



Critical Success Factors (CSF) to Commercializing Technologies in Universities: The Radar Framework

Jaqueline Vargas González^(✉) , André Luiz Zambalde ,
André Grützmann , and Thiago Bellotti Furtado 

Federal University of Lavras, Lavras, Brazil
javargon0101@gmail.com, thiagobellotti@gmail.com,
{zamba, andre5}@dcc.ufla.br

Abstract. Universities have been considered as potential sources of scientific development; therefore, they are involved in processes of Technology Commercialization (TC), associated with licensing and transfer to the market and/or society. The goal of this work is to develop and validate an instrument for the identification and analysis of the Critical Success Factors (CSF) in the commercialization of technologies in public Universities – radar framework. A bibliometric and systematic review, and interviews with specialists, provided a theoretical and empirical foundation that consider the process, mechanisms, ways, and means of commercialization, as well as the promotion and management of marketing policies. A Radar framework was built with four dimensions and explicit indicators to evaluate the CSF in public Universities. A framework contains enough elements to be used as an instrument to identify and analyze the CSF in the TC in Public Universities. The framework characteristics are especially useful for universities monitoring the factors for the improvement of the Technology Commercialization (TC) process, setting the groundwork for future studies related to this subject.

Keywords: Universities · Innovation · Technology transfer
Technology commercialization

1 Introduction

Nowadays, the research related to technology commercialization in Universities have been increasing. It is a complex process, fundament on the licenses concession, transferring and sells [31]. In [26] defined technology commercialization as the process of transferring a technology-based innovation from the developer of the technology to an organization utilizing and applying the technology for marketable products and bring benefits to the society.

Specifically, in the University context, the process of technology transfer is directly related to the commercialization of technology. From the specialized institutes to the business sector the transfer and commercialization of technology depend on the effects of the organizational and individual variables that compose them [45]. Because it is a multidimensional, complex, multidisciplinary and inter-organizational process, for its

monitoring and analysis it is necessary to take into account a large number of elements and factors [46].

In this way, for its proper understanding and analysis, it is necessary to take into account, elements central, which have been called critical success factors - CSF [32, 34]. In the context of universities and the commercialization of technologies (CT), CSF can be defined as a limited number of elements, factors or indicators, descriptive of strategic, culture, infrastructure and knowledge that must be considered in order to guarantee competitive performance and generation of value [4, 6, 26, 31, 37].

The CSF's offers effective support for the process of surveying, planning and monitoring information that can affect the competitive position of organizations, particularly when they are associated with instruments or models for evaluation and analysis [7]. In this sense, the main goals of this work were: (1) to carry out a systematic review of literature, associated with a review by specialists, on the CSF for the commercialization of technologies in Public Universities; (2) propose a model or instrument to measure these factors: A radar of the CSF; (3) describe a case study on the application of the CSF and the proposed radar framework in a public university of Brazil.

This research was organized as follows. First, the background and the context of commercializing technology in Universities is provided. Second, the theoretical definitions for this work are shown. Third, the methodology and the design of the investigation is described. As result, the radar framework with the critical success factors is proposed and applied in a case study. Also, research implications for future studies as well as for management practice are given.

2 Technology Commercialization – Background and Definitions

2.1 University, Intellectual Property and Innovation

In the era of knowledge economy, changing from classic university paradigm to Entrepreneurship University, associated to a Triple Helix model, is needed. The “third mission”, knowledge and technology transfer to the society [18, 23, 36], is being incorporated in the university context.

In this context, the key to the diffusion, competitiveness, and growth relies on a definition of Intellectual Property (IP) and its proper understanding. Intellectual property refers to the registration of inventions; literary and artistic works; and symbols, names, and images with the purpose of commercialization. Usually, this term (IP) is classified into two categories: (a) Industrial property: includes patents for inventions, trademarks, industrial designs and geographical indications; and (b) Copyright: covers literary works, films, music, artistic works and architectural design [50].

The concepts involved in IP are intimately related to the technology commercialization process (transfer, licenses and vending). This technology refers to a set of knowledge that generates and incorporates the products, processes, and services, subject to property registration or regulation [14].

The actors, cultures, and institutions participate and interact, from property regulation to innovation. As mentioned by [43], innovation refers to new products, new processes, new markets, new sources of supply or new organization of the sector, that generate economic and social value. Economic development is influenced by innovation through the dynamic process called “creative destruction” where new technologies replace the older ones. Radical innovations generate disruption, while incremental innovations allow continuous small changes [41].

In the [35], innovation means implementation of a new product (good or service), a new or significantly improved process, a new method of marketing, or a new organizational method in the business practice, in the internal organization or in external relationships. In a new perspective, “open innovation” requires the organizational capacity to access and adopt internal or external knowledge sources in a profitable way [13].

2.2 Technology Commercialization

The University can and must contribute to innovation by developing applied research and generating useful technologies to the society. Beyond that, it should, directly or indirectly, incorporate new technologies generated both on the public or productive sector. For this to happen, the university must pay close attention to the technology commercialization process [9, 14].

In a recent literature review, the following approaches to CSF were found: Technology knowledge and innovation [28]; Technology commercialization [11, 22]; Knowledge Transfer [44, 51].

According to [40], commercialization refers to transference, a process where a country, an organization or industry adopts a technology made by another. For [15, 25], it constitutes an acquisition, development, and use of technological knowledge of a country. It is a shift of know-how, technical knowledge or technology from one environment to another [39]. Commercialization or transference refers to a process where ideas and concepts move from laboratory to a market and to the society. Technology commercialization process can be understood as the result of constant interaction among actors and heterogeneous sources. Therefore, the meaning of technology commercialization is wide and it has been discussed for a long time.

Universities can implement technology commercialization through sales, interchanges, transferences, and licenses, using specific features (incubators, spin-offs, startups, innovation on request, production, direct sales); shared media (strategic alliances, joint ventures) and through third parties (license of intellectual property assets and franchises). In this scenario, universities or research centers are suppliers and companies that produce goods and services are the customers. Everything happens in exchange for a paid rate [30, 31].

Many universities have Technology Transfer Offices (TTO) or Office for Technology Transfer (OTT) to manage the technology commercialization process. These TTOs/OTTs are created to promote the register and commercialization of useful technologies to the industries, governments, and society.

In Brazil, TTOs are denominated Innovation Technology Centers (Núcleos de Inovação Tecnológica - NIT). They are institutional sectors created to manage the

intellectual property and create and promote the commercialization of research results. The NITs are particularly important to the Brazilian innovation system, since government-funded R&D in Brazil accounts for more than 63% of the total, while private capital contributes with 37% of R&D funding. A World Bank study about development, technology, and innovation notice that Brazil shows low rates transforming R&D into commercial applications, what could explain the weak collaboration among companies and universities. Hence, it is fundamental to look for understanding in the practices of technology commercialization in Brazilian Universities [20, 34].

2.3 Critical Success Factors (CSF) and Innovation Radar Chart

CSF's are internal or external aspects that should be considered by the organization to define its scope or objectives [17, 19]. Historically the CSF's answer the question "where we should focus?". When they are identified and managed, they can have a significant impact on the organization's success [5].

The identification of the CSF's is essential to the analysis of business environment, resources, and strategies. This identification must be according to the business sector, industry, and institution, so that the critical factors can help to build metrics, analyses decision or priorities [24, 29, 38].

CSF's of technology commercialization can be understood as a limited number of indicators that, if proven, will ensure an organization competitive performance [8, 27]. According to the literature, a "radar chart" is the instrument commonly used to measure the indicators. [42] propose a "radar of innovation" framework that represent twelve dimensions to measure the business innovation. These dimensions or indicators are connected with four principal axes and each dimension represents different ways to innovate.

