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Bibliometric Analysis and Research Management

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Abstract: Traditional research managements were mostly driven by expert opinions (i.e. bottom-up up decision making system). In the last ten years, however, citation metrics provided by search systems for scholarly literature, like Web of Knowledge (Thomson Reuters), Scopus (Elsevier) and Google Scholar gain interest in boardrooms of research laboratories and universities. This bibliometric analysis can develop to serve research managements and science and technology strategy building. This paper provides and discusses some examples of such citation metrics and methodology of identifying and ranking research fronts. As a result,100 hottest world research fronts are introduced. The corresponding situation is reported for Vietnam and proposals for changes in research managements, policies and decision making are suggested for Vietnam and other developing countries.

Keywords: Bibliometric analysis, research management, research fronts, innovation prediction.

1. Introduction

Research management at universities in the world, in particular and in developing countries in general, is a loosely coupled, mainly bottom up driven decision making system. The pinpointing instruments in use are a professor's plan with professor profiles and various systems of peer reviewed project funding. The bottom up element could guarantee the academic freedom. Non-experts, when involved in higher governance levels (faculty, university, funding agencies), always use expert opinions to base and underpin decision making.

The start of the quantitative approach by means of citation metrics already dates back to 1955, when Garfield [1] published his first famous paper in the field of *"Citation Indexes for Science: A New Dimension in Documentation through Association of Ideas."* However, only when abundant literature search and data systems became available at the turn of the century, research management became gradually a systematic and quantitatively underpinned boardroom instrument in research labs and universities [2,3].

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The first academic search engine is considered to be CiteSeer^X in the fields of Computer and Information Science and became public in 1998. It had many new features unavailable in academic search engines at that time. It included Autonomous Citation Indexing automatically created a citation index that can be used for literature search and evaluation, citation statistics. Related documents were computed for all articles cited in the database, allowing researchers to quickly and easily see what other researchers say about an article of interest. Since then development of broad research information management systems, like Web of Knowledge (Thomson Reuters), Scopus (Elsevier) and Google Scholar gained shape. Google Scholar is relatively young and less elaborate than Scopus. It indexes articles published from a large number of websites and is totally an open access. Neither database or search engine, introduced here is inclusive, they rather complement each other. So if a library or institute can only afford one, the choice must be based on institutional needs. Besides these general, broad databases, there are also confined search engines, e.g. Pubmed, which is a free search engine accessing primarily the MEDLINE database of references and abstracts on life sciences and biomedical topics. These databases, all together, continue to develop to keep pace with the evolving demands of the research community. New and other data will be included in the near future, such as funding data, data on people and collaborators, patent data, spin out company's data, impact data, etc. Building new tools on these broader databases will provide also a much broader applicability of these search engines. Continuous improvement to both content and functionality and greater interoperability with the tools in place, means these search engines can help you imagine the scientific breakthroughs of tomorrow.

The data retrieval and analysis made possible by search engines are becoming very powerful tools to develop research policies and decision making. They help universities, funding agencies and governments to assess and manage the research performance and to set research strategies at various levels. From researchers pursuing scientific breakthroughs to governments performing research evaluation, these search engines are an important and skillful instrument for those who need a global and comparing view on the world of research. They can help to improve research efficiency and effectiveness, to find the best people, the best collaborators, to increase the impact in society and to enhance valorization and commercialization of research. Practically, universities, e.g. Nanyang Technical University (Singapore) and The National Science Library (Chinese Academy of Sciences) have established their section of research supports and bibliometric analyses.

In this paper, we will provide and discuss of some examples of bibliometrics analysis based on the database of Web of Science. This analysis can serve to establish 100 hottest world research fronts and predict innovation tendencies for the world in 2025. In particular, several experiments about changes in research managements, policies and decision making can be proposed for Vietnam and other developing countries.

