2013 ECOSOC Annual Ministerial Review

Regional preparatory meeting for Western Asia

“Science, Technology and Innovation for Sustainable Development″

BACKGROUND NOTE

26 November 2012, 1:00 – 5:15 p.m.

Executive Summary:

For the 67th session of the United Nations General Assembly (2012), the UN Secretary General report on Options for a facilitation mechanism that promotes the development, transfer and dissemination of clean and environmentally sound technologies gives a global background on innovation and available knowledge: “Over the past 20 years, the number of people in the emerging global innovation cluster has more than doubled. Communication and interconnection in this increasingly urbanized cluster has reached levels unimaginable just a few decades ago. All of this should, in principle, put humanity in a much better position to find solutions to sustainable development challenges.”

The 17 Arab countries of Western Asia and North Africa are not socially or economically homogeneous. They can be categorized into 4 different groups based on similar socio-economic profiles. In all 4 groups, the roles of Science, Technology and Innovation (STI) in each society are interdependent, and interconnected to the higher education and research systems. STI is also critical – both directly and indirectly – for delivering social stability, environmental sustainability, and economic growth.

The population of the WANA region is overwhelmingly young, more so than any other region in the world. Based on a recent ILO report, over 60% of educated youth in the region are in neither school nor work. The region is also host to a number of paradoxes: its vast energy sources concurrent with frequent power outages; educated emigrants moving abroad alongside a great demand for imported products and labour; islands rich in natural resources in the midst of a degraded oceanic ecosystem; and selectively booming oases dispersed in an economic desert. The capacity is huge for over 300 million people given the region’s available natural resources, strategic geographical location, and authentic rooted culture. The potential to improve industrial and agricultural productivity through STI not only improves wages and the quality of life for local people but also contributes to more effective, sustainable stewardship of resources.

Much has been invested in education and related infrastructure in the region. Yet, the returns on these investments have not always yielded the necessary returns on issues including job creation, poverty reduction, international migration, political stability, security and sustainability.

In this background note for the regional meeting on “STI for sustainable development,” the state and present role of scientific research and innovation in the local society and economy will be explored. In addition, several recommendations will be proposed for the public regimes of these countries in order to improve the return on this societal investment towards improving the quality of life for current and future generations in the region.

This background note is organized as follows:

1- Introduction: the role of STI for sustainable development in WANA region

combination of investments, organization and technology, and individual success does not necessarily translate directly into economic indicators for all the economy.

Finally, it is important to emphasize that for research, as for innovation, the growth of activities follows a cumulative path. This path-dependency is particularly important because new research and innovation activities will always depend upon former investments, and former experiences. And, this is true both for research-driven activities as well as for innovation and technology generally. All technologies are constructed on prior experience, and this progressive technological learning builds paths made up of accumulated practices.

Since the Second World War, science has been thought of as a national endeavour hepered

A factorial analysis

The message delivered by this first analysis is that size indicators, dynamic indicators, and innovation indicators allow for a typology of Arab countries. Thus next to “size” we saw the importance of the variable of co-authorship: international collaboration plays a very important role in the explanation, and is closely related to the more rapidly growing countries. Those possessing high levels of co-authorship (Morocco, Tunisia, LeTc b0(a)4(t)-non, J0(ar)3(o)-d(t)-n) n

Gross expenditure on research and development (GERD) has been low in Arab countries for almost four decades, and is lower than the world average at between 0.1% and 1.2% of gross domestic product (GDP). OECD countries devote about 2.2% of GDP to research and development (R&D). There are signs of change however.

As in the case of innovation, there is neither congruence between GERD and GDP nor GDP (per capita). The interest in research is indeed not linked to it in a simplistic, linear fashion. Some rich countries do not invest in the development of science. Much depends on the will and interest of the government, political system, and ambient values – especially in relation to religion, colonial history and international support. Many Arab scientists leave their countries, and therefore do not contribute to the GDP of their countries. However, the private sector also possesses part of the responsibility. For the most part, R&D centers in the region are relatively small, and generally focused on late-stage development, rather than "blue skies" research. (The Economist Intelligence Unit, 2011:4)

In brief, when we

Middle East model	Syria
	Egypt
	Iraq

development to relatively independent councils and academies (Nabil ‘Abd al-MajidSalih, 2008, in Arabic) (UNDP, 2009:188).

