

Mapping of the Brazilian scientific production on Technology and Innovation Management in the period 2001-2011

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Abstract: The objective of this research was to map the Brazilian scientific production on Technology and Innovation Management (TIM) in the period 2001-2011. Specifically, it was intended to raise the following data: (i) number of articles published in the period, as well as in each of the years; (ii, iii, iv and v) number of articles published by journals, authors, institutions and states of the country. This identification is important, once literature has described that the development of TIM studies is a factor that helps countries to achieve higher levels of technological development (i) by making the national innovation system's agents (such as entrepreneurs, governmental policy-makers and researchers) more aware of the technology and innovation importance and their good practices of management and (ii) effectively making the change in their technological. This way, knowing the quantity and distribution of the national scientific production on TIM is important for governmental policy-makers in order to promote policies focused on increasing or better distribute the scientific production in the country, in order to make the country achieve higher levels of technological development. Knowing these aspects is also important for researchers, once they can help policy-makers in the elaboration of the mentioned policies or even because with this knowledge they can identify researchers and institutions that have stood out in this field and may be taken as reference, in any way, or as future research partners. From the results it was possible to identify that the Brazilian scientific production on TIM has been low in number of articles published in scientific articles and is has been too concentrated in terms of states and localities, factors that, according to the literature descriptions, hinder the dissemination and rooting of an innovation culture in the country.

Key-words: Technology and innovation management, Scientific production on TIM, S,T&I policies, Technological development, Socioeconomic development

Mapeamento da produo cientfica brasileira sobre Gesto da Tecnologia e da Inovao no perodo 2001-2011

Resumo: O presente trabalho teve como objetivo mapear a produo cientfica brasileira sobre Gesto da Tecnologia e da Inovao (GTI) no perodo 2001-2011. Especificamente, desejou-se levantar os seguintes aspectos: (i) nmero de artigos publicados no perodo, bem como em cada um dos anos; (ii, iii, iv e v) nmero de artigos publicados por cada peridico, autor, instituio e estado do pas. Esta identificao se mostra importante uma vez que a literatura tem descrito que o desenvolvimento de estudos na rea de GTI um fator auxilia os pas na disseminao do conhecimento de boas prticas tecnolgicas e conseqente enraizamento de uma cultura de inovao. Assim, conhecer como tem ocorrido a produo cientfica sobre GTI no pas um aspecto de relevncia para os agentes nacionais promotores de polticas de Cincia, Tecnologia & Inovao, os quais podem promover polticas para incentivar o aumento ou uma melhor distribuio da produo cientfica na rea, por exemplo. Tambm um aspecto de relevncia para pesquisadores, os quais podem auxiliar os agentes governamentais na elaborao de polticas adequadas, alm de poderem identificar autores e

instituições que tem se destacado na geração de conhecimento na área e que podem ser tomados como referência em algum aspecto ou serem visualizados como futuros parceiros de pesquisa. Dos resultados foi possível identificar que a produção científica brasileira na área tem sido pequena em número de artigos, além de estar majoritariamente distribuída somente nas regiões Sudeste e Sul, sendo estes aspectos que de acordo com a base teórica apresentada dificultam a disseminação de uma cultura de inovação e consequente desenvolvimento socioeconômico no país.

Palavras-chave: Gestão da tecnologia e da inovação, Produção científica em GTI, Políticas de C,T&I, Desenvolvimento tecnológico, Desenvolvimento socioeconômico

1. Introduction

It has been very stated in literature that in the current economic paradigms, in general, the countries whose companies has shown highest technological and innovator performance in the global market are those ones that have achieved highest levels of socioeconomic development (FLEURY; FLEURY, 1997; CARVALHO, 1999; MATTOS; GUIMARÃES, 2005; TIGRE, 2006; ANDREASSI, 2007; REIS, 2008).

