

Concepts and Criteria for the Characterization of the Entrepreneurial University: A Systematic Literature Review

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Abstract—Due to the current scenario of economic and technological development based on knowledge and innovation, young entrepreneurs and startups have become a key characteristic on the markets. Universities, in turn, assume the role of entrepreneurs when they create new ventures from teaching and research efforts and start to become relevant for regional economic e technological development. This paper presents the different aspects of the ‘Entrepreneurial University’, highlighting among the literature different approaches about its concepts and criteria for characterization. The study was conducted from a systematic literature review on scientific bases. A total of 361 papers were found, and after applying filters, 80 of these were analyzed. As a result, are presented quantitative analysis about the bibliographic production, and the main concepts present in the literature. Thus, this article contributes to a better understanding of what entrepreneurial universities are, and how it is possible to characterize them.

Index Terms—Entrepreneurial university, innovation, literature review, academic entrepreneurship, higher education.

I. INTRODUCTION

Against the background of the knowledge-based economy, in which the creation and use of knowledge is the central aspect of the decisions and economic growth [1], universities began to take on a greater role for the economic and social development of countries [2]. It should be noted, in the current model of economic development, that regions with greater capacity of technology, innovation and knowledge development, began to show greater prosperity in economic and social indicators [3]. As a consequence, policies for creating innovation clusters have intensified in various parts of the world. In these environments it should be noted that universities play a strategic role as one of the main sources of knowledge and innovation [4].

The creation and maintenance of these clusters, or “innovation regions”, have become object of study by the Academy, and widely disseminated within the regional and national public policy. From the 1990’s, a number of authors have addressed the theme of national systems of innovation, describing best practices and comparing the different systems of national innovation policies. In this context, [5]-[7] guided a series of authors who began to discuss the matter.

These authors put public (State) and industrial policies as main propulsion of innovation systems. Later, the approach of the ‘Triple Helix’ was based on the perspective of the university as an inducer of relations with business (productive sector of goods and services) and the government (regulatory sector and developers of economic activity), aimed at producing new knowledge, technological innovation and economic development [8].

Universities in the Triple Helix model are agencies of knowledge production, education and extension, which are characterized as entrepreneurs. The concept of Entrepreneurial University (EU) refers to a proactive posture of the institutions to transform knowledge generated in aggregate economic and social value. This concept reflects the expansion of the traditional role of Academia, from conservation (education) and creation (research) of knowledge, to incorporate the economic development function, by the dissemination of knowledge [9].

The phenomenon of entrepreneurial universities has gained attention from academia, government and private institutions [10]. A mapping of the progress of studies on the subject was conducted by [11], highlighting the main authors [12]-[17]; and empirical studies performed in Australia, Canada, China, Germany, Italy, Netherland, Singapore, Sweden, Thailand, United States, and other countries between 1995 and 2008 to explain the phenomenon of entrepreneurial universities, noting the expressiveness of the subject both in academia and public policy.

Considering innovation systems and the role of entrepreneurial university to regional development, and in order to identify the main features that make a university more or less entrepreneurial, this study will seek to answer two main questions: (i) How to conceptually understand the Entrepreneurial University from the major academic discourses on the subject? (ii) What are the key elements or criteria that characterize an entrepreneurial university?

This study aims to answer these questions by performing a systematic review in scientific journals and, from the reference literature mapping, build a conceptual framework to identify the characteristics that contribute to an entrepreneurial profile of universities.

II. ANALYSIS OF LITERATURE PRODUCTION

The literature review was performed in journals of Scopus bases, ISI (Web of Knowledge) and Engineering Village, accessed via the portal Capes - the journal database of the Coordinating Center for the Improvement of Higher

Manuscript received May 19, 2018; revised August 9, 2018.

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Education Personnel (CAPES in the Brazilian Portuguese acronym). These bases were selected due to its comprehensiveness and its recognition as sources of dissemination of scientific knowledge.