2. The methodology of identifying and ranking research fronts

A research front is defined as a specialty formed by a group (or cluster) of papers that are

frequently cited together and attains a certain level of activity and coherence. In this case, the co-cited papers serve as the front's foundational core [4,5]. In Thomson Reuters Essential Science Indicators (ESI) database, more than 8,000 research fronts currently found in 21 ESI fields. From these, 10 broad research areas were identified and classified (see below). Hot research fronts are simply assigned to each of these 10 areas by the top 10 percent of the fronts with respect to total citation ranking. The key research fronts, however, are determined by the top one percent.

The key research front is selected on the basis of the CPT index, which is given as [5]

CPT = ((C/P)/T),

where C represents the number of citing articles, i.e. the amount of articles citing core papers; P the number of (co-cited) core papers; T means the number of citing years, from the earliest year of a citing paper to present.

CPT is the ratio of the average citation impacts of a research front to the age/occurrence of its citing papers, meaning the higher the value, the hotter the topic.

These research fronts were then re-ranked according to the average (mean) year of their core papers to produce a top 10 list in each broad area. There were 100 hot research fronts in total. These 10 fronts selected for each of 10 highly aggregated, main areas of science and social sciences represent the hottest of the largest fronts, not necessarily the hottest research fronts across the database (all disciplines). Due to the different characteristics and citation behaviors in various disciplines, some fronts are much smaller than others in terms of number of core and citing papers.

3. Results and discussions

3.1. Broad research areas

As already mentioned above, following the classification of Thomson Reuters, the scientific specialties in the sciences and social sciences are classified in 10 broad research areas as [5]:

(i). Economics, Psychology and Social Sciences

(ii). Agriculture, Plant and Animal Sciences

(iii). Ecology and Environmental Sciences

(iv). Geosciences

(v). Clinical Medicine

(vi). Biological Sciences

(vii). Chemistry and Material Sciences

(viii). Physics

(ix). Astronomy and Astrophysics

(x). Mathematics, Computer Science and Engineering.

This classification links among researchers working on related threads of scientific inquiry, but whose backgrounds might not suggest that they belong to the same "invisible college." So that, beside "traditional" areas such as physics, biological sciences, geosciences etc., combined fields (and/or areas) of mathematics, computer science, and engineering; chemistry and material sciences; economics, psychology and social sciences, etc came together. This approach is developed well to an underlying problem set, which required interdisciplinary input. In Vietnam, however, the science and technology management, presently, has still been following single discipline approaches. In the one hand, this may forget advanced disciplines such as ecology; materials science and technology; nano science and technology; bioinformatics etc., but on the other hand, one

cannot integrate specialists from closed fields to solve "non-traditional" problems [6].

3.2. World research fronts

Applying the methodology of identifying and ranking research fronts presented in section 2, Thomson Reuters and The National Science Library, Chinese Academy of Sciences have reported hot research fronts as shown in Tables 1-10 [5]. As can be seen from these tables, for each broader area the top 10 research fronts are tabled with their numbers of core papers, citations and mean year of core papers. These research fronts are ranked by the (youngest) mean year of core papers. In these tables, however, the data of mean year of core paper are excluded. Among these, the hottest research front of each broad area (with highest CPT index) is remarked. They are: Mobile health technology (Economics, Psychology and Social Sciences); Statistics of foodborne disease in the USA and evaluation of economic loss (Agriculture, Plant and Animal Sciences); Predicting species potential distributions with Maxent (Ecology and Environmental Sciences); Source characterization, operational prediction and evaluation of 2009 Redoubt and 2010 Eyjafjallajokull volcanic eruptions (geosciences); Intensive insulin therapy and fluid resuscitation with hydroxyethyl starch in critically ill patients (Clinical Medicine); Human disease analysis using genome-wide association studies (Biological Sciences); Functional metal organic frameworks (Chemistry and Material Sciences); Observation of Higgs boson (Physics); Herschel Space Observatory performance and observational strategy (Astronomy and Astrophysics); Biodiesel fuel performance and emissions (Mathematics, Computer Science and Engineering) [5]. Combining the top ten fields of research fronts with the top ten fields of patent data, Thomson Reuters predicts 10 world innovations in 2025. Those are: drug development, cancer treatments; food production; Bio-nanocomposites based on nanocellulose, cellulose-derived packaging; A versatile human genome engineering is well developed, type 1 diabetes is preventable**;** Understanding of the human genome and genetic mutations leads to improved detection of, and prevention methods for, the onset of neurodegenerative diseases, the dementia declines; The evolution of micro-total analysis systems (single cell analysis) and advancements in nanotechnology, coupled with more widespread big data technologies, DNA mapping at birth is the norm to avoid disease risk; Methods for harvesting, storing and converting solar energy are so advanced and efficient that it becomes the primary source of energy on our planet, solar is the largest source of energy on the planet; Digital from the smallest personal items to the largest continents, everything, everywhere will be digitally connected, and responsive to our wants and likes**;** Light-weight aerospace engineering coupled with new battery technologies power electric vehicle transportation - on land and in the air - electric air transportation will take off; and Kinematical techniques used to understand the Higgs Boson particles generated in the Large Hadron Collider advance such that quantum teleportation are tested.