Technology has become increasingly important for the countries' economy according as the world economy is more globalized. The countries whose companies develop products or processes that best meet the market needs in their segments tend to be self-sufficient in such segments, not depending on importations, besides being great exporters (ROZENFELD et al., 2006).

It causes a very great effect on the countries' economy, once their companies tend to grow, generate more jobs and better distribute income. In addition to this, a large number of exportations usually generates a great amount of taxes for the government, so that this capital may be invested in areas that promote and maintain human and entrepreneurial development, such as Education, Health, Security, Infrastructure and others.

Such development of products or processes that best meet the market needs and causes the described benefits is usually obtained through Research and Development (R&D) of new technologies or through only innovation, without any technological increment (FREEMAN; SOETE, 1997).

Because of this, an adequate Technology and Innovation Management is extremely important for the countries. Governments have financed the development of researches and technologies in their (and even in private) universities and research centers and encouraged their transference for national companies. They have also been financing directly the companies' technological and innovator projects (STAL, 1997).

This management of technology and innovation, at all these levels, from the development and transference in companies and universities to the financing and encouraging promoted by governmental policy-makers and financiers, have been studied, due to its importance, and, this way, has been established the field of study "Technology and Innovation Management" (TIM).

According to several authors, such as Teixeira e Mota (2012), the development and dissemination of TIM studies in the countries may make the country's NSI agents more aware of the technology and innovation good practices and may make they improve theirs.

Although the produced knowledge is, very frequently, global, due to its public use character when available in free access web pages, the existence of researchers and institutions in a

country which are concerned with the development of such studies is an extra factor that helps the dissemination and rooting of the studied practices.

This way, the literature about bibliometrics and scientometrics and also the literature about TIM has claimed that knowing how much a country has been producing on the TIM field (quantity) and how (territorial distribution, institutions, journals, authors, etc.) is an aspect of strategic importance for governmental technology policy-makers, once promoting policies for improving such aspects is relevant because they help on countries' technological development (BIN, 2008, MARICATO, 2010).

It is also important for TIM researchers, because with such information they can identify possible intuitions and authors that may be taken as reference in the TIM study or even being future partners of research. Besides, TIM researchers may use such information for, in their studies, helping governmental agents by elaborating adequate policies. At this point enters in question the governmental interest on scientific research (BIN, 2008, MARICATO, 2010).

Once in Brazil no identifications like this have been made and given the relevance of Brazilian economy, in this work we map the scientific production on TIM in Brazil, analyzing the period 2001-2011. We adopted this period for considering it significant of the recent Brazilian economic historical and also of the TIM field's growth in developing countries.

Specifically, it was intended to map the following data that enables to gain insights on/in the quantity and way that Brazilian TIM scientific production has been occurring: (i) number of articles published in the Brazilian journals in the whole period, as well as in each of the years; (ii, iii, iv and v) number of articles published by each journal, author, institution and state of the country.

2. Some considerations about Scientometrics on Technology and Innovation Management

As presented in the introductory section, it is an aspect of interest for governments and researchers to know how scientific production in a certain field has been occurring and how it has been used.

The field of study that is especially concerned with identifying such aspects has grown ground over the last years and has been named "Scientometrics".

Scientometrics studies, for example, aim to identify the number of scientific publications on a certain (or more than one) field of study in a certain period, its growth in the period, its citations and its distribution in the region/country analyzed (TAGUE-SUTCKIFFE, 1992; KADEMANI et al., 2012, p. 2).

Analyzing the performance of researchers and institutions in a certain field is also an interest of scientometrics. Furthermore, this field is also concerned with measuring the absorption and use of the knowledge that has been produced in a specific field and geographic coverage (TAGUE-SUTCKIFFE, 1992; KADEMANI et al., 2012, p. 2).

From such data, scenarios may be observed, forecasts may be elaborated and decisions may be made in order to achieve improvements (TAGUE-SUTCKIFFE, 1992).

With the generalist intent of measuring science, scientometrics is a very large field of study and several approaches may be carried and specialties identified in scientometrics' studies in accordance with the objective of the research.

