Technology and policy:
exploring emerging and potential factors of progress at a global scale

by

Manuel Heitor

Center for Innovation, Technology and Policy Research, IN+
Instituto Superior Tecnico, Technical University of Lisbon, Portugal

Escola de Altos Estudos – CAPES
Instituto de Economia, Universidade Federal do Rio de Janeiro, UFRJ

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A research and advanced study program at UFRJ, March 2013

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List of contents:

1. Introduction
2. The research issue in brief
3. Program and Lectures
   • Developing human capital and research capacity: which science policies?
   • Government-industry-higher education relationships in a new era of international affairs: Internationalizing higher education?
   • A system approach towards knowledge networks and enhanced societal trust: Which tertiary education institutions and campuses?
   • Industrialization, geography and policy: new horizons for science, technology and innovation policies?
   • Forward looking in times of accelerated technical change: Which implications for Risk Governance, Knowledge Networks and Learning?
4. Sample topics for further research
   • Industrialization, geography and policy
   • Government-industry-higher education relationships in a new era of international affairs
   • Knowledge urbanism: new horizons for the integration of university campuses and knowledge infrastructures in urban contexts
   • Towards an observatory of scientific, technological and entrepreneurial capacities in Brazil

Annex: Manuel Heitor’s Brief Biographical Note and Curriculum Vitae
1. Introduction

The new conditions for the social construction of technological systems in both developed and developing societies will be discussed in terms of their impact on the emergence of new social realities in many countries, including Brazil. The increasing access to higher education and the continuous trends for the specialization of scientific, technological and industrial bases will be particularly discussed, including their impact for science, technology and higher education policies as factors of economic and social development on a global scale.

Main themes to be considered include:

- Emerging forms of inclusive scientific development and related knowledge networks in association with the increasing internationalization of the sources of knowledge production and diffusion and forms of international scientific and academic cooperation and development;
- Emerging trends in industrialization, the geography of innovation and paradigms in technological innovation, including the convergence of physical sciences, medical sciences and engineering and its impact on stakeholder engagement for science and technology policymaking;
- The evolution of the university and the necessary emergence of new forms of government-industry-higher education relationships and their potential impacts, including on the spatial integrating of “university campus” and related “knowledge infrastructures” in growing urban areas worldwide, with emphasis on developing regions and countries;
- The social appropriation of scientific culture and the social constituency for scientific development, including related implications for learning and knowledge networks.

These issues will be discussed and analyzed under the context of a policy framework for science and technology development.

Brazil and many emerging and developing countries are now facing the need and the opportunity of large investments in science, technology and higher education, aiming at responding to the explosive social demand for higher education and to the vast social and political transformations already induced by new waves of educated youth. These investments not only seek new skills and but also the certification of quality that may be expected from working along together with well established academic and scientific institutions from developed countries. In addition, new research on the design of higher education at a world level and in very different socio-economic and cultural contexts is expected to help guiding the modernization of our societies worldwide. The work will be based upon evidence and research, aiming at training a new generation of science and higher education policy leaders for Brazil and many other emerging and developing countries.
2. The research issue in brief

We live in challenging times, considering the emergence of China and other emerging economies\(^1\), as well as the current international financial crisis, with individual people and corporations increasingly believing in science and technology, as well as with unprecedented ways to access knowledge and to diffuse consumer goods worldwide. But these are also times of emerging risks, most of them associated with the concentration of people in cities, involving complex technological systems, as well as without understanding how to speed-up and improve the processes that enable investments in R&D and human capital to be transformed into economic growth and productivity gains in any region. But these are also times of unprecedented opportunities for science and technology and to modernize higher education and promote new learning systems across disciplines to build human capital and stimulate wealth creation across world regions.

To contribute for our understanding of these and other related issues, while bearing in mind the shaping factors of the emerging globalized economies and the current international financial crisis, the proposed program will focus on three main research themes, as follows: i) Fostering design thinking across disciplines to build human capital through modernized advanced education and research and facilitate diversified stakeholder involvement in the design of science and education policies, as well of new technological systems and related businesses; ii) The social construction of technological systems and the governance of emerging risks, involving knowledge diffusion and the public understanding of science and technology; and iii) Managing R&D at a global scale, together with international flows of human capital, the increasing internationalization of knowledge institutions and industry-science relationships towards productivity gains and new markets.