It is interesting to note that analysis of the activities and the developmental status of countries, institutions and authors showed not only the names from (intensive) developed countries, but also from the (new) developed

and/or developing countries [5]. Practically, China and Korea contributed many core papers to the hottest (or key) research fronts in human diseases analysis using genome-wide association studies and functional metal organic frameworks. Especially, for the research front of biodiesel fuel performance and emissions, the all contributions come from Malaysia, China, India, Indonesia and Turkey [5].

3.3. Researches related to world research fronts in Vietnam

In order to get information about the participation of Vietnam into world hot researches, the searches with the engine syntaxes of "corresponding (and/or related) topics", "address of Vietnam" and "timespan 2010-2014" are performed for all 100 world hot research fronts by using both Web of Science and Scopus databases. The obtained results are also integrated into Tables 1-10. As can be seen from these Tables, Vietnamsese scientists (who have been studied in Vietnam or abroad) have published a good number of papers with rather high citations on mental disorders (Table 1); biochar (Table 3); geochronology and sea level (Table 4); Lupus Erythematosus (Table 5); metal organic frameworks, photocatalysts, graphene, field-effect transistors (Table 7); Higgs boson (Table 8), neutrino (Table 9) and biodiesel fuel (Table 10). However, generally, investments for world hot research fronts are still rather weak, even research fronts which the country highly needs. Among such weaknesses, it is worth to mention and to improve the following research fronts:

Entrepreneurship and innovation in small and medium enterpries; family firms; mobile health technology and greenhouse in the area of Economics, Psychology and other Social sciences;

Marine ecosystems; landscape genetic studies and ecological communities in the area of Ecology and Environmental sciences;

Atmospheric aerosol nucleation and growth, Atmospheric secondary organic aerosol formation from isoprene in the area of Geosciences;

Intensive insulin therapy and fluid resuscitation with hydroxyethyl starch in critically ill patients and deep brain stimulation for treatment of Parkinson's disease in the area of Clinical Medicine;

Human disease analysis using genome-wide association studies; bioinformatics application in the prediction of protein structure and nucleosome positioning; in the erea of Biological sciences.

Moreover, the bibliomentric analysises shown in Tables 3 and 8 imply that although Vietnam has the agricultural tradition but researches in the area rather far from the world hot research fronts (except studies on Arabidopsis). In particular, while some theoretical physics groupes are still functioning, experiential physics of Vietnam seems to be disapeared from the world hot research fronts. In this case, one should clarify the border between physics and materials science.