In the presented research we had as objective to map the Brazilian scientific production on Technology and Innovation Management, given the importance of mapping such field.

In spite of the relevance of obtaining mappings like this, the conductors of the present research could find only a few mappings on TIM scientific production in global literature, for any type of country's or region's analysis.

That's important to notice that there's a great difference between mapping scientific production on a technological field or mapping it in the managerial field of Technology and Innovation Management.

Mappings of scientific production on technological fields generally are carried in order to, in last analysis, besides identifying major authors and institutions, gain insights in a country's or in a region's relations/dynamics between science, technology and innovation in such field. Such analysis may be base to elaborating policies that can enhance such dynamics which promotes economic and, as consequence, socioeconomic development.

Differently, mappings on Technology and Innovation Management like the one carried in this work, don't allow verifying Science, Technology and Innovation dynamics in specific fields, but they have a different focus. As TIM is a managerial field, the production on this field *is an indicator of the know-how the country owns in such managerial knowledge*. However, having this know-how doesn't mean it is practiced in the country. It must be executed.

Who carries the TIM researches and identifies better practices for the national TIM usually are TIM researchers and the agents that generally promote improvements in the national system of innovation are usually three other agents: (i) researches in technological fields that should be aware about the importance of practices as technology transfer, forecasting his country's industrial necessities in such field of study, etc.; (ii) the country's government or its agencies which are the agents that may implement improvement policies or programs with national range and (iii) the companies' staff which may become more aware of better technological practices and improve them within the companies' reach.

Furthermore, even when the national government is aware of better technological practices, it doesn't ensure such practices will be executed, once there are even the financial and managerial structure difficulties.

Anyway, knowing how the scientific production on TIM has been occurring in a country is significant once it is an indicator of the know-how the country has in such field and *this know-how is nearly a requirement factor for the country improvement of technological and innovative practices*.

This know-how may be given in terms of explicit knowledge in the scientific journals or even tacit knowledge mainly with those ones who study and generate such knowledge. Both, the journals and the researchers/authors (which are normally concentrated in institutions) are agents of dissemination of TIM knowledge. This dissemination is extremely important for making the country's agents more aware of technology and innovation relevance and then improve their practices.

This way scientific production in this managerial field is also an aspect that promotes socioeconomic development, since such knowledge has been properly spread and has been occurring knowledge transfer. Existing deficiencies in both, generation and transference of TIM knowledge, must be focus of governmental policies.

The aspect TIM knowledge transfer in Brazil is not measured in this work, which aims gain insights in the quantity and way this knowledge has been produced, but it is a gap of knowledge to be filled in future researches.

3. Material and Data

In order to obtain the aimed aspects about the Brazilian scientific production on TIM, it was adopted a scientometric method, according to the definition of scientometrics presented in the previous section.

Collecting articles from databases would not be an adequate method to achieve the objectives of this work, once it was intended to map the Brazilian general scenario on the TIM field and databases could limit the access to Brazilian journals that publishes articles on fields related to TIM.

This way, a more adequate method had to be developed. It consisted on collecting TIM articles directly from the Brazilian journals that publish works on the field of TIM.

Once authors like Cortês et al. (2005) and Tigre (2006) say that the generalist fields of Business Administration, Economics and Industrial Engineering are the three ones most concerned with the study of Technology and Innovation Management, it was selected the 51 Brazilian Journals with highest CAPES's scientific classification in such fields (equal or better than B4 in at least one of these fields, in a scale that includes the scores A1, A2, B1, B2, B3, B4, B5 and C) for mapping the Brazilian scientific articles published in the period 2001-2011. The journals with only scores B5, C or inexistent in the three mentioned fields were not taken as base, once it was considered that in such fields they have low scientific impact.

CAPES is the Brazilian coordination of post-graduation courses and research and their scientific journal's assessment is considered in the academic field to be reliable and coherent.