First, analyzing the increasing internationalization of knowledge networks as a major shaping factor for development at an unprecedented level will require understanding new paradigms for collaborative research and training and the internationalization of the university\(^2\). The recent explosion in demand for higher education by millions of young people around the world, associated with a growing perceived evidence of the potential benefits resulting from economic appropriation of the results and methods of science by society, have changed the perception of the “knowledge divide” at world level\(^3\).

New paradigms in international academic cooperation seem to emerge, including diversified forms of capacity building and the coaching and steering of research programs in developing countries, their early inclusion in international networks, and the affiliation of private companies to academic and

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These new arrangements do not appear to match the usual model for exporting services and although they provide new forms of expansion for institutions in developed countries (as they tend to help securing new financial or human resources), they clearly challenge their own traditional competences and agendas. Their understanding will gain from our increasing knowledge of the operational advantages and shortcomings of large international research consortia and organizations, as well as how investments in research and human capital can foster productivity gains. It also requires the understanding of the local characteristics of the processes of technical change and of specific regulatory and institutional constraints and it calls upon our knowledge of the social construction of technological systems.

Second, researching new understandings for the agglomeration of people and skills in urban contexts will help developing forms of “knowledge urbanism”, the governance of emerging risks and new futures for complex technological systems. Sustainable design and related practices has not been always associated with design excellence or design innovation and requires novel ways of design thinking that can contribute to the trans-disciplinary knowledge required to better understand complex urban environments. How best to propose a contribution at the intersection of emerging design methodologies and technical solutions (i.e., sustainable energy, intelligent grids, intelligent transportation), but also in line with the urban as site of complex economic, political, social and cultural relations, requires understanding the complexity of integrated systems and imagining new futures as potential factors of progress at a global scale. This will be applied to the design of future “university campus” in emerging and developing countries and regions.

In addition, the research program considers emerging trends in industrial policy and paradigms in technological innovation, including those in association with the convergence of physical sciences, medical sciences and engineering and oriented towards novel biomedical therapies. Their impact on stakeholder engagement for science and technology policymaking has been studied and will be reported.

The research work to be presented and discussed will gain from an in-depth analysis of the author’s self experience with the development of scientific and technological capacities in Portugal. The goal is to explore that knowledge to discuss new conditions for the social construction of technological systems in Brazil and other emerging and developing societies, emphasizing their impact on the emergence of new

4 M. Heitor (2012), “How far university global partnerships may facilitate a new era of international affairs and foster political and economic relations?”, Technological Forecasting and Social Change, submitted for publication. A version of this paper was presented at the ASHE Annual meeting 2012, Las Vegas, November 2012.
7 M. Heitor (2013). Open the box in times of uncertainty and globalized technical change: Implications for Risk Governance, Knowledge Networks and Learning. Working Paper
social realities in many countries and their potential as factors of economic and social development on a global scale.

It should be noted that the rational for this approach is associated with the development of Portuguese science and technology in recent years, as well as related reforms in tertiary education in Portugal, which maybe used to assist in the shaping of policies aimed at reinforcing and consolidating knowledge based economies in emerging societies and democracies. The goal is also to introduce issues for discussion concerning the challenges those societies face to sustain the growth of science and technology and to actively participate in international knowledge networks and flows.

Portugal has recently overcome its traditional gap in scientific and technological development and surpassed the average OECD level in terms of the number of researchers per thousand workforce, attaining 8.2 full time researchers per thousand workforce in 2009, as opposed to 3.5 in 2005 and only 1.5 in the late 1980s. Overall R&D expenditure more than doubled over the last five years: it was 1.71% of GDP in 2009, compared to 0.81% in 2005, and only 0.4% in the late 1980s. At the same time, the tertiary education system has been reformed, the social basis for recruitment of students has been enlarged and industry-science links have been strengthened, together with increased business expenditure on R&D (which represented 0.8% of GDP in 2009, compared to 0.3% in 2005 and less than 0.2% until some ten years ago).