Egypt currently has the largest number of research centers (fourteen specialised government research centers, 219 research centers under the auspices of ministries, and 114 centers at universities). In Tunisia, there are thirty three research centers comprising 139 laboratories and 643 branch research units. Technological research cities are few and are limited to Egypt, Saudi Arabia, and Tunisia (UNECA, 2008, in French). Other serious attempts exist in the Arab region, such as the Science and Technology Park that functions under the umbrella of the Qatar Foundation and sponsors numerous scientific and developmental studies in Qatar and worldwide. (UNDP, 2009:188).

Foundations

A number of national funds for science, technology and innovation have been set up in recent years. These include the 2008 European Union-Egypt Innovation Fund, and three national funds: the Qatar Foundation, Mohammed bin Rashid Al Maktoum Foundation in the United Arab Emirates (2007), and the Middle East Science Fund in Jordan (2009) (Snaer & Steve, 2011). Among them, Qatar set the bar highest by calling for the allocation of 2.8 per cent of the general budget to support scientific research in mid of 2008.[5] The set-up of the European Union–Egypt Innovation Fund in 2008 supports projects for applied research on a competitive basis, with a special emphasis on innovation (Mohamed, 2008; cited by Mouton and Waast, 2009).

5. Scientific Production

Usually scientific production is measured by indicators based on two types of data: the number of the publications in refereed international scientific journals and books, and the citations received by the published articles. Studying the use of citations is only possible using the Web of Science (WoS) (Thomson Reuters), and SCOPUS.

A rapidly growing scientific production

The mere numbers of scientific articles is still low in the Arab Countries. A recent report underlies that in 2007, the level of Arab Scientific Publications (approx. 15,000 papers) was equivalent to that of Brazil and South Korea in1985 (Mrad, 2011). Moreover, the number of articles published per 100 researchers each year was only 2 in four countries, 6 and 38 in two further countries, and was around 100 in Kuwait. If the total number of Arab university teaching staff is calculated at 180,000 doctorate holding university professors, and if we add around 30,000 researchers working full-time in specialised centres, then the academic-scientific corps working in Arab research and development is estimated at 210,000 researchers. Yet this corps produces only 5,000 academic papers per year, equating twenty-four scientific papers per 1,000 university professors and full-time researchers (UNDP:2009:201).

[5] La

great efforts in promoting the scientific production of its personnel, which shows in its staff's overall production figures. Jordan is also moving towards this pattern, although concentrated more in engineering research. It is now slowly broadening to include research connected to the medical sector. Nonetheless, the dominant research area in Jordan remains engineering-related areas of specialization.

This over-specialization in engineering might also partially explain the under-production of research in Arab countries. It is well known that Engineering sciences produce lower figures overall than do the biomedical and life sciences. Patterns of publication in Engineering are also lower as compared to basic sciences (chemistry, physics, biology). It is also true of Agricultural sciences which tend to patterns of production closer to engineering than to basic sciences.

Low Citations, low impact?AA3(r)-7(a)4-4(lc)4(ount)-2(r)3(i)-6(e)4(a)6(l)]TJ -0.004 Tc 0.00 Tw59 0.34

Another issue

researchers publish, and provide a venue for the diffusion of local scientific activity. These journals need to be of good quality and should avoid inconsistencies be such as irregular publishing, lack of objective peer review, and focus on irrelevant topics.

- Engage in a systematic analysis of impact of research programs

A notable effort is being made in creating observatories and indicators in science and technology in the region. An effort should be made to tackle the issue of impact of research.

From factor analysis and other indicators of the production of science and technology in the Arab countries, the first observation is that there are three categories of countries: (i) well established countries (Tunisia, Egypt and Morocco), (ii) emerging counties (SA, Lebanon, Algeria, Jordan and Qatar) and (iii) the “very small” science countries (the rest). For some output indicators, 20 Arab countries produce 6000 books per year, compared to 102 000 in North America (Lord, 2008, cited in UNESCO, 2010: 264)

6. Innovation

As mentioned in the introduction of this report, innovation is different from research, and not all innovation is research-based. This is why innovation needs special attention. Innovation policies have been developed and sustained quite firmly in the last years by some governments, for example in Algeria, Egypt, Turkey, Morocco and Tunisia. Other countries have also promoted specific schemes and measures for innovation (Jordan, Lebanon, and, to a lesser degree, Syria). Gulf countries have set-up also specific measures. It should be added that the European Union in the framework of the so-called “Barcelona process” (EU-Med cooperation) has also been suggesting more innovation-related actions for EU-Med cooperation in the hope of the set-up a “Euro-Mediterranean Innovation Space” (EMIS)(Pasimeni, Boisard, Arvanitis and Rodríguez, 2006). Many international organisations, bilateral donors and NGOs have participated in the need of the countries to transform their development models from low-cost into knowledge-based production: the EU, the OECD, UNESCO, UNIDO and ALECSO are only a few examples to name. Finally, the World Bank has actively promoted the policies in favour of knowledge and innovation (Reiffers, 2002).

Funding agencies and governments have put a specific emphasis on the development of techno-parks and industrial clusters (Saint Laurent, 2005). This policy shift toward innovation (rather than solely research support) was basically done through measures promoting innovation in the public sector and contacts between the public sector and the productive companies in many forms: engineering networks, promotion of technology transfer units, fiscal measures, promotion of start-ups and venture-capital funding. Finally, to varying degrees, all the MENA countries were profoundly affected by the EU, which served as an example by its own promotion of innovation and instruments used to measure it (such as the European Innovation Scoreboard).

In Western industrial countries and those with growing industrial economies, there is a positive correlation between the country's position on some 'innovation index' and the growth of their GDP. Arab countries, however, do not show such a positive correlation between GDP and innovation (Mouton, 2009). Despite the high GDP in oil-producing Arab countries, the ranking on the innovation and scientific research index of some of them remain low in comparison to other Arab countries with lower incomes.

Innovation is not yet part of S&T parlance in the region. This may be attributed to the weak linkages overall between private and public R&D, as evidenced by the low output of patents. However, recently many science parks were established in many Arabic countries, especially the Gulf monarchies (Qatar, Saudi Arabia, Kuwait, Bahrain, Oman and the United Arab Emirates). This represents a move towards partnerships in innovation between private and public R&D, and explains the relatively optimistic opinions from business executives on regional innovation captured by the World Bank Survey. Note particularly Qatar and SA, which were respectively ranked 11 and 21 over 142 countries. However, this indicator is analytically very weak as it depends on subjective criteria (opinion of the business executives). Science parks have been developed in Maghreb, mainly in Tunisia and Morocco. For Tunisia, it has been a systematic policy to promote technopoles (or technoparks). In Morocco, this has been a very recent move after some difficulties in setting-up successful technopoles. A first appraisal of this policy for Morocco and Tunisia concludes that it is rather too early to have conclusive observations {Arvanitis, 2009 #4845}. Nonetheless, undoubtedly, there has been the creation of new companies, in some cases of very successful medium to large companies. Most of these technoparks function as nurseries and incubators as well as technopoles.

Table 5: Patents Granted to 13 MENA Countries by US Patent Office (1977-2009)

Appendix 1. Patents granted to 13 MENA countries by US Patent Office (01/01/1977–12/31/2009)

Country	Number of patents	% to total
Saudi Arabia	324	40.75
Kuwait	126	15.84
Egypt	97	12.20
UAE	77	9.6[illegible]
Lebanon	58	7.2[illegible]
M[illegible]	4[illegible]	[illegible]
Jordan	24	3.01
Tunisia	18	2.26
Oman	8	1.006
Qatar	8	1.006
Algeria	5	0.628
Bahrain	5	0.628
Yemen	3	0.377
Total	795	100%

http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_all.htm

Lebanon	123	113	127	111	54	68	33

only to a lack of publications in the English language but also to the fact that many Arab universities are not research universities, even if a research focus is written in their bylaws. From 33,481 researchers in Egypt, statistics suggest that 13,941 estimates on full-time equivalents (FTE), but indeed only half of them will publish in refe1v 1id (,)Tj (o)2(m-6(e)4(d)]0 r)3(e)4(s)-1(e-0.Sub(b community will be triggered. In fact, the concept of ‘critical mass’ has no empirical basis in the social construction of a research community. However, it is known that numbers count, including 50 per cent of doctors, 23 per cent of engineers, and 15 per cent of scientists (Zahlan, 2004) (UNDP, 2009:208). For example, 34 per cent of skilled doctors in Britain are Arabs.

