to Germany. Iran and Turkey as the pioneers in publishing articles are 3.3 and 3.4 times less productive than Germany, respectively.

3-5- Innovation

Scientific research is a preliminary step towards R&D and provides a proper ground to promote innovation. The increase of the requested and registered patents is a good sign for the promotion of innovation. Finally, innovation is the competitive advantage of nations and corporations and a drive for more Hi-Tech products.

In Figure 6 the ranking of the innovation indices of the first 20 OIC Member Countries are presented. Malaysia, as the first innovative member of the OIC, is the 35th in the world ranking. This is an alarm for the OIC to promote innovation and Hi-Tech in the Member Countries.

The gap between rankings of countries with the most published papers and innovation index rankings (Figure 6) has a significant lesson for OIC. It indicates that countries like Turkey, Iran and Egypt have barriers to convert research to innovation. The difference between the innovation indices of OIC and of the world shows the urgent need for change. If such innovation conditions are continued, OIC will fall far behind the global economic competition.

[9] ISI Web of Knowledge, (2016), http://webofknowledge.com/.

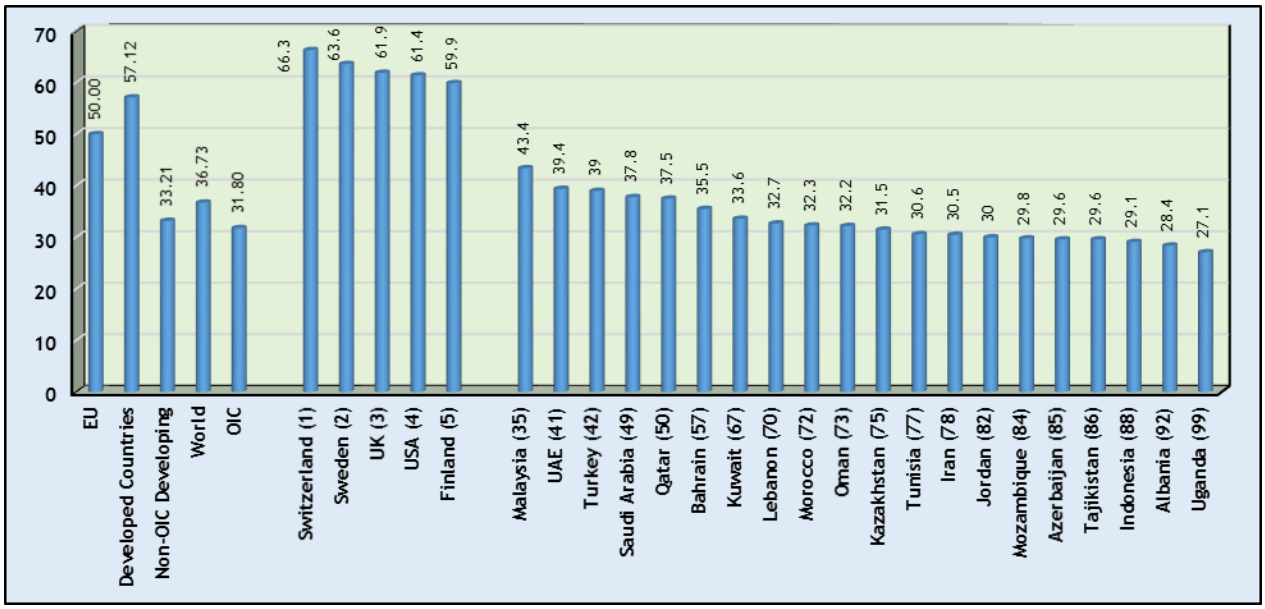

Figure 6- Global and Top 20 OIC Member Countries Innovation Index and Country Rankings[10]

3-6- Patent application

As shown in Table 2, the first five OIC Member Countries with the highest patent activity were Iran, Indonesia, Malaysia, Turkey and Saudi Arabia in 2014. Iran and Turkey are two countries that have more than 90% of patents filed by the residents. Indonesia, Malaysia and Saudi Arabia of the next highest patent activity are dependent to non-resident R&D.