Opportunities linked to emerging themes for knowledge exploration and discovery, as well as for advanced training, represent constant challenges for small and medium-sized countries, and Portugal has experienced such opportunities through strategic partnerships with leading partners worldwide. They cover diverse areas, from deep-sea biotechnology in the North Atlantic to the Internet of the future, and involve building further competencies in the nano- and biosciences, as well as in engineering systems and advanced computing.

The research work will be reported as an example of the need to focus upon in-depth knowledge of real social, political and economic processes of successful S&T development over the last decades. The foreseen critical policy framework to S&T development will address key policies and policy instruments aimed at reinforcing and consolidating knowledge based economies in emerging societies and democracies.
3. Program and Lectures

The proposed program will consider a set of five lectures to engage students and mobilize their interest in the themes mentioned above, as presented below.

3.1 Lecture 1: Developing human capital and research capacity: which science policies?

Science policies emphasizing the advanced qualification of human resources, together with democratizing the access to science and internationalizing the science base, are shown to help building the necessary conditions driving brain gain over time.

The lecture will explore themes of science and technology for development, including the advanced training of human resources and the role of infrastructures, institutions and incentives, together with the analysis of instruments and tools for scientific development (funding, evaluation, assessment and monitoring).

A specific case study will be presented and discussed by providing a dynamic approach and exploring a new set of data from Portugal over the period 1970-2010. It will focus on the analysis of flows of doctorates with the ultimate goal to help promoting the absorptive capacity that emerging regions and countries worldwide need to acquire to learn how to use science for economic development. It shows, by the end of that period, a notable process of brain gain and, above all, it provides a dynamic approach to the cumulative process of attempting to build knowledge-based societies. The results show the need to consider the co-evolution of brain gain, drain and circulation over time and space. In addition, they suggest the importance of a few major counter-intuitive policy instruments to facilitate the co-evolution of human capital formation and research capacity building. These instruments have included, in the case of Portugal, a centralized program of research grants, research careers independent of traditional faculty career tracks, and a diversified system of funding research units and institutions established upon research assessments through international peer reviews.

Background material:


Other potential readings:


3.2 Lecture 2: Government-industry-university relationships in a new era of international affairs: Internationalizing higher education?

A new paradigm of structured international university relationships is emerging as shaped by a new era of international affairs. It is driven by political and economic interests, but also by an increased perception of the growing perceived evidence of the potential benefits resulting from the economic appropriation of the results and methods of science by society.
This lecture argues that those relationships act as agents of change and a new narrative in university-government-industry relationships. They consider activities that are fundamentally different from the traditional role of universities, involving, most of the times, capacity building. They also require understanding the nature of international cooperation beyond the exporting/importing of “academic services” in all the institutions involved. In addition, they clearly break traditional boundaries of “national systems” and bring new challenges in terms of the necessary institutional integrity the partnering universities need to preserve and foster.

Background material:

- M. Heitor (2012), “How far university global partnerships may facilitate a new era of international affairs and foster political and economic relations?”, *Technological Forecasting and Social Change*, submitted for publication. A version of this paper was presented at the ASHE Annual meeting 2012, Las Vegas, November 2012.

Other potential readings:


3.3 Lecture 3: A system approach towards knowledge networks and enhanced societal trust: Which tertiary education institutions and campuses?

This lecture starts by arguing that strengthening the knowledge dimension and external societal links (i.e., “system linkages”) are critical in making the institutional changes required for tertiary education
institutions, TEIs, to meet the needs of global competition and the knowledge economy. In public policy terms, by focusing governmental and political actions on the growing appropriation of scientific and technological culture by society and on the external dimension of knowledge institutions, we require tertiary education institutions to strengthen their capacity to make the critical internal changes for modernizing their systems of teaching and research within a path of diversity and specialization, without compromising quality.