In [12] a radar chart was tested in order to confirm its easiness of use. The authors consider that the innovation radar could help the companies to perform innovation auto-diagnosis and to identify innovation opportunities when comparing results with competitors. Also, [47] discussed the development of a framework to measure innovation. This framework is based on research of (i) [47] - PwC Wheel of innovation Excellence; (ii) [42] - Innovation radar; (iii) BCG - Senior management survey [1, 33, 42].

A framework must focus on the importance of organization strategy linked to the innovation process [47]. Results must be presented on a simple chart in order to facilitate adoption, use and understanding. The questions related to the performance indicators must be structured in different levels, in order to make the measure easier. The framework must measure tangible and intangible innovation aspects.

Finally, through innovation radar, the framework describes an innovation dashboard based on six indicators: collaboration, commercialization, concept, leader, success, and talent [47].

The radar framework associated with the CSF's and an effective measuring methodology can help the organizations to identify threats and opportunities, weaknesses and strengths in order to prioritize factors. Then, this work intends to propose a model to validate CSF associated with technology commercialization.

3 Data and Method

This work is a qualitative case study based on Systematic Literature review (SLR) and experts review. A SLR consists in searching, studying and analyzing previous studies to develop a better understanding of a particular subject. An expert review aims to gather opinions to validate knowledge on a given research topic. In this study, the SLR focused on CSFs for technology commercialization in the Brazilian public university context. For the experts review, key people from universities were asked to review the results of the SLR. The results allowed them to refine data and propose an instrument consisting of questions related to CSFs for technology commercialization to be used in the case study. It is worth mentioning that a qualitative case study allows to deepen the understanding on CSFs from the reality of a chosen organization.

SLR (Table 1) helped identify the most cited papers and their authors, countries and journals with a higher number of publications related with technology commercialization. The timeframe was from 1990 to 2016, claring the US Bayh-Dole Act influence. The articles were analyzed to verify useful contributions to the subject, focusing on the success factors. The following categories were found: Management and Strategy, Organizational, Technical and Individual. Each category has CSFs related to technology commercialization.

Table 1. Research Systematic Literature Review (SLR) process

Purpose	Identify the success factors of technology commercialization
Survey data	699 papers (127 selected and 572 discarded papers)
Selected data (responded)	127 papers
Method	SLR (Systematic Literature Review)
Timeframe	1990–2016
Keywords	Technology transfer, technology commercialization, University*, licensing and patents (Languages: English, Portuguese and Spanish)

The study allowed them to identify the critical factors affecting technology commercialization success. In addition, experts were asked to analyze the factors and the proposed categorization from the literature review.

In the first round, five professionals from a Brazilian public university Innovation Technology Center were contacted: two professors, two researchers and one technical manager. The experts were selected based on the following criteria: (a) doctorate degree, (b) research line related to this work, and (c) availability and interest to contribute to this research. Each professional agreed to receive an instrument consisting of open-ended questions concerning to CSFs and its categories. A content analysis [3] was performed on the written opinions and suggestions of the experts.

In the second round, ten experts were asked to analyze and validate the categories and the critical success factors. All of them are teachers in a Brazilian public university located in Minas Gerais, Brazil. The contributions of each specialist were transcribed and analyzed using the content analysis techniques proposed by [3]. The results were

refined resulting in the Critical Success Factors presented at Table 2 (Sect. 4.1. Results and discussion) and in the variables showed on Table 3 (Sect. 4.2. Results and discussion). Following, the radar chart presented in Fig. 1 (Sect. 4 Results and discussion) was proposed.

An instrument for data collection was built based on the previous data. Each factor was split up in two questions using the Likert-scale. A questionnaire was used to perform the case study in this research (the questionnaire can be found at <http://bit.ly/2KKoudk>). In future studies, the instrument will be used for data collection from a larger number of Brazilian public universities.

4 Results and Discussion

4.1 CSF Systematic Literature Review

The Critical Success Factors for the technology commercialization in public universities were elaborated from a literature review process (Table 2).

Table 2. Critical success factors (CSFs) for the technology commercialization in public universities.