Table 1.Top 10 research fronts in economics, psychology and other social sciences.World data taken from [5]

Rank	Research Fronts	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citations (WoS; Scopus*)
1	Entrepreneurship and innovation in SMEs	49	1250	SMEs	1; 1*	1; 0*
2	Statistical evidence and replication in experimental psychology	20	1007	Experimental psychology	-	-
3	Human habitation and behavior in Middle Stone Age southern Africa	25	1032	Human habitation	0; 1*	0
4	Management and performance studies of family firms	26	1001	Family firms	0; 1*	0
5	Mobile health technology	20	1396	Mobile health technology	-	-
6	Diagnostic and statistical research (DSM-5) analysis of mental disorders	12	881	Mental disorders	28; 11*	225; 35*
7	Research on the sustainability of ecological landscape	29	1705	Ecological landscape	-	-
8	Early Homo origins and evolution	29	1149	Early Homo	-	-
9	The formation mechanism of idea and influential members in the internet social networks	20	968	Internet social networks	-	-
10	Structural decomposition analysis methods in the study of greenhouse gas emissions	44	2258	Greenhouse gas emissions	0; 4*	0; 5*

Table 2. Top 10 research fronts in agricultural, plant and animal sciences. World data taken from [5]

Rank	Research Fronts	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citation (WoS; Scopus*)
1	Statistics of foodborne disease and evaluation of economic loss	6	873	Foodborne disease	2; 2*	49; 1*
2	Regulation of circadian clock in Arabidopsis	20	998	Arabidopsis	46; 3*	810; 39*
3	Auxin biosynthesis and regulation	18	855	Auxin biosynthesis	-	-
4	Phylogenetic analysis of endophytic fungal species in plant	31	1150	Endophytic fungal	0; 1	47
5	Identification, growth and toxin production of Aspergillus niger	18	973	Aspergillus niger	12; 3*	157; 16*
6	Genetic theory of speciation	12	1061	Genetic theory	0; 1*	0
7	Organelles RNA editing	27	1473	RNA editing	0; 2*	0; 19*
8	Analysis of rhizosphere fungal communities using DNA sequencing	18	1040	Rhizosphere fungal	-	-
9	C-4 photosynthesis evolution and mesophyll conductance	22	1171	Mesophyll conductance	-	-
10	Biological control of invasive crop pest using predators	14	953	Invasive crop pest	-	-

Table 3. Top 10 research fronts in Ecology and Environmental Sciences. World data taken from [5]

Rank	Research Fronts	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citation (WoS; Scopus*)
1	Drought- and heat-induced tree mortality	21	1889	Drought	-	-
2	Shifting plant phenology in response to global change	15	1154	Shifting plant	-	-
3	Effects of ocean acidification on marine ecosystems	24	2186	Ocean acidification	-	-
4	Predicting species potential distributions with Maxent	36	5614	Maxent	2; 1*	4; 2*
5	Diversification rates and adaptive radiation	28	2554	Diversificati on rates	1; 1*	0
6	Landscape genetic studies	13	1077	Landscape genetic	-	-
7	Biochar amendment impacts environment	19	1538	Biochar	8; 3*	22; 4*
8	Ecological communities of ammoniaoxidizing archaea	30	3856	Ecological communities	-	-
9	Plant-animal mutualistic networks	11	1167	Mutualistic networks	-	-
10	Stable isotope ecology	12	1654	Isotope ecology	-	-

Table 4. Top 10 research fronts in geosciences. World data taken from [5]

Rank	Research Fronts (changed)	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citation (WoS; Scopus*)
1	Evaluation of 2009 Redoubt and 2010 Eyjafjallajokull volcanic eruptions	31	1035	Volcanic eruptions	1	0
2	The exchange of CO_2 between the deep sea and the atmosphere formed global climate change	25	1326	Exchange of carbon dioxide	-	-
3	2011 Tohoku earthquake and tsunami	35	2311	Earthquake and tsunami	5; 29*	7; 70*
4	Tectonic models of the North China Craton	34	2188	Tectonic	51; 20*	200; 80*
5	Greenland ice sheet dynamics-increasing rates of ice mass loss	29	2533	Ice mass loss	-	-