Over 200,000 PhD holders unable to connect with the local economy emigrate (representing 80% of Arab PhD holders) (Mrad, 2011). According to the NSF, very few scientists from the Maghreb are established in the USA. But scientists from the Maghreb are nevertheless heading for Europe

Program (UNDP), which implemented TOKTEN, demonstrated that specialists (who had migrated to other countries and achieved professional success aboard) were enthusiastic about providing short-term technical assistance to their country of origin. Often these individuals returned and settled permanently. This program has been applied over the past 22 years in some 30 different countries, resulting in the application of thousands of technical assistance missions by expatriate professionals to their home country (UNDP, 1996). One of the main catalysts in the creation of the TOKTEN program was the growing necessity of counteracting the so-called 'brain drain' from developing countries to the first world. The program has created databases of highly trained and experienced expatriate experts and in the 1990's assigned more than 400 of them per annum on a volunteer[10] basis to their countries of origin for periods ranging from one to six months. TOKTEN volunteers have served in governmental, public and private sector, academic and NGO sector capacities.

The TOKTEN program in the Palestinian Territories is considered one of the most successful with more than 178 Palestinian experts who have contributed to Palestinian development under the TOKTEN modality. Palestinian TOKTEN consultants, for example, have helped reform the treatment of kidney disease in Palestinian Territories and have guided the development of macro-economic frameworks and planning. TOKTEN skills also have been brought to bear in the realm of computer and information technology, on city planning, on university curriculum development and academic networking, on the upgrading of film and television capacities, on cultural preservation including the Bethlehem 2000 project. The lack of expertise in some sectors where people have volunteered under TOKTEN has generated some genuine success stories in Palestine, such as the construction and opening of the international airport in Gaza. In this case, 9 TOKTEN consultants have stayed on and presently constitute the backbone of the airport's operations (UNDP, 1999: 1-2).

Finally, the TOKTEN program raises questions concerning the nation-state framework's capacity to deal with issues of brain drain. In an increasingly globalized skill and labor market developing countries are rarely able to compete with developed countries which offer far higher wages. In such a case, TOKTEN can be considered a mechanism by which recipient countries (usually western) compensate countries of origin.

9. Conclusion: Three socio-cognitive challenges facing research and innovation

We identify here three major challenges: the model of development the Arab world wants to adopt; trust in science; and the social environment conducive to the development of science.

Models of development in the Arab world

Some of the Arab countries' reliance on income from natural resources (for example, oil economies or phosphate in Jordan and Morocco), or from the development of services (Tourism in Lebanon), might mean that they do not really need science and research. They may maintain

[10] - In the Palestinian Territories, TOKTEN consultants receive $2,000 US Dollars, if junior, and $3,000, if senior in addition to paid travel expenses and miscellaneous expenditures.

universities, invite topflight teachers, and support the research they pursue for their own career and the prestige of sponsors (as in some Gulf countries until recently), but their commitment is unclear.

There is a clear link between the development of science and industrialization. The nationalist governments that tried to develop import substitution, even when they failed in that plan, generally established a science base which remains a national asset for the country (see Egypt for some time, and the Maghreb countries). It must be stressed that the (re)building of a science base is slower and more difficult than its demise, and that the tribulations of a "to and fro" strategy in support of science leave clear, long-lasting scars.

Trust in science

> « Le discours sur la science a été partout légitimé, la pratique de la science, elle, ne l'a pas été »

may reach the point where practicing research has no other meaning than fulfilling the formal contrary, research should be promoted as part of a collective endeavour as part of shared activities and common working plans.

Another important aspect that relates to the institutional capability to support research is the existence of post-doctorate fellowship and grants. These are important yet rare in the Arab world. Many Arab universities give grants for research only to full professors, i.e. generally those aged 50 and older. Young faculty do not get easy support and there is a lot of room to increase the support to young faculty by promoting fellowships in accordance with university authorities. None of these measures can be of any success if both funders and employers (in this case university administration) are not involved in a common negotiation.

Finally, in universities a large part of the research activity needs to be included under the general frame of the Masters and PhD programmes. These need to be designed in such a way as to lead to research, in particular PhD programmes. There will be no research-efficient faculty if it cannot relate the teaching activity in PhD seminars to research orientations. Moreover, the use of cooperative or shared doctoral programmes with foreign universities could be a lever for more research inside the university. Research institutions need ensure a good ratio balance of researchers, research assistants, employees supporting research, PhD. candidates and post docs.