Once it was selected a group of journals that are significant of the Brazilian scientific production on TIM, it was necessary to adopt a method for obtaining TIM articles within such journals. The method consisted on inserting a group of key-words, related to TIM, in the search mechanism of each journal's web page. A total of 105 key-words were inserted in each of the journals' search mechanism.

Each search resulted in a certain number of sought articles or, in some cases, in zero articles. The titles of these articles were read and, in case of remaining doubt, their abstracts were read too, in order to indent whether each article was related to TIM or not.

The TIM articles were downloaded and subsequently their data like journal's name, year, authors, institutions and state of the country were inserted in a data bank, Microsoft Excel®, in order to make their classification and formulate the results.

4. Results

The five aspects mapped in the research are shown in the following subsections.

4.1 Number of articles published in the period

Through the mapping it was possible to count a total of 508 about Technology and Innovation Management published between 2001 and 2011 in the Brazilian scientific journals taken as base for this research. The number of articles published in each year of the period is shown in Figure 1.

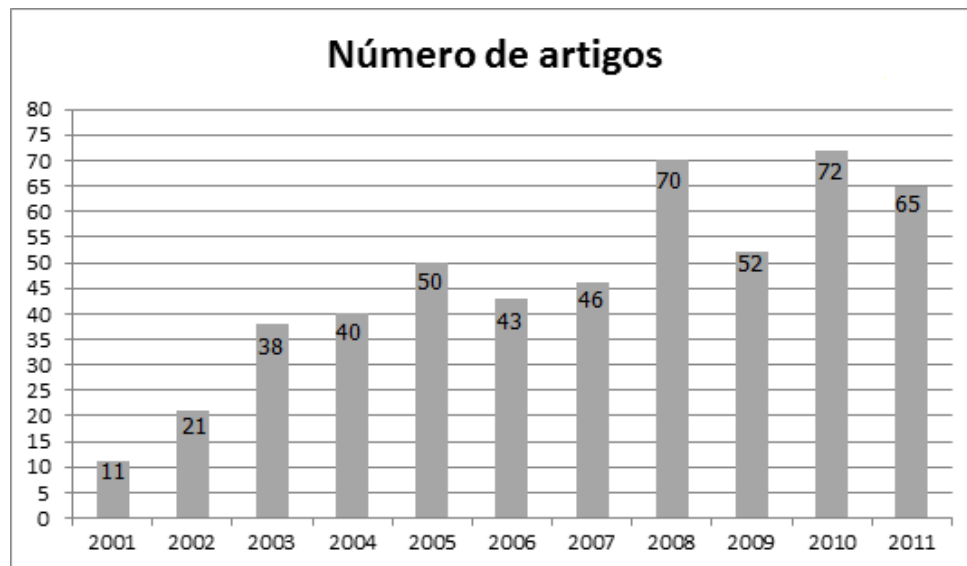


Figure 1 – Number of articles published about on Technology and Innovation Management between 2001 and 2011 in the 51 Brazilian Journals taken as base for the research

4.2 Number of articles published in each journal

It was noticed during the research that there are only two journals in Brazil that are specialized in the publication of TIM articles. They are *Revista Brasileira de Inovação* (Brazilian Journal of Innovation) and *Revista de Administração e Inovação* (Administration and Innovation Journal). As consequence, they were the two journals that most published TIM articles in the period.

The list of the number of TIM articles published in each journal in the studied period is shown in Table 1.