Categories	Factors
Management and strategy	Licensing strategies
	Technological transfer mechanisms
	Intellectual property rights
	Companies creation
Organizational	University, institutional, governmental policies
	Business experience
	Business development culture
	Culture of innovation
Technical	Understanding technological needs
	Nature of technology
	University-business liaisons
	Attributes of technological inventions
Individuals	Scientific quality
	Technological aptitude
	Individual characteristics of researchers
	Research reputation

The categories and their supporting authors are presented below:

- A. Management and strategy: strategies, processes, mechanisms, and structure for technology commercialization in the universities [16, 26, 48, 49];
- B. Organizational: managerial and political aspects in addition to the culture towards innovation and commercialization [2].

- C. Technicians: nature of technologies and market needs [21, 26, 27];
- D. Individuals: characteristics related to the knowledge domain and profile of the teachers, students, and technical staff [10, 12, 21, 26, 28, 52].

4.2 Experts Review and Radar Chart

The CSFs from the literature review were submitted to experts from Knowledge Management, Entrepreneurship, Innovation, and Marketing areas for analysis and revision. The specialists analyzed the terms correctness and the factors' appropriate validity and categorization. Also, experts were asked to propose changes or additions to presented factors and categories. In this sense, after the experts reviews a new table was created (Table 3) containing categories, acronyms, factors, and names for the variables to be used in the data collection instrument.

Table 3. CSFs for technology commercialization in public universities after experts review.

Category	Acronym	Factors	Variables
STRATEGY AND MANAGEMENT	SAM	Public and governmental policies	SAM01
		Strategy and strategic planning	SAM02
		Top management involvement	SAM03
		Intellectual property	SAM04
CULTURE AND STRUCTURE	CAS	Organizational culture	CAS01
		Entrepreneurial training	CAS02
		Technology support	CAS03
		Entrepreneur support	CAS04
MARKET AND TECHNOLOGIES	MAT	Market orientation	MAT01
		University-industry relationship	MAT02
		Quality and applicability of technologies	MAT03
		Diffusion of technologies	MAT04
INDIVIDUAL COMPETENCES	ICO	Scientific production reputation and quality	ICO01
		Innovation know-how	ICO02
		Researchers entrepreneurial profile	ICO03
		Real world problem-solving competences	ICO04

After defining categories, factors and variables, the framework “CSFs for technology commercialization in public universities” (Fig. 1) was proposed. The framework consists of 16 variables that will help to perform the case study. The radar chart will be created from field data collected using the questionnaire. Each variable has a set of closed-ended questions using a five points Likert scale (1 - Totally disagree to 5 - Totally agree).

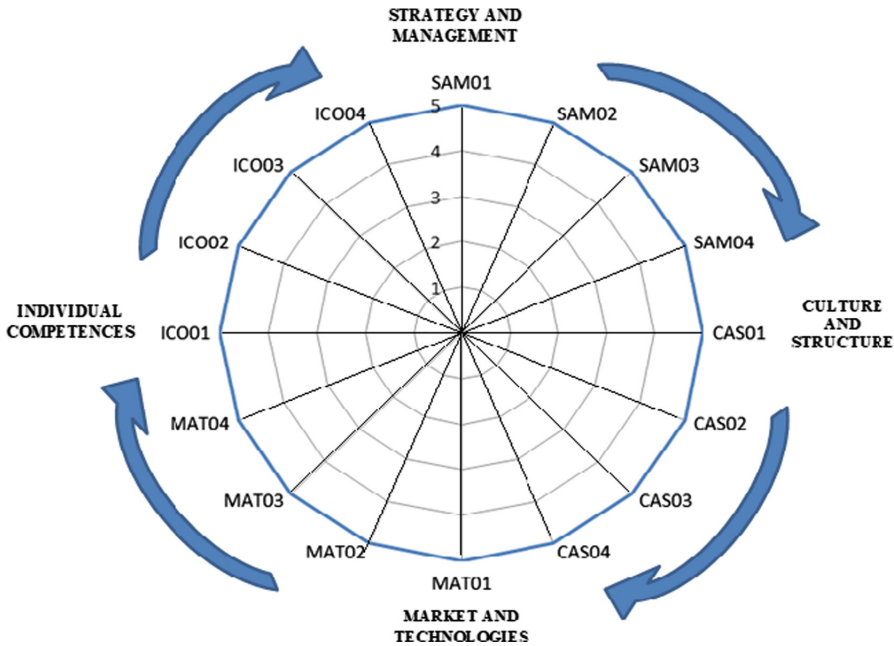


Fig. 1. CSFs for technology commercialization in public universities (radar chart).