A difficult issue relates to evaluation systems and the way the academic institutions measure their own performance. There is a low correlation between research output – even when restricted to academic publications – and the number of academic/research personnel. There is very small elite of researchers who will publish a lot and a large number of persons who publish much less; figures show a large quantity of teaching personnel with less than one article per year. This might not necessarily be a default considering that academic activity is not restricted to research. As we said before, even research has a multiplicity of forms. Evaluation systems should not be limited to measuring papers in journals. This leads to a certain dis-embeddedness of science from society and even the market.

Patenting might not be the right tool to measure applied research (in fact it is not a good tool since it relates to commercial considerations as much as technical ones). Nevertheless, here are too few patents in the region. Here again the issue is not measuring patents but giving support to academics that have inventions that need to be patented. Patenting might be expensive, uneasy or not worth the risk as compared to other strategies (secrecy in relating to an actual enterprise, common business plans, exchange contract between the university and the company, creation of start-up), but it should in any case be examined by a support and technology transfer unit. This unit needs a high degree of institutionalization.

Making innovation a clearly stated obj ective of public policy

Business incubators, technoparks and technopoles or industrial clusters in high-tech are not necessarily a panacea, or at least will probably be less of a solution than was initially thought. At the same time this is not to say that these efforts should be abandoned. On the contrary, these initiatives should be promoted and supported. Technoparks and the like are also parts of regional economies, and they can only function with economic and social entities nearby. Thus, they

final users is paramount. Consider for example, the construction industry which has considerably developed its new building materials based upon intense exchanges between the co research at AUB grew in this manner and with its intersection with the medical given through competitive funds. It is also clear that no research will ever grow satisfactorily if the internal mechanisms for spending external funds are not modified in most research institutions. Today, the challenge is less a lack of money than the management capacity to efficiently and effectively spend the money. We would recommend the promotion of systems of management for research and innovation, and make it a topic of high priority for training in the near future. Again, the experience of the EU Framework programmes shows the strong capacity for more research and better oriented programmes as a result of networking. Projects that are by themselves small networks tend always to expand in order to interest larger networks. The professional networking is thus particularly efficient and grounded on the actual practice of research. There is no reason why this kind of networking wouldn't work in specific professional areas.

This kind of linking strategy would make sense if it permits relatively strong research teams to participate. Participation in international collaborative networks without a parallel consolidation strategy would be like entering a river; it will end dissolving in the sea. Strong network poles that gather many researchers working in one topic would be profit from the knowledge contained in each network.

The World Bank has a quite clear view of what it calls the 'knowledge economy'. It has designed a Knowledge Economy Index (KEI) which has a rcl36 -1.15 Td -1(i)-n-2(d b1(i)-n-2(d b1(iud2(l)-2(s)-11(iuuh h

At the same time, lessons learnt from many countries in Latin America suggest the importance of connectivity in the level of institutions and individual researchers. Thus top down and bottom-up approaches are required.

Refereed academic journals

The Arab world needs more journals to publish scientific results. The objective should be to create a dynamic of exchange between members of the scientific community locally and to mobilize allies from peers, the public and decision makers. It should be noted that the main dynamic behind the publication of journals is the existence of a lively scientific community. Large publishing companies (Elsevier, Kluwer) have taken strong commercial positions, making the scientific community an instrument of commercial objectives. With the advent of Open Science, strong protests have emerged from working scientists that have used the force of ‘social digital networks’ to mobilize the community giving way to a renewal of peer partnerships. The Arab World could profit from this tendency; it should also encourage publishing in Arabic when – and only when this condition is given—there is a group of scientists that is demanding it. The main difficulty here is that academic institutions for reasons that are purely institutional have a tendency to promote departmental journals. In very large universities that might make sense; it is a waste of time in smaller ones. Journals are better defended when they belong to a specific disciplinary group, focused on some very precise topics or on broader disciplinary areas if the persons that want to defend the journal feel such a need. Moreover, universities and science councils should defend the popularization of science. A massive effort should be given to create a wider audience for science, technology and innovation by creating lively journals, websites, films, documentaries and other dissemination tools for scientific and technological activities. Citizens shouldn’t be kept in the ignorance of what happens in their own countries in the laboratories, schools and universities.

Diaspora options

There are many lesson learnt from the experiences in the last 15 years of TOKTEN program and Networking. It is extremely important that UNDP or any international organizations foster the temporary stay of scientific expatriates in their country of origin. All countries in the Arab world need the equivalent of PALESTA, Palestinian network of diaspora scientists involved with the development of Palestine remotely. This network costs little money but can harness development in the Arab World.