A glimpse of the total patent application in the world is given in Figure 10. Based on World Intellectual Property Organization (WIPO), the total number of patent applications around the world in 2014 is more than 2.68 million. China, USA, Japan and Korean Rep., have registered for more than 70 percent of the total patent applications in the world. Less than one percent of them were filed in OIC Member Countries. Based on the OIC population, the expected share of OIC should be more than 23 percent. This gap is an adverse sign of incapability to compete in developing Hi-Tech in the world market

[10] Global Innovation Index, (2016), https://www.globalinnovationindex.org/

Table 2- Patent Applications by OIC Member Countries: Residents and Non-residents, 2014[11]

Country	Resident	Non-Resident	Total
Iran	13683	119	13802
Indonesia	1058	8095	9153
Malaysia	1272	6455	7727
Turkey	5352	489	5841
Saudi Arabia	715	1691	2406
UAE	15	1738	1753
Kazakhstan	1271	232	1503
Morocco	224	797	1021
Pakistan	209	677	886
Algeria	89	716	805
Tunisia	180	409	589
Uzbekistan	288	219	507
Iraq	335	102	437
Bangladesh	41	299	340
Jordan	41	294	335
Lebanon	110	194	304
Sudan	267	1	268
Syria	198	0	198
Bahrain	8	185	193
Azerbaijan	184	0	184
Kyrgyzstan	122	4	126
Mozambique	24	78	102
Yemen	5	25	30
Albania	14	5	19
Uganda	9	0	9
Tajikistan	0	1	1

3-7- ICT

ICT (information and communication technology) has been the key "emergent property" of the world in last three decades. The gap among the nations roughly can be evaluated based on the gap of ICT indices. The ICT index is the average normalized penetrations (users per 1,000 people) of "telephone", 'computer', and 'internet' in a nation. As shown in Figures 7, OIC is far behind EU and also the developed individual countries such as Iceland and the Switzerland. Also OIC needs a significant change to reach the world ICT penetration index. As shown, the pioneer Member Countries in OIC -except Malaysia- are oil producing. These countries mainly are users of ICT products.

[11] World Intellectual Property Organization, Statistics on Patents, (2016), http://www.wipo.int/ipstats/en/

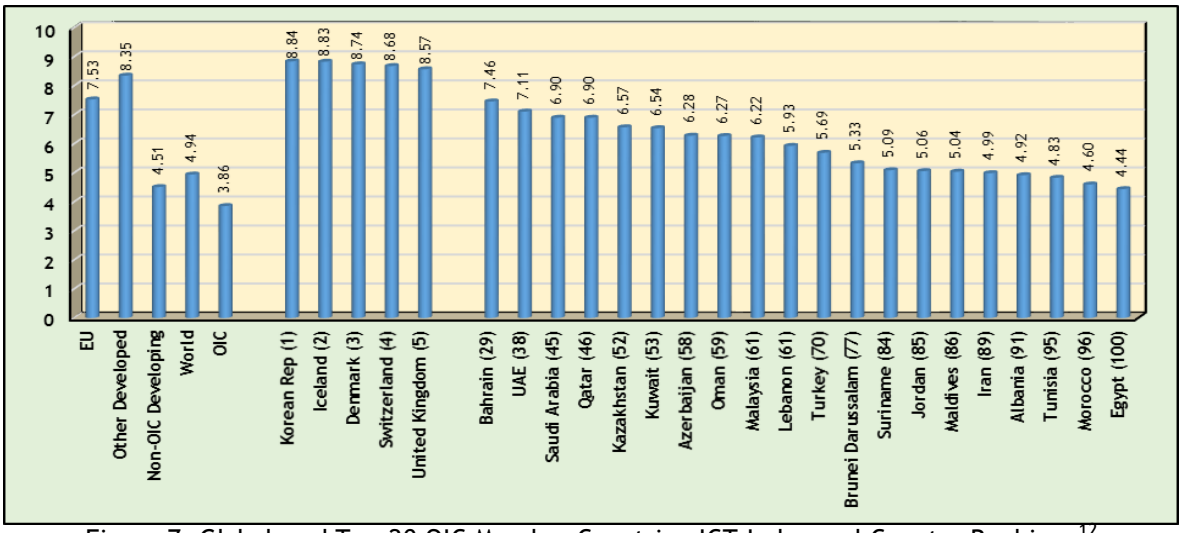

Figure 7- Global and Top 20 OIC Member Countries ICT Index and Country Rankings[12]

