An Integrated Scienceometric Information System Infrastructure for the Assessment of Scientific Impacts of Nations

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Abstract: The emphasis on enhancing higher education, scientific and research institutions in the member states of the Arab League is increasing. Such attention originates from the outcomes of the studies that highlight the low contribution of these states in global scientific production. The basic aim of this study is to examine the context of scientific impact of these states, examine the reasons for the decline of scientific impact of such states and propose some recommendations and an integrated information system infrastructure.
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1. Introduction

The improvement of quality of higher education and scientific research institutions has gained momentum attention over the last couple of years. Such attention has been accompanied with different types of organizational, institutional and technological transformations. The interest of higher education institutions to be accredited by international accreditation agencies and the growing concern for the improvement of institutional ranking motivated higher education institutions to focus on monitoring scientific production as a vehicle for measuring scientific impact of institutions and nations. Despite the existence of different frameworks, scientific production is usually monitored using citation based indicators mainly the number of publications and citations. By following the same trends of analysis, this paper examined the context of scientific impact of developing countries by taking the member states of the Arab League as a case study. Our analysis revealed that the current methods of assessment utilizing a limited number of indicators and sources reflect a low scientific contribution and impact for these states. Irrespective of the validity of the assumptions used by these methodologies and frameworks, the decline of scientific production in the member states of the AL can be attributed to two main reasons. First: situation-specific challenges (such as the destruction of large-scale systems, language differentials, centralized research governance mechanisms and institutions and massive brain drains). Second: assessment and data modeling considerations reflecting the methodological gaps of the assessment frameworks and their inability to incorporate publications published in the Arabic world, use multiple electronic databases and include publications that appear in local journals which are neither ISI-indexed. The paper appraises the potential role of pan-Arab and country-specific foundations as well as the rise of research budgets in relaxing situation-specific limitations. The efforts to address methodological concerns of data modeling are not moving with the same pace. This paper also proposes and integrated scienceometric information system infrastructure for the assessment of scientific impacts of nations.

2. Methods

The study is a longitudinal survey with both induction and deduction measures being included. The data for this study originates from different sources. Demographic information is collected from the reports of international organizations such as the UNICEF and UNFPA as well as from the human development reports published by UNDP. The economic classification of member states of the Arab League is based on the recent classification of the World Bank and its annotations. Publication and citation statistics are assembled from the ISI Web of Knowledge of Thompson Routers (esi.isiknowledge.com, n.d) by considering the impact factor only as a measure of journal assessment. Scientific indicators (publications and citations) are categorized and mapped against population data and represented in graphical formats. Because the study is making use of only ISI-indexed data, it goes without-mentioning that the data used does not include either data published and indexed in other electronic database or data published in other languages such as Arabic, the native language of the member states of the Arab league. Because no statistics exists for such published research, we

believe that its inclusion will of course improve the validity of this research and its outcomes.