Furthermore, by strengthening their institutional integrity together with enhancing their external links with society, tertiary education institutions are asked to carefully improve their relationships with economic, social and political actors, thereby creating “new” reinforced institutions that have gained societal trust.

The related implications for public policies are discussed with a special emphasis on the design and continuous adaptation of our educational and learning spaces. How far the growth in higher education worldwide and the prospects for the rapid evolution of research-based activities in many emerging economies and societies is calling for the need to better understand and frame potential evolving scenarios for spatially integrating universities, science parks and related “knowledge infrastructures and facilities” in growing urban areas worldwide?

The recent explosion in demand for higher education by millions of young people around the world, associated with a growing perceived evidence of the potential benefits resulting from economic appropriation of the results and methods of science by society, have changed the perception of the “academic divide” or “scientific divide” at world level. Consequently, does it make sense revisiting the “university campus” concept at a global scale? How far technology-enabled active learning environments and new types of students are changing the “University campus” concept? How far social and cultural requirements on the sustainability of future learning environments should be further considered?

In addition, university campuses and science parks have been built in urban peripheries all over the world and this has facilitated new city developments in many regions worldwide, at the same time they are causing the relative isolation of students and part of the academic communities, as well as unsustainable mobility patterns for teachers and other parts of those communities. How far adequate and inclusive urban planning and design of science parks and “knowledge infrastructures” can help engaging people in the “social construction of technological systems” and, consequently, accelerate the modernization of emerging societies worldwide in quite diversified national and regional contexts? Does it make sense to discuss “knowledge urbanism”, as an emerging issue at a global scale?

Background material:


Other potential readings:


• M. Mostafavi and G. Doherty (2010), Eds., “Ecological Urbanism”, Harvard University, Graduate School of Design; Lars Muller Publishers.
3.4 Lecture 4: Industrialization, geography and policy: new horizons for science, technology and innovation policies?

This lecture is intended to approach industrialization from complementary viewpoints in order to allow the development of a comprehensive perspective on this phenomenon, related risks, strategies, and tools to assess and monitor it. The main goal is to analyse existing strategies for industrialization in Brazil and in other emerging and developing regions, as well as for mitigating emerging deindustrialization risks in many regions worldwide. The focus will be on the dynamics of managing knowledge to foster competitiveness and, ultimately, reducing socioeconomic vulnerability to local and global crises. The analysis will consider comparative studies at regional and country levels, including emerging pathways to innovate and expand manufacturing industries. Sectorial analysis will include specific discussions about quite different industries, including the oil & gas, space and bio industries.

Deindustrialization risks are slow-developing risks impacting economies and societies in their various dimensions. These risks are all but obvious since many have considered in the past deindustrialization as a sign of development. In this context, this workshop is aimed to launch a set of research tasks oriented towards the definition of a framework allowing to identify those risks, assess their potential impact and outline strategies for managing and communicating them.

Analyzing industrialization patterns and technical dynamics requires methodologies able to encompass the complexities of the current global competitive framework. This requires considering technologies, markets, and firm relative positions in sectorial global value chains. The lecture will address these issues, by facilitating a discussion about tools and methods to facilitate an observatory for scientific capacity, technological change and industrialization.

The lecture will be divided into two parts, the first focusing on regulation as a tool to mitigate risks and foster industrial development. The case of the oil & gas industry in Brazil will be discussed among others and including emerging industrialization patterns in the space-related sector.

The second part will focus on the analysis of drug-device and biological-device combination products and will identify a pattern of technology innovation used by science-based firms to expand to distinct markets, creating new and uncontested market spaces. This new pattern of technological innovation is named as “technology adjacency”. Evidence from our work also suggests that this process strongly depends on collaborative strategies between different stakeholders, in particularly physicians. This is supported by detailed case studies associated with technologies to restore blood vessels function and complemented with a case study of Boston Scientific Corporation in order to facilitate our understanding of the phenomenon of technology adjacency and its impact on corporate change and growth.
Background material:


Other potential readings:

3.5 Lecture 5: **Forward looking in times of accelerated technical change: Which implications for Risk Governance, Knowledge Networks and Learning?**

The need to constantly rethink the training of the work force and the way to promote technical skills to face the continuous accelerated rate of technical change is discussed with implications for both developed and developing countries and regions, including Brazil. In particular, engineering education and the positioning of modern technical universities is analyzed in terms of emerging paradigms in university education. Even though some of the ideas are specific to European engineering education, the value and implications of the analysis is likely to be of importance for most technical universities around the world: engineering education must adapt to the emerging knowledge based economy, in which new demands and new expectations present significant challenges but, most importantly, great opportunities. The view presented in this lecture is that the key challenge, and greatest opportunity, for technical universities is to find a balance between striving for more social and economic relevance, while keeping the fundamental ability of being a place for new technical discoveries and free intellectual inquiry.

In addition, this lecture encompasses the idea that new paradigms on university education and technology production and diffusion are emerging through international academic and scientific cooperation, as a major shaping factor for development at an unprecedented level. We also focus on the capacity to turn science-based inventions into commercially viable innovations and related new potential factors of progress on a global scale, in association with a growing perceived evidence of the potential benefits resulting from economic appropriation of the results and methods of science by society.

**Background material:**


Other potential readings:


4. Sample topics for further research

The proposed program will consider the exploration of a set of new research topics, as follows:

- Industrialization, geography and policy
- Government-industry-higher education relationships in a new era of international affairs
- Knowledge urbanism: new horizons for the integration of university campuses and knowledge infrastructures in urban contexts
- Towards an observatory of scientific, technological and entrepreneurial capacities in Brazil
Manuel Heitor is Full Professor at Instituto Superior Técnico, IST, the engineering school of the Technical University of Lisbon, www.ist.utl.pt, and director of IN+, the Center for Innovation, Technology and Policy Research at IST, http://in3.dem.ist.utl.pt/. From March 2005 to June 2011 he served as Secretary of State for Science, Technology and Higher Education in the Government of Portugal. Most recently, in the 2011-12 academic year he was a Visiting Scholar at Harvard University’s Graduate School of Design and in the Science, Technology and Public Policy Program at the Kennedy School.

After earning a (five-year) degree in Mechanical Engineering at IST in 1981, he obtained his Doctorate at the Imperial College London in 1985 in the area of fluid mechanics and combustion. In 1986 he conducted post-doctoral study at the University of California-San Diego in microgravity flame propagation. Manuel Heitor was appointed Assistant Professor in the Department of Mechanical Engineering at IST in 1986, Associate Professor in 1991 and Full Professor in 1995. He served as Deputy-President of Instituto Superior Técnico from 1993 to 1998.

In addition to his engineering research, Manuel Heitor has worked and published extensively in the interrelated fields of technology management, innovation, and science and higher education policy. His chief activities in these fields are summarized below.

**Internationally:** Since 1995 he has been a Research Fellow of the IC² Institute (for “Innovation, Creativity and Capital”) at the University of Texas at Austin. From 1996 to 2005 he chaired the Organizing Committee of the series of International Conferences on Technology Policy and Innovation, http://in3.dem.ist.utl.pt/confpolicy/. In 2002 he was co-founder of Globelics: the Global Network for the Economics of Learning, Innovation, and Competence-building Systems; and served until 2005 as a member of its Scientific Board and co-Director of the Globelics Academy. Manuel Heitor has participated in several international fora on science, technology and innovation policy, and represented Portugal in the OECD’s initiative on Steering and Funding of Public Research and in its Futures Programme. He is a founding member of the Science and Technology Council of the International Risk Governance Council, IRGC.

**In Portugal:** Manuel Heitor was the founding director of IN+, the Center for Innovation, Technology and Policy Research at IST, http://in3.dem.ist.utl.pt/, which in 2005 was named one of the top 50 global research centers in technology management by the International Association of Management of Technology. He also launched IST’s programmes in Engineering Policy and Management of Technology (1998) and in Engineering Design (2002), as well as the IST Design Studio (2002). In 1999 he was appointed National Coordinator of the Research Assessment Exercise by the Portuguese Ministry of Science and Technology. In 2003 he coordinated a national initiative and exhibition on the history of engineering in Portugal in the 20th century, which won the Dibner Award of the Society for the History of Technology.