6	Application of regional climate models in the prediction of surface temperature	14	1086	Regional climate models	2; 10*	0; 25*
7	Zircon U-Pb geochronology in southern Tibet	25	1636	Geochronology	14; 3*	75; 6*
8	Global sea level change	42	3870	Sea level	29; 23*	150; 80*
9	Atmospheric aerosol nucleation and growth	33	2502	Atmospheric aerosol	1*	12*
10	Atmospheric secondary organic aerosol formation from isoprene	18	1647	Organic aerosol	-	-

Table 5. Top 10 research fronts in clinical medicine. World data taken from [5]

Rank	Research Fronts (changed)	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citation (WoS; Scopus*)
1	Catheter-based renal sympathetic denervation for resistant hypertension	19	1707	Renal sympathetic denervation	-	-
2	Treatment and rapid diagnosis with XPERT MTB/RIF assay for tuberculosis and HIV-associated tuberculosis	47	2907	XPERT MTB/RIF assay	1	0
3	Transcatheter aortic valve implantation	47	6255	Transcatheter aortic valve	-	-
4	Fecal microbiota transplantation for recurrent Clostridium difficile infection	35	3509	Fecal microbiota transplantation	-	-
5	Deep brain stimulation for treatment of Parkinson's disease	32	2521	Parkinson's disease	3; 3*	39; 4*
6	Prostate cancer-associated mutations, gene fusions	25	2443	Gene fusions	2; 1*	132; 2*
7	Intensive insulin therapy and fluid resuscitation with hydroxyethyl starch	33	4876	Insulin therapy	2; 4*	11; 26*
8	Clinical trials for immunotherapy of Systemic Lupus Erythematosus	24	2030	Lupus Erythematosus	7; 1*	57; 10*
9	Enhanced depth imaging optical coherence tomography of the choroid	27	1869	Optical coherence tomography	-	-
10	Relationship between benign prostatic hyperplasia and prostate cancer	22	1788	Prostatic hyperplasia	-	-

Table 6. Top 10 research fronts in biological sciences. World data taken from [5]

Rank	Research Fronts (changed)	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citation (WoS; Scopus*)
1	Hexanucleotide repeat expansion and frontotemporal dementia and amyotrophic lateral sclerosis	37	2285	Dementia and sclerosis	2; 0*	55; 0*
2	In vivo imaging of neurons using fluorescent indicator	48	2657	Mapping of neurons	-	-
3	Detection of synthetic cannabinoids and cathinone derivatives in herbal products	39	1442	Cannabinoid /cathinone	-	-
4	Dendritic cell, macrophages and immunotherapy	18	1676	Dendritic cell	16; 0*	55; 0*
5	Human disease analysis using genome-wide association studies	13	3492	Human disease	14; 3*	55; 18*
6	Direct reprogramming of fibroblasts into neurons and cardiomyocytes	15	3009	Reprogram ming of fibroblasts	-	-
7	Signaling pathways of sensor proteins in the immune system	36	4870	Sensor proteins	-	-
8	Genome editing technology—transcription activatorlike effectors nuclease	18	2098	Genome editing	-	-
9	Melatonin and oxidative stress	20	1915	Melatonin/ oxidative stress	-	-
10	Rapid antidepressive action of ketamine	21	1798	Ketamine	-	-

Table 7. Top 10 research fronts in chemistry and materials science. World data taken from [5]

Rank	Research Fronts (changed)	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citation (WoS; Scopus*)
1	Electrode materials for sodium-ion batteries	45	1607	Sodium-ion batteries	-	-
2	Functional metal organic frameworks	8	2976	Metal organic frameworks	6; 9*	280; 15*
3	Synthesis of pillar [5/6] arenes and their host-guest chemistry	41	2058	Pillar arenes	-	-
4	Rhodium-catalyzed C-H activation	36	1802	Rhodium-catalyzed	-	
5	Graphene-based photocatalysts	19	1537	Photocatalysts	11; 6*	90; 30*
6	Synthesis and application of graphene quantum dots	31	2340	Grapheme quantum dots	-	-
7	Carbonic anhydrase inhibitors	27	2252	Carbonic anhydrase	3; 0*	10; 0*
8	Graphene and graphene oxide in	44	5259	Graphene	102; 29*	550; 80*

	biomedical application					
9	Polymer-based high-performance field-effect transistors and photovoltaic devices	35	3255	field-effect transistors	22; 11*	110; 35*
10	Highly enantioselective synthesis of spirooxindoles	22	1884	spirooxindoles	-	-