4.3 Case Study – Brazilian Public University

The case study was conducted from January to February 2018 within an Office for Technology Transfer (OTT) in a Brazilian public university located in Minas Gerais, Brazil (called University 1).

4.4 Office for Technology Transfer

The OTT is the department responsible for the policies of technological innovation and the intellectual protection of the knowledge generated within the university. It is linked to the research process, collaborating with professors, researchers, and technical staff. One of its main objectives is to disseminate the importance of the research in the University 1. The structure of Office for Technology Transfer at University 1 is the following: General Coordinator, Intellectual Property Coordinator, and Technological Park Coordinator.

In accordance to the industrial property laws, University 1 elaborated a resolution of the Board of Education, Research and Extension which governs its intellectual property policy. This resolution provides characteristics for determining the ownership and profits division from technology transfer within University 1.

4.5 CSFs Radar in OTT-University 1

Figure 2 shows the opinion of the five respondents from the OTT at University 1 regarding the CSFs categorization and its items.

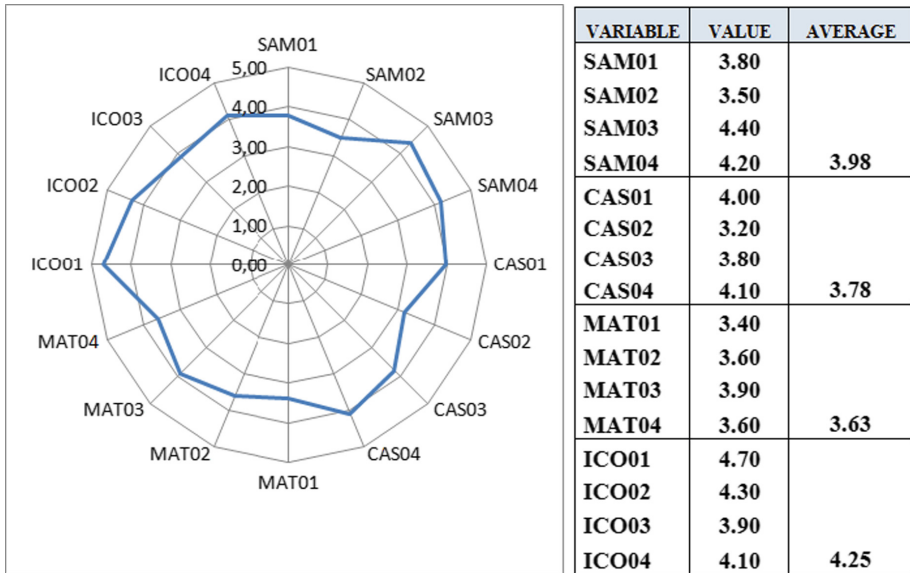


Fig. 2. CSFs radar of the University 1.

The results of CSF in OTT-University 1 show that the highest value is associated to ICO01 (Scientific production reputation and quality) and the low value item is the CAS02 (Entrepreneurial training). In the category Strategy and Management (SAM) the Organizational strategy (SAM02) was the lowest average, while the highest average was the Top management involvement (SAM03). The Culture and Structure lowest value was Entrepreneurial training (CAS02) and the highest was Entrepreneur support (CAS04). For Market and Technologies the lowest average was Market orientation (MAT01) and the highest was Quality and applicability of technologies (MAT03). In the category Individual Competencies, the lowest average was Researchers entrepreneurial profile (ICO03) while the highest was scientific production reputation and quality (ICO01).