Journal	Number of articles	Journal	Number of articles
Revista Brasileira de Inovação	85	Revista de Estudos Econômicos	6
Revista de Administração e Inovação	46	Rev. de Administração Pública	5
Revista Eletrônica de Administração	32	Análise Econômica	5
Revista Ciências Administrativas	26	Revista de Administração FACES	5
Revista Gestão & Tecnologia	25	Estudos Econômicos	5
Gestão & Produção	21	Rev. de Adm., Contab. e Econ.	5
Produção Online	15	Rev. Bras. de Estudos Regionais e Urbanos	5
Revista Gestão Industrial	15	Gestão.Org	3
Produção	14	Economia Aplicada	3
Revista Brasileira De Gestão e Desenvolvimento Regional	14	Rev. de Administração da FEAD	3
Revista de Administração Contemporânea	14	Rev. Econômica do Nordeste	3
Revista de Administração da USP	13	Revista Bras. de Gestão Negócios	2
Revista de Ciências da Administração	12	Produto & Produção	2
Revista de Negócios	12	Revista de Economia Política	2
Revista Economia & Gestão	10	Nova Economia	2
Rev. de Administração de Empresas	9	Revista de Economia e Administração	2
Revista de Administração Mackenzie	9	Rev. Brasileira de Economia	1

Brazilian Administration Review	9	Revista de Estudos de Administração	1
Rev. de Desenvolvimento Econômico	9	Rev. Eletrônica Produção & Engenharia	1
Revista de Economia	9	Política e Sociedade	1
Econômica	9	Gestão & Planejamento	0
Organizações & Sociedade	8	Brazilian Business Review	0
Economia e Sociedade	8	Revista de Políticas Públicas	0
REGE. Revista de Gestão USP	7	Rev. Bras. de Estudos Urb. e Regionais	0
Revista de Economia Contemporânea	7		
Revista Portuguesa e Brasileira de Gestão	7		

Table 1 – Number of articles published on Technology and Innovation Management between 2001 and 2011 in the 51 mapped Brazilian journals

4.3 Number of articles developed by each author

The ranking of the authors that published more TIM articles in the period 2001-2011 is shown in Table 2. The whole ranking can be obtained with the authors, via e-mail.

Author	Institution	Number of articles
Paulo Negreiros Figueiredo	Fundação Getúlio Vargas (FGV)	11
Andréia Paula Segatto	Universidade Federal do Paraná (UFPR)	8
Eduardo Gonçalves	Universidade Federal de Minas Gerais (UFMG)	7
Ana Urraca Ruiz	Universidade Federal Fluminense (UFF)	6
Geciane Silveira Porto	Universidade de São Paulo (USP)	6
Renato Dagnino	Universidade Estadual de Campinas (UNICAMP)	6
Aline França Abreu	Universidade Federal de Santa Catarina (UFSC)	5
Ana Lúcia Vitale Torkomian	Universidade Federal de São Carlos (UFSCar)	5
Eduardo da Motta e Albuquerque	Universidade Federal de Minas Gerais (UFMG)	5
João Luiz Kovaleski	Universidade Tecnológica Federal do Paraná (UTFPR)	5
Marcelo Seido Nagano	Universidade de São Paulo (USP)	5
Milton de Abreu Campanário	Universidade Nove de Julho (UNINOVE)	5
Roberto Sbragia	Universidade de São Paulo (USP)	5
Wilson Suzigan	Universidade Estadual de Campinas (UNICAMP)	5
Dálcio Roberto dos Reis	Universidade Tecnológica Federal do Paraná (UTFPR)	4
Daniel Capaldo Amaral	Universidade de São Paulo (USP)	4
Eva Stal	Universidade Nove de Julho (UNINOVE)	4
Fabiano Maury Raupp	Universidade do Estado de Santa Catarina (UDESC)	4
Francisco Lima Cruz Teixeira	Universidade Federal da Bahia (UFBA)	4
Isabel Cristina dos Santos	Universidade de Taubaté (UNITAU)	4
José Vitor Bomtempo	Universidade Federal do Rio de Janeiro (UFRJ)	4
Luiz Paulo Bignetti	Universidade do Vale dos Sinos (UNISINOS)	4
Marta Araújo Tavares	Universidade Federal de Minas Gerais (UFMG)	4
Paulo Bastos Tigre	Universidade Federal do Rio de Janeiro (UFRJ)	4
Paulo Roberto Tavares Dalcol	Pontifícia Universidade Católica do RJ (PUC-RJ)	4
Sieglinde Kindle Cunha	Universidade Positivo (UP)	4
Simone Vasconcelos Ribeiro Galina	Universidade de São Paulo (USP)	4

Fonte: Autores

Table 2 – Authors that developed more articles about Technology and Innovation Management between 2001 and 2011 in the 51 mapped Brazilian journals

4.4 Number of articles developed by each institution

The ranking of institutions that have published more TIM articles in the period 2001-2011 is shown in Table 3. The whole ranking can be obtained with the authors, via e-mail.