3-8- Economic Incentive Regime

The Economic Incentive Regime is the next meta-factor that affects the socio-economy of a nation, region or union. This meta-factor is the resultant of a combination of factors such as facilities and constraints according to the legal system of a nation. As shown in Figure 8, Oman, Qatar, Bahrain, UAE, Kuwait, Malaysia, Jordan, and Turkey and Saudi Arabia, as two relatively more populated countries, are the countries above the world average index in 2012. The CIS countries and Iran are at the lowest Economic Incentive Regime Index among the OIC Member Countries. The legacy and limitation of the centralized state-based economy is the main reason for this shortcoming. The rules and regulations, oversize and bureaucracy of governments hinder economic development.

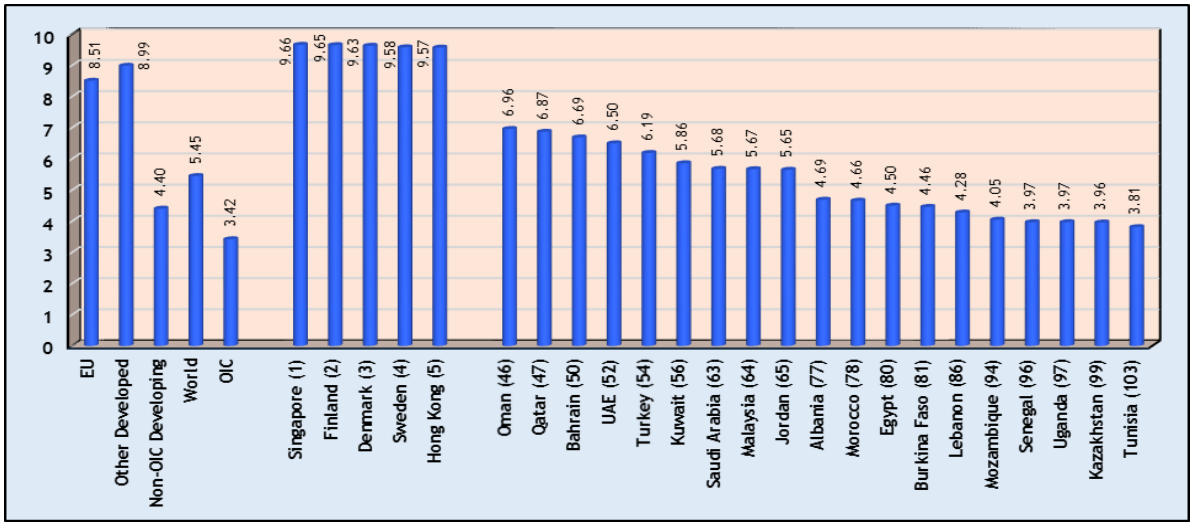

Figure 8- Global and Top 20 OIC Member Countries Economic Incentive Regime Index and Country Rankings, Data for the most Recent Year Available (2012)[13]

3-9- High-Technology Exports (HTE)

[12] International Telecommunication Union, (2016), https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

[13] Knoema, (2016), https://knoema.com/WBKEI2013/knowledge-economy-index-world-bank-2012

Technomart is mainly based on the market of Hi-Technology. This includes producing, supply, demand and all transfer initiations of Hi-Technology in OIC Member Countries. Hi-Technology comprises of technology and products of pharmaceuticals, especially newly developed drugs, electronics, semiconductors, robotics, nanotechnology, new materials and composites, aerospace, complex arms, information and communication, especially computer hardware and software. Meanwhile, many OIC Member Countries need conventional and monopolistic technology such as power plant, large dams design and construction.

In Figure 9 the World HTE indices are depicted. In 2014, OIC with about 23 percent of the world population has only 3.3 percent of the global share. Malaysia, Indonesia and Kazakhstan have been the first 3 OIC Member Countries with more than 95 percent of the HTE in OIC. Malaysia, with annual volume of $57 billion in 2015, is the largest exporter of high technology products among the OIC Member Countries. Indonesia, Kazakhstan and Turkey, each with HTE figures above $2 billion, exhibit good prospects for further increase in their HTEs.

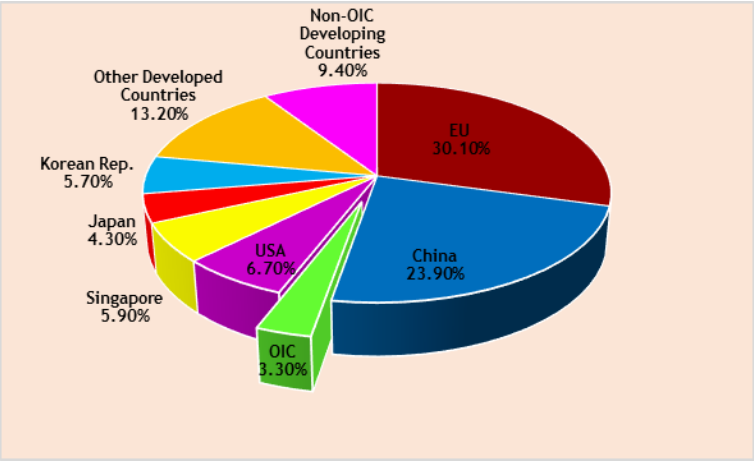

Figure 9- HTE, % of World Total[14]

4- Model Development

4-1- TP-Based Grouping of OIC Member Countries

The 9 meta-factors which affect TP were discussed previously. As a result, the OIC Member Countries are ranked according to their ability based on a set of certain meta-factors, i.e., some OIC countries can assist the others to promote certain meta-factors, as a proxy of TP. Based on the abilities of the countries, they could be considered in three groups as follows:

- Pioneers. This group of countries possesses a remarkable record in a certain TP-oriented functionality. Pioneers can assist all OIC members.
- Intermediate. This group of countries is in a good position in a certain area and is able to partially help other countries with lower ranking.
- Followers. This group of countries is in lower rankings and needs to be improved by the "pioneers" and/or "intermediate" members.

These groups and the countries in each group are shown in Table 3. The pioneer countries are in 3 subgroup as large, medium and small countries. This was mainly because of considering the synergic merits of large and medium countries in helping others.

[14] World Bank, WDI Online, (2016), https://data.worldbank.org/indicator/TX.VAL.TECH.CD

Table 3- Ranking of Pioneer and Intermediate OIC Member Countries Based on 9 Attributes

Level \ Factor	Education	QME	No. of published articles	GERD	innovation	Patent application	ICT	Economic Incentive and institutional Regime	HTE
Pioneer	1-Kazakhstan	1-Qatar	1-Iran	1-Malaysia	1-Malaysia	1-Iran	1-Bahrain	1-Oman	1-Malaysia
	2-Bahrain	2-Lebanon	2-Turkey	2-Turkey	2-UAE	2-Indonesia	2-UAE	2-Qatar	2-Indonesia
	3-Azerbaijan	3-Tunisia	3-Saudi Arabia	3-Morocco	3-Turkey	3-Malaysia	3-Saudi Arabia	3-Bahrain	3-Kazakhstan
	4-UAE	4-UAE	4-Malaysia	4-UAE	4-Saudi Arabia	4-Turkey	4-Qatar	4-UAE	
	5-Saudi Arabia	5-Malaysia	5-Egypt	5-Egypt			5-Kazakhstan	5-Turkey	
	6-Uzbekistan	6-Iran	6-Pakistan						
Intermediate	1-Jordan	1-Bahrain	1-Tunisia	1-Tunisia	1-Qatar	1-Saudi Arabia	1-Kuwait	1-Kuwait	1.Turkey
	2-Lebanon	2-Indonesia	2-Algeria	2-Gabon	2-Bahrain	2-UAE	2-Azerbaijan	2-Saudi Arabia	2.UAE
	3-Guyana	3-Turkey	3-Nigeria	3-Senegal	3-Kuwait	3-Kazakhstan	3-Oman	3-Malaysia	3.Tunisia
	4-Kyrgyzstan	4-Saudi Arabia	4-Indonesia	4-Qatar	4-Lebanon	4-Morocco	4-Malaysia		4.Iran
	5-Algeria	5-Albania	5-UAE	5-Jordan	5-Morocco	5-Pakistan	5-Lebanon		5.Morocco
	Large Pioneer			medium pioneer			small pioneer		

The major merit of these three groups and subgroups is the provision of an "OIC division of roles" among the Member Countries.

This achievement is applicable for TP. Also, the generalization of this approach to other socioeconomic areas will provide some feasible steps towards the integration of OIC members. It is worthwhile to note that measuring OIC countries based on KEI would lack the merit of the proposed approach. In fact, using KEI or KI does not have the proper details to determine the competencies of each country member; therefore, is incapable to a synergic structure for TP.

4-2- Processes of TP

It has been mentioned that TP is a complex process. In this section the hierarchical processes of TP has been designed[15]. A hierarchical and detailed process of the TP is shown Figure 15. As shown in Figure 15, Technomart information collection is the first core process and can be subdivided into the three following processes:

1. Collecting technology supply information
2. Collecting technology demand information
3. Collecting potential technology supply centers information

Technological products will also be provided in the Technomart. However, the performance measurement of such products needs special test facilities. The technological products are of great number and diversity.

In many cases Technomarts in developing countries cannot afford to provide the required test facilities to measure the performance of such a divers set of technological products. Therefore, the Technomart plays an intermediary role in this situation. It links technology providers to accredited labs and the test centers to provide technology seekers with performance information of technological products.

Technology may be provided in the form of technological knowledge instead of a final product. In these cases, the performance measurement is more complex and needs the involvement of the related experts. Such experts are not full-time staff of the Technomart and are usually asked to cooperate on demand.

The Technomart attaches the assessment and evaluation of results to the technology information. Thus, the technology seekers can easily access the valuable information about the supplied technologies. Such information facilitates taking more intelligent decisions and negotiations.

Users of Technomart can directly search to find the proper technology supplies, demand and the potential technology supply centers. However, it provides on demand consultation services for choosing the best alternative. Such consultation services are based on the rich background of the previous experiences of technology transfer.

When both parties of technology transfer are identified, they can start negotiations. Technology transfer coordination encompasses the negotiation activities until the contract closure. Three processes are concurrently performed which are technology pricing, contract consulting, and informal regulatory and mediation. When the terms and conditions are agreed upon by both parties, then, formal regulatory and contracting are implemented.

Finally, TP requires many supportive services. The supportive processes for TP are given in Figure 16. To establish TP system, it needs a requirement analysis of the constituent processes is needed to be done, which is out of this study

[15] Ramazani Khorshid Doust (2017), A Prologue to the Feasibility of TechMart in OIC, INSTP.

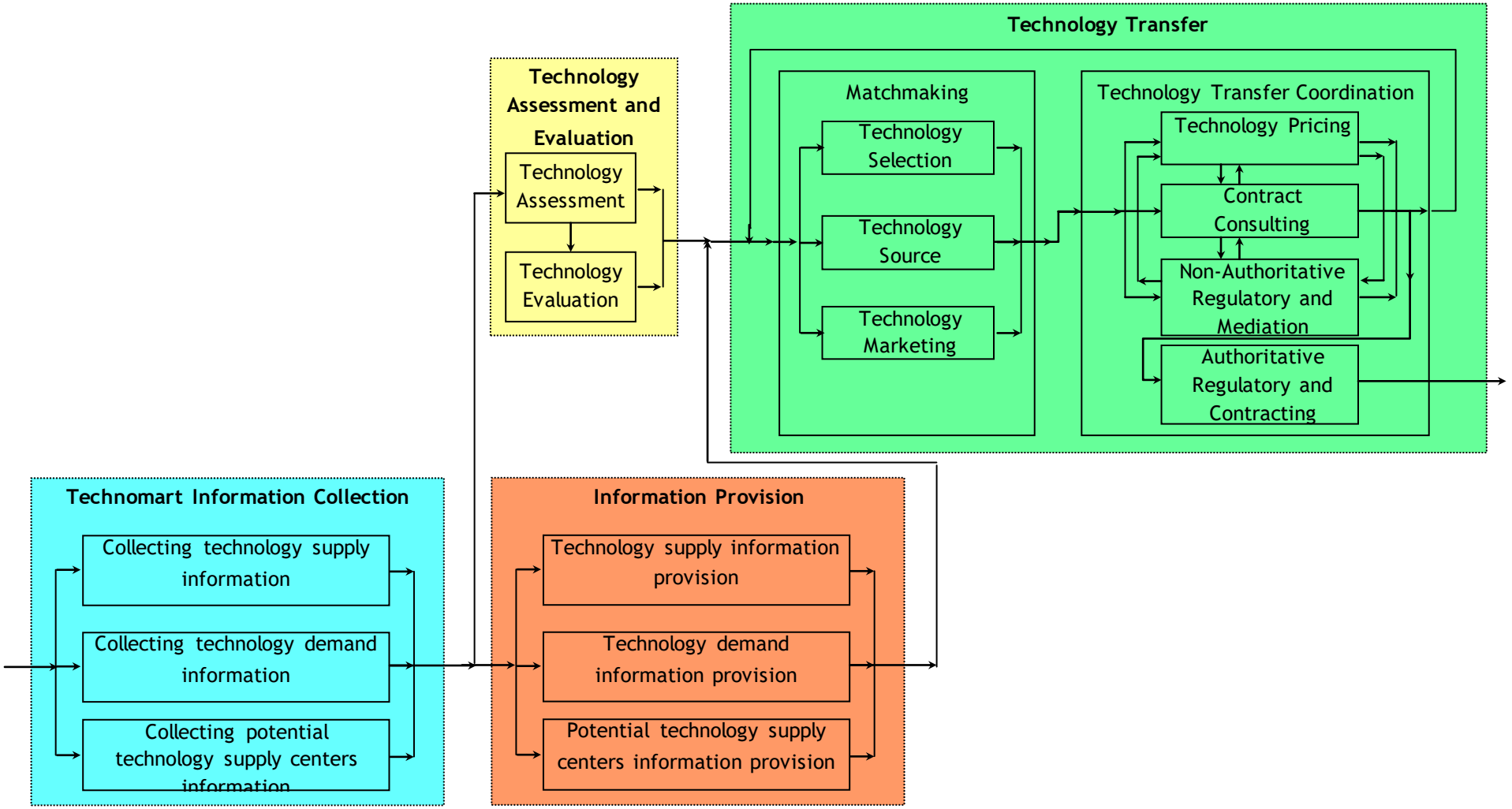

Figure 15- Technomart Multi-Level Processes

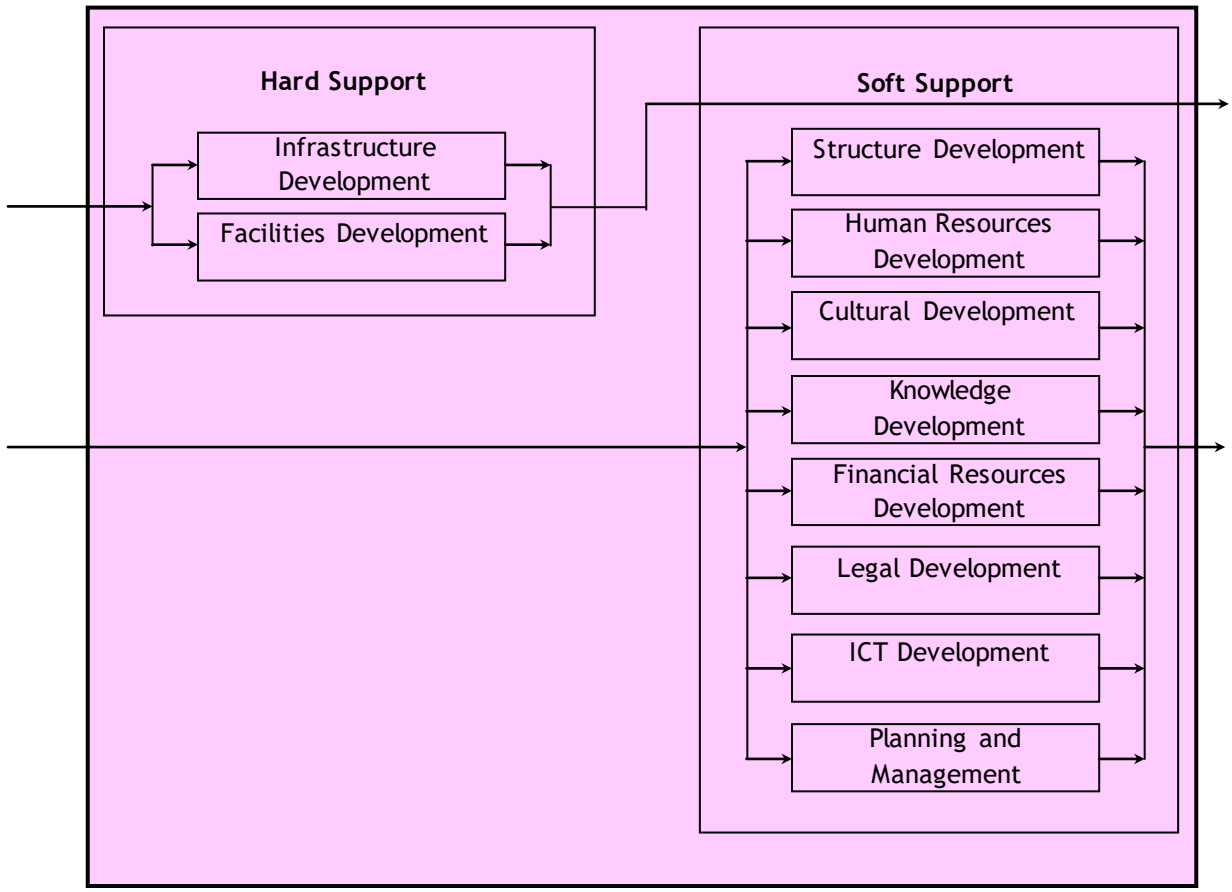

Figure 16- Technomart Supportive Processes

5- CONCLUSION

This study has focused on Technomart, which is a very important current issue in the world. Promoting Technomart among the OIC member countries is a proper step towards more integration and competitive strength. Theoretically, this study depicts that summing up a set of attributes has severe flaws, similar to adding up apples and oranges. Practically, ranking based on KEI conceals the abilities of the OIC members. As an alternative, nine attributes have been introduced to measure the position of the OIC member countries to promote hi-tech and Technomart. Some of the attributes are similarly used in KEI, but a different method has been applied. In fact, Multi-Attribute Utility Theory (MAUT) has been applied instead of simple summing up.

There exist several merits for the approach used in this study. First, every capability of each OIC members is presented separately. This helps to determine the specific roles of each country to fill the gap in the process of Technomart promotion. Second, this study has ranked the OIC countries as "pioneer" and "intermediate" in a certain area relating to Technomart. Finally, we found that none of the OIC countries is pioneer in all competencies. That is, even the "pioneer" countries in some areas need the help of others to promote their abilities in Technomart. The "OIC division of roles" among the OIC member countries is the significant result of this study, which can be a cornerstone for a feasible approach to integrate of the Islamic world.