Table 8. Top 10 research fronts in physics. World data taken from [5]

Rank	Research Fronts	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citation (WoS; Scopus*)
1	Observation of Higgs boson	2	1905	Higgs boson	7; 2*	30; 16*
2	Global neutrino data analysis	12	2350	Neutrino data	-	-
3	Nonlinear massive gravity	32	1814	Massive gravity	-	-
4	The growth and properties of silicene	25	1859	Silicene	4; 3*	4; 9*
5	MoS2 and transistors	20	3147	MoS2	0; 1*	0
6	Spin-orbit coupled Fermi gases	43	3246	Fermi gases	-	-
7	Alkali-doped iron selenide superconductors AxFe2-ySe2	35	2995	Selenide supercond-uctors	-	-
8	Graphene plasmonics	15	1711	Graphene plasmonics	-	-
9	Topological Mott insulators	33	2326	Topological Mott insulators	-	-
10	Hydrodynamics of relativistic heavy ion collisions	29	2020	relativistic heavy ion collisions	-	-

Table 9. Top 10 research fronts in astronomy and astrophysics. World data taken from [5]

Rank	Research Fronts (changed)	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citation (WoS; Scopus*)
1	Sloan digital sky survey-III baryon oscillation	13	2103	Sloan digital sky	-	-
2	Extra-solar planet and accuracy radial velocity planet searcher	49	4450	Solar planet	-	-
3	Herschel Space Observatory performance	7	2122	Herschel Space Observatory	-	-
4	High redshift galaxies with space-based and groundbased observatories	24	2704	High redshift galaxies	-	-
5	The large area telescope on Fermi gamma-ray space telescope	11	2356	Space telescope	0; 2*	0

	performance					
6	Neutrino and antineutrino research with different approaches	17	1949	Neutrino	46; 5*	350; 36*
7	Galileon cosmology & Galileon field	18	1894	Galileon cosmology/ Galileon field	-	-
8	Solar atmosphere and magnetic field researches based on the observation from Hinode	26	4134	Solar atmosphere/magnetic field	-	-
9	Binary black hole and neutron star merger theory and observation	38	3786	Black hole/ neutron star	3; 2*	18; 5*
10	Theoretical and observational studies of star and galaxy formation	29	4983	Star formation	5; 1*	30; 5*

Table 10. Top 10 research fronts in mathematics, computer science and engineering. World data taken from [5]

Rank	Research Fronts (changed)	The World		Vietnam		
		Core papers	Citations	Keywods	Papers (WoS; Scopus*)	Citation (WoS; Scopus*)
1	Particle swarm and other optimization algorithms	41	961	Particle swarm algorithms	-	-
2	Biodiesel fuel performance and emissions	23	919	Biodiesel fuel	6; 6*	30; 70*
3	Modified couple stress theory	37	1174	Couple stress theory	-	-
4	Fuzzy Lyapunov method	36	1116	Fuzzy Lyapunov method	-	-
5	Coupled fixed point theorems in G-Metric Spaces	30	985	G-Metric Spaces	2; 0*	35; 0*
6	Applications of various difference equations	34	869	Difference equations	6; 6*	2; 25*
7	Predictive control in power electronics and drives	35	1167	Power electronics	1; 2*	1; 1*
8	Vanadium redox flow battery	22	1218	Vanadium redox flow battery	-	-
9	High-capacity electrodes for lithium-ion batteries	16	1004	Lithium-ion batteries	6; 2*	60; 5*
10	Entransy dissipation in heat exchangers	26	942	Heat exchangers	3; 2*	11; 0*