Institution	Number of articles	Institution	Number of articles
USP	74	Embrapa	6
UFRJ	29	UFLA	6
UNICAMP	27	UFPB	6
UFMG	25	UFV	6
UFPR	25	UNITAU	6
FGV	24	Fund. Pedro Leopoldo	5
UFRGS	20	Ipea	5
UFSC	19	PUC-RS	5
UFSCar	17	UEM	5
UNINOVE	15	UFCE	5
UNISINOS	14	UNIFOR	5
UFF	12	Fund. João Pinheiro	4
UFPE	11	INPI	4
FURB	10	IPT	4
UTFPR	10	Mackenzie	4
PUC-MG	9	Petrobras	4
UFBA	9	PUC-RJ	4
UFJF	9	UECE	4
UFSM	8	UFCG	4
UFU	8	UNIFACS	4
UnB	8	Universidade Positivo	4

Table 3 – Institutions that developed more articles about Technology and Innovation Management between 2001 and 2011 in the 51 mapped Brazilian journals

4.5 Number of articles developed in states of the country

By knowing the accounting of articles developed by each institution and their location it was possible to count the number of articles published in each state of the country. This analysis is shown in Table 4.

State	Number of articles	State	Number of articles
São Paulo	190	Ceará	14
Minas Gerais	97	Paraíba	10
Rio de Janeiro	69	Distrito Federal	8
Paraná	53	Espírito Santo	3
Rio Grande do Sul	57	Alagoas	2
Santa Catarina	37	Goiás	2
Bahia	15	Pará	2
Pernambuco	15	Sergipe	2

Table 4 – Number of articles developed in Brazilian states

5. Concluding remarks

From the articles raising and from the mapped aspects it was possible to notice some significant aspects of the Brazilian scientific production on TIM that must be mentioned due to their important consequences to Brazil's technological and socioeconomic development.

The first observation from the mapped aspects is about the low number of TIM articles published in the period, once Brazil is a large country in terms of extent and population. 508 articles about TIM are considered a low number. It represents an average of only 46.18 articles per year or even 0.905 articles per year in each of the 51 mapped journals.

The second observation is that, besides being little, the development of TIM articles has been occurring in a very concentrated way, in an institutional analysis and, as consequence, geographically as well.

According to literature both mentioned factors may hinder the dissemination and rooting of an innovation culture in the country, breaking, therefore, the technological and socioeconomic development of the country.

This way, the present work elucidates that in Brazil specific governmental policies have been necessary (certainly to be executed by the Science, Technology and Innovation Ministry) in order to incentivize a higher scientific production in the TIM field and in a better distributed way.

Some appropriate measures could be encouraging the creation of more TIM specialty scientific journals, financing the post-graduation degree grants, in order to have more obtain more researchers in this field in the future, etc.

In addition to the scope of this work, literature has also shown the necessity for policies or programs that can encourage economic agents, as companies, to absorb the TIM knowledge that have been generated. Together with a significant and well distributed scientific on this field, its transfer will help ensuring the country's development.

Furthermore, a third observation, this one from the data collecting, is that in Brazil, among the 51 TIM's main journals, there are only two that have the English as the first language for articles' publication. It is an aspect that may hinder the exchange of experiences between TIM Brazilian Researchers and developed country's TIM researchers, which could bring valuable contributions to the Brazilian system of innovation.

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