The highest average was found in the Individual Competencies category, which can indicate that the human factor is key to develop technology commercialization. Scientific production reputation and quality (ICO01) it is considered of special importance by respondents. They mentioned that the university reputation can work as a brand that shows trust to society and to the organizations.

5 Conclusion

The main research goal was to present an empirically validated framework of CSFs for technology commercialization in public universities. After a systematic review of literature and an experts review, CSFs radar was described to be used in a case study.

The data analysis allowed knowing the perception of respondents about the pertinence and relevance of the CSFs categories proposed in this work. The radar chart provides a graphical view of the data. This chart can be used by a public university to map out its situation and compare to other institutions.

The CSFs categories and subcategories definition showed good results, according to the respondents perception. This was evidenced by the scores awarded to each subcategory, thus those scores were used to find out the average of each category.

The literature review found no previous research that uses the radar chart for the analysis of CSF for technology commercialization. Nevertheless, the results of this study can be used for further research.

The ability to visualize the institution's situation concerning CSFs is one of the reasons and motivations pursued when identifying CSFs. Also, this study provides an opportunity to provide tools to monitor strengths and weaknesses, gather information that can help improvements, and adapt procedures. Besides those, increased competitiveness and grounds to formulate strategies and tools towards decision-making are desired.

Although beyond the scope of the current research, the analysis of CSF can provide substantial knowledge to manage the initiatives of the universities OTTs. The proposed radar framework need additional experimental tests and analysis to map out the technologies commercialization capabilities. By using the CSF framework, the Universities can focus on particular aspects of their technology commercialization capabilities through the efficient use of the scarce resources of the organization. Thus, the OTTs can identify items and categories of the CSF framework that need improvements. Monitoring of how organizations improve their technology commercialization capabilities can add value to innovation research.

This work come with its limitations given the small number of respondents in a single institution from a specific country. However, an extension to the study is planned with more universities in Brazil and Mexico, so internal and external validity can be tested in a large and heterogeneous sample.

Acknowledgments. The authors would like to thank the National Council for Scientific and Technological Development (CNPq - Brazil) - Process CHSSA 444072/2015-2, the Minas Gerais State Foundation for Research Development (FAPEMIG-MG-Brazil), and the Organization of American States (OAS-COIMBRA) for the financial support.