4. Research policies for Vietnam

As can be seen from the examples quoted in sections 3, Web of Science and Scopus are exponents of a trend in information management which provide more and more facts and figures to make better-informed decisions on how to manage the future research capacity at various levels. Elsevier, amongst others, offers the Pure Information-Management System for daily use in research management, combining new-generation SciVal® tools with rich data assets and customized analytical services. Such a tool can improve the ability to establish, execute and

evaluate institutional research strategy. At present most of these search and information systems are not open access tools, which means that substantial fees are involved. These database and corresponding bibliometric analysis are not only about where to put one's research money, but also about the image and reputation management of institutions and people nowadays. For developing countries, particularly for Vietnam that may be an issue, however, in due course more search systems and large scientific databases will be usable and accessible without intermediation of scientific publishers in the open access domain. In the case of Vietnam where the knowledge infrastructure is rapidly developing, and where many evolving plans for new universities, such research search systems may be very helpful to make the proper choices.

The bibliometrics analysis for whole sciences and social sciences offers a global view on the world research. However, it may be too broad and concentrates on top ten of hot research fronts only. It seems that the analyzed results are not so stable, but there are some fluctuations between two consecutive years. It needs narrower and deeper analyses for each area or additional information. For conclusion, nevertheless, the following remarks can be drawn.

Firstly, the classification of scientific fields, areas and or fronts should follow interdisciplinary approaches. This is only the ways that can integrate multidisciplinary knowledge to solve "non-traditional" problems of the recent epoch.

Secondly, thanks to the development of the scholar database, the research management at universities, research institutions, or even at higher governance levels (e.g. funding agencies, etc.) nowadays can change from the expert opinions based- to bibliometrics analysis based-decision making. This is a highly precise, objective, global and comparing view on the world of research. They help universities, funding agencies and governments to assess and manage the research performance and to set research strategies at various levels. They can also help to improve research efficiency and effectiveness, to find the best people, the best collaborators, to increase the impact in society and to enhance valorization and commercialization of research. In this case, the establishment of research support and bibliometrics analysis section, e.g. the experience of the Nanyang Technical University, would be a solution.

Finally, bibliometric analysis is very strong in supporting research strategy building, where one can find hot and key research fronts and rich innovation predictions of the world. This information leads us to good direction of investment for science and technology developments. In the case of lacking big strategists, we can look at the world tendencies and chose adaptable research fronts for Vietnam in order to reach the world leading like Asian countries focused on the biodiesel fuel last years. By this way, science and technology can become driving forces for the sustainable development of the country.

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Phân tích cơ sở dữ liệu khoa học và quản lý nghiên cứu

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Tóm tắt: Quản lý nghiên cứu khoa học truyền thống thường dựa trên hệ thống chuyên gia. Trong 10 năm qua, với sự phát triển của các hệ thống cơ sở dữ liệu học thuật của Web of Knowledge (Thomson Reuteurs), Scopus (Elsevier) and Google Scholar, việc phân tích số liệu trích dẫn đã mang lại cho các nhà khoa học ở các phòng thí nghiệm, viện nghiên cứu và trường đại học rất nhiều hữu ích. Đặc biệt, việc phân tích cơ sở dữ liệu học thuật còn cho phép thay đổi phương thức quản lý nghiên cứu khoa học và xây dựng chiến lược phát triển khoa học và công nghệ. Bài báo này cung cấp và thảo luận một số ví dụ của phân tích cơ sở dữ liệu khoa học, trong đó tập trung vào các hướng nghiên cứu ưu tiên; đồng thời giới thiệu 100 hướng nghiên cứu đang được nghiên cứu mạnh mẽ nhất trong các lĩnh vực khoa học tự nhiên và khoa học xã hội trên thế giới và so sánh tình hình nghiên cứu của trên các lĩnh vực tương ứng ở Việt Nam; cuối cùng, bài báo đưa ra một số đề xuất đổi mới chính sách quản lý nghiên cứu khoa học.

Từ khóa: Phân tích bibliometrics, quản lý khoa học, hướng nghiên cứu, tiến bộ công nghệ.