Better living conditions

Scientists and engineers would probably accept comparatively lower salaries than their colleagues in the USA or Europe if they have better conditions in the academic institutions in their own country.

Bibliography

Aburdene O. (2010). Creating Jobs in the Arab World through Innovation and a Culture of Venture Capital.

Al-Athel, S. (2003) Science and Technology in Saudi Arabia.Proceedings of the 14th Conference of the IslamicWorld Academy of Sciences. Kuala Lumpur.

Arvanitis R. &Hanafi S. (Forthcoming) Knowledge Production inthe Arab World.

Castellacci F. &Natera J. M. (2011). The Dynamics of National Innovation Systems: A Panel Cointegration Analysis of The Coevolution Between Innovative Capability and Absorptive Capacity

CNRS. (2011). Five Years Report (2007-2011)

Cooper, S. (1997) 'Plenitude and alienation: the subject of virtual reality', in Holmes, D. (ed.) Virtual P5 Td [-2(t)-2(he 32.77 0 35)-2(m)-2Tj [(2011)ion >>B2(r)d(2011>B2(on i)-2)L83n >>Buj [(2011 http://ipac.kacst.edu.sa/eDoc/eBook/4382.pdf

Khalaf, Samir. Protestant Missionaries in the Levant: Ungodly Puritans, 1820-1860. Routledge, 2012.

Khelfaoui, H. 2000. Les ingénieurs dans le système éducatif: L'aventure des instituts technologiques algériens. Paris: Publisud.

Khelfaoui, H. 2004. "ScientificResearch in Algeria: Institutionalisation versus Professionalisation". Science, Technology and Society, 9(2), 75-101.

Kleiche, M. and Waast, R. 2008.Le Maroc Scientifique. Paris: Publisud.

Losego, P., &Arvanitis, R. (2008).Science in non-hegemonic countries.Revue d'Anthropologie des Connaissances, 2(3), 343-350.

Morgan M. &O'gorman P. (2011) Enhancing the Employability Skills of Undergraduate Engineering Students.

Mouton, J. et Waast, R. (2009). Comparative Study on National Research Systems: Findings and Lessons. In V. L. Meek, U. Teicheret M.-L. Kearney (Eds.), Higher Education, Research and Innovation: Changing Dynamics. Paris: UNESCO, pp. 147-169. http://firgoa.usc.es/drupal/files/UNESCO_Research_and_Innovation.pdf#page=152

Mrad F. (2011). RDI for Knowledge Economy. ESCWA

Mrad F. (2010).Scientific Innovation among Arab Youth: A Sampling Tour and Reality TV Workshop Perspective.

M-Said, O. (2011). A Development Perspective of Technology-based Entrepreneurship in the Middle East and North Africa.Annals of Innovation &Entrepreneurship ,Vol 2.

Nour, Samia (2005), "Science and Technology (S&T) Development Indicators in the Arab Region: A comparative Study of Arab Gulf and Mediterranean Countries".The Journal of Science, Technology and Society, Vol.10; No. 2; September 2005; pp. 249-274.

Oukil M.-S. (no date). PhD Enhancing Innovation and Entrepreneurship for Growth and

Oukil, M-S.(2011). A Development Perspective of Technology-based Entrepreneurship in the Middle East and North Africa.Annals of Innovation & Entrepreneurship, Vol 2, N°1 (2011)

Romani, V. (2011). Enseignement Supérieur, Pouvoir et Mondialisation dans le monde arabe. Revue des mondes musulmans et de la Méditerranée.

Rossi, P. L. (2010). Scientific Production in Arab Countries: A Bibliometric Perspective Science, Technology & Society, 15(2), 339-370.

Rossi, P. L. 2009. Bibliometric study of Mediterranean Countries (for the ESTIME Project,http://www.estime.ird.fr).

Satti, N. S. (2005). "Science and Technology Development Indicators in the Arab Region. Science Technology & Society 10(2), 249-275.

Schwartzman, S. 1991. A Space for Science: The Development of the Scientific Community in Brazil. University of Pennsylvania Press. Johann Moutton and Roland Waast169

Snaer, G., & Steve, B. (2011).The Age of Knowledge.

the Economist Intelligence Unit. (2011). Laying the foundations A new era for R&D in the Middle East List of Arab entrepreneurship initiatives. (no date).

The World Bank(2012)Knowledge Assessment Methodology. Knowledge Economy Index (KEI) 2012 Rankings

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