3. Related work

Different attempts have been done to assess scientific impacts of nations. Mehrad & Gazni (2010) examined the scientific impact of the member states of the Organization of Islamic Conference by using the essential science indicators of Thompson Reuters. Their examination included economic class, population, citation and publications in 22 disciplines. They concluded the failure of some publications such as Butler (2006), Giles (2006), Fergany (2006) to fairly and comprehensively reflect on the stat us of scientific publications by the Islamic countries. They raised the limitation of focusing on a single database such as ISI Web of Science managed by Thomson Reuter because scientists publish their scientific production in several places and journals. Waast (2010) examined the context of research in Arab Countries with emphasis on North Africa and West Asia by focusing on the differences among three sub-regions: Gulf countries (Kuwait, Bahrain, Qatar, United Arab Emirates and Oman), eastern (a.k.a Machreq) countries (Lebanon, Jordan and Syria) and western (a.k.a Maghreb) countries (Tunisia, Algeria and Morocco). Maziak (2005) explored the progress of science in the Arab World by focusing on the historic development of science and the periods of decline. He attributed decline of scientific bases in the Arab world to the lack of funding, poor institutional support, and meager integration within the international scientific community. Masoud (2002) raised the importance of promoting scientific production and commented on the positive trends towards the establishment of research foundations in the Arab region by focusing on the perspectives of the Arab Science and Technology Foundation (ASTF) and the potential roles it can play in the advancement of scientific research in the Arab world. (Editorial, 2006) commented on one of the scientific research program of ASTF known as Izdihar (the equivalent of prosperity in Arabic). The program aims at improving the quality of life of people in the Arab region through the development of research-based solutions in large scale sectors healthcare, environment, energy and agriculture) and the commercialization of knowledge. (Deleu, Mrgaret, Northway & Yolande, 2001) examined the geographical distribution of Medline-listed biomedical publications from the Gulf Corporation Council countries. The authors raised the limitations of using Medline database such as its limited focus on biomedical literature, the under-recording of publications originating from the Gulf region, its indexing of only the first author's affiliation and excluding the affiliations of the other contributors, and the exclusion of citation-based affiliation in "Editorials" and "Research Letters". Neves & lammers (2007) investigated the growth in biomedical publications and scientific institutions in the Emirates (1998–2004) by searching PubMed, EMBASE And Current Contents (via the ISI Web of Knowledge portal) databases. Their study revealed that the total number of publications produced by 109 institutions during the period of the study (i.e., 1998–2004) was 1369 publications with the majority of institutions (72 institutions) producing less than five publications in that 8-year period. Because of the local focus of some of the publications and the demands of project sponsors, they are published in Emirate-based journal or regional ones inside the Gulf region with low or no impact factor.

4. Scienceometric analysis of the scientific impact of the Arab world

4.1 The context of the Arab League

The Arab League (AL) is an intergovernmental regional organization that serves the interest of its Arab member states such as other regional organizations (e.g. the European Union and the Conference of Islamic Countries). The AL currently has twenty two countries namely: Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, State of Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Tunisia, United Arab Emirates, Syria and Yemen. The main goal of the league is to "draw closer the relations between member States and co-ordinate collaboration between them, to safeguard their independence and sovereignty, and to consider in a general way the affairs and interests of the Arab countries (Wikipedia, n.d). It has some sector-based institutions such as the Arab League Educational, Cultural and Scientific Organization (ALECSO) and the Economic and Social Council of the Arab League's Council of Arab Economic Unity (CAEU), among others. The total area of the Arab league is 13,333,296 km2. 2011's population estimate is 349,870,608 with a density of 24.33/km2. According to the same estimate, total GDP (PPP) is $4.766 trillion and estimated per capita of $7,682. 2011's estimate of total GDP (nominal) is 3.526 trillion and estimated per capita of $4,239. According to the latest country classification scheme adopted by the World Bank (Worldbank.org, n.d), countries are classified into three categories: low income, middle income and high income. The member states of the Arab League constitute 8.2% of the low income countries (4 countries), 0.12% of the middle income countries (13 countries) and 0.07 of the high income countries (4 countries) of the world. Figure (1) below depicts the classification of AL member states according to income classes.

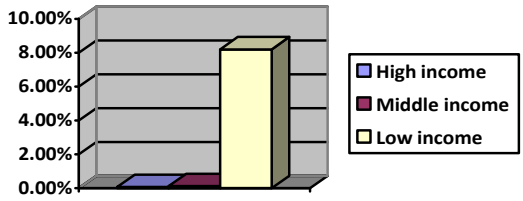

Figure (1): AL member state classification by income

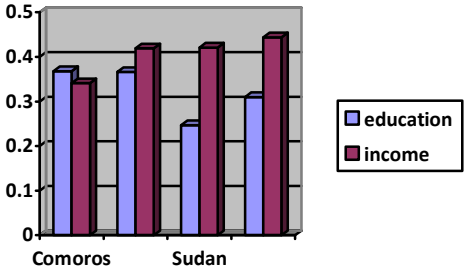

Figure (2) Income-education development index for low-income AL member states

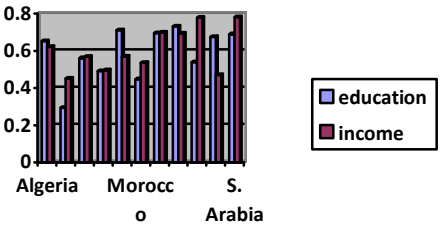

Figure (3) Income-education development index for middle-income AL member states

According to international organizations (UNDP for example), the differences among countries are described in terms of their human development indicators. Figures (2), (3) and (4) below depict the education and income indexes of the low-income, middle income and high-income member states of the AL. The education index shows the mean years of schooling and expected years of schooling measured by the adult literacy rate (with two-thirds weighting) and the combined primary, secondary, and tertiary gross enrollment ratio (with one-third weighting) (Wikipedia, n.d). Such indexes are directly related to the context of scientific research and education in general. The figures show index differentials across the member states of AL in each economic class as well as across economic classes according to population sizes and educational structures.

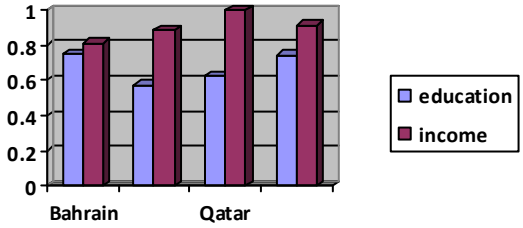

Figure (4): Income-education development index for high-income AL member

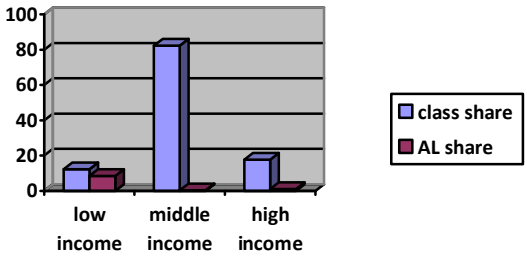

Figure (5): Class-based population share of the member states of the AL

The total population of the world is 6,986,951,000 in 2011 according to the World Population Data sheet. 1,241,580,000 of this number belong to developed high income countries and 5,745,371,000 belong to the middle and low income countries. This means that the population share of high income AL countries is 17.77%, middle income countries 82.22% and low income countries is 12.32%. The population of the high income members of the AL constitute 1.103% of the high income class, 0.313% of the middle income class and 8.44% of the low income class. Figure (5) above shows the population share of the member states of the AL compared with world population in accordance to economic classes.

According to [11], the low income and lower middle-income classes include 71 countries which represent 71% of the world's population, 10% of world publications and 4% of world citations. The member states of the AL contribute a total share of .829 % of publications, .301% of citations and 5.103% of world population. Figure (6) below shows population and publication share of the member states of AL across their respective economic classes. Figures (7), (8) and (9) below show publication (P.S), citation (C.S) and population (Pop.S) shares for the member states of the Arab League accordance to their economic status and population share.

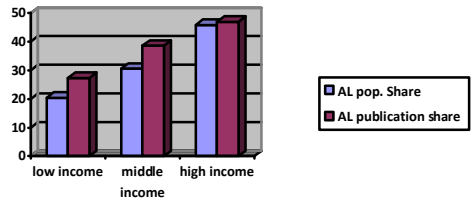

Figure (6): AL population share and publications share

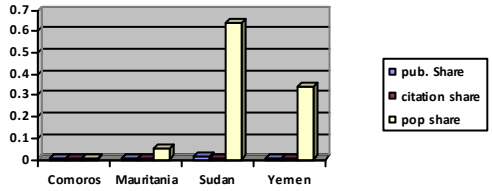

Figure (7): publications, citation and population share of the low-income member states of the AL

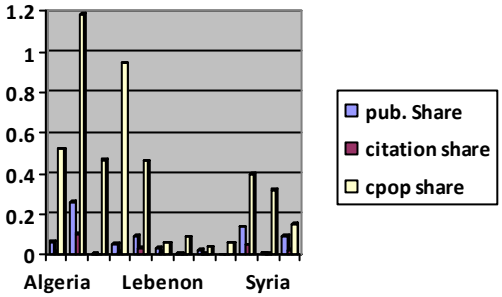

Figure (8): publications, citation and population share of the middle-income member states of the AL.

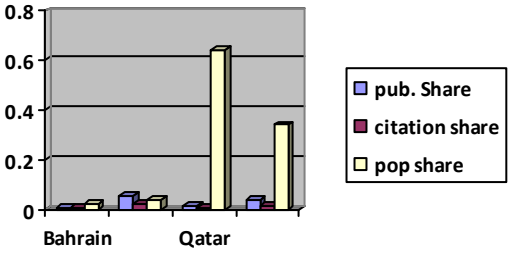

Figure (9): publications, citation and population share of the middle-income member states of the AL

4.2 Discussion

During the period 900 – 1200 A.D science have flourished in different cities in the member states of the AL such as Baghdad, Damascus, Cairo, and Cordoba, among other cities. Major progress was made in areas such as medicine, agronomy, botany, mathematics, chemistry, and optics ([14]. According to In the 1914 to 1945 period, Muslims slowly, and often in desperation, tried to reinforce indigenous science against the imported variety. New universities with an emphasis on engineering and medicine sprang up in Egypt, Turkey, Syria, Sudan, Algeria and Iran. The current level of efforts in science and technology in Muslim countries is much below than desired. The figures shown above show the decline of the scientific contribution of the member states of the AL. Such a decline can be attributed to some situation-specific factors and measurement data modeling limitations.

4.2.1 Situation-specific factors:

These are the factors that relate to the situations in different countries and the possibility of cooperation among the member states of the AL. The member states of the Arab League differ in terms of their orientations towards scientific research as well as in terms of the governance processes used to maintain scientific production. Such differences can be summarized below:

A. The destruction of large-scale systems:

The last couple of years have witnessed the destruction and in-appropriate functionality of large scale systems such as irrigated agriculture, animal production schemes and transportation in some of the member states of the AL. Because such systems are managed by "ministries" they tend to have their own scientific research centers. Their laboratories and field experiments significantly contribute to the status of national scientific production and publications. Because of massive destruction of such large scale systems and their inability to function properly due to political instability, mismanagement and restrictions on the acquisition of raw materials, spare parts and expertise from international markets, their scientific role declined dramatically.

B. Language differentials:

The members of the AL use different languages for instruction in higher education institutions and different terminologies for scientific resrach, despite the remain of the Arabic language as the mother toungue in all arab states. Howevere, some member states (such as Saudi Arabia, Sudan and Jordan, for example) are using English language as a medium of research and instruction with scientific terms used in English. On the other hand, other states (Tunisia, Algeria and Morocco, for example) use French language as a medium of research and instruction. Countries such as Egypt, Syria, Lebanon and Palestine, for example use Arabic as a medium of research and instruction as well as Arabic research terminologies. While some Gulf countries (such as United Arab Emirates) are using both Arabic and English languages for instruction and research, others

are using Arabic as a medium of research and instruction as well as Arabic terminologies (such as Iraq). While language differentials constitute an obstacle for scientific cooperation, the situation became worse because of the resulting translation burden for which neither powerful translation institutions nor budgets exist. As a result, the member states of the AL fail to utilize available joint projects, share solutions and improve their scientific production and citations accordingly.

C. Scientific research governance and funding

Scientific research in the member states of the AL continued to be dominated by "centralized" governance processes and institutions. Over years, higher education institutions (mainly universities) and national research institutes continued to play core roles in scientific research governance either directly through government-funded research projects or through their large amount of scientific production that originate from their research-based graduate programs. Over years, funding for scientific research continued to be provided by governments with limited engagement from private sector institutions. However, the sustainability of such core roles continued to be challenged by the following factors:

(1) The lack of funds necessary for conducting scientific research, acquiring and maintaining scientific requirements (such as laboratories, information technology infrastructure), compensating researchers and developing and accrediting scientific patents. According to [13], the annual spending on research and development in Arab countries is estimated at 0.15% of their gross domestic product (GDP), compared to a world average of 1.4%.

(2) The difficulty of commercializing scientific research and the engagement of private sector organizations in funding. Because scientific research in many member states of the AL is not directly linked to the main economic sectors, it is regarded as a "luxury" complementary activity rather than a core factor of production.

(3) The massive brain drain of university personnel, scientists and researchers mainly to Europe and the United States. Despite the role of such expatriates in knowledge transfer, their mobility has reduced the scientific competence and production of their home countries dramatically.

4.2.2 Assessment and data modeling considerations

Some of the reasons for describing scientific impacts of the member states of the AL are related to the following assessment and data modeling considerations:

1. The lack of a universally accepted assessment measure:

Different assessment has been used for the assessment of the quality of scientific publications. The journal's impact factor indicator is a measure of the frequency with which the "average article" in a journal has been cited in a particular year or period (Thomsonreuters.com, n.d). It is calculated by dividing the number of citations received in a past year by the total number of articles published in the two previous years provided that the citing and cited journals are registered in the concerned electronic database The same as same as the journal impact factor, the Eigen factor score is a5-year page-rank algorithm (Bergstrom, 2007; Bollen et al, 2009). The same as impact factor, the article influence factor is a page-rank algorithm calculated by dividing the Eigen-factor by the percentage of all articles recorded in the journal citation report JCR. Elsevier's Scopus or SCImago journal rank is a page rank algorithm is calculated using the Google PageRank algorithm for all journals indexed in Elsevier's free access Scopus database.

However, the use of "impact factor" continued to be dominant over the last couple of years. But despite its wide adoption, the impact factor is criticised for its limited scope of certain databases, possibility of misuse (review articles, self-citation, Source and non-source articles) and the tendency to "read" but not "publish to cite" or tendency to "Read and cite" but publish in another database (chew, Villanueva & Weyden, 2007; Agarwal & Agarwal, 2007).

2. The use of electronic databases and directories that document the publication and citation of scientific production written in English language

Different types of electronic databases have been established with different levels of coverage (wide coverage vs. specialized limited coverage) and accessibility (open access vs. subscription). Thompson Reuters's ISI web of knowledge operate as a unified search platform that provides access to information in the sciences, social sciences, arts, and humanities (Thomsonreuters.com, n.d). Scopus database is one of the largest abstract and citation database that ccontains 47 million records, 70% with abstracts, over 19,500 titles from 5,000 publishers worldwide, over 4.9 million conference papers and 100% Medline coverage (Scopus.com, n.d). Info-Sci database is regarded as the premier research database for teaching cases on information technology utilization and management (igi-global.com, n.d). Microsoft Academic Search is a free service developed by Microsoft Research to help scholars, scientists, students, and practitioners quickly and easily find academic content, researchers, institutions, and activities (Microsoft.com, n.d). EBSCO databases and discovery technologies are the most-used, premium online information resources for tens of thousands of

institutions worldwide, representing millions of end-users (ebscohost.com, n.d). The Chinese Database of CEPS is the comprehensive online database of full-text periodicals from China and Taiwan (oclc.org, n.d). ProQuest/CSA Technology Research Database provides a single mega-file of all the unique records available (proquest.co, n.d). The Norwegian Social Science Data Services (NSD) is one of the largest archives for research data that provides data to researchers and students in Norway and abroad (nsd.uib.no, n.d). Index Copernicus is a Web-based Research Infrastructure that provides essential tools for scientists, research administrators and government agencies and an interactive, multi-parameter and reliable scientists' evaluation system (indexcopernicus.com, n.d). In addition to electronic databases many electronic directories and search engines emerged as a part of the citation-based infrastructure such as Ulrich's Periodicals Directory (library.dialog.com, n.d), Cabell's Directory (cabells.com, n.d) and Google (google.com, n.d), among others. The main problems with these electronic databases is their exclusion of scientific production written in languages other than the English language such as the publications written in the Arabic language. In addition, the majority of the local journals are not ISI- indexed which also means that the work published in these journals is not taken into account when the status of scientific impact of the member states of the AL is assessed.

To meet situation-specific challenges there have been some genuine initiatives to promote scientific research through the establishment of country-specific and pan-Arab "research foundations". Qatar Foundation for Education & Science, King Abdul-Aziz City for Science and Technology in Saudi Arabia (Riyadh), Africa City of Technology in Sudan (Khartoum) and Kuwait Foundation for the Advancement of Science in Kuwait (Kuwait), among others, are examples of country-specific foundations. The Arab Science and Technology Foundation (ASTF), based in the United Arab Emirates (Sharjah city), acts as a pan-Arab funding agency and scientific platforms for Arab scientists across the world. There have also been some efforts to strengthen scientific links with international foundations such as the European Union, DAAD (Germany) and government-based international cooperation agencies such as Canadian International Development Agency (CIDA) and the Swedish International Development Agency (SIDA), among others. In addition to the establishment of scientific research foundations, some countries (mainly oil-producing Gulf countries) have engaged in scientific partnerships with international scientific and research institutions (mainly European and American ones) either through the establishment of branches for such institutions to conduct teaching and research in Arab countries or through the engagement in parallel scientific research and innovation development.

5. An integrated scienceometric information system infrastructure for the assessment of scientific impact of nations

The work towards relaxing and resolving data modeling considerations in the Arab region are moving slowly. Except the experience of the Islamic Citation Centre (ISC) established by the Organization of the Islamic Conference (OIC), no serious initiative is documented. The center aims at promoting cooperation among Islamic scientists and science and technology centers by proposing suitable instruments and mechanisms needed for increasing the quantity and quality of scientific journals in the member states of the OIC. It is also hoped that the center will "ISC will also help science policymakers in assessing the national and regional return for research and development investment by measuring key research performance indicators such as number of publications and patents per researcher, as well as number of publications and patents relative to GDP and amount of money spent on R&D" (isc.gov.ir, n.d). In this study, we propose an integrated scienceometric information system infrastructure that investigate and describe the scientific field from the AL; for example, they report on research topics, utilized methods, leading researchers, institutions and countries, collaboration activities, co-citation analyses, research anomalies, and journal rankings. Integrated scienceometric includes three main components: consumable user generated contents, system-based services and tools and system-generated user consumable content, as shown in figure (10) below.

The system's Scientometrics databases stores text, metadata (information about document such as type and creation date) and other related content for documents (such as links, anchor text, etc.). The basic aim is to facilitate access to documents for search and retrieval purposes (in the form of generating result lists, for example). Text acquisition is associated with text transformation and the use of parsers (to process the sequence of text tokens into the document to recognize structural elements such as titles, links, headings, etc.). A tokenizer recognizes "words" in the text while considering issues like capitalization, hyphens, apostrophes, non-alpha characters, separators. The use of agents in the entire infrastructure also facilitates considering some issues such as (a) "stopping" issues associated with removing common words (e.g., "and", "or", "the", "in") which significantly affect the efficiency and effectiveness of the overall information retrieval and

text acquisition process, and (b) stemming where a group of words can be derived from a common stem (e.g., "computer", "computers", "computing", "compute".

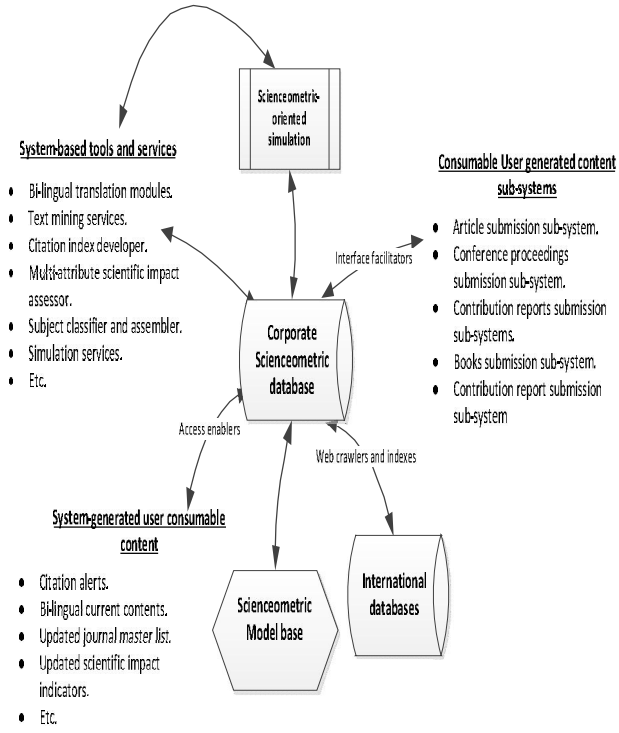

Fig. (10): an integrated scienceometric information system infrastructure

The text acquisition process depends on the efficiency of the interface agent. It acts as a crawler which identifies and acquires documents for search and information retrieval by following links to find documents. Therefore, it must be efficient enough to find huge numbers of web pages (coverage) and keep them up-to-date (freshness). Whether it is a desktop, enterprise or web crawler, the interface agent can be a single site crawler (for site search) or topical or focused crawlers for vertical search. It can also acts as a document crawlers for enterprise and desktop search which follows links and scan directories.

In addition, text acquisition is also concerned with ensuring the availability and continuity of feeds including real-time streams of documents (such as web feeds for news, blogs, video, radio, tv) and RSS readers providing new XML documents to search engine). To facilitate text acquisition, the entire agent infrastructure should also provide provisions for conversion of a variety of documents into a consistent text plus metadata format (e.g. HTML, XML, Word, PDF, etc. → XML) and converting text encoding for different languages (Using a Unicode standard like UTF-8). Such information is essential for conducting link analysis (by making use of links and anchor text in web pages) which identifies popularity and community information (e.g., PageRank). Anchor text can significantly enhance the representation of pages pointed to by links. It also help in preparing document statistics (e.g., counts and positions of words and other features that can be used for weighting ranking algorithm).

Information Extraction processes in the infrastructure focus on identifying classes of index terms that are important for some applications (e.g., named entity recognizers identify classes such as people, locations, companies, dates, etc.). The use of classifiers helps in identifying class-related metadata for documents (i.e., assigns labels to documents e.g., topics, reading levels, sentiment, genre). To facilitate information retrieval in the entire infrastructure, emphasis should be made on inversion (which converts document-term information to term-document for indexing) to facilitate fast query processing, handle updates and improve efficiency through compression. To enable real time and distributed processing, the entire index of documents should be distributed across multiple computers and/or multiple sites to allow for fast query processing with large numbers of documents and many document variations in terms of document distribution, term distribution and replication. The processing of queries in a distributed environment through the use of "Query broker" and "caching".

The availability of consumable system and user generated content depends heavily on user interaction. In this context, query inputs can provide interface and parser for query languages used to describe more complex queries and results of query transformation (e.g., Boolean queries, Indri and Galago query languages). On the other hand, the process of query transformation aims at improving initial query, both before and after initial search as it includes text transformation techniques used for documents where Spell checking and query suggestion provide alternatives to original query. Query expansion and relevance feedback modify the original query with additional terms. Results output constructs the display of ranked documents for a query by generating snippets (to show how queries match documents), highlights important words and passages and providing clustering and other visualization tools.

The entire agent also conducts ranking. It focus on scoring (calculating scores for documents using a ranking algorithm), performance optimization (by designing ranking algorithms for efficient processing such as Term-at-a time vs. document-at-a-time processing or Safe vs. unsafe optimizations).

a. consumable user generated content:

In addition to an integrated model base, the sub-systems included in this component work on different types of scientific production (scholarly, non-scholarly, ordinary and scientific research) that can be published in scientific publications (such as journals, periodicals, books, conference proceedings and magazines), electronic databases and a set of assessment criteria. Among these types of scientific publications journals tend to be of high priority for many research institutions. While the majority of journals are scholarly in nature, some others are non-scholarly (peripheral) showing low depth of research and intrinsic value of results. Journals can be classified according to different dimensions such as sources (academic vs. non-academic), orientation (qualitative specialized vs. Quantitative not specialized), depth (archival, secondary and review journals) and geographical coverage or spread (international, regional and local journals). On the other hand, periodicals include all publications which appears in parts or volumes as regular interval (daily, weekly, biweekly, monthly, quarterly), therefore a periodical can be a newspaper, scientific magazine or journal. To account for all possibly publishable and citable content, this component uses bi-lingual database interfaces. One of the reasons for this is that many of the existing electronic databases and citation based impact assessment schemes din not take care of scientific products published in languages other than English language. Information retrieval algorithms in association with such data acquisition sub-systems also reflect the bi-lingual orientation which is necessary for ranking and assessment of scientific publications across a landscape of multiple indicators.

b. System-based services and tools:

The list of system based services and tools include bi-lingual translation modules, text mining services, citation and index developers, intelligent comparers, multi-impact assessment tools, subject classifiers and simulation services, among others. Citation and index developers is the examination of the frequency, patterns and graphs of citations in articles and books from the AL. Using System-based services and tools citations of AL scholarly works can be used to establish links to other works or other researches. Beside peer review, citation analysis has over the past three decades been increasingly used to judge and quantify the importance of scientists and scientific research and which can be incorporated in AL citation Analysis. System-based services and tools can also be used as a machinery to measure the journal "impact factors" mostly of the AL–the merit that researchers take note of when deciding which journal to submit their work to so that it is read as widely as possible in relate to AL. By using Text mining services and subject classifier and assembler of AL the significant impact of works or scientists can be used where scholarly activities are quoted more often than others citations reflect the comparative effect and value of a work, author, department, or journal's publications within their larger scientific domains.

Researchers of AL can System-based services and tools for several reasons:

- To find out how much impact a particular article from AL has had, by showing which other authors based some work upon it or cited it as an example within their own papers by using citation index developers.
- By text mining services one can determine more about a field or topic by reading the papers that cite a seminal work in that area.
- Multiple- attributes scientific impact assessor can be used to find out how much impact a particular author has had by looking at his/her total citations mostly from an AL author.
- The entire integrated scienceometric information system requires an interaction with international databases to access information about publication and citation of materials originating from the member states of the AL or outside the region to know the scientific impact from the AL nations.

c. System-generated user consumable outcomes:

As of recently, ISI (currently Thomsons Scientific) has been assessing the research performance of countries on the basis of citation studies. Followed by, SCOPUS a subsidiary of ELSEVIER, did also start in this regard and is now considered as one of the serious rivals of ISI. Besides, Google Scholar is another scientometrics tool which evaluates research output based on the scientometrics criteria. Parallel to the citation analysis activities of these institutes, some countries like China, have also taken steps to set up their national scientometrics tools and have gained considerable achievements in this regard.

System-generated user consumable services provided to users including citation alerts, bi-lingual current content, updated journal, proceedings etc master list, updated scientific impact indicators etc., can be used by, ISI and Scopus productions are internationally considered as powerful scientometrics tools, but on the other, because of the ISI and Scopus bias towards English language, most of the scientific productions written in the national languages of non-English language countries do not have any opportunities to enter ISI or Scopus databases and in turn where the services of Integrated scienceometric can be used where the contributions from the AL will not be kept out of the world scientists' sight. Therefore, an Integrated scientometrics tools similar to those of citation system is necessary in order to

evaluate the research performance of the AL which Regional Information Center for Science and Technology (RICeST) has begun implementing scientometrics tools similar to those of citation systems in order to be able to evaluate the research performance of the Islamic world scientists and provide the grounds for implementing the Islamic world scientific network.

The proposed information system infrastructure also includes other components such as scienceometric-oriented simulations necessary for incorporating multiple assessment indicators and situational change agents such as population shares and income etc. Together with the system's model base, different simulation scenarios can be generated at different levels of analysis (author, institution, publication, local, regional and international). According, information retrieval can be centered on a configurable set of citation-based indicators according to scientific disciplines (humanities & social sciences, science, engineering & technology and computing sciences & information technology, among others.

6. Conclusions

The interest in the assessment of scientific quality and impacts is expected to increase over the coming years due to the growing emphasis on accreditation programs, the emergence of different knowledge-commercialization initiatives and the expected rise of research funding through national and pan-Arab foundations. The efforts to address situation-specific factors are also expected to be activated at different levels in order to promote scientific production, citations and institutional rankings. However, addressing data modeling challenges that constrain the generation of a reasonable assessment of the scientific impact of the member states of the AL deserves additional efforts. In addition to the proposed scienceometric information system infrastructure, there is an urgent need for the adoption of an integrated and multi-attribute assessment framework that incorporates additional determinants of scientific production. The need also rises for investment in improving institutional knowledge management practices through the implementation of national and pan-Arab capacity building programs. Because of its focus on information modeling and simulation, the proposed infrastructure is expected to help in establishing electronic databases for scientific production written in the Arabic language and provide citation statistics and alerts through large-scale linkages. The operational value of the proposed infrastructure also deserves the engagement of the member states of the AL in cross-country scientific cooperation and scientific publishing, the improvement of scientific research governance processes and the emphasis on making scientific research initiatives and projects to be more citizen-centric and commercialize-able. The establishment of translation centers and building the capacity of relevant personnel in different countries especially in the countries that use French as a medium of instruction and scientific research is also essential.

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