The review was limited to the use of information sources, using only scientific journals and thereby excluding information from the “gray literature”, such as professional journals (industry magazines), industry magazines, textbooks, working papers and conferences, which, according to the author, it is a procedure generally used in the literature for studies that aim to conduct systematic reviews of the literature on a particular topic. The concentration on scientific journals is justified by the fact that they are generally used by academics and professionals to acquire knowledge and disseminate new results, representing the highest level of investigation [18].

A. Research Design

In terms of methods, this research was divided into four stages: planning, exploration, refinement and analysis. The planning stage was initiated after the preliminary reading of a few papers and definition of the research problem, related to the theme of entrepreneurial universities. The objective was to define the keywords and databases for conducting the survey of the literature.

The second stage (exploring) was held from the access to the CAPES journal portal, which allows access to the SCOPUS, ISI Web of Science and Engineering Village scientific basis. This step resulted in the selection of a total of 361 distinct papers on the topic.

The third stage, refinement, filtered first papers which were available for download from CAPES portal. Of the total number of papers found, 277 were available. The second filter was made from the analysis of the abstracts and evaluation of the relevance of the paper about the goals of this research. The result of this second application filter was the observation that 118 papers were not relevant to the survey, 79 papers had some relevance, but did not provide significant contributions and, finally, 80 articles that were extremely relevant to the research.

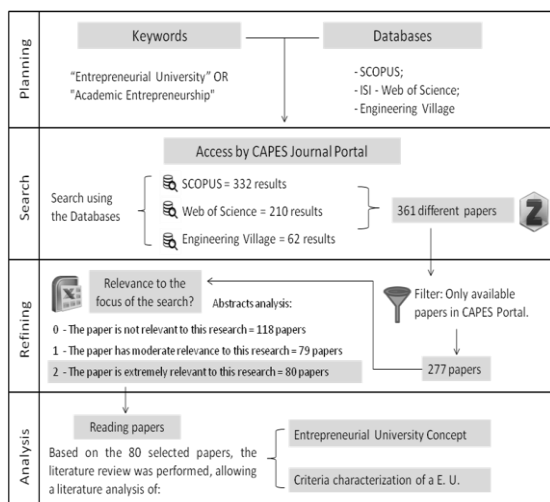


Fig. 1. Research process.

The last stage consisted of the reading and analysis of 80 selected papers, identifying approaches in the literature on the

concept of entrepreneurial universities and features (or attributes). Finally, this method allowed the systematization of these conceptual approaches and the definition of a panorama for analysis of the profile and characteristics of entrepreneurial universities. Fig. 1 presents a summary of the methods used.

B. Data Source

As shown previously, the research was performed in SCOPUS databases, ISI Web of Science and Engineering Village. The first step was to perform a search in databases using the phrase ("entrepreneurial university" OR "academic entrepreneurship") into titles, summary or keywords. This research was limited to journal papers, as a strategy to exclude the documents called “gray literature”. There were no assigned restrictions at the time of publication or area of knowledge. The execution of this first step resulted in 331 papers in SCOPUS, 217 in the ISI Web of Science and 64 in Engineering Village.

It is worth noting that in compiling this result, with the support of software Zotero, duplicates of existing items were eliminated. It was verified that 50 papers were present in the 3 bases considered; the 210 papers of the ISI Web of Science, 171 were available in SCOPUS, and all papers in the Engineering Village were also in SCOPUS. Fig. 2 presents a detailing of the quantitative results of the search in databases.

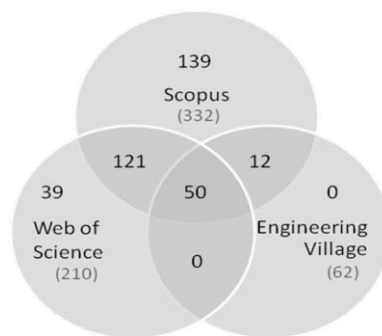


Fig. 2. Quantitative result of the research in databases.