**Books, Journals, Papers:** Manuel Heitor is co-author of New Ideas for the University (in Portuguese, IST Press, 1998) and Innovation for All? (Praeger, 2005). He is co-editor of the book series on Technology Policy and Innovation, launched by Greenwood Publishing Group and currently continued by Purdue University Press. He is on the Advisory Boards of the journals Technological Forecasting and Social Change and the International Journal of Technology, Policy and Management, where he has served as guest editor for several special Issues. He has written numerous papers on these topics.

**While in the Government of Portugal,** Manuel Heitor was successfully involved in attracting public and private investment in R&D, growing the research landscape of the country, and in the reform and modernization of higher education (including, but not limited to, reforms under the Bologna Process). He was instrumental in forming international consortia for research and advanced education with several U.S. universities. These consortia are of varying types and scale, and include industry relationships and technology commercialization activities.

**Annex:** Manuel Heitor’s Brief Biographical Note (full CV available at http://in3.dem.ist.utl.pt/ )
Manuel Heitor: Brief Curriculum Vitae (January 2013)

Name: Manuel Frederico Tojal de Valsassina Heitor

Birth: September 21, 1958 - Lisbon, Portugal; Nationality: Portuguese

Contact/Email: mheitor@ist.utl.pt

Area of Specialization:
Science, Technology and Innovation Policy; Higher Education Policy, Engineering and Public Policy;

Other research areas of interest:
Management of Science and Technology; Risk Governance
Energy and Environmental Technologies;
Engineering design;

Education:
1981: Engineering Diplom (5 years) in Mechanical Engineering, IST, Technical University of Lisbon
1985: Ph.D. in Mechanical Engineering, Imperial College, University of London, UK
1992: “Agregação”, D. Sc., in Mechanical Engineering, IST, Technical University of Lisbon

Academic and Research Career:
1981-1985: Research student, Imperial College, University of London, UK
1985-…: Lecturer at IST, Technical University of Lisbon
1986- Post-doctoral researcher, University of California at San Diego, USA
1995-…: Full Professor, IST, Mechanical Engineering Department

Main awards:
• IAMOT Award 2005 (institutional) – “Top 50 global centres of research on Management of Technology”, Intl. Association for the Management of Technology
• IAMOT Award 2004 – Excellence in Research Award on Technology Innovation Management, Intl. Association for the Management of Technology
• "Solvay Innovation Trophy 2003" for "Management Improvement", through the project "Solvay Ideas Challenge", http://www.green-wheel.net/ (co-winner)
• Dibner Award 2003 – Society for the History of Technology, SHOT, Best Exhibition, through the project “Engineering in Portugal in the 20th century” (co-winner)
• Prémio TELecência 2003 (4º lugar) - V Festival Internacional do Filme de Divulgação Científica, através do filme “ENGENHO E OBRA: Engineering in Portugal in the 20th century”

Political and Government Appointments

Institutional Development and University Management Appointments:
1993-1998: Deputy-President of the Instituto Superior Técnico, Technical University of Lisbon
1998-2005: Founder and Director of the "Center for Innovation, Technology and Policy Research”, IN+, at the Instituto Superior Técnico, Technical University of Lisbon
2013-…: Director of the "Center for Innovation, Technology and Policy Research”, IN+, at the Instituto Superior Técnico, Technical University of Lisbon

Coordination of University Programs:
1997-2005: Founder and Director of the M.Sc. Program at IST on “Engineering Policy and Management of Technology”
1997-2000: Director of the IMPACT Program at IST on science and technology commercialization
2001-2005: Director of the VECTOR* Program at IST on science and technology commercialization
2002-2005: Founder and Director of the M.Sc. Program at IST on “Engineering Design”
2004-2005: Director, Globelics Academy – PhD School on Systems of Innovation and Economic Development
2012-....: Director of the Ph.D. Program at IST on “Engineering and Public Policy”