References

1. Andrew, J.P., Haanaes, K., Michael, D.C., Sirkin, H.L.: *Measuring Innovation 2009: The Need for Action – A BCG Senior Management Survey*. The Boston Consulting Group (2009). www.bcg.com/documents/file15484.pdf
2. Antonites, M.: Assessing antecedents of entrepreneurial activities of academics at South African Universities. *Int. J. Innov. Manag.* **20**, 1650058 (2016)
3. Bardin, L.: *Análise de Conteúdo-Content Analysis*. Edicoes, Lisbon (2006)
4. Bortolussi, S.: *Gestão de propriedade intelectual em Universidades: Análise do desempenho da Universidade Federal de Minas Gerais no processo de Transferência de Tecnologia*. Encontro nacional de Engenharia de Produção. Fortaleza, Brasil, Outubro de 2015
5. Bullen, C., Rockart, J.: *A prime on critical Success Factors*. Center for Information Systems Research Sloan School of Management No. 69, Massachusetts Institute of technology (1981)
6. Calderón-Martínez, G.: Patentes en Instituciones de Educación Superior en México. *Revista de la Educación Superior* **43**(170), 37–56 (2014)
7. Caralli, R.: *The critical success factors method: establishing of foundation for enterprise security management*. Technical report CMU/SEI-2004-TR-010-ESC-TR-2004-010 (2004)
8. Carayannis, E.A.: Technology commercialization in entrepreneurial universities: the US and Russian experience. *J. Technol. Transf.* **41**, 1135–1147 (2016)
9. de Lima, C., Rochade, O.: Análise do radar da inovação no segmento de bares e restaurantes da região metropolitana de Natal-RN. *Revista Eletrônica de Ciências* **9**(3), 175–193 (2016)
10. Chang, Y.C.: The determinants of academic research commercial performance: towards an organizational ambidexterity perspective. *Res. Policy* **38**, 936–946 (2009)
11. Chatterjee, D., Sankaran, B.: Commercializing academic research in emerging economies: do organizational identities matter? *Sci. Public Policy* **42**, 599–613 (2015)
12. Chen, J.: *Defining and measuring business innovation: the innovation radar*. Kellogg School of Management Working Paper (2010)
13. Chesbrough, H.: *Managing Open Innovation in Large Firms*. Fraunhofer Institute for Industrial Engineering, Stuttgart (2013)
14. De Benedicto: *Apropriação da inovação em agrotecnologias: estudo multicaso em Universidades Brasileiras*. Tese (Doutorado em Inovação) UFLA (2011)
15. Derakhshani, S.: Negotiating technology transfer agreements. *World Exec. Dig.* **8**(5), 47–49 (1987)
16. Dias, A.A.: Como a USP transfere tecnologia? *Organizações Sociedade* **21**, 489–507 (2014)
17. Didriksson, A.: La universidad desde su futuro. *Pro-Posições* **15**, 63–73 (2004)
18. Etzkowitz, H.: The evolution of entrepreneurial university. *Int. Technol. Glob.* **1**, 64–77 (2004)
19. Ferguson, C.R., Dickinson, R.: Critical success factors for directors in the eighties. *Bus. Horiz.* **25**(3), 14–18 (1982)
20. Fernandes Jr., O., Oliveira, E.: *A inovação faz a diferença - Como o Brasil pode tirar melhor proveito das pesquisas tecnológicas*. In: *Desafios do desenvolvimento*. BNDES, Brasília-Brasil (2007). http://ipea.gov.br/desafios/index.php?option=com_content&view=article&id=1466:catid=28&Itemid=23
21. Fukugawa, N.: Knowledge creation and dissemination by Kosetsushi in sectoral innovation systems: insights from patent data. *Scientometrics* **109**, 2303–2327 (2016)

22. Goldstein, H.B.: University mission creep? Comparing EU and US faculty views of university involvement in regional economic development and commercialization. *Ann. Reg. Sci.* **50**, 453–477 (2013)
23. Gómez, J., Mira, S.I.: Las Spin Offs Académicas como vía de Transferencia Tecnológica. *Economía Industrial* **366**, 61–72 (2007)
24. Jk, L., Av, B.: Identifying and using critical success factors. *Long Range Plan.* **17**(1), 23–32 (1984)
25. Kanyak, E.: *Transfer of Technology from Developed Countries: Some Insights from Turkey*. Quarum Books, Westport (1985)
26. Kirchberger, M.A., Polh, L.: Technology Commercialization: a literature review of success factors and antecedents across different contexts. *Technol. Trans.* **41**, 1077–1112 (2016)
27. Kumar, U.U.: Critical success factors in technology transfer from government laboratories to private sector: a study based on Canadian Federal Government Departments. In: ASAC (2007)
28. Lee, J.: University reputation and technology commercialization: evidence from nanoscale science. *J. Technol. Trans.* **41**, 586–609 (2016)
29. Martins, H.: Metodologia qualitativa de pesquisa. *Educação e Pesquisa*, São Paulo **30**(2), 289–300 (2004)
30. Medellín, E.: *Construir la Innovación: gestión tecnológica en la empresa*. SigloXXI, México (2013)
31. Molero, K.: *Comercialización de tecnología como estrategia del consejo de fomento en la Universidad del Zulia*. Trabajo de grado presentado como requisito para obtener grado de Magíster Scenciarium en Planificación, p. 147, Maracaibo (2013)
32. Morioka, S.: Análise de fatores críticos de sucesso de projetos em uma empresa de varejo. *Trabalho de Formatura - Escola Politécnica da Universidade de São Paulo*. Departamento de Engenharia de Produção, São Paulo, Brasil (2010)
33. Morris, L.: *The innovation master plan: the CEO's guide to innovation*. Innovation Academy, Walnut Creek (2011)
34. Oliveira, H.V., Sá, V.C.: Identificação e análise dos fatores críticos de sucesso: o caso da Master Produções e Eventos. *Revista de Administração de Roraima - RARR*, Ed 2, vol. 1, pp. 41–66. Boa Vista - RR - Brasil, 1º. Sem 2012 (2012)
35. Oslo Manual: Guidelines for collecting and Interpreting Innovation Data: Directrices para la recogida e interpretación de información relativa a Innovación. OCDE y Eurostat, Madrid: Comunidad de Madrid Consejería de Educación Dirección General de Universidades e Investigación de información relativa a Innovación (2005)
36. Padilla, D.Á.: Factores determinantes de la transferencia tecnológica en el ámbito Universitario. La perspectiva del investigador. *Dialnet, Economía Industrial*, pp. 91–106 (2010)
37. Pérez-Hernández, P., Calderón-Martínez, G.: Análisis de los Procesos de Comercialización de tecnología en dos Instituciones de Educación Superior Mexicanas. *J. Technol. Manag. Innov.* **9**, 196–209 (2014)
38. Rockart, J.: Chief executive define their own data needs. *Harv. Bus. Rev.* **57**(2), 81–93 (1979)
39. Roessner, J.D.: What companies want from the federal labs. *Issues Sci. Technol.* **10**(1), 37–42 (1993)
40. Rogers, E.M.: *Diffusion of Innovations*, 5th edn, p. 2003. Simon & Schuster, Inc., New York (2003)
41. Sabater, J.G.: *Manual de Transferencia de tecnología y Conocimiento*. Instituto de transferencia de tecnología y conocimiento, España (2010)

42. Sawhney, M., Wolcott, R.C., Arroniz, I.: The 12 different ways for companies to innovate. *MIT Sloan Manag. Rev.* **47**(3), 75–81 (2006)
43. Schumpeter, J.: The theory of economic development (s.d.). <https://books.google.com.br/books?id=-OZwWcOGewC&printsec=frontcover&hl=es#v=onepage&q&f=false>. Transaction Publishers, United States of America (2004, tenth printing)
44. Siegel, D.S., Wright, M., Lockett, A.: The rise of entrepreneurial activity at universities: organizational and societal implications. *Ind. Corp. Change* **16**, 489–504 (2007)
45. Silva Santiago, C.V.: Análisis de los factores que influyen en el éxito de la transferencia tecnológica desde los institutos tecnológicos a las Pymes: los casos de España y Brasil. *J. Technol. Manag. Innov.* **1**, 57–70 (2006)
46. Sira, S.: Letter to the editor: factors affecting the university technology transfer processes to promote effective and efficient interaction with external sectors. *Revista Ingeniería UC* **23**(2), 223–236 (2016)
47. Skerlj, T.: Measuring innovation excellence: measurement framework for PWC's wheel of innovation excellence concept (s.d.). In: *Human Capital without Borders: Knowledge and Learning for Quality of Life; Proceedings of the Management, Knowledge and Learning International Conference*, pp. 221–229. ToKnowPress (2014)
48. Suvinen, N.K.: How necessary are intermediary organizations in the commercialization of research? *Eur. Plan. Stud.* **18**, 1365–1389 (2010)
49. Valente, L.: Hélice tripla: metáfora dos anos 90 descreve bem o mais sustentável modelo de sistema de inovação. *Conhecimento Inovação* **6**, 6–9 (2010)
50. WIPO: Acesso em Feb de 2017 (s.d.). What is Intellectual Property. http://www.wipo.int/edocs/pubdocs/en/intproperty/450/wipo_pub_450.pdf
51. Wood, M.: Does one size fit all? The multiple organizational forms leading to successful academic entrepreneurship. *Entrep. Theory Pract.* **33**, 929–947 (2009)
52. Wu, Y.W.: Commercialization of university inventions: individual and institutional factors affecting licensing of university patents. *Technovation* **36**, 12–25 (2015)