Finally, to the 273 articles of SCOPUS, 28 papers were added from ISI Web of Science base and none of Engineering Village. However, it is important to note that after the refinement of the research (conducted from the availability of complete papers by CAPES portal and reading the abstracts) which resulted in 80 papers, only 3 did not belong to SCOPUS. Thus, it was used as a basis for quantitative analysis of the literature considering its representation to the research universe.

C. Data Analysis

In order to generate an overall quantitative overview of the publications on the subject Entrepreneurial University, to support further qualitative analysis of bibliographical production as suggested by the webibliomining technique [19] were held some analyzes from the SCOPUS data.

It presents initially the chronological analysis of the publications. The result, shown in Fig. 3, shows that the subject started to be explored with greater intensity in the last 10 years. By 2003, no more than 3 papers on the topic were published per year. Apparently, [20] had an important

contribution to the growth of research in this area; which is one of the three most cited papers on the subject (317 citations). After a second peak of production in 2005, the number of publications had continuous growth since 2006, reaching a new quantitative level from 2010.

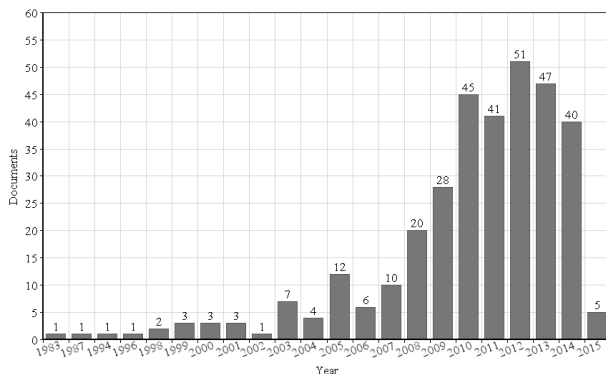


Fig. 3. Number of records of entrepreneurial university based on SCOPUS.

An analysis of the first records of "Entrepreneurial University" in the databases shows that the theme first appeared in 1983. However only from the 90s is that the subject began to be published more frequently. The author with more publications on the subject is Henry Etzkowitz, creator of the Triple Helix model which has the Entrepreneurial University as a central concept. The research indicates that this he is the main reference on the subject, being also the author with the highest number of citations. As indicated in Table I, other authors such as Urbano, Guerrero and Wright are also worth mentioning by volume of publications. This indicates the need for a special analysis on the bibliographic production of these authors.

TABLE I: AUTHORS WITH THE HIGHEST PUBLICATIONS IN SCOPUS

Author	Documents
Etzkowitz, H.	12
Guerrero, M.	9
Urbano, D.	9
Wright, M.	7
Czarnitzki, D.	6
Meyer, M.	5
Grimaldi, R.	5
Audretsch, D.B.	5
Toole, A.A.	5
Klofsten, M.	5
Rasmussen, E.	5

An analysis of the areas of expertise of the publications indicates that the topic "entrepreneurial university" is widespread in the areas of Business and Management, Economics, Social Sciences, and Engineering. The relative smaller expressiveness of publications in the field of Decision Sciences could suggest a need for further studies on models of decision-making to support entrepreneurial universities. Table II presents the volume of publications found on the base, by knowledge area.

TABLE II: RECORDS ON SCOPUS

Subject Area	Documents
Business, Management and Accounting	175
Social Sciences	123
Economics, Econometrics and Finance	70

Engineering	70
Decision Sciences	40
Arts and Humanities	27
Environmental Science	17
Computer Science	12
Multidisciplinary	8

Table III shows that the United States is the country with more authors about the topic. However European countries are prevalent in publications. In addition to the USA, only Canada is among the non-European countries with more publications on the subject.

TABLE III: COUNTRIES WITH THE HIGHEST PUBLICATIONS ON SCOPUS

Country	Documents
United States	79
United Kingdom	57
Sweden	31
Germany	28
Spain	25
Italy	25
Belgium	22
Finland	17
Canada	13
Denmark	13

About the affiliation of the authors, there is a concentration on the following institutions: University of Leuven, Belgium (15 publications); Imperial College London, United Kingdom (13); Universitat Autònoma de Barcelona, Spain (10); University of Bologna, Italy (8); Halmstad University, Sweden (7); and Stanford University, USA (6).

Finally, journals are presented with the highest number of records about Entrepreneurial University at the base, as research parameters. Table IV presents the resulting list, indicating emphasis on Research Policy and Journal of Technology Transfer.

TABLE IV: JOURNALS WITH THE HIGHEST RECORDS IN SCOPUS

Source	Documents
Research Policy	31
Journal of Technology Transfer	26
Higher Education	12
Int. Journal of Entrepreneurship and Small Business	7
Economics of Innovation and New Technology	7
European Planning Studies	6
Science and Public Policy	6
Technology Analysis and Strategic Management	6
Technovation	6

III. CONCEPTS OF ENTREPRENEURIAL UNIVERSITY

From the literature review and analysis of selected articles, this study sought to summarize the main conceptual definitions for Entrepreneurial University. The main selected authors on the subject and their definitions are presented in Table V.

TABLE V: MAIN CONCEPTS OF ENTREPRENEURIAL UNIVERSITY

Source	Definition
[4]	An entrepreneurial university is an important catalyst for regional economic and social development because they are natural incubators that create new ideas and technologies, promote new business creation, and offer a variety of resources and capabilities that contribute to

	creating a sustained competitive advantage
[7]	An entrepreneurial university is a university that is able to take on several roles in society and in the innovation (eco) system. Is expected to have close relationships and interactions with stakeholders to produce and to develop (new) knowledge/technology as well as to strengthen its position in the knowledge-based society and to generate new sources of income.
[8]	An entrepreneurial university is any university that undertakes entrepreneurial activities with the objective of improving regional or national economic performance as well as the university's financial advantage and that of its faculty.
[11]	The role of the entrepreneurial university is not simply producing new knowledge, but also disseminating this new knowledge to industry and society.
[12]	"university [that] actively seeks to innovate in how it goes about its business."
[14]	An entrepreneurial university could be defined as a survivor of competitive environments with a common strategy oriented to be the best in all its activities (e.g., having good finances, selecting good students and teachers, producing quality research) and tries to be more productive and creative in establishing links between education and research.
[20]	The entrepreneurial university has the ability to generate a focused strategic direction, both in formulating academic goals and in translating knowledge produced within the university into economic and social utility.
[21]	An entrepreneurial university is characterized by organizational adaptation to environmental changes, its managerial and governance distinctiveness, new activities oriented to the development of entrepreneurial culture at all levels, its contribution to economic development with the creation of new ventures, or the commercialization of research.
[22]	An entrepreneurial university is a dynamic system, which includes special inputs, processes, outputs and aims to mobilize all of its resources, abilities and capabilities in order to fulfill its Third Mission.
[23]	Entrepreneurial university is one that: contribute and provide leadership for creating entrepreneurial thinking, actions, institutions, and entrepreneurship capital.
[24]	(...) a university which is adaptive and innovative to the needs of the outside world.
[25]	Entrepreneurial university is one that is unafraid to maximize the potential for commercialization of its ideas and to create value in society while not seeing this as a significant threat to academic values.
[26]	A university-based entrepreneurship encompasses both commercialization (e.g. custom made further education courses, consultancy services, extension activities) and commodification (e.g. patents, licensing, faculty or student owned start-ups).
[27]	An entrepreneurial university is a natural incubator that, by adopting a coordinated strategy across critical activities (e.g., teaching, research and entrepreneurship), tries to provide an adequate atmosphere in which the university community (e.g., academics, students and staff) can explore, evaluate and exploit ideas that could be transformed into social and economic entrepreneurial initiatives
[28]	Entrepreneurial university implements several strategies and new institutional configuration to work together with the government and industries to facilitate the generation and exploitation of knowledge and technology
[29]	Entrepreneurial universities are involved in partnerships, networks and other relationships with public and private organizations that are an umbrella for interaction, collaboration, co-operation and among the core elements of a national innovation system many different interactions may exist.

IV. CHARACTERIZATION CRITERIA

In addition to the conceptual definitions of entrepreneurial university, this study sought to map from the selected articles, the approaches to analysis or evaluation of entrepreneurial universities. The main approaches observed in the literature are presented below.

- There are five elements for entrepreneurial universities, which are as follows: A strengthened steering core, an expanded developmental periphery, a diversified funding base, a stimulated academic heartland, and an integrated entrepreneurial culture [12].

- There are a series of elements which are: Mission, goals, structure, management, governance and leadership, networks, conglomerates and strategic alliances, and culture [13].

- There are seven strategic actions intended to promote an enterprise culture in universities. The factors that have been identified as formal are strategic actions related with the organization, endorsement, incorporation, implementation, and communication. The factors identified as informal are related to promotion, recognition and reward, and endorsement [14].

- There is a group of elements, i.e. policies and technology, culture, agents, status, networks, and localization [15].

- These elements are of paramount importance: human capital resources, financial resources, physical resources, commercial resources, status and prestige, networks and alliances, and localization [16].

- The Entrepreneurial University model can be expressed in four inter-related propositions: (i) Interaction - The entrepreneurial university interacts closely with industry and government; it is not an ivory-tower university isolated from society; (ii) Independence - The entrepreneurial university is a relatively independent institution; it is not a dependent creature of another institutional sphere; (iii) Hybridization - The resolution of the tensions between the principles of interaction and independence are an impetus to the creation of hybrid organizational formats to realize both objectives simultaneously; (iv) Reciprocity - There is a continuing renovation of the internal structure of the university as its relation to industry and government changes, and of industry and government as their relationship to the university is revised [20].

- The entrepreneurial university can be investigated with Institutional theory and categorized the elements in two groups: formal and informal. And the Resource Based View Theory can explain how internal factors (resources and capabilities) could generate a competitive advantage for entrepreneurial universities, categorized these factors in two groups: resources (human, financial, physical, and commercial), and capabilities (status, networks, and localization). For effective impact on economic development, the entrepreneurial university is required to fulfil three missions simultaneously, which otherwise might be at odds with one another: teaching, research, and entrepreneurship [21].

- There are special inputs (resources, rules and regulations, structure, mission, entrepreneurial capabilities, and expectations of the society, industry, government and market.), processes (teaching, research, managerial processes,

logistical processes, commercialization, selection, funding and financial processes, networking, multilateral interaction, and innovation, research and development activities), and outputs (entrepreneur human resources, effective researches in line with the market needs, innovations and inventions, entrepreneurial networks, and entrepreneurial centers) [22].

- It can be explained by a metamodel consisting of six dimensions: Entrepreneurial vision; committed strategic leadership; generation of innovative knowledge; capitalization of innovative knowledge; economic, social and cultural development of the region; and an integrated entrepreneurial culture [30].

- There are four main dimensions in the conceptualization for entrepreneurial universities, which are: Mission (entrepreneur generation, applied research, knowledge and technology transfer, contribution in socio-economic development, and developing an entrepreneurial culture), Resources (categorized in soft resources: entrepreneur and motivated human resources, educational and research resources, entrepreneurial background, entrepreneurial prestige, and dynamic and learning structure; and hard resources: government financial resources, private financial resources, creative and innovative financial resources, infrastructural and physical resources, and technological resources), Capabilities (status and localization, background, networks and partners, and resource absorption and management), and Impeding factors (political behavior and lobbying, and resistance) [31].

- A fully integrated entrepreneurship model: The University-wide application of entrepreneurship teaching; Joined with office of technology transfer; Innovative pedagogical support for every department; Lifelong learning approach in all departments; All Departments and subjects covered; Professorial status for Research and Development excellence; Development' Sabbaticals for staff wishing to commercialize IP; Professors of Practice, Adjunct Professors, Visiting Development Fellows, Entrepreneur teams invited in to harvest ideas; Social integration of entrepreneurs and status awarded to them; Entrepreneurship as an office of the VC; All activities academic led but in partnership with external stakeholders; Research and development activity rewarded in all departments; Active stakeholder participation with university staff in joint ventures; Open approach to intellectual property and investment in university ventures; Staff of departments trained to develop and offer entrepreneurship courses [32].

- There are many factors that decide entrepreneurial success, such as cultural tradition, practice base, strong needs from local industry development, productive academic results available to be capitalized, and emergence of excellent entrepreneurs [33].

- Five specific dimensions that are important determinants of an environment conducive to entrepreneurial behavior: (1) top management support, (2) work discretion/autonomy, (3) rewards/reinforcement, (4) time availability, and (5) organizational boundaries [34].

- University entrepreneurial orientation consists of the following four dimensions: research mobilization, unconventionality, industry collaboration, and university policies [35].

V. RESULTS DISCUSSION

From the concepts of entrepreneurial university identified in the literature review, it was possible to highlight some features that well define these universities, as presented in Table VI.

TABLE VI: SOME DEFINITIONS OF ENTREPRENEURIAL UNIVERSITY

Main concepts related to entrepreneurial universities
"...natural incubators that create new ideas and technologies, promote new business creation..." [4].
"...is an important catalyst for regional economic and social development..." [4].
"...close relationships and interactions with stakeholders to produce and to develop (new) knowledge/technology..." [7].
"...actively seeks to innovate in how it goes about its business..." [12].
"...has the ability in translating knowledge produced within the university into economic and social utility..." [20]. "...mobilize all of its resources, abilities and capabilities in order to fulfill its Third Mission..." [22].
"...adaptive and innovative to the needs of the outside world..." [24].
"...provide an adequate atmosphere to social and economic entrepreneurial initiatives..." [27].
"...one of the core elements of a national innovation system..." [29].

This selection of key concepts presented in Table VI, reinforces the emphasis of the EU in the third mission (Entrepreneurial Activities). However, this does not mean that such universities do not value the first and second mission (Teaching and Research). As discussed in the literature, what really differentiates an EU is its ability to articulate these three academic missions, and thereby generate economic and social impact in its region of influence.

The examination of the phenomenon of entrepreneurial universities is available in the literature under a wide variety of methodologies. In the papers selected were observed studies of the following methods: Resource Base View (RBV); Creating Shared Value (CVS); Force Field Analysis; Input, process, output, outcome; Importance Performance Analysis; TOPSIS; Decision Sciences; Cluster analysis and case studies and surveys.

This study was not focused on analyzing these methodologies, sought only to create an overview about the characterization criteria of entrepreneurial universities. In this way, as a way of analyzing the content presented in Table VI, a cloud of characterization criteria is presented. Emphasis on the words is based in its frequencies.



Fig. 4. Quantitative Analyses of characterization criteria.

Among the highlighted criteria, "Localization", "Network"

and "Status" are at first evidence. The relative importance of these criteria characterization meets the definitions and conceptual approaches to the EU, which characterize it as an element of an innovation system, with strong interactions with other system elements. These criteria can be classified as Capabilities, within a larger classification called Internal Factors, which takes into account also the resources [11]. Of these, "physical and financial resources" have excelled in Fig. 4, and in a second level, "human and commercial resources." Still following the conceptual model proposed by [11], one can notice a quantitative relevance of the criteria characterized as Environmental Factors (formal or informal), among which are entrepreneur Entrepreneurial culture technology transfer.

VI. CONCLUSIONS

First, it is important to highlight the growing importance of studies on entrepreneurial university. As shown in the literature review chapter, universities have assumed an increasingly important role for economic and social development of the regions, through the strengthening of its third mission. The analysis of bibliographical production ratifies this premise showing an accelerated growth in the number of publications on the subject, driven primarily by the most innovative countries such as United States, United Kingdom, Sweden and Germany. The profile of the publications in journals of academic relevance in the areas of management, business and innovation, also indicates a special attention from academy to deal with this issue.

Returning to the main purpose of this article, from the systematic literature review was possible to establish a conceptual framework on "entrepreneurial universities", highlighting the main concepts and criteria for the characterization. The initial works of Etzkowitz and the prospect of the Triple Helix approach gave prominence to the role of universities in the "knowledge society" and induced a series of new studies. The different definitions presented in this paper indicate important features of entrepreneurial universities: are dynamic, adaptable and innovative in its business model. Therefore, it is understandable that the taxonomies and characterization criteria are also dynamic and characterized from regional environmental specificities under review, as noted.

The conceptual approaches present in the literature, are unanimous about the role (goal or mission) of the entrepreneurial university for regional economic and social development. The authors define the university as an agent of regional innovation, highlighting entrepreneurship as a key element. Each author, however, describes this phenomenon different optics, different approaches and practical cases, generating multiple perspectives on the subject. By bringing together the main theoretical references this study can present a good overview about these different perspectives.

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He is an assistant professor in the production engineering graduate at Federal University of Rio de Janeiro, Macaé Brazil. He is coordinator of the Innovation Center for Sustainable Operations and coordinator of a business incubator, with researches in innovation, entrepreneurship, business management, science and technological parks, and regional development.



Francisco Esteves was born in Cascavel, state of Ceará Brazil, on September 4, 1950. He holds a bachelor's degree in biology from the Federal University of Rio de Janeiro (1973) and a Ph.D. from Max-Planck Institut für Limnologie - Kiel University (Christian-Albrechts) (1978). He is currently the general director - Nucleus in Ecology and Socio-environmental Development of Macaé (NUPEM / UFRJ), of which he was the founder. He participates in the coordinating commission of the pie

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He has experience in ecology, with emphasis in ecology of aquatic ecosystems, working mainly in the following subjects: ecology of ecosystems, aquatic environments, coastal lagoons, aquatic macrophytes and biogeochemical cycles. In addition, he has been involved in environmental education and scientific outreach with an emphasis on ecology, also with pioneering experience in the recovery of continental aquatic ecosystems in Brazil.

Prof. Francisco Esteves is considered pioneer in Brazil in research on the ecology of continental aquatic ecosystems, especially in the coastal lagoons

of the Northern Fluminense and lakes and rivers of the Amazon. His research on these ecosystems and others throughout Brazil has resulted in a massive scientific production, generating over 200 articles published in national and international journals, as well as 6 books, 55 book chapters and dozens of articles in scientific divulgation, ecological literacy and environmental education.



Ramon B. Narcizo was born in Rio de Janeiro, Brazil on June 15, 1982. He obtained in 2009 a summa cum laude degree in industrial engineering at the Fluminense Federal University, Brazil. In 2012 and 2017, respectively, he obtained his masters and doctoral titles in industrial engineering, with emphasis in management and innovation, by COPPE-Federal University of Rio de Janeiro, Brazil. His main area of professional activity is research and

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He has book chapters and more than thirty articles published in national and international events, also in peer reviewed journals. He has developed research on business incubators, technology parks and local innovation systems. His research focus is currently oriented towards innovation in small companies with low technological dynamism.

Dr. Narcizo is currently an adjunct professor in the Department of Engineering at Fluminense Federal University's Institute of Science and Technology, in the city of Rio das Ostras, Brazil. He teaches new product development, innovation & technology management, innovation management, organizational and production management.



Rodolfo Cardoso was born in Rio de Janeiro, Brazil, on May 9, 1971. He is a mechanical engineer from the Fluminense Federal University in 1994 and army engineer from the Military Engineering Institute in 1996. He holds a Ph.D. in production engineering, with emphasis in management and innovation, from the Federal University of Rio de Janeiro in 2008. He is currently an associate professor in the production engineering graduate and

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Prof. Rodolfo has worked as a National Quality Foundation (FNQ), as an advisor to the National Quality Award (PNQ) since 2006, as senior examiner from 2002 to 2005, examiner from 1999 to 2004 and instructor since 2001. He was a member of Model Criteria Committee of Excellence of FNQ Management from 2000 to 2014. He has published two books, several book chapters and dozens of articles.