Appointments in Academia, Research and Scientific Institutions
1996- ...: “Senior Research Fellow”, IC2 Institute (Innovation, Creativity, Capital), The University of Texas at Austin, USA.
1996: Coordinator of the Research Assessment Exercise in the area of Mechanical Engineering, Foundation for Science and Technology (FCT), Portugal.
2002- ...: Co-founder and member of the “Scientific Board” of the international network “Globelics - the global network for the economics of learning, innovation, and competence building systems”
2004-....: Member of the Science and Technology Council, International Risk Governance Council.
2002-2004: Member of the Examiners Committee of the Technology Policy Program, Cambridge-MIT Institute (CIT), University of Cambridge, Judge Institute of Management.
2009-....: Member of Serbian Academy of Engineering Sciences (elected foreign member).
2010-....: Member of the International Advisory Committee of the President of Carnegie Mellon University for the area of “Engineering and Public Policy”.
2011-....: Member of the International Advisory Board of the University of Macau, China.
2012-....: Member of the Academy of Engineering, Portugal.

Other Functions:
2000-2001: Expert at OECD, Science, Technology and Industry Division, for “Steering and Funding of Public Research”
2000-2004: Expert at OECD, for the Project “Futures”
2002/03: Director for the exhibition “Engineering in Portugal in the 20th century”
2002-2003: Director, “Pensar e Fazer – Engineering for youngsters”

Sample list of publications:
Recent Books, in preparation:

Books (co-authorship):
• Conceição, P., Heitor, M.V. e Santos, F. (1998), New ideas for the University (in Portuguese), Lisbon: IST Press.

Books (edition):
• M. Heitor (ed.), (2004), “Pensar e fazer engenharia com os mais novos: um ensaio sobre cultura tecnológica para pais e educadores” (in Portuguese), Lisboa: Dom Quixote
• M. Heitor (2001), “National evaluation of R&D Units in Portugal” (in Portuguese), Portuguese Ministry of Science and Technology.
• M. Heitor (1999) “National evaluation of R&D Units in Mechanical Engineering in Portugal” (in Portuguese), Portuguese Ministry of Science and Technology.

Technical Journals Edited:
• Technological Forecasting and Social Change, Elsevier Science Inc.
• Intl. Journal of technology, Policy and Management, Inderscience Publishers

Main Papers in Technical Journals and Books:
Recent Papers submitted for publication in international journals:
• M. Heitor (2012), “How far university global partnerships may facilitate a new era of international affairs and foster political and economic relations?”, Technological Forecasting and Social Change, submitted for publication. A version of this paper was presented at the ASHE Annual meeting 2012, Las Vegas, November 2012.


Recent Working papers:


Sample published papers:


• M. Heitor and M. Bravo (2010), “Portugal on the crosstalk of change, facing the shock of the new: People, knowledge and ideas fostering the social fabric to facilitate the concentration of knowledge integrated communities”, Technological Forecasting and Social Change, 77, pp. 218-247.


• P. Conceição, M.V. Heitor, and H. Horta (2005), " R&D funding in US universities: from public to private support or public policies strengthening diversification?" em Enders, J., and Jongbloed, B., (Eds) Public-Private Dynamics in Higher Education: Expectations, Developments and Outcomes, (CHEPS, University of Twente).


• P. Ferrão, M. V. Heitor (1998)."Simultaneous velocity and scalar measurements in premixed recirculating flames", Experiments in Fluids, 24, pp. 399-407


• Carvalho, I.S. and Heitor, M.V. (1998), "Liquids Film Break-up in a Model of a Prefilming Airblast Nozzle". Experiments in Fluids 24, (5/6), pp. 408-415.


• P. Conceição, M. V. Heitor, P. Oliveira, (1998)"University-based Technology Licensing in the Knowledge Based Economy", Technovation, 18 (10), pp. 615-625.


Sample of Main Papers in Portuguese Technical Journals and Books: