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Center for Innovation, Technology and Policy Research

Centro de Estudos em Inovação, Tecnologia e Políticas de Desenvolvimento

Progress Report 2000

and

Plan of Activities 2001

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Instituto Superior Técnico, Lisboa

March 2001

IN^{+} ***Center for Innovation, Technology and Policy Research***

Centro de Estudos em Inovação, Tecn. e Políticas de Desenvolvimento

Progress Report: 2000

Contents

I. RESEARCH TEAM AND PROJECTS

a) Research Team (as by December, 2000)

Ph.D.:

- Manuel V. Heitor, Full Professor - I.S.T., Dept. Mech. Engng
- Diamantino Durão, Full Professor - I.S.T., Dept. Mech. Engng
- Mário N. R. Nina, Associate Professor - I.S.T., Dept. Mech. Engng
- João Ventura, Assistant professor - IST, Dept. Mech. Engng
- José Miguel Mendes-Lopes, Assistant professor - IST, Dept. Mech. Engng
- António L.N. Moreira, Assistant Professor - I.S.T., Dept. Mech. Engng
- Paulo M.C. Ferrão, Assistant Professor - I.S.T., Dept. Mech. Engng
- Gabriel Pita, Assistant Professor - I.S.T., Dept. Mech. Engng
- Edgar Fernandes, Assistant Professor - I.S.T., Dept. Mech. Engng
- Pedro Conceição, Assistant Professor - I.S.T., Dept. Physics
- Rui Baptista, IST, Invited Assistant Professor
- Armando Caldeira-Pires, Research Assistant.
- Sergei Ivanovich Cthork, Research Assistant
- Vayalakkara Sivadas, Research Assistant.
- Francisco Veloso, Research Assistant

Ph.D. Students:

- Filipe Santos, M.Sc., Assistant - I.S.T. (on leave at Stanford University, USA)
- Pedro Oliveira, IST - Research Student (on leave at University of North Carolina at Chapel Hill, USA)
- Pedro Ferreira, IST - Research Student (on leave at Massachusetts Institute of Technology, USA)
- Paulo Anacleto, M.Sc. - IST - Research Student
- Duarte P. Correia, IST - Research Student
- José Manuel P. Amaral, IST - Research Student
- Abel Rodrigues, M.Sc., IST - Research Student
- Casimiro Eduardo C. Cala, M.Sc., IST - Research Student
- Jorge Olívio P. Nhambiu, M.Sc., IST - Research Student

M.Sc. Students:

- João Pina, IST - Research Student
- Alberto Diogo, IST - Research Student
- Miguel Silva, IST - Research Student
- Hongyun Meng, IST - Research Student
- Angela Canas, IST - Research Student
- Paulo Silva, IST - Research Student
- Paulo Ribeiro, IST - Research Student
- Paulo Vaz, IST - Research Student
- Rita Ferreira, IST - Research Student
- Danilo Rubini, IST - Research Student
- Marta Silva, IST - Research Student

- Renato Salles, IST - Research Student
- Ana Moita, IST - Research Student
- Mosca Francesco, IST - Research Student
- Pedro Cabral S. Faria, IST - Research Student

Other Researchers:

- Nuno Creado Rolo, IST - Research Student
- Isabel Pina, MSc, Research Assistant
- Ivo Lima Veiga, MSc, Research Assistant
- Paula Meireles, Researcher
- Pedro Rama, Researcher
- Salomé Ladeira, Researcher
- Robert Edward Leandro, IST - Research Student

Research Unit (as by December 2000):

a) Doctorate Researchers

Name	Function	Title	Insti-tution	Position	Time % for research in the Unit	Time % for research outside the Unit	Time % for other professional activities incl/ teaching
					Total = 100%		
M. Heitor	Coord/Res.	Agregado/PhD	IST	Full Professor	75	-	25
D.F.G. Durão	Researcher	Agregado/PhD	IST	Full Professor	0	-	100
P.M. Ferrão	Researcher	PhD	IST	Associate Prof.	70	-	30
M.N. Nina	Researcher	PhD	IST	Associate Prof.	30	-	70
J. Ventura	Researcher	PhD	IST	Assistant Prof.	40	-	60
J.M.Mendes-Lopes	Researcher	PhD	IST	Assistant Prof.	40	-	60
A.L. Moreira	Researcher	PhD	IST	Assistant Prof.	40	-	60
G.P. Pita	Researcher	PhD	IST	Assistant Prof.	40	-	60
E. Fernandes	Researcher	PhD	IST	Assistant Prof.	70	-	30
P. Conceição	Researcher	PhD	IST	Assistant Prof.	75	-	25
S. I. Cthork	Researcher	PhD	IST	Res. Assistant	100	-	0
S. Sivadas	Researcher	PhD	IST	Res. Assistant	100	-	0
R. Baptista	Researcher	PhD	IST	Inv.Assistant Prof.	20	-	30
A. Caldeira-Pires	Researcher	PhD	IST	Res. Assistant	100	-	0
F. Veloso	Researcher	PhD	IST	Res. Assistant	50	50	0

b) Research students and other researchers

Name	Function	Title	Insti-tution	Position	Time % for research in the Unit	Time % for research outside the Unit	Time % for other professional activities incl/ teaching
Filipe Santos	Researcher	MSc- PhD student.	IST	Assistant	-	100	0
P. Oliveira	Researcher	MSc-PhD student	IST	Researcher	-	100	0
P. Ferreira	Researcher	MSc-PhD student	IST	Researcher	-	100	0
P. Anacleto	Researcher	MSc-PhD student	IST	Researcher	25	-	75
D. Correia	Researcher	PhD student	IST	Researcher	100		0
J. P. Amaral	Researcher	PhD student	IST	Researcher	100		0
A. Rodrigues	Researcher	MSc-PhD student	IST	Researcher	100		0
Casimiro E. C. Cala	Researcher	MSc-PhD student	IST	Researcher	100		0
Jorge O. Nhambiu	Researcher	MSc-PhD student	IST	Researcher	100		0
A. Diogo	Researcher	M.Sc. student	IST	Researcher	100		0
J. Pina	Researcher	M.Sc. student	IST	Researcher	100		0
H. Meng	Researcher	M.Sc. student	IST	Researcher	100		0
Miguel Silva	Researcher	M.Sc. student	IST	Researcher	100		0
Marta silva	Researcher	M.Sc. student	IST	Researcher	100		0
Angela Canas	Researcher	M.Sc. student	IST	Researcher	100		0
Paulo Silva	Researcher	M.Sc. student	IST	Researcher	100		0
Paulo Ribeiro	Researcher	M.Sc. student	IST	Researcher	100		0
Paulo Vaz	Researcher	M.Sc. student	IST	Researcher	100		0
Rita Ferreira	Researcher	M.Sc. student	IST	Researcher	100		0
Danilo Rubini	Researcher	M.Sc. student	IST	Researcher	100		0
Renato Salles	Researcher	M.Sc. student	IST	Researcher	100		0
Ana Moita	Researcher	M.Sc. student	IST	Researcher	100		0
Mosca Francesco	Researcher	M.Sc. student	IST	Researcher	100		0

Pedro C. S. Faria	Researcher	M.Sc. student	IST	Researcher	100		0
Nuno C. Rolo	Researcher	-	IST	Researcher	100		0
Isabel Pina	Researcher	-	IST	Researcher	100		0
Ivo Veiga	Researcher	-	IST	Researcher	100		0
Paula Meireles	Researcher	-	IST	Researcher	100		0
Pedro Rama	Researcher	-	IST	Researcher	25		75
Salomé Ladeira	Researcher	-	IST	Researcher	100		0
Robert E. Leandro	Researcher	-	IST	Researcher	100		0

b) Main Research Contracts **(with reference to on-going projects in 2000)**

The activities of the Center are organised on the basis of research projects, and those providing external funding are described in the following table, with related details given in the following pages:

Main R&D Area	Topic	FUNDING - CONTRACT	Coordi-nator	Contracting Institution
Combustion research	Gas turbine combustion	• EC-BRITE/EURAM: CT95-0109:LES 4LPP;	MVH	IST
	Turbulent mixing	• PRAXIS/P/EME/12222/1998	MVH/PF	IST
Environmental physics and technologies	Ecosystems	• EC-MAST: MAS3-PL96-1152: INDIA • PRAXIS/3/3.1/CEG/2503/95: PFR • EC-BRITE/EURAM: CT97-0043: TRESHIP • PRAXIS/P/EME/12222/1998:Eco-Management • SOCIEDADE PONTO VERDE • AUTO-RECYCLING; PEDIP-PROTAP • ET 2000– ESTUDO AMBIENTE	PF GP PF PF PF PF PF	IST IST IST IST IST IST IST
Industrial furnaces and processes		• EC-BRITE/EURAM: CT95-0033: CLEAN GLASS • PEDIP - PROJ. MOBILIZADOR, Nº 351 VIDRO • PRAXIS/2/2.1/TPAR/2038/95: PRODUÇÂO LIMPA DE VIDRO	MVH/PF MVH/PF MVH/PF	IST IST IST
Systems for knowledge creation, diffusion and usage	Higher education policy	• PRAXIS – PCSH/C/CED/0152/96: PÓS-GRAD	MVH	IST
Risk Assessment				

PIVNET – A European Collaboration Development and Application Network

Project Co-ordinator at IST

1.	Name	Manuel Heitor / Paulo Ferrão
2.	Category	Full Professor / Assistant Professor
3.	Department	Mechanical Engineering Dpt.
4.	Section	Applied Thermodynamics
5.	Telephone	+351 1 841 73 79
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Project

1.	Project Title	PIVNET – A European Collaboration Development and Application Network
2.	Contract	BRRT-CT97-5037
3.	IST Project Number	C378
4.	Funding Source	European Commission
5.	Program	BRITE/EURAM
6.	Type of Contract	Marginal Costs
7.	Start Date	1 December 1997
8.	Duration (months)	48 months
9.	Funding	
9.1.	Total	
9.2.	IST	14 000 ECU

10. Summary and Objectives

Thematic network on advanced instrumentation based on particle image velocimetry for fluid flow research.

11. Partners (for type we mean University, Company, Research Ins Institute, etc.)

Name	Country	Type
DLR	D	IND
INSKARM	BE	EDU
INTA	ES	IND
LLG	DE	IND
ONERA	FR	IND
OPFS	GB	IND
PININFAR	IT	IND
QUANTEL	FR	IND
RR	GB	IND
RWTH	DE	EDU
TUB	DE	EDU
TUDFT	NL	EDU
TUGRAZ	IT	EDU
UANC	IT	EDU
UCGAL	IE	EDU
UEDIN	GB	EDU

12. IST Research Team

Name	Category	Contract with IST(Y/N)
P. Ferrão	Assistant Professor	Y
M. Matos		Y

Low NOxIII – Low Emission Technology

Project Co-ordinator at IST

1.	Name	Manuel Heitor
2.	Category	Full Professor
3.	Department	Mechanical Engineering Dpt.
4.	Section	Applied Thermodynamics
5.	Telephone	+351 1 841 73 67
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Project

1.	Project Title	Low NOxIII – Low Emission Technology
2.	Contract	BRPR-CT95-0122
3.	IST Project Number	C273
4.	Funding Source	European Commission
5.	Program	BRITE/EURAM
6.	Type of Contract	Marginal Costs
7.	Start Date	1 January 1996
8.	Duration (months)	extended to June 2000
9.2.	IST	Funding 270 000 ECU

10. Summary and Objectives

The third phase of the Low Nox project (which is being developed since 1989) is devoted to the demonstration of Low Nox technologies in both modular and full size combustors for aeroengines applications, with respect to the size and operating conditions of large and small engines. The emphasis is given to lean-premixed-prevaporised, LPP, combustors. The project will consider the development and validation of new analytical tools, technologies and advanced design concepts, which enable the realisation of efficient operational combustor systems yielding substantial reductions in Nox emissions. Tests will be done at laboratory- and full-scales covering practical conditions. The work at IST will concentrate on the analysis of the process of fuel atomis ation and will consider two sets of experiments: I) a 2-liquid sheet for basic analysis of liquid breakdown; II) the testing of a new atomiser of the liquid phase.

11. Partners (for type we mean University, Company, Research Ins Institute, etc.)

Name	Country	Type
BMW/RR	UK	IND
DLR/SM-AT	D	IND
EBI	D	IND
SENER	D	IND
University of Rouen	F	EDU
CRS4	I	EDU
MTU	D	IND
ONERA	F	IND
University of Patras	G	EDU
University of Lund	SW	EDU
ENSMA	F	IND
ITS	D	IND
University of Madrid	S	EDU
ALFA ROMEO Avio	I	IND
CERT/ONERA	F	IND
Technical University of Munchen	D	EDU
Def. Research Agency	UK	IND
Rolls Royce plc	UK	IND
Ecole Centrale de Lyon	FR	EDU
ENSMA (Poitiers)	FR	EDU

SNECMA	FR	EDU
VOLVO	SW	IND

12. IST Research Team

Name	Category	Contract with IST(Y/N)
M.V. Heitor	Full Professor	Y
A.L.N. Moreira	Assistant Professor	Y
E. Fernandes	Assistant	Y
I. Carvalho	Research Assistant	N
D. Santos	Research Student	N

13. Most significant Results of the Research Project

Chapter in Book:

- I.S. Carvalho and M.V. Heitor (1995). "*Liquid Film Break-up and Droplet Characterisation in Strongly Swirling Jet Flows*". Proc. 2nd Intl. Conf. Multi-Phase Flow ´95, Kyoto, April 3-7, Japan 1995. Vol 1, pp. SP9-SP14. Published in: "Advanced in Multiphase Flows", eds. T. Fukano and J. Bataille, Elsevier Sc. Publ., pp. 119-128.

Papers in Journals:

- I.S. Carvalho and M.V. Heitor (1996). "*Visualisation of Vortex Berakdown in Turbulent Unconfined Jet Flames*". Optical Diagnostics in Engineering, 1 (2), pp. 22-30.

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

- Adzic, M. Carvalho, I.S. and Heitor, M.V. (1997). "*Error Analysis and Calibration Procedure whrn using an ICCD Camera for the Study of Spray Formations*". Journal of Flow Visualisation and Image Processing, 4, pp. 149-162.

Communication in Proceedings with referees

- I.S. Carvalho, M.V. Heitor and D. Santos (1997). "*Disintegration Mechanisms in Flat and Annular Liquid Films*", Proc. 13th Annual Conf. On Liquid Atomisation and Spray Systems, 9-11 July, Firenze, Italy.

New Technologies of Fuel Injection in Low Pollutant Emissions Aeronautic Engines

Project Co-ordinator at IST

1.	Name	Manuel Valsassina Heitor / Antonio Luis Moreira
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Project

1.	Project Title	New Technologies of Fuel Injection in Low Pollutant Emissions Aeronautic Engines
2.	Contract	PRAXIS/2/2.1/TPAR/1917/95
3.	IST Project Number	J465
4.	Funding Source	MCT – PRAXIS
5.	Program	PRAXIS XXI
6.	Type of Contract	Marginal Costs
7.	Start Date	1 July 1997
8.	Duration (months)	36
13.	Funding	
9.1.	Total	30 000 000 PTE
9.2.	IST	21 677 000 PTE

10. Summary and Objectives

To develop and apply advanced diagnostic methods to optimise fuel injection system in combustion chambers. This project will address the optimisation of air-blast atomisers, with pressure ranging from atmospheric values to 8 bar, at several IST rigs and including axissymetric and planar liquid sprays. The project includes co-operation with the University of Beira Interior, whose participation focus on the mathematical modelling of the systems studied at IST.

11. Partners (for type we mean University, Company, Research Institute, etc.)

Name	Country	Type
UNB	PT	EDU

12. IST Research Team

Name	Category	Contract with IST(Y/N)
M. Heitor	Full Professor	Y
A. L. Moreira	Assistant Professor	Y
I. Carvalho	Research Assistant	N
D. Santos	Research Student	N
A. Barros	Research Student	N

13. Most significant Results of the Research Project

M.Sc. Thesis:

- Santos, D. (1998). “Liquid Sheet Disintegration”, IST-UTL.
- Barros, A. (1998). “Experiments in Two-Phase Flows at High Pressure”, IST-UTL.

Papers in Journals:

- I.S. Carvalho and M.V. Heitor (1996). “*Visualisation of Vortex Berakdown in Turbulent Unconfined Jet Flames*”. Optical Diagnostics in Engineering, 1 (2), pp. 22-30.

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

- Adzic, M. Carvalho, I.S. and Heitor, M.V. (1997). "*Error Analysis and Calibration Procedure whrn using an ICCD Camera for the Study of Spray Formations*". Journal of Flow Visualisation and Image Processing, 4, pp. 149-162.

Communication in Proceedings with referees

- I.S. Carvalho, M.V. Heitor and D. Santos (1997). "*Disintegration Mechanisms in Flat and Annular Liquid Films*", Proc. 13th Annual Cof. On Liquid Atomisation and Spray Systems, 9-11 July, Firenze, Italy.

"CLEAN-GLASS" – Lox-NO_x Cost effective Oil and Gas Combustion Technology for Glass Furnaces, Scaling by Modelling and Measurement by Spectral Sensors

- **Project Co-ordinator at IST**

1.	Name	Manuel Heitor / Paulo Ferrão
2.	Category	Full Professor / Assistant Professor
3.	Department	Mechanical Engineering Dpt.
4.	Section	Applied Thermodynamics
5.	Telephone	+351 1 841 73 67
6.	Fax Number	+351 1 849 61 56
7.	E-mail	mheitor@dem.ist.utl.pt

Project

1.	Project Title	"CLEAN-GLASS" – Lox-NO_x Cost effective Oil and Gas Combustion Technology for Glass Furnaces, Scaling by Modelling and Measurement by Spectral Sensors
2.	Contract	BRPR-CT95-0033
3.	IST Project Number	C270
4.	Funding Source	European Commission
5.	Program	BRITE/EURAM
6.	Type of Contract	Marginal Costs
7.	Start Date	1 February 1996
8.	Duration (months)	48 (31 January 2000)
13.	Funding	
Total		
9.2.	IST	310.447 ECU

10. Summary and Objectives

To develop and use cost effective non-polluting technologies to burn current fuels and to support operators of large regenerative glass furnaces with the ultimate objective to promote the clean environment in Europe. The specific objectives are twofold: i) to develop a new generation of Low-No_X burners to be used in large glass furnaces; and ii) to develop advanced optical sensors to be used in large furnaces, namely using images of the flames within the combustion chamber.

New burner systems, including a new smart regulating element, will be developed together with advanced sensors in order to limit the amount of Nox formed during combustion to values below 500ppm at the chimney. The scientific and technical approach will encompass the laboratory, semi-industrial and industrial scales, with the interpretation of No_X formation phenomena and the burning scaling up being ensured by modelling. The work of IST will focus in two major areas, namely: i) the laboratory testing and development of a new generation of low-No_X combustion strategies, in order to allow the development of new burners; and ii) the development of a new sensor for glass furnaces based on the tomographic reconstruction of the flame characteristics, through the digital analysis of flame images.

11. Partners (for type we mean University, Company, Research Ins Institute, etc.)

Name	Country	Type
St. Gobain	FR	IND
Gas de France	FR	IND
CNRS-CORIA	FR	UNI
IFRF	NL	RES
AGEMA	SW	IND
Hotwork-Koster	DE	IND

12. IST Research Team

Name	Category	Contract with IST(Y/N)

M.V. Heitor	Full Professor	Y
P. Ferrão	Assistant Professor	Y
A. Caldeira-Pires	Research Assistant	N
D. Correia	PhD Student	N
A.L.N. Moreira	Assistant Professor	Y

13. Most significant Results of the Research Project

Papers in International Journal with referees:

- D. Correia, P. Ferrão, M.V. Heitor and T.F. Silva (1996). "*Low-emissions Glass Furnace Technology-based on Advanced Control and Metrology*". Glass Sci. and Tech., 69 (10), pp. 305-310.

- Caldeira-Pires, A. and Heitor, M.V. (1998). *"Temperature and Related statistics Measurements in Turbulent Jet Flames"*. Experiments in Fluids, 24, (4), pp. 118-129.

- Caldeira-Pires, A., Heitor, M.V. and Moreira, A.L.N. (1998). *"On the Turbulent Transport Characteristics of Non-premixed Jet Flames in Mutual Interaction"*. Exp. Thermal & Fluid Science, accepted for publication.

- Caldeira-Pires, A., Heitor, M.V. and Moreira, A.L.N. (1998). *"Analysis of Temperature Dissipation in a Turbulent Jet Propane Flame"*. Exp. Thermal & Fluid Science, accepted for publication.

Communication in Proceedings with referees

- Correia, D.P., Caldera-Pires, Ferrão, P. and Heitor, M.V. (1997). *"A Temperature Tomographic Sensor for Cmbustion Analysis. Proc. ICIASF'97*, Intl. Cong. On Instrumentation. In Aerospace Simulation Facilities, Pacific Grove, California, September 23-October 2, IEEE Publication 97CH 36121.

"NOVOVIDRO" – New Technologies, Innovation and Flexibility in the Glass Industry

Project Co-ordinator at IST

1.	Name	Manuel Heitor / Paulo Ferrão
2.	Category	Full Professor / Assistant Professor
3.	Department	Mechanical Engineering Dpt.
4.	Section	Applied Thermodynamics
5.	Telephone	+351 1 841 73 67
6.	Fax Number	+351 1 849 61 56
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Project

1.	Project Title	"NOVOVIDRO" – New Technologies, Innovation and Flexibility in the Glass Industry
3.	IST Project Number	N351
4.	Funding Source	PEDIP – Portuguese Ministry of Economy
5.	Program	"Projecto Mobilizador"
6.	Type of Contract	Full Costs
7.	Start Date	Oct. 1995
8.	Duration (months)	48 months; extended until September 2000
13.	Funding	
Total		
9.2.	IST	65 000 000 PTE

10. Summary and Objectives

Novovidro, a project for the technological development of the glass industry, consists in the design and implementation of a pilot plant that enables the development and endogenization of new technologies and concepts in the production of glass, with advanced design and low environmental impact. As well as assuring the launching of competitive products with upstream added value, in order to make the most of the plant, this installation demonstrated new forms of production and the valorisation of human resources. This is a project for the technological development which brought together several complementary competencies with the purpose of renewing traditional processes, through the introduction of systems and techniques of high innovative content.
The specific areas include technological aspects (energy, environment, automation), integrated with the design and the process quality and products, with emphasis on the following topics:

- promotion of the Portuguese project of industrial furnaces, fostering the national industry of combustion thermal projects;
- design and optimization of new glass composites, criating specific brands (eco-labelling / product life cycle assessment);
- rational use of energy and diversification of the use of fuels, in particular with the introduction of natural gas;
- promotion of industrial design and design management, reinforcing the use of the competitive factor;
- integration of an environmental component in the company strategy, fostering the application of the Cleaner Production;
- demonstration and dissemination of integrated systems of information, including multimedia technologies, applied to monitorization, control and management of industrial processes;
- logistics automation of the industrial process and demonstration of automatic transport systems based on industrial robotics;
- incentive to new attitudes and behaviours at all levels within the company to foster the development of a new enterpreneurial culture and the ways of production organisation;
- support to the establishment of norms concerning the problems of employment in the crystal sector, in particular through the valorisation of workforce by the ongoing restructuring process.

11. Partners (for type we mean University, Company, Research Ins Institute, etc.)

Name	Country	Type
Atlantis/Crisal	P	IND
DAMASO	P	IND
IFAVIDRO	P	IND
FORNOCERAMICA	P	IND
VIDROCERAMICA	P	IND
INETI	P	IND

12. IST Research Team

Name	Category	Contract with IST(Y/N)
M. Heitor	Full Professor	Y
P. Ferrão	Assistant Professor	Y
A. Caldeira-Pires	Research Assistant	N
J. Pina	Research Student	N
T. Silva	Research Student	N
César Branco	Research Student	N
A. Diogo	Research Student	N

13. Most significant Results of the Research Project

Chapter in book

- Ferrão, P. and Heitor, M.V. (1998). "Integrating Environmental Policy and Business Strategies: the need for innovative management in industry. ". In: Science, Technology and Innovation Policy: Challenges and Opportunities for the 21st Century, eds. Conceição, P., et al., Quorum Publ., New York.

Development of Integrated Manufacturing Systems for Clean Glass Production

Project Co-ordinator at IST

1.	Name	Manuel Heitor / Paulo Ferrão
2.	Category	Full Professor / Assistant Professor
3.	Department	Mechanical Engineering Dpt.
4.	Section	Applied Thermodynamics
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Project

1.	Project Title	Development of Integrated Manufacturing Systems for Clean Glass Production
2.	Contract	PRAXIS/2/2.1/TPAR/2038/95
3.	IST Project Number	J518
4.	Funding Source	MCT – PRAXIS
5.	Program	PRAXIS XXI
6.	Type of Contract	Research and Development
7.	Start Date	1 July 1997
8.	Duration (months)	24
13.	Funding	
Total		
9.2.	IST	25 000 000 PTE
9.3	Special Remark	EUREKA Project Nº !E1844 – K-LEAN

10. Summary and Objectives

The objectives. I) to promote the sustainable development of traditional industries focused on hand-made glass manufacturing, through learning and flexible environments; ii) to guarantee operation within safety margins and to allow easy adaptation to new environmental conditions.

The approach. I) development and implementation of advanced burning systems and multisensor technologies to control and monitor hand-made glass manufacturing processes; ii) design and implementation of intelligent dialogue between the operators and the process, supported by a top-level knowledge-based system and purpose-built interfaces; iii) fostering the implementation of industrial ecology concepts, by identifying economy-environment interactions and by applying life-cycle assessment techniques and eco-design procedures; iv) promotion of learning environments and integrated product design and competitiveness, under continued cultural, technological and economic evolution; v) integration of advanced manufacturing systems within a scenario of regional development and wealth creation.

11. Partners (for type we mean University, Company, Research Institute, etc.)

Name	Country	Type
IST	PT	EDU

12. IST Research Team

Name	Category	Contract with IST(Y/N)
M. Heitor	Full Professor	Y
P. Ferrão	Assistant Professor	Y
Armando Caldeira-Pires	Associate Researcher	N
Duarte Pupo Correia	Research Student	N
J. Pina	Research Student	N
T. Silva	Research Student	N

13. Most significant Results of the Research Project

Papers in International Journal with referees

- D. Correia, P. Ferrão, M.V. Heitor and T.F. Silva (1996). "Low-emissions Glass Furnace Technology based on Advanced Control and Monitoring". Glass. Sc. And Tech., 69 (10), pp. 305-310.

Communication in Proceedings with referees

- Correia, D.P., Caldeira -Pires, A., Ferrão, P. and Heitor, M.V. (1998) Temperature Transfer Sensor for Combustion Analysis. Proc. ICIASF'97, Intl. Cong. On Instrumentation in Aerospace Simulation Facilities, Pacific Grove, California, September-October 2, IEEE Publication 97 CH 36121.

- Ferrão, P., Cardeira, P. (1997). "Towards Eco-efficiency in the Crystal Industry: The Atlantis Experience", 9th International technical Exchange Conference of the International Crystal Federation, Estoril, September.

TRESHIP – "Technologies for reduced environmental impact of ships"

Project Co-ordinator at IST

1.	Name	Paulo Manuel Cadete Ferrão
2.	Category	Assistant Professor
3.	Department	Mechanical Engineering Dpt.
4.	Section	Applied Thermodynamics
5.	Telephone	+351 1 841 73 67
6.	Fax Number	+351 1 849 61 56
7.	E-mail	ferrao@dem.ist.utl.pt

Project

1.	Project Title	ENFRISHIP – "Environmentally Friendly Ships – an exploratory phase thematic network application"
2.	Contract	
3.	IST Project Number	C338
4.	Funding Source	European Commission
5.	Program	BRITE/EURAM
6.	Type of Contract	Research and Development
7.	Start Date	1 January 1997
8.	Duration (months)	24 (31 December 1999)
13.	Funding	
Total		
9.2.	IST	4 600 ECU

10. Summary and Objectives

The environmental impact is becoming an increasingly important factor for the shipping and ship building industry. The industry is faced with increasing environmental requirements and regulations for the building, operation and maintenance of ships, but there is a lack of insight into how new requirements and new technologies will impact ship design, construction, operation, maintenance, and scrapping. The direct impact on the environment due to accidents or actions of ships and crews during the operation of the vessels, have been the incitement for introducing the new regulations.

It is in the interest of the entire industry that knowlwdge of available methods for environmental impact reduction are disseminated, and that facts are documented on the life cycle environmental impact of the maritime transportation industry. Objective data and methods to assess life cycle environmental impact can be made available to support the development and assessment of new rules and regulations to be applied to the industry. Applying such methods, one can avoid that single spectacular events in the industry, and other subjects which for some reason are receiving high media attention, are disproportionately influencing regulations to be implemented.

The overall objectives of the thematic network are:

- Initiate coordinated activities in industrial companies, research and educational institutions in European shipping nations to enhance the awareness of the potential for reducing the life cycle environmental impact from maritime transportation in the short and long term.
- Foster development and adaptation of technologies, and design and analysis methods for ship concepts, ship building processes, and ship operation, maintenance and scrapping practices which can lead to significant improvement of ship life cycle environmental performance.

Promote methods for life cycle environmental impact assessment, and design methods suited to incorporate means for reduced environemental impact reduction in futire ship designs.

11. Partners (for type we mean University, Company, Research Ins Institute, etc.)

No.	Acronym	Name	Category	Country
1	GL	Germanischer Lloyd	IND	DE
2	HSVA	Hamburg Ship Model Tank	ROR	DE
3	WI	Wuppertal Institute	ROR	DE
4	HEM	Hempel	IND	DK
5	SCLIN	Scandline	IND	DK
6	VTT		ROR	FI
7	ACE	ARMINES, Centre d'Energetique	ROR	FR
8	BV	Bureau Veritas	IND	FR
9	EXP	Expertel - France Telecom Group	IND	FR
10	INR	INRETS - Institut National de Recherhe sur les Transports et leur Securite	ROR	FR
11	SNSM	Societe National de Sauvetage en Mer	OTH	FR
12	TM	Turbomeca	IND	FR
13	VSM	V.Ships - Monaco	IND	FR
14	BMT	British Marine Technologies	ROR	GB
15	LR	Lloyds Register of Shipping	IND	GB
16	NCU	Newcastle University	EDU	GB
17	RR	Rolls Royce	IND	GB
18	UGS	Greek Shipowners' Association	OTH	GR
19	CET	CETENA	IND	IT
20	RINA	Registro Italiano Navale	IND	IT
21	APPO	D'Appolonia	IND	IT
22	CTC	Cleaner Technology Centre	EDU	MT
23	MD	Malta Drydocks	IND	MT
24	MARIN	The Maritime Research Institute Netherlands	ROR	NL
25	TME	Institute for applied environmental economics	ROR	NL
26	TNO	Netherlands Organization for Applied Scientific Research	ROR	NL
27	TUD	Technical University Delft	EDU	NL
28	DNV	Det Norske Veritas	IND	NO
29	HAM	Hydro Aluminium Maritime	IND	NO
30	KTD	Kvaerner Technology Development	IND	NO
31	MARINTEK	Norwegian Marine Technology Research Institute	ROR	NO

32	MR	Moere Research	ROR	NO
33	NSA	Norwegian Shipowners' Association	OTH	NO
34	NTNU	Norwegian University for Science and Technology	EDU	NO
35	IST	Instituto Superior Tecnico	EDU	PT
36	ITEC	Instituto Tecnologica Para a Europa Comunitaria	ROR	PT
37	SSPA	Swedish Ship Testing Facility	IND	SE

12. IST Research Team

Name	Category	Contract with IST(Y/N)
P. Ferrão	Assistant Professor	Y

13. Most significant Results of the Research Project

STATE-OF-THE-ART REPORT ON TECHNOLOGIES FOR REDUCED ENVIRONMENTAL IMPACT FROM SHIPS

Post-Graduate Teaching in Engineering, science and Technology for the Knowledge Society

Project Co-ordinator at IST

1.	Name	Manuel Valsassina Heitor
2.	Category	Full Professor
3.	Department	Mechanical Engineering Dpt.
4.	Section	Applied Thermodynamics
5.	Telephone	+351 1 841 73 67
6.	Fax Number	+351 1 849 61 56
7.	E-mail	mheitor@dem.ist.utl.pt

Project

1.	Project Title	Post-Graduate Teaching in Engineering, science and Technology for the Knowledge Society
2.	Contract	CED/0152/96
3.	IST Project Number	J467
4.	Funding Source	Portuguese Government
5.	Program	PRAXIS XXI
6.	Type of Contract	Marginal Costs
7.	Start Date	October 1997
8.	Duration (months)	24
13.	Funding	
Total		
9.2.	IST	105.199 ECU

10. Summary and Objectives

This research project aims to analyse the strategic positioning, contents and organisation of the Portuguese post-graduation-system in the areas of Engineering, Science and Technology, in order to fulfil the new requirements of the Knowledge society.

The project develops an innovative analysis for all stages of the education process, involving the identification of relevant scientific fields, the structure and organisation of the teaching programmes, the integration with research activities, the application of new technologies on pedagogy and the development of new evaluation and control methods.

11. Partners (for type we mean University, Company, Research Ins Institute, etc.)

Name	Country	Type
IST	PT	EDU

12. IST Research Team

Name	Category	Contract with IST(Y/N)
M.V. Heitor	Full Professor	Y
Sten Thore	Invited Professor	N
Pedro Conceição	Assistant	Y
Filipe Santos	Assistant	Y
Pedro Oliveira	PhD Student	N

13. Most significant Results of the Research Project

Books

- Conceição, P., Durão, D.F.G., Heitor, M.V e Santos F. (1998). Novas Ideias para a Universidade, IST Press (232 páginas, 1000 exemplares).

Chapters in Book

- Conceição, P., Heitor, M.V. and Oliveira, P. (1998). Challenges and Opportunities for Intellectual Property Protection of Universities". In: "Technology Transfer: From Invention to Innovation ". Ed. A. Inzelt, J. Hilton, Kluwer Academic Publishers.

Papers in International Journal with referees

- Conceição, P., Heitor, M.V., Gibson, D. and shariq, S. (1997). "Towards a Research Agenda for Knowledge Policies and Management", J. Knowledge Management, 1, (2), pp. 129-141.

- Conceição, P., Gibson, D., Heitor, M.V. and Shariq, S. (1998 "*The Emerging Importance Of Knowledge For Development: Management And Policy Implications", Technological Forecasting And Social Change*, 58, (3), pp. 181-202.

- Conceição, P., Heitor, M.V. and Oliveira, P. (1988). "Expectations for the University in the Age of Knowledge-based Societies. Tech. Forecasting and Socail Change, 58 (3), pp. .

- Conceição, P., Heitor, M.V. and Oliveira, P. (1998). "*University-based Technology Licensing in the Knoweldge-based Economy*", Technnovation, accepted for publication, October.

- Caraça, J., Heitor, M.V. and Santos, F. (1998). "On the evolution of University's Organization and Management. OECD Intl. Journal of Higher Education Management, accepted for publication.

Caraça, J., Conceição, P. and Heitor, M.V. (1998). "On the Definition of a Public Policy Towards a Research University". Higher Education Policy. Accepted for Publication.

c) Number of Publications of Each Doctorate

Name/% of R&D time	Type	1998	1999	Publications in 2000
	BA	1	0	-
	BE	-	3	**3**
	CB	2	6	**4**
Manuel V. Heitor	IJ	11	6	**6**
75 %	JE	1	-	**1**
	NJ	2	-	**1**
	CR	15	3	**5**
	BA	1	-	-
	BE	-	1	**1**
Diamantino F.G. Durão	CB	-	-	-
0 %	IJ	-	-	-
	CR	-	-	**1**
	BA	1		-
	BE	-	-	**1**
Paulo M.C. Ferrão	CB	-	1	**8**
70 %	IJ	3	-	-
	CR	-	-	**4**
	BE	-	-	--
J. Ventura	CB	-	-	-
40%	IJ	-	-	-
	NJ	-	-	-
	CR	6	5	-

Key:
BA-Book Author; BE-Book Editor, CB-Chapter in Book, JE-Journal Editor IJ-Int'l Journal, NJ-Nat'l Journal, CR-Conference Proceedings

Continuation…

Name/% of R&D time	Type	1998	1999	Publications in 2000
J.M. Mendes-Lopes	BE	-	-	-
40 %	CB	-	-	-
	IJ	-	-	-
	NJ	-	1	**1**
	CR	2	1	-
António L. N. Moreira	BE	-	-	-
40 %	CB	1	-	-
	IJ	3		-
	NJ	-	-	-
	CR	-	-	-
Mário N. R. Nina	BE	-	-	-
30 %	CB	-	-	-
	IJ	-		-
	NJ	-	-	-
	CR	-	-	-
	BA	-	-	-
Gabriel Pita	BE	-	-	-
40 %	CB	-	-	-
	IJ	1	-	-
	NJ	-	1	-
	CR	-	-	-

Key:
BA-Book Author; BE-Book Editor, CB-Chapter in Book, IJ-Int'l Journal, NJ-Nat'l Journal, CR-Conference Proceedings

Continuation…

Name/% of R&D time	Type	1998	1999	Publications in 2000
	BA	-	-	-
	BE	-	-	-
	CB	-	-	**1**
Armando Caldeira-Pires				
	IJ	3	3	**4**
70 %	NJ	-	-	-
	CR	1	3	**2**
	BA	-	-	-
	BE	-	-	-
	CB	-	-	**1**
Edgar Fernandes				
	IJ	-	-	-
70 %	NJ	-	-	-
	CR	-	-	**1**
	BA	-	-	-
	BE	-	2	**2**
	CB	-	-	**1**
P Conceição				
	IJ	1	1	**7**
70 %	JE	1	-	**1**
	NJ	-	1	**1**
	CR	-	6	**2**
	BE	-	2	-
	CB	-	-	-
S. Sivadas				
	IJ	1	1	**1**
100 %	NJ	-	1	-
	CR	-	6	-

S. I. Ctorkh 100 %	BA BE CB IJ NJ CR	- - - 3 - 2	- - - - - -	- - - **1**
Rui Baptista 20 %	BA BE CB IJ NJ CR	- - - 1 - -	- - 1 2 - -	- - - **2** - **1**
Francisco Veloso 50 %	BA BE CB IJ NJ CR	- - - 1 - -	- - 1 2 - -	- **1** - - - **1**

Key:
BA-Book Author; BE-Book Editor, CB-Chapter in Book, IJ-Int'l Journal, NJ-Nat'l Journal, CR-Conference Proceedings

d) Individual CV's of Doctorate Researchers (as by December 2000)

All the CV's are available at http://in3.dem.ist.utl.pt/resteam/

- Manuel Heitor
- Paulo Ferrão
- João Ventura
- José Miguel Mendes -Lopes
- António L.N. Moreira
- Gabriel Pita
- Edgar Fernandes
- Pedro Conceição
- Rui Baptista
- Francisco Veloso
- Armando Caldeira-Pires
- Sergei Ctorkh
- Vayalakkara Sivadas

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MANUEL HEITOR - *CURRICULUM VITÆ (Brief, March 2000)*

Name: Manuel Frederico Tojal de Valsassina Heitor

Place and date of birth: Lisbon, September 21, 1958

Nationality: Portuguese

Institutional address: Instituto Superior Técnico, Av. Rovisco Pais, 1049-001 Lisboa, Portugal
"Center for Innovation, Technology and Policy Research, IN+"
http//in3.dem.ist.utl.pt/

Telephone: (+351) 21 841 73 79; **Fax:** (+351) 21 849 61 56; **Email:** mheitor@dem.ist.utl.pt

Academic degrees:

1981 • Engineering Diplom (5 years) in Mechanical Engineering,
Instituto Superior Técnico, Technical University of Lisbon, Lisbon, PT

1985 • PhD. in Mechanical Engineering, Imperial College of Science, Technology and Medicine, University of London, UK

1992 • "Agregação", D. Sc., in Mechanical Engineering,
Instituto Superior Técnico, Technical University of Lisbon, Lisbon, PT

Academic / Research Career:

1980-1981 • Research scholarship student, IST, Dept. Mechanical Engineering,

1981-1985 • Research scholarship student, Imperial College of Science, Technology and Medicine, University of London, UK.

1985-… • Lecturer at the Mechanical Engineering Department of Instituto Superior Técnico Technical University of Lisbon

1995-… • Full Professor at the Mechanical Engineering Department of Instituto Superior Técnico, Technical University of Lisbon

Management and Academic Representation Activities:

1993-1998 • Deputy-President of the Instituto Superior Técnico, Technical University of Lisbon

1997-… • Director of the M. Sc. Programme at IST on "Engineering Policy and Management of Technology"

1998-… • Director of the "Center for Innovation, Technology and Policy Research, IN+"

Other Functions:

1996- • Coordinator of the national evaluation of R&D units in the area of Mechanical Engineering, 1996 Portuguese Ministry of Science and Technology

1999- • National Coordinator of the evaluation of R&D Units in Portugal, Portuguese Ministry of Science and Technology

Area of Specialization:

- Engineering and Public Policy; Management of Technology; Innovation
- Energy and Environmental Technologies; Experimental Fluid Mechanics and Combustion;

Other research areas of interest:

- Science, Technology and Innovation Policy
- Higher Education Policy.
- Industrial Ecology

Prizes:

- Senior Research Fellow, IC^2 Institute (Innovation, Creativity, Capital), The University of Texas at Austin. Since March 1996.
- Sudgen Award 1986 - The most significant contribution of the year attributed by the British Section of the Combustion Institute.
- Diploma of Member of the Imperial College, D.I.C., 1985.

Recent Publications:

Books Published:

- Conceição, P., Durão, D.F.G., Heitor, M.V. e Santos, F. (1998), *Novas ideias para a Universidade*, IST Press, (232 páginas, 1000 exemplares; in Portuguese).

Books edited:

- Conceição, P., Gibson, D., Heitor, M.V. and Shariq, S. (2000). *Science, Technology and Innovation Policy: Opportunities and Challenges for the Knowledge Economy*. QUORUM Publ., New York.
- Adrian, R., Durão, D.F.G., Durst, F., Heitor, M.V., Maeda, M. e Whitelaw, J.H. (2000). *Laser Techniques Applied to Fluid Mechanics*, Springer *Verlag.* (638 páginas, 600 exemplares).
- Adrian, R., Durão, D.F.G., Durst, F., Heitor, M.V., Maeda, M. e Whitelaw, J.H. (1997). *Developments in Laser Techniques and Fluid Mechanics*, Springer *Verlag.* (571 páginas, 600 exemplares).
- Adrian, R., Durão, D.F.G., Durst, F., Heitor, M.V., Maeda, M. e Whitelaw, J.H. (1996). *Developments in Laser Techniques and Applications to Fluid Mechanics*, Springer Verlag (477 páginas; 600 exemplares).
- Culick, F., Heitor, M.V. and Whitelaw, J.H. (1996). *Unsteady Combustion*, Kluwer Academic Publishers, NATO/ASI Series (590 páginas, 700 exemplares).

Scientific Journals Edited:

- *Technological Forecasting and Social Change*, Special issue on "Knowledge for the Inclusive Development", September, 2000.
- *Technological Forecasting and Social Change*, Special issue on "Science, Technology, and Innovation Policies", Vol. 58 (3), July,1998.

Papers in Scientific Jounals:

- Conceição, P., and Heitor, M.V. (2000)."UNIVERSITIES IN THE LEARNING ECONOMY: Balancing Institutional Integrity with Organizational Diversity", in :"*The Globalising Learning Economy:Major Socio-Economic trends and European innovation Policy*", Eds. Bengt-Aake Lundvall and Daniele Archibugi, Oxford University Press.

- Conceição, P., Gibson, D. V., Heitor, M.V. and Sirilli, G. (2000). "Knowledge for Inclusive Development: The Challange of Globally Integrated and Learning Implications for Science and Technology Policy", *Technological Forecasting and Social Change*, September 2000
- Caraça, J., Conceição, P., and Heitor, M.V. (2000). "Suggesting a Public Policy towards the Research University in Portugal", *Higher Education Policy*, June 2000, 13, pp.181-201.
- Caldeira-Pires, A., Carvalho, J. A. and Heitor, M.V. (2000)."Characteristics of Nitric Oxide formation rates in turbulent non-premixed jet flames", *Combustion and Flame*, 120, pp. 383-391
- Conceição, P. and Heitor, M.V. (1999). "On the role of the university in the knowledge-based economy. *Science and Public Policy*, 26 (1), pp. 37-51.
- Duarte, D., Ferrão, P. and Heitor, M.V. (1999). "Turbulence Statistics and Scalar Transport in Higlhy-Sheared Premixed Flames", *Flow, Turbulence and Combustion*, 60, pp. 361-376
- Caldeira-Pires, A. and Heitor, M.V. (1999)."On the analysis of Propane jet Flames in Mutual Interaction", *Combust. Sci. and Technology*, 141, pp.37-57.
- P. Ferrão, M. V. Heitor (1998)."Simultaneous velocity and scalar measurements in premixed recirculating flames", *Experiments in Fluids*, 24, pp. 399-407
- Ferrão, P., and Heitor, M.V., (1998). "Probe and Optical Diagnostics in Premixed Flames". *Experiments in Fluids*, 24, (5/6), pp. 389-398.
- Carvalho, I.S. and Heitor, M.V. (1998). "Liquid Film Break-up in a Model of a Prefilming Airblast Nozzle". *Experiments in Fluids* 24, (5/6), pp. 408-415.
- Caldeira-Pires, A., Heitor, M.V. and Moreira, A.L.N. (1998). "Analysis of temperature Dissipation in a Turbulent Jet Propane Flame ". *Experimental Thermal and Fluid Science*, 18, pp. 116-121.
- P. Conceição, D. V. Gibson, M. V. Heitor, S. S. Shariq (1998), "The Emerging Importance of Knowledge for Development: Implications for Technology Policy and Innovation", *Technological Forecasting and Social Change*, 58(3), pp. 181-202.
- P. Conceição, M. V. Heitor, P. Oliveira (1998), "Expectations for the University in the Knowledge Based Economy", *Technological Forecasting and Social Change*, 58(3), pp. 203-214.
- P. Conceição, M. V. Heitor, P. Oliveira, (1998)"University-based Technology Licensing in the Knowledge Based Economy", *Technovation*, 18 (10), pp. 615-625.
- Santos, F., Heitor, M. V., and Caraça , J.(1998). "Organizational challenges for the university". Higher *Education Management*, 10 (3), pp. 87-107.
- Caraça, J., Conceição, P., Heitor, M. V. (1998), "A Contribution Towards a Methodology for University Public Funding", *Higher Education Policy*, 11(1) pp. 37-58.
- Caldeira-Pires, A. and Heitor, M.V. (1998). "Temperature and Related Statistics Measurements in Turbulent Jet Flames". *Experiments in Fluids*, 24, pp. 118-129.
- Conceição, P. and Heitor, M. V. (1998). "Perspectivas sobre o papel da universidade na economia do conhecimento". *Colóquio/Educação e Sociedade*, nº 2, pp. 71-98.
- Caldeira-Pires, A., Heitor, M.V. and Moreira, A.L.N. (1998). "On the transport characteristics of non-premixed diffusion flames in mitral interaction. *J. Braz. Soc. Mech. Sciences*, XX (2), pp. 164-178.
- Ferrão, P., Heitor, M.V., Moreira, A.L. and Silva, T. (1997). "Experiments in turbulent flames: from industrial to laboratory scale. *Thermal Science*, 1 (2), pp. 3-26.
- Conceição, P., Gibson D., Heitor, M.V. and Shariq, S. (1997). "Towards a research Agenda for Knowledge Policies and Management, *Journal of Knowledge Management*, 1(2), pp. 129-141.
- Anacleto, P., Heitor M. V., and Moreira A. L. N. (1996). "The Mean and Turbulent Flowfields in a Model RQL Gas-turbine Combustor". *"Experiments in Fluids"*, 22, pp. 153-164.
- E.C. Fernandes and M.V. Heitor (1996). *"On the Analysis of Oscillating Flames".* In: "Unsteady Combustion", ed. F. Culick, M.V. Heitor and J.H. Whitelaw, Kluwer Academic Publ., NATO ASI Series, pp. 1-17
- D. Correia, P. Ferrão, M.V. Heitor and T.F. Silva (1996). "Low-emissions Glass Furnace Technology based on Advanced Control and Monitoring". *Glass Sci. and Tech.*, 69 (10), pp. 305-310.
- Carvalho, I.S. and Heitor, M.V. (1996). "Visualization of Vortex Breakdown in Turbulent Unconfined Jet Flames". *Optical Diagnostics in Engineering*, 1, (2), pp. 22-30.

- Caseiro, T., Conceição, P., Durão, D.F.G. and Heitor, M.V., (1996). "On the Development of High Engineering Education in Portugal and the Monitoring of Admissions: a Case Study". Presented at the 7th Intl Conf. Assessing Quality in Higher Education, Tampere, Finland, July 21-23, 1995. *European Journal of Engng. Education*, 21 (4), pp. 435-445.
- E.A. Spencer, M.V. Heitor and I.P. Castro (1995). "Intercomparison of Flow Measurements and Computations Through a Contraction and a Diffuser". *Flow Meas. and Instrumentation*., 6, (1), pp. 13-14.

Organization of recent scientific international Meetings:

- Member of the Organizing Committee and Local Chairman of the Intl. Conferences on "Applications of Laser Techniques to Fluid Mechanics", http://in3.dem.ist.utl.pt/lisboa-laser/
  - 10th Intl Conference: Lisboa, 10-13 July, 2000
  - 9th Intl Conference: Lisboa, 13-16 July, 1998;
  - 8th Intl Conference: Lisboa, 8-11 July, 1996
- Chairman of the Intl. Conferences on "Technology Policy and Innovation", http://in3.dem.ist.utl.pt/conf.policy/:
  - 4th Intl. Conference: Curitiba-BR, 28 August-1September, 2000;
  - 3rd Intl. Conference: Austin-USA, 30 August - 2 September, 1999;
  - 2nd Intl. Conference: Lisboa-PT, 3-5 August, 1998;
  - 1st Intl. Conference: Macau, 2-7 July, 1997
- Chairman, Workshops on "Science, Technology and Society: perspectives on knowledge for sustainable development", http://in3.dem.ist.utl.pt/adv/workshops/

PAULO MANUEL CADETE FERRÃO

CURRICULUM VITÆ

)

Personal Information

Name: Paulo Manuel Cadete Ferrão
Date of birth: May, 31, 1962
Place of birth: Lisboa
Institutional adress:

Instituto Superior Técnico
Av. Rovisco Pais
1049-001 Lisboa
Pnone: 218417987
e-mail: ferrao@dem.ist.utl.pt
URL: http://in3.dem.ist.utl.pt/

Academic degrees

1980/81 - 84/85	Engineering Diplom in Mechanical Engineering at Universidade Técnica de Lisboa, Instituto Superior Técnico
1985/86 - 87/88	MsC in Energy Transfer and Energy Technologies at Universidade Técnica de Lisboa, Instituto Superior Técnico
1987/88	Advanced course on Technological Inovation and Organization: "Strategic management in a context of innovation " at Instituto Superior de Ciências do Trabalho e da Empresa, Centro Interdisciplinar de Estudos Económicos, CIDEC.
1987/88 - 92/93	PhD in Mechanical Engineering

Academic position

Assistant Professor at Instituto Superior Técnico
Responsibility of the following disciplines:

- **Energy and Environment**, Mechanical and Environmental Engineering courses
- **Environment, Energy and Development Policies for Economic Growth**, MsC on Engineering and Technology Management

Organization of international conferences

"Advanced Technologies for Glass Production"

Instituto Superior Técnico, Lisboa, Dezembro: 5 e 6, 1994

FUNÇÃO: Co-Director, juntamente com Prof. M.V.Heitor

"1st International Conference on Technology Policy and Innovation"

Macau, July 2-4, 1997; http://in3.dem.ist.utl.pt/confpolicy/

FUNÇÃO: *Chairman* do *Workshop* em

"**Life Cycle Assessment for Policy Making**",

"2nd International Conference on Technology Policy and Innovation"

Lisboa, 3-5 August, 1988; http://in3.dem.ist.utl.pt/confpolicy/

FUNÇÃO: Membro da organização local e *chairman* do *workshop* em

"**Environmental management and policies".**

"European Seminar on Environmental Management and Policies"

Seminário financiado pela Comissão Europeia, DG XIII

Instituto Superior Técnico, Lisboa, Outubro: 12 e 13, 1998

FUNÇÃO: Membro da comissão organizadora, com Prof. J.D. Domingos,

Prof. M.V.Heitor e Dr. A. Caldeira Pires.

“International Workshop on the automotive industry:

Component suppliers – current and prospective regulatory approaches”

Conferência organizada pela Comissão Europeia.

Santa Maria da Feira, Porto, Portugal, 4-5 May, 2000.

FUNÇÃO: Organizador da sessão em:

“**Suppliers Within An Ecologically Aware Automotive Sector”**

Participation in international PROJECTS

"Fluidised Bed Combustion of Coals and Different Types of Wastes".
Instituto Superior Técnico, 1986 - 1989
Projecto de I & D, envolvendo: I.S.T., I.N.E.T.I., Mague, P; University of Sheffield, UK.
Programa de energia não-nuclear da C E E/DG XII - Contrato Nº EN3F-0013-C
Função: Investigador

" Improved Design of Glass Melting Kilns "
Instituto Superior Técnico, 1987 - 1989
Projecto de I & D, envolvendo: I.S.T., I.N.E.T.I.., Mague, P; Imperial College, UK; University of Erlangen, RFG.
Programa de energia não-nuclear da C E E/DG XII - Contrato Nº EN3E-0153-P
Função: Investigador

"Turbulent mixing and flame extinction in flames stabilised by recirculation zones"
Instituto Superior Técnico, 1990-1993
Projecto de I & D, envolvendo: I.S.T.; Imperial College of Science Technology and Medicine, UK; Universidad de Zaragoza, E; Delft University of Technology, H;
Programa "Science" da C E E/DG XII - Contrato SC1-0459.
Função: Investigador

"Modern development in instrumentation for engineering measurements in flows and flames- A Pan European Consortium".
Instituto Superior Técnico, 1991 - 1994
Projecto Europeu de formação no âmbito do programa TEMPUS - Contrato JEP-1501-91/1 envolvendo instituições de cinco países: IST, P; Budapest Tech. Univ, Tech. Univ. Heavy Industry Miskole, Hungarian Elect. Board, H; Tech. Univ. Braunschweig, Univ. Frid. Karlsruhe, Tech. Univ. Clausthal, D; Univ. degli Studi di Roma "La Sapienza", European Inst. Tech., I; EDF Intl., F.
Função: Formador

"Improvement of combustion processes by swirling flows and turbulent recirculating flames".
Instituto Superior Técnico, 1991-1994
Projecto de I&D envolvendo IST, P; e Tel-Aviv Univ, IR.
Intl. Sci. e Tech. Cooperation, C.C.E.-DGXII, Contrato Nº 89-3001-IR
Função: Investigador

"Basic study on accuracy of industrial flow measurements"
Instituto Superior Técnico, 1991-1994
Programa de cooperação Luso-Japonesa patrocinado pelo Laboratório Nacional de Metrologia do Japão
Função: Investigador

"PDF/CFD - Based methods: Development and validation for Low Emissions Combustion Technology".
Instituto Superior Técnico, 1993-1995
Programa BRITE/EURAM, da CE-DGXII; (Área 5-Aeronáutica). Contrato nº AERO-CT/92-0035, envolvendo IST, P; Universidad de Zaragoza, ES; Univ. of Stutgart, D; Rolls Royce, UK; Universite de Rouen, SNECMA, F.
Função: Investigador

"EURACO - European Robust and Adaptive Control Network".
Instituto Superior Técnico, 1994-1996
Rede de Investigação envolvendo: University of Strathclyde, Queen´s University of Belfast, GB; Twente University, NL; Lund Institute of Technology, SE; Aristotle University of Thessaloniki, Gr; Aalborg University, DK; Universitá di Firenze, IT; Dublin City University, IE; DLR, DE. TMR Program, C.C.E.-DGXII
Função: Co-Coordenação das actividades do I.S.T. com Prof. M.V.Heitor.

"Low-emission systems simulation procedures for the development of fuel efficient combustor technology".
Instituto Superior Técnico, 1995-1999

Projecto seleccionado no âmbito do programa BRITE/EURAM, da CE-DGXII; proposta nº BE95-1927, envolvendo IST, P; Universidad de Zaragoza, ES; BBR Heidelberg University, D; Imperial College, Rolls Royce, UK; Universite de Rouen, SNECMA, F.
Função: Investigador

"Clean Glass: Low-Nox cost effective oil and gas combustion technology for glass furnaces, scaling by modelling and measurement by spectral sensors".

Instituto Superior Técnico, 1995-1999
Projecto seleccionado no âmbito do programa BRITE/EURAM, da CE-DGXII; proposta nº BE95-1708, envolvendo IST, P; Saint Gobain, Gas de France, CNRS-CORIA, F; IFRF, NL; Agema, SW; Hotwork-Koster, D.
Função: Co-Coordenação das actividades do I.S.T. com Prof. M.V.Heitor.

"High-Efficiency Low-Power Cogeneration Systems Using Industrial Residuals as Fuel".

Instituto Superior Técnico, 1994-1998
Projecto de I&D envolvendo IST, Fexol, Vaporel, P, KKK, Ge
Programa Thermie, C.C.E.-DGXVII, Contrato Nº IN/401/94/PO
Função: Coordenador das actividades do IST.

ENFRISHIP- Environmentally friendly ships - LCA of ships

Instituto Superior Técnico, 1996-1998
Projecto seleccionado no âmbito da fase exploratória de uma rede europeia, Brite-Euram III, envolvendo IST, Portugal; NTNU/Marine Technology Centre, Norway; Kvaerner ASA, Norway; Moere Research, Norway; TU Delft, Netherlands, Det Norske Veritas, Norway, Hydro, Norway.
Função: Coordenador das actividades do IST.

TRESHIP- Technologies for Reduced Environmental Impact from Ships

Instituto Superior Técnico, 1999-2003
Brite-Euram temhatic network: BRRT-CT98-509
The TRESHIP network has participation from 11 European nations, 37 institutions, with a mixture of industry, research organisations, and educational institutions.
Função: Coordenador das actividades do IST-DEM.

PARTICIPATION IN NATIONAL PROJECTS

"Desenvolvimento e implementação de sistema multisensorial para o controle automático de processos de secagem na indústria de extracção de óleos alimentares".

PEDIP - Programa 5, Acção A1
Instituto Superior Técnico, 1992-1993
Empresa: Fexol
Função: Coordenação técnica.

"Aplicação de tecnologias multimedia para optimização do fabrico e recozimento do vidro".

Programa RETEX - Submedida C2B - Acção de Demonstração, Acção A1
Instituto Superior Técnico, 1994-1995
Função: Coordenador.

"NOVOVIDRO- Novas tecnologias, inovação e flexibilidade na indústria do vidro".

Projecto de construção e optimização do funcionamento de uma fábrica de vidro inovadora, seleccionado como Projecto Mobilizador pelo PEDIP II, envolvendo: Crisal, Dâmaso, Ifavidro, Fornocerâmica, INETI-ITA, ITEC/INT.
Instituto Superior Técnico, 1995-1999
Função: Director Técnico.

"Eco-gestão no cluster do automóvel, em portugal, baseada na análise do ciclo de vida."

Instituto Superior Técnico, 1999-2001
Projecto Praxis XXI/98-Engenharia Mecânica, P/EME/12222
Função: Coordenador.

"AUTOREC-PROTAP: Reciclagem dos materiais componentes do veículo automóvel"

Instituto Superior Técnico, 1999-2001
Projecto mobilizador PROTAP- PEDIP
Função: Coordenador.

"Engenharia e Tecnologia 2000"

Ordem dos Engenheiros, 1999-2000
Projecto financiado pela Comunidade Europeia e pelo PEDIP II,
Organizado pela Academia de Engenharia, Ordem dos Engenheiros e Associação da Indústria Portuguesa.
Função: Coordenador do estudo horizontal na área de Ambiente.

"Avaliação do ciclo de vida das embalagens de produtos alimentares em portugal"
Instituto Superior Técnico, 2000-2002
Projecto financiado pela Sociedade Ponto Verde
Função: Coordenador.

PUBLICATIONS

BOOKS

Paulo Ferrão (1998) "**Introdução à gestão ambiental: A avaliação do ciclo de vida de produtos**". Colecção ensino da ciência e tecnologia. Editado pela IST PRESS (219 páginas, 1500 exemplares) ISBN: 972-8469-05-05.

Paulo Ferrão e José Figueiredo (eds.) (2000) "A Ecologia Industrial e o Automóvel em Portugal". (268 páginas, 1000 exemplares). CELTA Editora. ISBN: 972-774-092-8.

PAPERS AND CHAPTERS IN EDITED BOOKS

1. D.F.G. Durão, et al (1988). "Fuidised bed combustion of coals and different types of wastes". Publicado em: Fluidized Bed Combustor Design, Construction and Operation, pp. 27-36, Eds. P.F. Sens e J.K. Wilkinson, C C E, Elsevier Applied Science - Londres.
2. P. Ferrão and M. V. Heitor (1991). "Probe and optical techniques for simultaneous scalar-velocity measurements". Publicado em: Combusting Flow Diagnostics, pp.169-231, Eds. D.F.G. Durão et al, Kluwer Academic Publishers.
3. E.C. Fernandes, P. Ferrão, M.V. Heitor and A.L.N. Moreira (1993). "Velocity temperature correlations in recirculating flow with and without swirl". Publicado em: Engineering Turbulence Modelling and Experiments, pp. 857-866. Eds. W. Rodi and F. Martelli, Elsevier Science Publishers.
4. P. Ferrão and M.V. Heitor (1993). "Probe and optical sensors for the analysis of turbulent heat transfer in recirculating flames": Publicado em: Energy Efficiency in Process Technology, pp. 301-310. Ed. P.A. Pilavachi, Elsevier Applied Science.
5. P. Ferrão and M.V. Heitor (1994). "Optical Analysis of Turbulent Heat Transfer in Disc-stabilized Flames". Publicado em: "Non-intrusive Combustion Diagnostics", pp. 441-448. Ed,s. K.K. Kuo and T.P., Parr., Begell House.
6. P. Ferrão and M.V. Heitor (1995). *"Turbulent Mixing and Non-gradient Diffusion in Baffle Stabilized Flames.* Publicado em: "Turbulent ShearFlows - 9", pp. 427-438. Eds. Durst et al., Springer Verlag.
7. D. Duarte, P. Ferrão and M.V. Heitor (1995). "Flame Structure Characterisation Based on Rayleigh Thermometry and Two-Point Laser-Doppler Measurements". Publicado em: "Developments in Laser Techniques and Applications to Fluid Mechanics ", pp. 185-200. Eds. Adrian et al., Springer Verlag.
8. F. Caldas, D. Duarte, P. Ferrão, M.V. Heitor and C. Pope (1997). "On the use of laser Rayleigh scattering to study the aerothermochemistry of recirculating premixed flames". Publicado em: "Developments in Laser Techniques and Fluid Mechanics", pp. 439-454. Eds. Adrian et al., Springer Verlag.
9. P. Ferrão and M. V. Heitor (2000) "Integrating environmental policy and business strategies: The need for innovative management in industry", Publicado em: Science Technology and Innovation Policy: opportunities and challenges for the knowledge economy. pp. 503-518. Eds. P. Conceição, D. Gibson, M. Heitor and S. Shariq, Quorum Books.
10. J. Ehrenfeld, P. Ferrão and I. Reis (2000) "Tools to support innovation of sustainable product systems", Publicado em: Knowledge for the Inclusive Development. Eds. P. Conceição, D. Gibson, M. Heitor and F. Veloso, Quorum Books.
11. A. Giacommucci, M. Graziolo, P. Ferrão and A. Caldeira Pires (2000) "Environmental assessment in the electromechanical industry", Publicado em: Knowledge for the Inclusive Development. Eds. P. Conceição, D. Gibson, M. Heitor and F. Veloso, Quorum Books.
12. P. Ferrão (2000) "O automóvel no contexto da Ecologia Industrial", Publicado em: A Ecologia Industrial e o Automóvel em Portugal. Pp. 5-17. Paulo Ferrão e José Figueiredo (eds.). Celta Editores
13. J. Amaral e P. Ferrão (2000) "Veículos em fim de vida em Portugal", Publicado em: A Ecologia Industrial e o Automóvel em Portugal. Pp. 41-55. Paulo Ferrão e José Figueiredo (eds.). Celta Editores
14. P. Ferrão et al. (2000) "Fileiras de materiais e components resultants de processamento de VFV", Publicado em: A Ecologia Industrial e o Automóvel em Portugal. pp. 75-231. Paulo Ferrão e José Figueiredo (eds.). Celta Editores

15. J. Amaral, P. Ferrão e S. Ladeira (2000) “A directiva europeia e o sistema nacional de processamento de VFV: consequências da sua aplicação”, pp. 255-268. Publicado em: A Ecologia Industrial e o Automóvel em Portugal. Paulo Ferrão e José Figueiredo (eds.). Celta Editores

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1. D.F.G. Durão, P. Ferrão and M.V. Heitor (1989). "On modelling the burning of a high ash coal in a fluidized bed". Combustion Science and Technology, 64, pp. 81-95.
2. D.F.G. Durão, P. Ferrão, I. Gulyurtlu and M.V. Heitor (1990). "Combustion kinetics of high-ash coals in fluidized beds". Combustion and Flame, 79, pp. 162-174.
3. E.C. Fernandes, P. Ferrão, M.V. Heitor e A. L. N. Moreira (1994). "Velocity-Temperature Correlations in Recirculating Flames With and Without Swirl". Experimental Thermal and Fluid Science, 9, (2), pp. 241-249.
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8. P. Ferrão, A. Figueiredo and F. Freire (1998) " Experimental analysis of the drying kinetics of a food product". Drying Technology, 16, (8), pp. 1687-1702.
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10. F. Freire, P. Ferrão and A. Figueiredo (1999) “Thermal analysis and drying kinetics of olive bagasse". Drying Technology, 17, (4&5), pp. 895-907.
11. D. Duarte, P. Ferrão, and M.V.Heitor (1999) "Turbulence statistics and scalar transport in highly sheared premixed flames". Journal of Flow, Turbulence and Combustion, 60, pp. 361-376.

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13. D.P. Correia, P. Ferrão, and A. Caldeira-Pires “Advanced 3D emission advanced 3d emission tomography flame temperature sensor”, Combustion Science and Technology. (aceite para publicação).
14. F. Freire, S. Thore and P. Ferrão “Life Cycle Activity Analysis: Logistics and environmental policies for bottled water in Portugal”, OR Spectrum Journal. (publicado em 2001).
15. P. Ferrão, J. Ehrenfeld and J. Amaral “Strategies for meeting EU end-of-life vehicles re-use/recovery targets, in Portugal”. Journal of Industrial Ecology, MIT Press. (Submetido em Abril de 2000; em avaliação).

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1. D.F.G. Durão, P. Ferrão, I. Gulyurtlu e M.V. Heitor (1987). "Combustion kinetics in shallow fluidized beds". International Specialists Meeting on Solid Fuel, Julho 6-9, Lisboa, Portugal.
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3. P. Ferrão and M.V. Heitor (1993). "On the analysis of turbulent mixing in recirculating flames". Joint meeting of the British and German sections of the Combustion Institute, Março, 29 - Abril, 2, Cambridge, pp. 80-83.
4. P. Ferrão and M.V. Heitor (1993). "Optical analysis of turbulent heat transfer in disc-stabilised flames". 3rd Symp. (Intl.) on Special Topics in Chemical Propulsion: Non Intrusive Combustion Diagnostics, 10-14th Maio, Scheveningen, Holanda.
5. P. Ferrão and M.V. Heitor (1993). "Turbulent mixing and non-gradient diffusion in baffle-stabilized flames". 9th Symposium on Turbulent Shear Flows, paper 28-2, Agosto 16-18, Kyoto, Japão.
6. P. Ferrão and M. V. Heitor (1993). "Optical diagnostics on turbulent reacting flows" Euromech, 390, Gottingen- Alemanha, September 28 - October 1.

7. D. Duarte, P. Ferrão and M. V. Heitor (1994). "Flame Structure Characterization Based on Rayleigh Thermometry and Two-Point Laser-Doppler Measurements". 7th International Symp. on Applications of Laser techniques to Fluid Mechanics", Lisboa, 11-14 Julho 1994.
8. P. Ferrão e M.V. Heitor (1995). "Advanced Optical Diagnostics for the Analysis of Turbulent Heat Transfer in Disc-Stabilized Flames". CUBA 95, Escola de Fluidodinamica de la Combustion, 4-6 Janeiro, 1995, Cuba.
9. D. Correia, P. Ferrão, M.V. Heitor and T. Silva (1995). "Advanced Glass Furnace Monitoring and Control System". Advances in Fusion & Processing of Glass - 4th International Conf. 22-24 May 1995. Publicado em: Glastechnische Berichte Glass Science and technology, 68 C2, pp. 39-46.
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11. P. Almeida, P. Ferrão and M.V. Heitor (1995). "The Effect of Swirl on the Interaction Between Pressure Gradients and Density Fluctuations in Baffle-Stabilised Premixed Flames". Tenth Symposium on Turbulent Shear Flows, Agosto 14-16, 1995.
12. P. Ferrão, M.V. Heitor and D.P. Correia (1996). "On the control of industrial glass furnaces". Joint Meeting of the Portuguese, British, Spanish and Swedish Sections of the Combustion Institute", Funchal, Madeira,1-4 April.
13. P.C. Ferrão, M.V. Heitor, and D. Duarte (1996). "On the nature of turbulent recirculating flames". Proc. of the "Joint Meeting of the Portuguese, British, Spanish and Swedish Sections of the Combustion Institute, Funchal, Madeira Island- 1-4 April.
14. Ferrão, P. and Reis, I. (1996) "On the use of Life Cycle Assessment for Environmental Appraisal". International Symposium and Workshop on Environment and Interaction, Porto, Nov.18-19, 1996.
15. F. Caldas, D. Duarte, P. Ferrão, M.V. Heitor and C. Pope (1996). "On the use of laser Rayleigh scattering to study the aerothermochemistry of recirculating premixed flames". 8th International Symp. on Applications of Laser techniques to Fluid Mechanics", Lisboa, 8-11 Julho 1996.
16. D.P.Correia, A. Caldeira-Pires, P.Ferrão e M.V.Heitor (1997) "A Temperature Tomographic Sensor Combustion Analysis". 17th ICIASF-International Congress on Instrumentation in Aerospace Simulation Facilities. Monterey CA-USA, 29 de Setembro a 2 de Outubro.
17. P. Ferrão and A. Caldeira Pires and J. Carranca (1997) " Life Cycle Analysis for technology assessment in process industry". First Intl. Conf. on Technology Policy and Innovation, Macau, June 1997.
18. P. Ferrão and M.V. Heitor (1997) "Integrating environmental policy and business strategies: The need for innovative management in industry". First Intl. Conf. on Technology Policy and Innovation, Macau, June 1997.
19. P. Ferrão, J.N. Carranca and A. Caldeira-Pires (1997) " Life cycle assessment as a business strategy methodology". Annual conference of the ICIMS-NOE, ASI 97, Life Cycle Approaches to Production Systems: Management, Control, Supervision. Budapest, Hungary, July 14-18, 1997.
20. D. Duarte, P. Ferrão, and M.V.Heitor (1997) "Turbulence statistics and scalar transport in highly sheared premixed flames". Eleventh Symposium on Turbulent Shear Flows, September, 8-11, Grenoble, France.
21. D. Duarte, P. Ferrão and M.V. Heitor (1997) "On the aerothermochemistry of recirculating premixed flames with and without swirl". 90th Symposium of the propulsion and energetics panel on advanced non-intrusive instrumentation for propulsion engines, October 20-24, 1997, Bruxelles, Belgium.
22. D. Duarte and P. Ferrão (1998) "The effect of rotation on bluff-body stabilised flames". Proceedings of the 9th International Symp. on Applications of Laser techniques to Fluid Mechanics", Lisboa, July, 13-16, 1998.
23. F. Caldas, P. Ferrão, M.V. Heitor and M. de Matos (1998) "On the analysis of turbulent scalar mixing in coaxial jets". Proceedings of the 9th International Symp. on Applications of Laser techniques to Fluid Mechanics", Lisboa, July, 13-16, 1998.
24. A. Giacommuci, P. Ferrão and A. Caldeira Pires (1988) "Environmental assessment in the electronic industry". Proccedings of the 2nd International Conference on Technology Policy and Innovation. Lisbon, August 3-5, 1998.
25. P. Ferrão, M. V. Heitor, M.F. Matos (1999) “On the development of large-scales in curved shear layers” 3rd International Conference on Particle Image Velocimetry. September 16-18, Santa Barbara, California.
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27. P. Ferrão and J. Amaral (2000) “Models for recycling and reuse activities in the automotive industry, the Portuguese case study”. 5Th World Congress on integrated resources management-R´2000- Recovery, Recycling and Re-integration”. June 5-9, Toronto, Canada.
28. F. Freire, P. Ferrão, C. Reis and S. Thore (2000) “Life Cycle Activity Analysis applied to the Portuguese used tire market”. Total Life Cycle Conference of the SAE, Society of Automotive Engineers-USA. April 26-28, Detroit, Michigan, USA. Artigo premiado com: “Best paper award”.

29. D.P. Correia, P. Ferrão, and A.Caldeira-Pires (2000) “Flame 3d tomography sensor for in-furnace diagnostics”. 28th International Symposium on Combustion. July, 30th to August, 4th; University of Edinburgh, Scotland.

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1.P. Ferrão, L. Gomes, M. Águas (1990) “ Estudo energético ao sistema de extracção de óleo da fábrica da Folgosa do Douro, do grupo J. Carvalho Coimbra”.
2.P. Ferrão, F. Moita, F. Esmeraldo, C. Figueiredo (1991) " Gestão da produção no fabrico de louça para forno e micro-ondas, em grés fino. Relatório de projecto na empresa Gresval, S.A."
3.C. Martins, C. Gois, P. Ferrão, J. Camara (1992) “ Organização e gestão global de uma empresa cerâmica. Relatório de projecto na A. Santos, S.A.”.
4.P. Ferrão, P. Maia, J. Camara (1992) "Gestão da produção e automação na indústria de extracção de óleos de oleaginosas de origem nacional. Relatório de projecto na empresa Fexol, lda"
5.P. Ferrão, J. Camara e M. V. Heitor, (1993) "Análise energética do sector da cristalaria em Portugal".
6.P. Ferrão, A. Maia, J. Camara, M. Seabra (1993) “Automação e integração de uma filosofia de fabrico manual/semi-automático aplicada à produção e reciclagem de vidro boro-silicato científico. Relatório de projecto na empresa Normax, lda”.
7.P. Ferrão, H. Freire, M. Águas, J. Camara (1993) “ Auditoria energética e plano de racionalização dos consumos energéticos na empresa Hoesch-Impormol”
8.P. Ferrão, D. Santos, J. Marrão, H. Freire, J. Camara (1994) " Diagnóstico de Análise Estratégica da empresa Crisal, S.A."
9.P. Ferrão, J. Camara e H. Freire (1995)" Auditoria energética e plano de racionalização dos consumos energéticos da empresa Crisal, S.A.: Unidade fabril da Marinha Grande - Artigos de Vidro Comum”
10. P. Ferrão, J. Camara e H. Freire (1995)" Auditoria energética e plano de racionalização dos consumos energéticos da empresa Crisal, S.A.: Unidade fabril de Alcobaça – Artigos de Cristal"
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13. P. Ferrão, M. Heitor (1996) “Melhoria da produtividade através da aplicação de tecnologias multimédia para optimização do fabrico e recozimento de vidro. Relatório divulgação de projecto na empresa Crisal, S.A.”
14. P. Ferrão, G. Cunha, J. Barreiras (1997) “Racionalização industrial no fabrico de molas parabólicas para veículos. Relatório de projecto na empresa Impormol, S.A.”
15. J. Amaral, P. Ferrão (2000) “Caracterização da frota automóvel portuguesa e do parque automóvel em fim de vida”
16. R. Stork, J. Amaral, P. Ferrão (2000) “Caracterização das duas instalações de fragmentação portuguesas”
17. J. Amaral, P. Ferrão (2000) “Produção, utilização e opções de fim de vida para baterias”
18. A. Canas, P. Ferrão (2000) “Produção, utilização e opções de fim de vida para óleos”
19. C. Reis, P. Ferrão (2000) “Produção, utilização e opções de fim de vida para pneus”
20. R. Stork, J. Amaral, P. Ferrão (2000) “Exemplos internacionais de iniciativas de processamento de veículos em fim de vida”
21. R. Stork, J. Amaral, P. Ferrão (2000) “Exemplos internacionais de consórcios para o processamento de veículos em fim de vida”
22. J. Amaral, T. Canas, P. Ferrão (2000) “Caracterização da situação nacional de processamento de VFV”
23. P. Ferrão, J. Amaral, R. Stork (2000) “Manual técnico para a valorização da actividade de desmantelamento de veículos em fim de vida em Portugal”
24. P. Ferrão, A. Canas, A. Pires (2000) “Estudo prospectivo sobre a relevância das questões ambientais no desenvolvimento de diferentes sectores de actividade.” Relatório desenvolvido no âmbito do projecto: Engenharia e Tecnologia 2000, Visão estratégica sobre engenharia e tecnologia em Portugal.
25. P. Ferrão (2000) " Suppliers Within An Ecologically Aware Automotive Sector "
Study for the European Commission under the topic: The automotive industry, Component suppliers – current and prospective regulatory approaches.

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Qualificações académicas

Licenciatura em Engenharia Mecânica, Instituto Superior Técnico (UTL), 1971.
Master of Technical Science (M. Sc. Tech.), Universidade de Sheffield, Inglaterra, 1977.
Doctor of Philosophy (Ph. D.), Universidade de Sheffield, Inglaterra, 1981.

Associações profissionais e científicas

Ordem dos Engenheiros (membro sénior e especialista em Segurança)
Sindicato dos Professores da Grande Lisboa
Instituto de Combustão (Secção Portuguesa)
The International Association of Wildland Fire

Actividades anteriores e situação actual em termos científicos e/ou profissionais

Instituto Superior Técnico - Monitor / 1970-71; Assistente / 1971/82; Professor Auxiliar / desde 1982.
Responsável pelos seguintes projectos: AGARD Nº P47/PEP (Coherent Structures in Jet Flames) / 1984/86; JNICT nº PEAM/C/RNT/79/91 (Modelação da interacção vento / incêndio florestal como factor de risco ambiental) 1992/95; STRIDE nº STRD/A/738/CEG/92 (Desenvolvimento de técnicas de visualização de escoamentos com aplicação ao estudo de fenómenos de combustão) 1993/95; PEAM/P/FF/465/95 (Curvas temperatura-tempo no incêndio florestal: modelação e relação com efeitos e combate), protocolo JNICT/CNEFF/1995.
Responsável científico, por parte do IST, dos seguintes projectos europeus: STEP-CT90-0087 (Forest fire prevention through prescribed burning) / 1991-92; EV5V-CT94-0473 (Forest fire prevention through prescribed burning, prediction of effects on trees) / 1994-96; ENV4-CT96-0299 (EFAISTOS – Experiments and simulations for improvement and validation of behaviour models of forest fires) / 1996-98.

Domínio de especialização Engenharia Mecânica

Outros domínios Combustão

Actuais interesses de investigação Incêndios Florestais / Fogos Urbanos / Segurança Industrial / Riscos Naturais e Tecnológicos

Línguas (conversação, leitura, escrita) Português, Inglês, Francês, Espanhol

Publicações mais recentes

João Ventura, Mário Macedo e Nelson Sousa, *Lessons Learned from Emergencies After Accidents in Portugal Involving Dangerous Chemical Substances*, Report EUR 16121 EN, Joint Research Centre, European Comission, 1995.

Ribeiro, J. e J.M.P. Ventura, *Evaluation of textile bobbins drying processes: experimental and modelling studies*, Drying Technology, 13(1&2), 239-265 (1995).

Ventura, João M.P., João M. Ribeiro e Carlos Tomás, *Physical simulation of fire development in compartments*, Joint Meeting of the Portuguese, British, Spanish and Swedish Sections of the Combustion Institute, Proceedings, 23.9.1-5, April 1-4, 1996.

Bento, P., Brederode, V., Rego, F. e Ventura, J., *Utilização de meios aéreos de combate a incêndios florestais em Portugal*, estudo elaborado para a Secretaria de Estado da Administração Interna, Abril 1996.

Ventura, J., J. Mendes-Lopes e L. Ripado, *Interaction between a moving surface fire and a tree trunk*, Proceedings da 13th Conference on Fire and Forest Meteorology, Lorne, Australia, Outubro 27-31, 1996.

Ventura, J. e F. Rego, *Modeling the shape of temperature-time curves*, Proceedings da 13th Conference on Fire and Forest Meteorology, Lorne, Australia, October 27-31, 1996.

Mendes-Lopes, J.M.C., Ventura, J.M.P., & Amaral, J.M.P., *Rate of spread and flame characteristics in a bed of pine needles*, joint 3rd Intern. Confer. on Forest Fire Research and 14th Confer. on Fire Forest Meteorology, vol. 1, pp. 497-511, Luso (Portugal), Novembro 16-20, 1998.

Ventura, J.M.P., Mendes-Lopes, J.M.C., & Ripado, L.M.O., *Temperature-time curves in fire propagating in beds of pine needles*, joint 3rd Intern. Confer. on Forest Fire Research and 14th Confer. on Fire Forest Meteorology, vol. 1, pp. 699-711, Luso (Portugal), Novembro 16-20, 1998.

P. Azevedo, I. Gulyurtlu, I. Cabrita & J. Ventura, *Numerical and experimental study of a prototype natural gas furnace*, Actas da Second European Conference on Small Burner and Heating Technology, vol 2, pp. 277 a 284.

Ventura, João e José Mendes Lopes, *Fogo florestal: modelação do comportamento do fogo e fogo controlado*, poster apresentado no Congresso'98 da Ordem dos Engenheiros, Lisboa, 18-21 de Junho.

Ventura, J.M.P., Mendes-Lopes, J.M.C., & Ripado, L.M.O, *Temperature-time curves in fire propagating in beds of pine needles*, joint 3rd Intern. Confer. on Forest Fire Research and 14th Confer. on Fire Forest Meteorology, vol. 1, pp. 699-711, Luso (Portugal), November 16-20, 1998

Mendes-Lopes, J.M.C., Ventura, J.M.P., & Amaral, J.M.P., *Rate of spread and flame characteristics in a bed of pine needles*, joint 3rd Intern. Confer. on Forest Fire Research and 14th Confer. on Fire Forest Meteorology, vol. 1, pp. 497-511, Luso (Portugal), November 16-20, 1998

Ventura, João, *A disciplina Segurança Industrial na licenciatura em Engenharia Mecânica do Instituto Superior Técnico: Balanço de uma experiência*, Actas do Seminário "Segurança, Fiabilidade e Análise de Avarias", Escola Naval, 8-9 de Abril de 1999.

Ventura, João, *Aprendizagem de conteúdos e desenvolvimento de capacidades e aptidões: uma experiência na Licenciatura em Engenharia do Ambiente*, comunicação ao Encontro sobre Iniciativas Pedagógicas no/para o IST, Jornadas Pedagógicas, IST, 16 de Junho de 1999.

Olim, Marisa, Ana Pereira e João Ventura, *Utilização de um SIG para a caracterização de riscos naturais na região do Alentejo*, Actas do Encontro sobre "Sistemas de Informação Geográfica e Geológica de Base Regional" promovido pelo Instituto Geológico e Mineiro, Beja, 23 de Setembro de 1999.

Ventura, João M.P., *A disciplina Riscos Naturais e Tecnológicos na Licenciatura em Engenharia do Ambiente do IST: Descrição de uma experiência*, Actas do V Congresso Nacional de Engenharia do Ambiente (em CD-ROM), Lisboa, 11-13 de Novembro de 1999.

Ventura, João M.P. e José M. Mendes Lopes, *Modelação física do comportamento do fogo florestal*, Actas do V Congresso Nacional de Engenharia do Ambiente (em CD-ROM), Lisboa, 11-13 de Nov. de 1999.

CURRICULUM VITÆ (2000)

Name : José Miguel Carrusca Mendes Lopes

Place and Date of Birth : Lisbon, 20 January 1954

Nationality : Portuguese

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Academic Qualifications : Ph.D. degree in Mechanical Engineering
(Cambridge University, UK – 1984)

Field of Expertise :
- Forest Fire Combustion

Other Fields :
- Internal Combustion Engines

Current Research Interests : Forest Fire Combustion
(experimental and physical modelling work)

Thermodynamics (combustion, in particular) of Internal Combustion Engines

Main Recent Publications :

Recent Articles in Proceedings of International Conferencees

- Ventura J M P, Mendes-Lopes J M C, Rego F M C, and Botelho H S: "Temperature-time curves in forest fire", 2nd Int. Conf. Forest Fire Research, Vol. 1, B.15, pp. 335-342, Coimbra, Nov. 1994;

- Ventura J M P, Mendes-Lopes J M C, and Ripado L: "Interaction between a moving surface fire and a tree trunk", 13th Conf. on Fire and Forest Meteorology, Lorne, October 1996;

- Mendes-Lopes J M C, Ventura J M P, and Amaral J M P: "Rate of spread and flame characteristics in a bed of pine needles", 3rd Int. Conf. Forest Fire Research / 14th Conf. on Fire and Forest Meteorology, Vol. 1, pp. 497-511, Luso, November 1998

- Ventura J M P, Mendes-Lopes J M C, and Ripado L: "Temperature-time curves in fire propagating in beds of pine needles", 3rd Int. Conf. Forest Fire Research / 14th Conf. on Fire and Forest Meteorology, Vol. 1, pp. 699-711, Luso, November 1998

- Mendes-Lopes J M C, Martins N, and Oliveira H:"Bench tests of the ARMOR UAV propulsive model system", 14th Bristol International Conference on Unmanned Air Vehicle Systems, Bristol, April 1999

CURRICULUM VITAE

ANTÓNIO LUÍS NOBRE MOREIRA
Data de Nascimento: 26 de Novembro de 1956
Natural de Lisboa, Portugal

I - FORMAÇÃO ACADÉMICA

1977/78 - 1981/82	Licenciatura em Engenharia Mecânica (Ramo de Termodinâmica Aplicada) no Instituto Superior Técnico da Universidade Técnica de Lisboa - curso de 5 anos.
1985	Grau de Mestre em Engª Mecânica - Transferência e Conversão de Energia no Instituto Superior Técnico.
1991	Doutoramento em Engenharia Mecânica obtido na Universidade Técnica de Lisboa (Instituto Superior Técnico).

II - ACTIVIDADE DOCENTE

a) Cursos de Licenciatura

1982/83 - 1989/90	MECÂNICA DOS FLUIDOS I e II - Licenciatura em Engenharia Mecânica do Instituto Superior Técnico - disciplinas do tronco comum, 4º ano, 1º e 2º semestres. (Aulas teórico-práticas e de Laboratório).
1989/90 - 1991/92	TERMODINÂMICA I e II- Licenciatura em Engenharia Mecânica do Instituto Superior Técnico - disciplinas do tronco cumum, 3º ano, 1º e 2º semestres. (Aulas teóricas e práticas).
1989/90 - 1993/94	TRANSMISSÃO DE CALOR - Licenciatura de Engenharia Mecânica do Instituto Superior Técnico - disciplina do 5º ano, 1º semestre dos ramos de Sistemas e de Produção. (Aulas teóricas, práticas e de Laboratório).
1992/93 - ...	ELEMENTOS DE ENGENHARIA MECÂNICA - Licenciatura em Engenharia e Gestão Industrial do Instituto Superior Técnico - disciplina do 3º ano, 1º semestre do perfil de Gestão Global e do perfil de Gestão de Empreendimentos. (Aulas teóricas e práticas). **Responsável da disciplina na área de Energia e Termodinâmica Aplicada**.
1994/95 - ...	TERMODINÂMICA E FENÓMENOS DE TRANSPORTE - Licenciatura em Engenharia e Gestão Industrial do Instituto Superior Técnico - disciplina do 3º ano, 1º semestre do perfil de Gestão Global e do perfil de Gestão de Empreendimentos. (Aulas teóricas e práticas) **Responsável da disciplina**.
1996/97 - ...	TERMODINÂMICA I e II - Licenciatura em Engenharia Mecânica do Instituto Superior Técnico - disciplinas do tronco cumum, 3º ano, 1º e 2º semestres. (Aulas teóricas).

2000/01 - ... COMBUSTÃO - Licenciatura em Engenharia Mecânica do Instituto Superior Técnico - disciplina do 5º ano, 1º semestre, do ramo de Termodinâmica Aplicada.

b) Cursos de Pós-Graduação

1993/94 MÉTODOS INSTRUMENTAIS
Curso de Mestrado em Engenharia Mecânica do Instituto Superior Técnico. (Aulas teóricas e de laboratório).
Responsável da disciplina pelo perfil de Energia.

1994/95 - ... MÉTODOS INSTRUMENTAIS DE ANÁLISE E CONTROLO EM ENERGIA E AMBIENTE
Curso de Mestrado em Engenharia Mecânica do Instituto Superior Técnico (Aulas teóricas)

1994/95 - ... COMBUSTÃO
Curso de Mestrado em Engenharia Mecânica do Instituto Superior Técnico (Aulas teóricas)
Responsável da disciplina em 1995/96.

2000/01 MÉTODOS INSTRUMENTAIS EM ENERGIA E AMBIENTE
Disciplina de Mestrado em Engenharia Mecânica do Instituto Superior Técnico.

III - PARTICIPAÇÃO EM PROJECTOS DE I & D

a) Projectos Internacionais

"Combustion Instabilities"
Instituto Superior Técnico e Imperial College of Science, Technology and Medicine da Universidade de Londres, U. K., 1983-1986
Projecto AGARD, P55, contract 576.55.1D
Projecto de I & D envolvendo: IST, Portugal; Imperial College, U.K.
Função: *Investigador.*

"Combustão de carvões e vários tipos de resíduos em leitos fluidizados".
Instituto Superior Técnico, 1986 - 1989.
Programa de Energia Não-Nuclear da C.C.E./DG XII - Contrato Nº EN3F-0013-C(T.T.).
Projecto de I & D envolvendo: I.S.T, LNETI, Mague, Portugal; Universidade de Sheffield, Reino Unido.
Função*: Investigador.*

"Improved Design of Glass-Melting Kilns"
Instituto Superior Técnico, 1987-1989
Programa de Energia Não-Nuclear da C.C.E./DG XII - Contrato Nº EN3E-0153-P.
Projecto de I & D envolvendo I.S.T., LNETI, Metal Portuguesa, Portugal; Imperial College, Reino Unido; Universidade de Erlangen, Alemanha.
Função*: Investigador.*

"Intercomparison of Flow Measurements and Computations"
Instituto Superior Técnico, 1988-1991.
Programa do "Community Bureau of Reference", BCR, C.C.E. - DG XII - Contrato Nº 3166/1/0/121/87/7 - BCR - P(30).
Projecto de I & D envolvendo: I.S.T., P; Univ. Thessalonika, GR; Cranfield Inst. Techn. National Eng. Lab., Univ. Surrey, UK; Delft Hydraulics Lab., Eindhoven Univ. of Techn., Nederlandse Gasunie, Nat. Serv. Metrology, NL; ONERA - CERT, F; Trinity College Dublin, IR; Univ. Aachen, D; Univ. Ancona, I.
Função: *Investigador.*

AIMBURN "Advanced Intelligent Multi-sensor System for Control of Large Industrial Boilers and Furnaces".
Instituto Superior Técnico, 1989 - 1992.
Programa ESPRIT II da C.C.E./DG XIII: Contrato Nº 2192.
Projecto de I & D envolvendo: A.D.I.S.T. - I.S.T., Fábrica de Vidros Barbosa e Almeida, Mague, Servotrol, Unisoft, Portugal; Trion, Alemanha; IDS, IGC e Universidade Pol. de Madrid, Espanha; Imperial College of Science, Technology and Medicine, Reino Unido.
Função*: Investigador.*

"Turbulent Mixing and Flame Extinction in Flames Stabilized by Recirculation Zones"
Instituto Superior Técnico, 1990 - 1993
Programa SCIENCE da CEE - DG XII
Projecto de I & D envolvendo: IST, Portugal; Imperial College of Science, Technology and Medicine, Reino-Unido; Universidade de Zaragoza, Espanha; Delft University of Technology, Holanda.
Função*: Investigador.*

"Improvement of Combustion Processes by Swirling Flows and Turbulent Recirculating Flames"
Instituto Superior Técnico, 1991 - 1994.
Intl. Sci. and Tech. Cooperation, C.C.E. - DG XII, Contrato nº 89-3001 - IR.
Projecto de I & D envolvendo IST e Telaviv University, Israel.
Função: *Investigador.*

"Basic Study on Accuracy of Industrial Flow Measurements"

Instituto Superior Técnico, e National Laboratory of Metrology, Japão. 1991 - 1994
Programa de Cooperação Luso-Japonesa patrocinado pela Agency of Industrial Science and Technology do Japão.
Função: *Investigador.*

"PDF/CFD - Based Methods: Development and Validation for Low Emissio ns Combustion Technology"
Instituto Superior Técnico, 1993 - 1995
Programa BRITE/EURAM (Área 5 - Aeronáutica") da CEC-DGXII, Contracto Nº 2018. Projecto de I&D envolvendo: IST, Portugal; Univ. Zaragoza, Espanha; ICSTM, Rolls Royce, Reino-Unido; Univ. Rouen, SNECMA, França; Univ. Stuttgart, Alemanha.
Função: *Investigador, coordenador das actividades experimentais no Laboratório do I.S.T..*

"Low-Emission Combustion Technology - Phase II"
Instituto Superior Técnico, 1993 - 1995.
Programa BRITE - EURAM (Área 5 - "Aeronáutica") da CEC - DGXII, Contrato Nº 2019. Projecto de I&D envolvendo: IST, P; MTU, BMW, Tech. Univ. Munchen, Univ. Heidelberg, DLR, Univ. Karlsruhe, D; Rolls Royce, DRA, Cranfield Institute of Technology, UK; SNECMA, Turbomeca, ONERA, CERT, Univ. Rouen, LED, F; FiatAvio, Alfa Romeo, I; Univ. Patras, GR; Volvo, SW.
Função: *Investigador, coordenador das actividades experimentais no Laboratório do I.S.T..*

"Large Eddy Simulation Modelling for Lean Prevapourised, Premixed Combustion"
Instituto Superior Técnico 1996 - 1999.
Programa BRITE/EURAM (Área 5 - Aeronáutica) da CEC - DGXII, Contrato nº 1953. Projecto de I&D envolvendo: IST, Portugal; Cranfield University, U.K.; Chalmers University, SE; École Central de Lyon, F; ENSMA - Poitiers, F; Loughborough University, U.K.; Lund University, SE; Rolls-Royce, U.K.; SNECMA, F; Volvo Aero Corporation, SE; DRA, U.K..
Função: *Investigador, coordenador das actividades experimentais no Laboratório do I.S.T..*

"Direct Injection engine Spray Processes – Mechanisms to Improve Performance"
Instituto Superior Técnico 2000 - 2003.
Projecto do programa Comunitário de Energia, Ambiente e Desenvolvimento Sustentado.
Projecto de I&D envolvendo: IST (P), Univ. Polit. Valencia (E), PSA (F), UEN (D), AVL (A), Imp. College Sci. Tech. Medicine (UK), Aura (F) and CNRS (F)
Função: *Investigador.*

b) Projectos Nacionais

"Análise Experimental de Combustão Industrial para a Protecção do Ambiente"
Instituto Superior Técnico, 1992 - 1995.
Programa Específico JNICT/DGQA para o Ambiente/91 - Projecto nº 144.
Função: *Co-Responsável e Investigador.*

"Caracterização Térmica do Sistema do Grupo Gerador de Vapor da Central Termoeléctrica da EDP no Barreiro".
Projecto conjunto com o Departamento de Apoio Técnico da EDP desenvolvido na Central Termoeléctrica da EDP no Barreiro, 1992
Função: *Co-Responsável; coordenador da actividade experimental levada a cabo na Central da EDP.*

"Desenvolvimento e Aplicação de Técnicas Ópticas Multidimensionais de Análise de Escoamentos com Interesse Industrial".
Instituto de Engenharia Mecânica, 1992-1995.
Programa JNICT/STRIDE
Função: *Co-Responsável e Investigador.*

"Análise da Distribuição do Escoamento de Ar em Sistemas de Queima de Grupos Geradores de Vapor em Centrais Termoeléctricas".

Projecto financiado pelo Departamento de Apoio Técnico da EDP.
Instituto Superior Técnico, 1992/1993.
Função: *Co-Responsável e investigador.*

"Caracterização Térmica do Grupo Gerador de Vapor da Central Termoeléctrica de Setúbal: Análise do Processo de Atomização de Combustível".
Projecto financiado pelo Departamento de Apoio Técnico da EDP desenvolvido na Central Termoeléctrica da EDP em Setúbal, 1993.
Função: *Investigador.*

"Aperfeiçoamento de Contadores de Água de Elevada Precisão".
Projecto conjunto Instituto Superior Técnico-Sociedade de Aparelhos de Precisão, Bruno Janz.
Projecto financiado pela Agência de Inovação, 1994/1995.
Função: *Co-Responsável.*

"Optimização de Sistemas de Queima de Grupos Geradores de Vapor de Centrais Termoeléctricas".
Projecto financiado pelo Departamento de Apoio Técnico da EDP.
Instituto Superior Técnico, 1994.
Função: *Co-Responsável.*

"Caracterização Térmica de um Grupo Gerador de Vapor da Central Térmoeléctrica da EDP em Setúbal - análise da combustão de um óleo de emulsão".
Projecto conjunto com o Departamento de Apoio Técnico da EDP.
Instituto Superior Técnico, 1994.
Função: *Investigador.*

"Instalação Didática para o Estudo Experimental de Processos de Combustão".
Projecto com a STA.
Instituto Superior Técnico, 1995
Função: *Responsável.*

"Novas tecnologias de preparação e injecção de combustível em sistemas aeroespaciais com reduzida emissão de poluentes"
Projecto Praxis 3/3.1/CTAE/1917/95 com a Universidade da Beira Interior.
Instituto Superior Técnico, 1997-1999.
Função: *Investigador – Co responsável.*

"Flow and heat transfer characteristics of evaporating impinging sprays"
Projecto Sapiens POCTI/1999/EME/32960 com a Universidade da Beira Interior.
Instituto Superior Técnico, 2001-2004.
Função: *Coordenador.*

IV - PUBLICAÇÕES E RELATÓRIOS

a) Artigos em Revistas

1. "Flow Measurements in a Model Burner - Part 1" (1991).
   D. F. G. Durão, M. V. Heitor and A. L. N. Moreira.
   Journal of Fluids Engineering, vol. 113, December, pp. 668-674.

2. "On the Analysis of Spray Atomization in Swirling Recirculating Flows" (1991).
   D. F. G. Durão, M. V. Heitor and A. L. N. Moreira.
   Bulletin of the European Research Community on Flow Turbulence and Combustion, pp.6-8.

3. "On the Stabilization of Flames on Multi-Jet Industrial Burners" (1992).
   D. F. G. Durão, M. V. Heitor and A. L. N. Moreira.
   Experimental Thermal and Fluid Science, vol. 5, No. 6, pp. 736-746.

4. "Velocity characteristics of a swirling recirculating flow" (1992).
   M. V. Heitor and A. L. N. Moreira.
   Experimental Thermal and Fluid Science, vol. 5, No. 3, pp. 369 - 380.

5. "O Escoamento Turbulento em Sistemas de Queima" (1992).
   M. V. Heitor e A. L. N. Moreira.
   Revista "Técnica", pp. 151-164.

6. "On the Analysis of Turbulent Transport Processes in Multi-Jet Burners" (1992).
   M. V. Heitor and A. L. N. Moreira.
   Experiments in Fluids, vol. 13, pp. 179 - 189.

7. "Flow Measurements in a Model Burner - Part 2" (1993).
   D. F. G. Durão, M. V. Heitor and A. L. N. Moreira.
   Journal of Fluids Engineering, vol. 115, No. 2, pp. 309-316.

8. "Thermocouples and Sampling Probes for Combustion Studies" (1993).
   M. V. Heitor and A. L. N. Moreira.
   Progress in Energy and Combustion Science, vol. 19, pp. 259 - 278.

9. "Experimental Analysis of the Influence of Burner Design on the Preformance of a Utility Oil-fired Boiler" (1994).

   M.V. Heitor, A.L.N. Moreira, A.M.C. Silva e T.F. Silva.

   Journal of the Institute of Energy, June, pp. 50-60.

10. "Temperature, Species and Heat Transfer Characteristics of a 250MWe Utility Boiler" (1994).

    J. Cassiano, M.V. Heitor, A.L.N. Moreira e T.F. Silva.

    Combustion Science and Technology, vol. 98, 1-3, pp.199-215.

11. "Velocity-Temperature Correlations in Recirculating Flames With and Without Swirl" (1994).

    E.C. Fernandes, P. Ferrão, M.V. Heitor and A.L.N. Moreira.

    Experimental Thermal and Fluid Science, vol. 9, No 2, pp. 241-249.
    (Artigo apresentado no 2nd Intl. Symp. on Eng. Turbulence, Modelling and Measurements, Florence, Italia, Junho, 1993 e seleccionado para publicação numa edição especial da revista)

12. "Comparison of Measurements and Predictions of Wall Heat Flux and Gas Composition in an Oil-Fired Utility Boiler" (1994).

M.G. Carvalho, P. Coelho, A.L.N. Moreira, A. Silva e T. Silva.

25th Symposium (Intl.) on Combustion, pp. 227 - 234.

13. "The Mean and Turbulent Flowfields in a Model RQL Gas-Turbine Combustor" (1996),.

P. Anacleto, M. V. Heitor and A. L. N. Moreira.
Experiments in Fluids, 22, pp. 153 - 164.

14. "Implicações da Queima Industrial de Emulsões em Água em Sistemas de Produção de Energia" (1997).

M. V. Heitor, A. L. N. Moreira, A. M. C. Silva e T. F. Silva.
Inginium, 2ª Série, nº 16, pp. 74-79.

15. "On the Turbulent Transport Characteristics of Non Premixed Diffusion Flames in Mutual Interaction" (1998).

A. Caldeira-Pires, M. V. Heitor and A. L. N. Moreira.
RBCM - Journal of the Braz. Soc. Mechanical Sciences, Vol. XX - No.2 - pp. 164-178.

16. "On the Analysis of Temperature Dissipation in a Turbulent Jet Propane Flame" (1998).

A. Caldeira-Pires, M. V. Heitor and A. L. N. Moreira.
Experimental Thermal and Fluid Science, Volume 18, Number 2, October 1998, pp.116-121.

17. "Experiments in Turbulent Flames: from Industrial to Laboratory Scale" (1998).

P. Ferrão, M. V. Heitor and A. L. N. Moreira.
Thermal Science, Vol. 1, No. 2,

b) Artigos e Capítulos em Livros

1. "Fluidized Bed Combustion of Coals and Different Types of Wastes" (1988).

D. F. G. Durão, M. V. Heitor and A. L. N. Moreira.
In Fluidized Bed Combustor Design, Construction and Operation, edited by P. F. Seins and J. K. Wilkinson, Elsevier Applied Science, London.

2. "The Turbulent Characteristics of Swirling Flows in Typical Burners" (1990).

D. F. G. Durão, M. V. Heitor and A. L. N. Moreira.
In Engineering Turbulence Modelling and Measurements, ed. W. Rodi, E. N. Ganic, Elsevier Publications, pp. 705-716.
(artigo apresentado no 1st Intl. Symp. on Eng. Turbulence, Modelling and Measurements, Dubronik, Yugoslavia, September 4-9, 1990).

3. "Flow Measurements in a Liquid Fuelled Burner" (1991).

D. F. G. Durão, M. V. Heitor and A. L. N. Moreira.
In: Applications of Laser Techniques to Fluid Mechanics, vol. 5, edited by R. J. Adrian, D. F. G. Durão, F. Durst, M. Maeda and J. H. Whitelaw, Springer-Verlag . pp. 163-182.
(Artigo seleccionado no 5th Intl. Symp. on Applications of Laser Techniques to Fluid Mechanics, Lisboa, Portugal, Julho, 1990).

4. "Probe Measurements of Scalar Properties in Combusting Systems" (1992).

M. V. Heitor and A. L. N. Moreira.
In: Combusting Flow Diagnostics, ed. Durão et al., Kluwer Academic Publ., pp. 79-136.

5. "Experiments in Large-Scale Combustion Systems and the Characterization of the Burning Equipments" (1993).

J. Cassiano, M.V. Heitor, A.L.N. Moreira and T.F. Silva.
In: Energy Efficiency in the Process Technology, edited by P.A. Pilavachi, Elsevier Applied Science, pp. 893-902.
(Artigo apresentado na International Conference on Energy Efficiency in Process Technology, Atenas, Outubro 19-22, 1992).

6. "Velocity-Temperature Correlations in Recirculating Flames with and without Swirl" (1993).

E.C. Fernandes, P. Ferrão, M.V. Heitor and A.L.N. Moreira.
In: Engineering Turbulence Modelling and Experiments, Vol. 2, ed. W. Rodi, F. Martelli, Elsevier Publications, pp. 857-866.
(Artigo apresentado no 2nd Intl. Symp. on Eng. Turbulence, Modelling and Measurements, Florence, Italia, Junho, 1993)

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4. "Laser Diagnostics of the Flow in Industrial Burners" (1988).

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   Euromech 237 - Influence of Density Variations on the Structure of Low Speed Turbulent Flows, Marseille, França, 18-21 Julho.

7. "On the stabilization of Flames on Multi-Jet Industrial Burners" (1988).

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   1st World Conference on heat and Mass Transfer, Fluid Mechanics and Thermodynamics, Dubrovnik, Yugoslavia, Setembro 4-9.

8. "Detection of Flame Front Instability in Premixed Combustion" (1988).

   A. L. N. Moreira and M. N. R. Nina.
   72nd PEP Specialist´s Meeting on Combustion Instabilities in Liquid-Fuelled Propulsion Systems, Bath, U. K., Outubro, 6-7.

9. "Laser-Doppler Measurements of the Flow in Model Burners" (1988).

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   ICALEO´88, Laser Institute of America, Santa Clara, California, USA, October 30 - Novembro 4.

10. "The Interaction of Coaxial Jets with Swirl Stabilized Flames" (1989).

    I. S. Carvalho, D. F. G. Durão, M. V. Heitor and A. L. N. Moreira.
    12th ICDERS, University of Michigan, Michigan, USA, Julho 23-28.

11. "Turbulent Swirling Flames in Multi-Jet Burners" (1989).

    D. F. G. Durão, M. V. Heitor and A. L. N. Moreira.
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12. "Turbulent Transport Processes in Swirling Recirculating Non-premixed Flames" (1991).

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13. "Velocity, Temperature and Species Characteristics of High Intensity Swirling Recirculating Non-Premixed Flames" (1992).

    M. V. Heitor and A. L. N. Moreira.
    24th Symposium (Intl.) on Combustion (poster session), Sydney, Australia, Julho 5 - 10.

14. "Experiments in Large Scale Combustion Systems and the Characterization of the Burning Equipment" (1992).

    J. Cassiano, M. V. Heitor, A. L. N. Moreira and T. Silva.
    International Conference on Energy Efficiency in Process Technology, Atenas, Outubro 19-22.

15. "Premixed Turbulent Combustion in Model Combustors" (1993).

    P.M. Anacleto, M.V. Heitor, A.L.N. Moreira and J.B. Wei.
    International Scientific Colloquium on the Impact of Emissions from Aircraft and Spacecraft upon the Atmosphere", Cologne, Germany, April 18-20 (1994).

16. "Velocity and Temperature Characteristics of Jet Diffusion Flames in Mutual Interaction" (1994).

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17. "Experiments on Polydisperse Two-Phase Turbulent Jets" (1994).

    M.V. Heitor and A.L.N. Moreira.
    6th International Conference on Liquid Atomization and Spray Systems. Rouen, France, 18-22 Julho, 1994.

18. "Interaction of Multiple Jet Propane Flames" (1994).

    M.V. Heitor, A.L.N. Moreira and A.M.C-Pires.
    25th Symposium (Intl.) on Combustion (poster session), Los Angeles, Julho 31 - Agosto 5.

19. "Experimental Analysis of the In-Furnace Processes in a 250 MWe Oil-Fired Utility Boiler" (1994).
    M.V. Heitor, A.L.N. Moreira, A.M.C. Silva e T.F. Silva
    10th International Heat Transfer Conference, Brighton, England, 14-18 Agosto.

20. "Free-Radical Quenching in Multiple Jet Propane Flames" (1995).
    M. V. Heitor, A. L. N. Moreira and A. C. Pires.
    CUBA´95, Escuela de Fluidodinâmica de la Combustion, 4-6 Janeiro, Cuba.

21. "Experiments in Full Scale Utility Boilers" (1995).

    J. Cassiano, M. V. Heitor, A. L. N. Moreira and T. F. Silva.
    CUBA´95, Escuela de Fluidodinâmica de la Combustion, 4-6 Janeiro, Cuba.

22. "Temperature Fluctuations and Dissipation in a Turbulent Jet Propane Flame", (1995).

    M. V. Heitor, A. L. N. Moreira and A. C. Pires.
    Tenth Symposium on Turbulent Shear Flows, The Pennsylvania State University, U.S.A., August 14-16.

23. "Lean Burn and Flame Stability for Low-Emission Combustion Technology", (1995).

    P. Anacleto, M. V. Heitor and A. L. N. Moreira.
    III International Congress on Energy, Environment and Technological Innovations, Caracas, Venezuela, November 6-11.

24. "Scalar Fluctuations Characteristics of Jet Diffusion Flames in Mutual Interaction", (1995).

    M. V. Heitor, A. L. N. Moreira and A. C. Pires.
    XIII Congresso Brasileiro e II Congresso Ibero-Americano de Engenharia Mecânica, COBEM-CIDIM/95, Belo Horizonte, Brasil, 12-15 Dezembro.

25. "The Implementation of Flue Gas Recirculation Startegies for NO_x reduction in a 0.2 MW Liquid Fuelled Furnace", (1996).

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    Joint Meeting of the Portuguese, British, Spanish and Swedish Sections of the Combustion Institute, April 1-4, Funchal, Madeira, Portugal.

26. "Particle Dispersion in an Acoustically Excited Round Jet" (1996).

    R. Hoffmann and A. L. N. Moreira.
    8th Intl. Symp. on Applications of Laser Techniques to Fluid Mechanics, Lisboa, Julho 8-11.

27. "A Laser-Doppler Analysis of Cooling and Mixing in a Research Combustor" (1996).

    P. Anacleto, M. V. Heitor and A. L. N. Moreira.
    8th Intl. Symp. on Applications of Laser Techniques to Fluid Mechanics, Lisboa, Julho 8-11.

28. "Fuel-Droplet Dispersion in the Premix-Prevapourise Duct of Low NO_X Aero Engines" (1997).
    A. N. Barros and A. L. N. Moreira.
    Workshop on Aerospace and Powered Lift Technologies, UBI, Covilhã, 7-9 Julho 1997.

d) Relatórios

1. "A Model of Particle Elutriation in a Fluidized Bed Combustor" (1986).

   A. L. N. Moreira.
   Instituto Superior Técnico, Dept. Eng. Mecânica - C.T.A.M.F.U.T.L.

2. "Intercomparison of Flow Measurements and Computations: First Report on the experimental analysis" (1989).

   M. V. Heitor, P. C. Ferreira, A. L. N. Moreira and H. Lamarão.
   C.C.E. - DG XII/BCR Report.

3. "Velocity Characteristics of Swirl Recirculating Flows with and without Combustion" (1991).

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4. "Flow Measurements in Pipe Components at IST" (1992).

   G. P. Almeida, M. V. Heitor, A. L. N. Moreira and J. M. Rodrigues.
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5. "Caracterização Térmica do Grupo Gerador de Vapor da Central Termoeléctrica do Barreiro" (1993).
   M.V. Heitor, A.L.N. Moreira, A.M.C. Silva e T.F. Silva.
   Relatório de Projecto.

6. "Caracterização Térmica do Grupo Gerador de Vapor da Central Termoeléctrica de Setúbal" (1993).
   M.V. Heitor, A.L.N. Moreira, A.M.C. Silva e T.F. Silva.
   Relatório de Projecto.

7. "Análise de Distribuição do Escoamento de Ar em Sistemas de Queima de Grupos Geradores de Vapor em Centrais Termoeléctricas" (1994).
   M.V. Heitor, A.L.N. Moreira e T.F. Silva.
   Relatório Final de Projecto.

8. “Aperfeiçoamento de contadores de água de elevada precisão” (1994).

   G. Almeida, M.V. Heitor e A. L. N. Moreira.
   Relatório Final de Projecto

9. “Caracterização Térmica de um Grupo Gerador de Vapor da Central Térmoeléctrica da EDP em Setúbal - análise da combustão de um óleo de emulsão”, (1995).
   M. V. Heitor, A. L. N. Moreira, T. F. Silva e A. C. Silva.
   Relatório Final de Projecto.

10. “Simulação Laboratorial de Novos Sistemas de Queima Industrial” (1995).
    M. V. Heitor, A. L. N. Moreira, T. F. Silva e A. M. C. Silva.
    Relatório de Projecto

11. “Laser-Doppler Measurements in the Tubular RQL Perspex model” (1995).
    P. Anacleto, M. V. Heitor and A. L. N. Moreira.
    Relatório de Projecto.

12. “Optimização do Sistema de Alimentação de Ar a Sistemas de Queima Industrial” (1995).
    M. V. Heitor, A. L. N. Moreira, T. F. Silva e A. M. C. Silva.
    Relatório de Projecto.

13. “The use of the phase Doppler anemometer in biphasic flows – some notes on the interpretation of the measurements” (1999).
A. L. N. Moreira.

e) Textos de índole pedagógica

1. "Instrumentação e Aquisição de Dados" (1986).
M. V. Heitor e A. L. N. Moreira. Instituto Superior Técnico.
Dep. Eng. Mecânica - C.T.A.M.F.U.T.L.

2. "Termodinâmica" (1993).
Departamento de Engenharia Mecânica, Secção de Termodinâmica Aplicada.
Texto elaborado para apoio à disciplina de Fenómenos de Transporte em Cursos de Formação Profissional.

3. "Elementos para a Análise de Sistemas Energéticos" (1993).
Departamento de Engenharia Mecânica, Secção de Termodinâmica Aplicada. Texto de Apoio à Disciplina de Elementos de Engenharia Mecânica da Licenciatura em Engenharia e Gestão Industrial.

4. “Elementos de Engenharia Mecânica” – Colecção de problemas (1994).
Colecção de enunciados de problemas para as aulas práticas da disciplina de Elementos de Engenharia Mecânica da Licenciatura em Engenharia e Gestão Industrial.

5. “Elementos de Engenharia Mecânica – proposta de alteração do programa da disciplina” (1995).

6. “Termodinâmica II” – Colecção de problemas para as aulas práticas (1999)

CURRICULUM VITAE RESUMIDO

DE

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1.- NOTA BIOGRÁFICA

Nasceu no Funchal em 25 de Maio de 1952.
Terminou o curso do Liceu em 1969 no Liceu Nacional do Funchal.
Ingressou no Instituto Superior Técnico em 1969 onde em 1975 concluiu o curso de Engenharia Mecânica, ramo de Termodinâmica Aplicada

Em Abril de 1988 obteve o grau de Doutor em Engenharia Mecânica em provas realizadas no Instituto Superior Técnico.

2.- ACTIVIDADE DE INVESTIGAÇÃO E TÉCNICA

2.1-Participação em projectos e trabalhos realizados no país.

Em Maio de 1979 participou no grupo de trabalho que efectuou *os balanços térmicos aos três Fornos de Vidro da Covina, Santa Iria da Azóia.*

Em 1983 foi colaborador no Projecto Grant AFOSR-83-0319 com a Força Aérea dos EUA. O Projecto desenvolveu-se no *estudo das instabilidades de chamas de pré mistura estabilizadas em discos.*

No ano de 1985 colaborou nos seguintes projectos de apoio à industria:
-*Avaliação de Fouling em Permutadores de Calor Shell and Tube para a Petrogal, Sines.*
-*Ensaios de recepção do Energy Bus do IAPMEI.*
-*Balanço Energético da fábrica de cigarros da Tabaqueira em Cabo Ruivo Lisboa.*

Em 1986, 1987 e 1988 participou na coordenação dos cursos de formação profissional "*Formação de técnicos para a industria da cortiça*", realizados no IST e financiado pelo Fundo Social Europeu e Ministério do Trabalho.

Em Novembro de 1987 requereu provas de doutoramento em Engenharia Mecânica no Instituto Superior Técnico com a apresentação da tese "*Técnicas Experimentais em Escoamentos com e sem Combustão*"

Participou no projecto "*Recuperação de Energia em Fornos de Cimento da Cimpo*r" em 1988.

Participou no projecto *Balanços de Massa e Energia do programa Energy an Plant Productivity*, contratoNº10210 da C.C.E.(1988/1990)
Desenvolveu actividade de investigação nos projectos *Flameholder Design in Combustion Oscillations* (1990) e *Active Control Methods in Combustion Oscillations*,(1991-1993) ONR - Naval Weapons Center.

Foi o Investigador responsável do projecto JNICT - "**Balanços mássico e energético em Estufas**" 1993/96

É o investigador responsável pela participação do IST no projecto Praxis XXI " **Interacção Floresta-Ambiente em Ecossistemas Sujeitos a Perturbações Naturais e/ou Antropogénicas em Regiões de Transição Atlantico-Mediterranea"**. 1997/00
É o investigador responsável pelo projecto Sapiens35626/99 - **Carbon Balance of Eicalyptus Plantations in Portugal - The Kyoto Forest Problem. - 2000/02**

É Professor Auxiliar no Departamento de Engenharia Mecânica do Instituto Superior Técnico,

Orientação de Teses:
Quatro mestrados concluidos
Um doutoramento a decorrer

2.2.PUBLICAÇÕES

1-Caracterização da Fornalha Vertical do CTAMFUTL
M.N.Nina e G.Pita
Maio 1979

2-**Teste dos Analisadores de CO e CO2**
G.P.Pita
Novembro 1979

3-**Messungen des Tropfchenspektrums und des Konzentration und Utersuchung des Einflusses des Gemischaufbereitung auf die Schadstoffbildung in der primarzone einer Gasturbinenbrennkammer**.
A.Kaiser und G.Pita
Die Industriefeurung 21, pag 26, (1981)

4-**Coherent Structures in Axisymmetric jets**.
D.F.Durão, M.N.Nina and G.P.Pita
Proceedings Int. Symp. On Applications of L.D.A. to Fluid Mechanics paper 1.3 (1982)

5-**Some Consequences of Bias Effects in Laser-Doppler Velocimeter**.
D.F.Durão, M.A.Founti, J.Laker, G.Pita, A.Velho and J.H.Whitelaw
Proceedings Int. Symp. on Applications of L.D.A. to Fluid Mechanics, paper 16.1 (1982)

6-**Droplet Size Distribution and Liquid Volume Concentration in a water Spray. Predictions and Measurements.**
G.P.Pita
Proceedings AGARD Conference n 353, paper 16 (1983)

7-**Some consequences of Bias effects**.
D.F.Durão, G.Pita, A.Velho, M.A.Founti, J.Laker, J.H.Whitelaw
Laser Anemometry in Fluid Mechanics 381-391, (1984), Ladoan

8-**Coherent structures in the near field of round jets**.
D.F. Durão and G.Pita
Experiments in Fluids 2,145-149 (1984).

9-**Coherent Structures in Hot Jets**
D.F.Durão and G.P.Pita

Proceedings Second Int. Symp. on Applications of L.D.A. to Fluid Mechanics, paper 16.1 (1984)

10-**Coherent Structures in Hot Jets**
D.F.Durão and G.P.Pita
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11-**Measurements of Fluctuating Gas Temperatures Using Compensated Fine Wire Thermocouples.**
M.N.R. Nina and G.P.A.Pita
Proceedings 65th AGARD Symposium "Heat Transfer an Cooling in Gas Turbines", conference proceedings n.390, Paper 32 (1985)

12-**Processing Techniques for Correlation of LDA and Thermocouple Signals"**
M.N.R. Nina and G.P.A. Pita
Proceeding 67th AGARD Symposium "Advanced Instrumentaion for Aero Engine Components, conference proceedings n.399, Paper 24 (1986)

13-**Técnicas Experimentais em Escoamentos com e sem Combustão**.
Tese apresentada no Instituto Superior Técnico para a obtenção do grau de Doutor em Engenharia Mêcanica.
Novembro de 1987

14-**O Uso de Termopares em Chamas.**
Curso: Prática e Uso de Técnicas Experimentais em Escoamentos Complexos, I.S.T/I.T.E.C. programa Comett da Comissão das Comunidades Europeias. 1988

15-**Errors Induced by Catalytic Effects in Premixed Flame Temperature**
G.P.A.Pita and M.N.R.Nina
ICIASF'89, International Congress on Instrumentation in Aerospace Simulation Facilities, Gottingen, Alemanha/RFA, Setembro de 1989.

16-**Suppression of "buzz" Instability by Geometrical Design of the Flameholder**
E.Gutmark, K.C.Schadow, M.N.R.Nina and G.P.A.Pita 26h Joint Propulsion Conference, Orlando, Florida, EUA, Julho 1990.

17-**Experimental Analysis of Combustion Oscillations with Reference to Ramjet Propulsion**
M.N.R.Nina and G.P.Pita
" AGARD 79th Symposium in Airbreathing Propulsion for Missiles and Projectiles" Maio de 1992, Bordéus, França

18- **Balanço Energético Foliar em Estufas**
Gabriel P. A. Pita e Abel M. Rodrigues
Silva Lusitana, Volume 2, 1994

19-**The Energy Budget of a Tomato Leaf**
Gabriel P.A. Pita, A.C.Vargues, Abel Rodrigues and A.A.Monteiro
Acta Horticulae, Number 399, March 1995, pp 207-214, ISHS

20-**Suppression of Combustion Instability by Geometrical Design of the Bluff.Body Stabilizer.**
E.Gutmark, K.C.Schadow, M.N.R.Nina and G.P.A.Pita
Journal of Propulsion and Power, Volume 11, Nº3, May-June 1995,
pp 456-463

21 - **Balanço Energético em Estufas**.. G.Pita, Fernando Mestre e João Castanheira.
Relatório de progresso 1995

22- **Active Control of instability and pollutant Emissions in a Bluff-Body Combustor**
M.N.R.Nina, G.A.Pita and J.P.Gonçalves and E.J. Gutmark.
Joint Meeting of The Portuguese, British, Spanish and Swedish Sections of the Combustion Institute,
1-4 April, 1996 , Funchal , Madeira.

23-," **Measurements of sensible and latent heat above a grassland**", Gabriel P.A. Pita ,Proceedings of 14th International Congress of biometeorology, 1-8 September 1996, Ljubljana, Slovenia.

24 - **Measurements of sensible and latent heat above a grassland**,
Gabriel P.A. Pita, Proceedings of 14th International Congress of Biometeorology, 1-8 September 1996, Ljubljana, Slovenia.

25- **Balanço Energético em Montado de Sobro**,
Abel Martins Rodrigues e Gabriel P.A. Pita, Silva Lusitana 5(1): 95-112, 1997

26- **Mediterranean Greenhouse Energy Balance** ,
Gabriel P.A.Pita, Alberto Vargues, Manuel Pontes
Acta Horticulae, Number 456, 1998, pp 375-382, ISHS

27- **Measurements of Monentum, Sensible and Latente Fluxes above a Cork Oak Stand by Aerodynamic and Eddy Correlation Methods**
Abel Martins Rodrigues e Gabriel P.A. Pita, Revista de Ciências Agrarias, volume XXII, número 1, 1999, pp119-130.

Curriculum Vitae
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DADOS PESSOAIS

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FORMAÇÃO ACADÉMICA

1974/75 - 81/82 -	Escola Secundária
1982/83 - 87/88 -	Licenciatura em Engenharia Mecânica, Ramo de Termodinâmica Aplicada Instituto Superior Técnico, Universidade Técnica de LIsboa.
1988/91	Mestrado em Engenharia Mecânica- Perfil de Energia Tese: "Estabilidade e Estrutura de Chamas Turbulentas Confinadas em Geometrias Axissimétricas" Instituto Superior Técnico, Dept. de Engenharia Mecânica.
1991/1998...	Doutoramento em Engenharia Mecânica. Tese: “The Onset of Combustion-Driven Acoustic Oscillations” Instituto Superior Técnico, Dept. de Engenharia Mecânica.

BOLSAS DE ESTUDO

Set. 91/ Fev. 92.-	Bolsa da OTAN (NATO fellowship) (Ref.11/A/91/PO) Local: Universidade da Califórnia - IRVINE. Laboratório de Combustão. Tema do Trabalho: Aplicação de Técnicas Avançadas de Diagnóstico Laser a Escoamentos Multi-Fásicos. Supervisor: Prof. Gary Scott Samuelsen.
1988/91 -	Subsídio de formação do PEDIP 2, acção F, relativo ao curso "Técnica de Aquisição e Processamento de Dados no Controlo de Processos Industriais". Local: Instituto Superior Técnico Supervisor: Prof. M.V. Heitor.
1987/88 -	Bolsa de Estudo da JNICT para Jovens Investigadores. Tema do Trabalho: Combustão de Resíduos Florestais. Local: Instituto Superior Técnico Supervisor:Prof. D.F.G. Durão e Prof. J.M.P. Ventura

ACTIVIDADE PROFISSIONAL

DOCÊNCIA ACADÉMICA

2000/... Prof. Auxiliar do Instituto Superior Técnico, Departamento de Engenharia Mecânica, Secção de Termodinâmica Aplicada
Disciplinas de Licenciatura: Termodinâmica Aplicada I e II
Disciplinas de Mestrado em Eng. Mecânica: Métodos Instrumentais

1998/2000 Assistente do Instituto Superior Técnico, Departamento de Engenharia Mecânica, Secção de Termodinâmica Aplicada
Disciplinas de Termodinâmica Aplicada I e II

1995/1997 - Assistente do Instituto Superior Técnico, Departamento de Engenharia Mecânica, Secção de Termodinâmica Aplicada
Disciplinas de Termodinâmica Aplicada I e II

-Mestrado em Engenharia Mecânica - Perfil Energia, Instituto Superior Técnico, Departamento de Engenharia Mecânica, Secção de Termodinâmica Aplicada
Disciplina: Métodos Instrumentais
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1994/ ... - Assistente do Instituto Superior Técnico, Departamento de Engenharia Mecânica, Secção de Termodinâmica Aplicada
Disciplinas de Termodinâmica I e II e Combustão

1992/93 - Assistente do Instituto Superior Técnico, Departamento de Engenharia Mecânica, Secção de Termodinâmica Aplicada
Disciplinas de Termodinâmica I e II

DOCÊNCIA EM CURSOS DE FORMAÇÃO PROFISSIONAL

1993 - ***Contrato de Formação Específica na Área de Termodinâmica e Transmissão de Calor pela COPRAI/AIP***

1993/94 - ***Instrumentação de Análise e Controlo em Energia e Ambiente***
- Curso de Formação Profissional Financiado pelo Fundo Social Europeu
  Responsável pela disciplina de poluição Sonora

- ***Tecnologias de Utilização de Gás Natural***
- Curso de Formação Profissional Financiado pelo Fundo Social Europeu
  Responsável por aulas teóricas e práticas de: Combustíveis Gasosos

- ***Técnicas de Previsão de Dispersão de Poluentes***
- Curso de Formação Profissional Financiado pelo Fundo Social Europeu
  Coordenador - Prof. José Carlos Pereira
  Aulas teóricas e práticas de: Termodinâmica

1989 - ***Climatização e Ar Condicionado***
- INESC - Fundetec. Financiado pelo Fundo Social Europeu
  Coordenador - Eng. Jorge Duque

Aulas teóricas e práticas de: Termodinâmica Aplicada (Ar Condicionado e Refrigeração Industrial), Transferência de Calor e de Mecânica dos Fluidos

- ***Instrumentação e Aquisição de Dados em Combustão, Energia e Poluição***
  - Instituto Superior Técnico. Acções de treino financiadas pelo CEE.
    Aulas teóricas de Combustão

Aulas Téoricas/Práticas no laboratório, sobre instrumentação para aquisição e processamento de dados

1988
- ***Climatização-Gestão de Energia***
- ***Fornalhas e Caldeiras Industriais***
- ***Energia e Combustão***
  - Instituto Superior Técnico. Acções de treino financiadas pelo Fundo Social Europeu
    Organização e assistência a aulas práticas
    Montagem e teste de equipamento de laboratório
- ***Impacto Ambiental e Poluição***
  - Instituto Superior Técnico. Acções de treino financiadas pelo Fundo Social Europeu
    Aulas práticas na disciplina de Propagação de Fogos em Florestas

1986/87 - ***Técnicos para a Indústria da Cortiça***
  - Instituto Superior Técnico. Acções de treino financiadas pelo Fundo Social Europeu
    Monitor de laboratório
    Organização e assistência a aulas práticas
    Montagem de equipamento para testes sobre a conductividade e inflamabilidade da cortiça

1984/85 - Membro Executivo da Direcção da Associação de Estudantes do Instituto Superior Técnico (AEIST) para a Área Pedagógica.

SUPERVISÃO DE ALUNOS

Graduação - Projecto de Licenciatura

<u>Co-Supervisão</u>

V. Diniz - Câmara de Combustão Pulsante de Frequência Variável
Licenciatura em Eng. Mecânica
1995 - Instituto Superior Técnico

P. Santos - Aplicação de Combustão Pulsante a uma fornalha semi-industrial
Licenciatura em Eng. Mecânica
1997 - Instituto Superior Técnico

N. Rosa - Redução de Ruído através do Controlo Activo de Sistemas de Combustão.
Licenciatura em Eng. Mecânica
1998 - Instituto Superior Técnico

J. Carvalho- Estudo da Gama de Estabilidade de Chamas em Escoamentos com Aspiração Coaxial e Imposição de Sinais Acústicos
Licenciatura em Eng. Mecânica
1999 - Instituto Superior Técnico

Supervisão

F. Santos - Controlo Activo de Camada de Corte
Licenciatura em Eng. Mecânica
2000 - Instituto Superior Técnico

N. Rolo- Estabilização de Chamas em Escoamentos em Contra-Corrente
Licenciatura em Eng. Mecânica
2000- Instituto Superior Técnico

J. Rosa, N. Vaz- Influência Acústica na Atomização de Fluídos
Licenciatura em Eng. Aeroespacial
2000- Instituto Superior Técnico

Doutoramento

Co-Supervisão

Casimiro Cala - Estudo experimental sobre o efeito acústico na estabilização de chamas de pre-mistura pobres
2000 - Instituto Superior Técnico

ACTIVIDADE DE INVESTIGAÇÃO

1993/... - Combustão pulsante
- Acústica de sistemas de queima e chamas
- Sistemas de queima em regime pobre
- Métodos de controlo activo.
- Estabilidade e estrutura de chamas em escoamentos em contra-corrente

1992 - Análise experimental de chamas sem pré-mistura estabilizadas por rotação.

1991 - Estudo de atomizadores de combustível líquido de câmaras de combustão de turbinas a gás, com base em técnicas de diagnóstico Laser. Trabalhos efectuados em atomizadores da PARKER-HANNIFIN e em modelos reais de câmaras de combustão da General Electric. Universidade da Califórnia - Irvine.

1987/91 - Estudos sobre chamas turbulentas, confinadas e não confinadas. Análise de estrutura, estabilidade, acústicas e espectrometria de chamas.

1990 - Simulação experimental de desenvolvimento de fogos em compartimentos
Instituto Superior Técnico, Departamento de Engenharia Mecânica.

1987/... - Participação no projecto de investigação sobre Propagação de Fogos em Florestas
Instituto Superior Técnico, Departamento de Engenharia Mecânica.

PROJECTOS DE INVESTIGAÇÃO

2000/... - Cordenação do projecto de investigação "Controlo dinâmico da estabilização de chamas em reime de queima ultra-pobre". FCT/SAPIENS99/PCTI/1999/EME/34768

2000/... - Participação no projecto Europeu "DIME-Direct Injection Engine Spray Processes-mechanisms to improve performance".

ARTIGOS PUBLICADOS

Artigos Conferências:

- "*Combustion of Forest Residues - Some Results*", J.M.P. Ventura, E.C. Fernandes and D.F.G. Durão (1988). Simpósio sobre Fogos Florestais, Coimbra, Portugal, November 23rd to 25th 1988.
- "*Physical and Mathematical Modelling of Compartment Fires*", J.M.P. Ventura and E.C. Fernandes (1989). Eurotherm Seminar Nº 11, Harwell Laboratory, England. December 7th to 8th.
- "*Mathematical Modelling and Experimental Validation of Growth of Fires in Compartments*", A. Arantes, M.G. Carvalho, E.C. Fernandes and J.M.P. Ventura. Eurotherm Seminar Nº 13. Fire Modelling, June 5-6 1990, England.
- "*Combustion of Forest Residues*", J.M.P. Ventura, E.C. Fernandes and D.F.G. Durão. Eurotherm Seminar Nº 13. Fire Modelling, June 5-6 1990, England.
- "*On Noise Characteristics of Confined Swirl Combustor*", E.C. Fernandes and M.V. Heitor (1990). - Paper No. 90-WA/HT-6, ASME - Winter Annual Meeting, Dallas, Texas, November 25-30, 1990, U.S.A.
- "*Physical Modelling of Compartment Fires*", E.C. Fernandes, J.M.P. Ventura and D.F.G. Durão. Poster no 23rd Inst. Symposium on Combustion, University Campus of Orleans, July 22-27, 1990, France.
- "*On Performance on Swirl Combustors*", I.S. Carvalho, D.F.G. Durão, E.C. Fernandes and M.V. Heitor. Fifth Int. Symposium on Application of Laser Techniques to Fluid Mechanics. July 9-12, 1990, Lisbon, Portugal.
- "*Physical Modelling of Compartment Fires*", E.C. Fernandes, J.M.P. Ventura and D.F.G. Durão. Fifth Int. Symposium on Application of Laser Techniques to Fluid Mechanics. July 9-12, 1990, Lisbon, Portugal.
- "*Fires Propagation of Eucalyptus sp. Leaves*" J.M.P. Ventura, E.C. Fernandes and A.M. Rodrigues 2nd National Forest Meeting, Faculdade de Economia, Porto, November 7-10, 1990, Portugal.
- *"On the Combustion Characteristics of Interacting Jet Flames"* M.V. Heitor, E.C. Fernandes, J.P. Simões and J. Wei. EUROTHERM SEMINAR Nº17-Heat Transfer in Radiating and Combusting System. 8-10 October 1990. Cascais, Portugal.
- *"A Vision System for Analysis and Classification of Industrial Flames"*, J.P. Costeira, E.C. Fernandes, M.V. Heitor, J. Sentieiro, J.P. Simões and J.A. Victor (1990).. Proc. 6th CIM-Europe Annual Conference, Lisbon 15-17 May. Ed. Faria L. and Van Pruymbroeck, V., Springer Verlag, pp. 448-457.
- *"On the Generation of Noise in Axisymmetric Combustors"* E.C. Fernandes, M.V. Heitor, Procd. of IUTAM, Taiwan.
- "*On the Operation of a Cylindrical Pulse Combustor*", E.C. Fernandes and M.V. Heitor. Joint Meeting of the British, Spanish and Swedish Sections of the Combustion Institute. April 1-4, 1996, Funchal-Madeira, Portugal.
- "*Velocity, Temperature and Pressure Characteristics of Pulsed Premixed Flames*", E.C. Fernandes and M.V. Heitor. Submetido ao Eighth Int. Symposium on Application of Laser Techniques to Fluid Mechanics. July 8-11, 1996, Lisbon, Portugal.
- "*The Simultaneous Measurements of Velocity, Pressure, Temperature and Heat Release in an Oscillating Flame*", Fernandes, E.C., Heitor, M.V., (1997) AGARD – 90th Symposium of the Propulsion and Energetics Panel on the Advanced Non-Intrusive Intrumentation for Propulsive Engines, Brussels, Belgium 20-24 October.
- " *On the extension of a laser-Doppler anemometer to the analysis of oscillating flames"*, E.C. Fernandes and M.V. Heitor. Ninth Int. Symposium on Application of Laser Techniques to Fluid Mechanics. July 13-16, 1998, Lisbon, Portugal
- " Towards Controlled Lquid Atomization", E.C. Fernandes, M.V. Heitor and V. Sivadas. Tenth Int. Symposium on Application of Laser Techniques to Fluid Mechanics. July 10-13, 2000, Lisbon, Portugal

Artigos em Revistas/Livos:

- "*Simulation of Compartament Fire Development*". "International Video Journal of Engineering Research". J.M.P. Ventura and E.C. Fernandes (1992). , Vol. 2, 99-106
- *"LDA Measurements of Velocity and Turbulent Transport Processes in a 200MW Swirl-stabilized Flame"*. D.F.G. Durão, E.C. Fernandes, M.V. Heitor e A.L.N. Moreira (1993). Publicado em "Application of Laser Techniques to Fluid Mechanics - VI", ed. Adrian et al., Springer Verlag, pp. 470-489.
- *"Velocity-temperature Correlations in Recirculating Flames with and without Combustion"*. E.C. Fernandes, P. Ferrão, A.L.N. Moreira and M.V. Heitor (1994). Experimental Thermal and Fluid Science, 9, No 2, pp. 241-249.
- *"Unsteady Flames and the Rayleigh Criterion"*. E.C. Fernandes and M.V. Heitor (1994). Publicado em "Unsteady Combustion", ed. F. Culick, M.V. Heitor and J.H. Whitelaw, Kluwer Academic Publ., NATO ASI Aeries.
- *"On the extension of a laser-Doppler anemometer to the analysis of oscillating flames"*., E.C. Fernandes, M.V. Heitor e A.L.N. Moreira (1998). Publicado em "Application of Laser Techniques to Fluid Mechanics - IX", ed. Adrian et al., Springer Verlag, pp. 383-401.
- *"Phase Average Analysis of an Oscillating Reacting Shear Layer"*., E.C. Fernandes and M.V. Heitor (2000). Submetido à Combustion Science and Technology
- *"Characteristics of a Semi-Infinite Probe-Tube for Pressure Fluctuation Measurements in Combustion Chambers "*., E.C. Fernandes and M.V. Heitor (2000). Submetido ao Journal of Sound and Vibration

PALESTRAS CONVIDADAS

- Tema: "On the noise characteristics of confined swirl combustor" dada em Southwest Research Institute, November 1990, San Antonio, Texas, USA, Contracto da "U.S. Army Research Department" London, England (Contract No. DAJA4591M0037-R&D 6654-AN-06).

- Tema: “Combustão Pulsada-Instabilidades Acústicas Induzidas por Combustão”, 1999 - INPE-Instituto Nacional de Pesquisas Espaciais, Brasil

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Curriculum Vitæ

(December 2000)

Pedro Filipe Teixeira da Conceição

PERSONAL Information

Address:	Rua Illha dos Amores, Lote 4.1002, BLE, 4º Dto.
	1990-120 Lisboa, Portugal
Phone:	+351-21 895 73 50 (home)
	+351-21 841 94 04 (office)
Languages:	Portuguese (native) and English. Spanish and French (written and oral understanding)

Portuguese National

Current Positions

- Assistant Professor at Instituto Superior Técnico, Technical University of Lisbon, Portugal.
- Researcher at the Center for Innovation, Technology and Policy Research- IN+, Instituto Superior Técnico, Technical University of Lisbon.
- Researcher at the University of Texas Inequality Project, The University of Texas at Austin.
- Research Fellow of the IC^2 Institute, The University of Texas at Austin.

Education

December 2000 Ph. D. in Public Policy, Lyndon B. Johnson School of Public Affairs, University of Texas at Austin. Supervisor: James K. Galbraith. Committee members: Kenneth S. Flamm, David V. Gibson, Chandler Stolp, Robert H. Wilson.

December 1995 "Mestre" (M. Sc.) in Economics and Management of Science and Technology, "Instituto Superior de Economia e Gestão" (ISEG), Technical University of Lisbon. Supervisors: João Caraça and Manuel V. Heitor. Jury: Diogo de Lucena and João Ferreira do Amaral.

July 1992 "Licenciado" (five-year university degree) in Physics Engineering, "Instituto Superior Técnico" (IST), Technical University of Lisbon.

November 1994 Executive course on Managing Technology and Innovation, The Wharton School, University of Pennsylvania.

I Experience

TEACHING

October 1993 - December 2000 "Assistente" (Lecturer) at IST, Technical University of Lisbon (on leave between September 1995 and September 2000).

Subjects taught: Physics, Environmental Economics, Advanced Research Methods.

January - May 1997; January - May 1998 Graduate Research Assistant, Masters of Science on Science and Technology Commercialization, IC^2 Institute, UT Austin.

SUPERVISION OF GRADUATE STUDENTS

March, 2000 Pedro Ferreira, IST, Technical University of Lisbon. Masters Thesis title: *Wage Inequality and Technology: An Exploration Using the Theil Index and Industry Estimations of Technology Intensity*. Co-supervised with Manuel V. Heitor.

Ongoing

Pedro Vieria, IST, Technical University of Lisbon. Masters Thesis title: *Do Environmental Concerns Drive Innovation? Evidence from the Community Innovation Survey Results for Portugal*. Co-supervised with Manuel V. Heitor.

Meng Honguy, IST, Technical University of Lisbon. Masters Thesis title: *Fostering the Digital Economy: Perspective for Internet Clusters*. Co-supervised with Manuel V. Heitor

RESEARCH

January 1998 -...

Center for Innovation, Technology and Policy Research- IN+ [http://in3.dem.ist.utl.pt/**]**, an interdisciplinary research group that integrates engineering, social, economic, and policy research. I have contributed to the development of several research projects and taught a course in the Fall of 1998, by video-conference (from Austin), of the IST's Masters Program on Engineering Policy and Technology Management.

August 1998 -…

University of Texas Inequality Project [http://utip.gov.utexas.edu] a research group led by Prof. James K. Galbraith addressing problems associated with causes and consequences of economic inequality from multiple perspectives (funding from the Ford Foundation). My focus has been on methods to measure inequality and on the association between technology and inequality, with empirical work on OECD countries.

April 1998 - …

CEPCEP- Centro de Estudos de Povos de Cultura e Expressão Portuguesa [Center of Studies of Peoples of Portuguese Culture]**, Portuguese Catholic University**, an interdisciplinary research center devoted to the study of Portuguese culture, with an incidence on social, economic and historic aspects of culture. I have collaborated in several studies, under the supervision of Prof. Roberto Carneiro, on the characteristics of the Portuguese labor force and on the education and training needs of the Portuguese economy. Most studies have been commissioned by the Portuguese Government.

January 1996 - September 2000

IC^2 Institute [http://www.ic2.org/]. As a Visiting Scholar, first, and a Research Associate, later, I developed and coordinated several joint education, research, and business development ventures between UT-Austin and IST. I am now a Research Fellow.

January 1998 - January 1999

Innovation Clusters Project, led by Dr. David V. Gibson, this project was developed at the IC^2 Institute as part of a larger project of the Canadian International Development Research Center (IDRC). The report

is available at:

http://www.idrc.ca/lacro/smmeit/innovacion/ic2.html

April 1998 - October 1999 — **Stanford University KNEXUS Project**, a worldwide research network aimed at achieving a better understanding of the roles of knowledge creation and sharing in economic development across regions; the project is led by Profs. Nathan Rosenberg, Gavin Wright, James March, and Douglass North, and by Dr. Syed Shariq (funding from Bechtel Civil). My role was to integrate Portugal as a region to be studied in the project, by participating in meetings with the project leaders and developing research proposals.

July 1991 - December 1992 — Research Assistant, "Centro de Fusão Nuclear da Associação EURATOM/IST" [Nuclear Fusion Research Center], IST, Lisbon, under Prof. Carlos Varandas. Study of lower hybrid current drive in the JET Tokamak.

July - October 1991; January - April 1992 — Research Assistant, JET-Joint European Torus, Oxford, UK, under Dr. Marco Brusatti. Data collection and analysis from the JET tokamak for the study of lower hybrid current drive.

October 1990 - September 1991 — Research Assistant, "Centro de Electrodinâmica da UTL" [Electrodynamics Research Center], IST, Lisbon, under Prof. Tito de Mendonça. Study of the dynamics of a charged particle under the forces of the tokamak-standard configuration.

University Administration

April 1993 - September 1995 — Founder and Coordinator of the **Studies and Planning Office** at Instituto Superior Técnico, Technical University of Lisbon, working directly with the university admnistration advising on strategic and financial goals and plans.

CONSULTING

September 1998-... — Advisor to the **Ministry for Science and Technology**, being responsible for the analysis of the first Community Innovation Survey performed in Portugal during 1998.

September 1998-... — Consultant in projects associated with e-commerce and Internet policies for Grupo Forum, Lisbon, Portugal. Projects included a strategic plan for the promotion Internet adoption for the Government of Macau, and studies commissioned by the Portuguese Ministry of Culture and the Portuguese Ministry of the Economy, and by the Instituto das

	Comunicações de Portugal [Portuguese Institute of Telecommunications, the regulatory agency for telecommunications in Portugal].
May 24-25, 1999	Course “Autonomia das Universidades: Referenciais Portugueses” [Portuguese Experience on Higher Education Policy], at the invitation of the Governmet of the State of Paraná, Curitiba, Brazil.

Fellowships and Awards

April 1999	Recipient of the 1999 Outstanding **IC^2 Institute Resident Researcher Award**, which is given annually to the best researcher at the IC^2 Institute, The University of Texas at Austin.
September 1995 - September 1999	Fulbright Grant, United States Federal Government.
September 1995 - September 1999	NATO Scientific Advanced Studies Program Fellowship.
October 1992 - September 1993	"Bolsa para Mestrado" (M. Sc. Scholarship) from "Junta Nacional de Investigação Científica e Tecnológica" (JNICT), Lisbon (the Portuguese government agency for R&D).
October 1991 - September 1992	"Bolsa para Jovens Investigadores" (Young Researchers Scholarship), JNICT.
July 1991 - October 1991	Student Assistant Fellowship, from the Joint European Torus, Oxford, UK.
October 1990 - September 1991	"Iniciação à Investigação" (Junior Researchers Scholarship), JNICT.

Academic PUBLICATIONS

Books (author)

1. P. Conceição, D. F. G. Durão, M. V. Heitor, F. Santos (1998), *Novas Ideias para a Universidade* [New Ideas for the University, in Portuguese], Lisbon: IST Press.

Books (editor)

1. P. Conceição, D. Gibson, M. V. Heitor, S. S. Shariq (eds.), (2000), *Science, Technology, and Innovation Policy: Opportunities and Challenges for the Knowledge Econnomy*, Westport and London: Quorum Books.

- P. Conceição, D. Gibson, M. V. Heitor, G. Sirilli, F. Veloso (eds.), (forthcoming in 2001), *Knowledge for Inclusive Development*. Westport and London: Quorum Books.
- P. Conceição, D. Gibson, M. V. Heitor, C. Stolp (eds.), (forthcoming in 2001), *Systems and Policies for the Globalized Learning Econnomy*, Westport and London: Quorum Books.
- P. Conceição, M. V. Heitor (eds.), (forthcoming in 2001), *On the Dynamics of Technological Change in Small Open Economies: Engineering and Technology for Innovation in Portugal*, Westport and London: Quorum Books.

Books (contributor)

1. *Aprender e Trabalhar no Século XXI* (2000) [Learning and Working in the 21st Century, in Portuguese], Lisbon: Direcçcão Geral do Emprego e Formação Profissional, Ministério do Trabalho [Portuguese Ministry of Employment].

Guest Editor of International Refereed Journals

1. P. Conceição, D. V. Gibson, M. V. Heitor, S. S. Shariq (eds.), (1998), Topic: Science, Technology and Innovation Policies Towards the Knowledge Society, Special Issue of the journal *Technological Forecasting and Social Change*, **58**(3).
2. P. Conceição, D. V. Gibson, M. V. Heitor, G. Sirilli (eds.), (2001), Topic: Knowledge for Inclusive Development, Special Issue of the journal *Technological Forecasting and Social Change*, **66**(1).

- P. Conceição, D. V. Gibson, M. V. Heitor, G. Sirilli (eds.), (2001), Topic: Technology Policy and Innovation in the Globalized Learning Economy, Special Issue of the journal *Technological Forecasting and Social Change*, **67**(2), expected.
- P. Conceição, M. V. Heitor (eds.), (forthcoming), Topic: Technology Policy and Innovation, Special Issue of the journal *Technological Forecasting and Social Change*.

Book Series

- M. V. Heitor, D. V. Gibson, P. Conceição. Editors of the *International Series on Technology Policy and Innovation*, published by Quorum Books (Westport and London), for the IC2 Institute- The University of Texas at Austin, and for The Center for Innovation, Technology and Policy Research, Instituto Superior Técnico, Lisbon Portugal. Information available at http://in3.dem.ist.utl.pt/quorumseries/.

I International Refereed Journals

1. P. Conceição, James K. Galbraith (2000), "Constructing Long and Dense Time-Series of Inequality Using the Theil Index," *Eastern Economic Journal*, **26**(1): 61-74.
2. P. du Pin Calmon, P. Conceição, James K. Galbraith, V. Garza Cantu, A. Hibert (2000), "The Evolution of Industrial Wage Inequality in Mexico and Brazil: a Comparative Study," *Review of Development Economics*, **4**(2): 194-203.
3. R. Carneiro, P. Conceição, A. V. Fernandes (2000), "Enabling Digital Cluster Formation in a Local Context: A Case Study of Macau," *Foresight*, **2**(6): pages TBA.
4. J. Caraça, P. Conceição, M. V. Heitor (2000), "A Public Policy Towards the Research University", *Higher Education Policy*, **13**(2): 181-201.
5. E. Figueroa, P. Conceição (2000), "Rethinking the Innovation Process in Large Organizations: A Case Study of 3M," *Journal of Engineering and Technology Management*., **17**(1): 93-109.
6. P. Conceição, P. Ferreira, James K. Galbraith (2000), "Ungleicheit und Arbeitslosigkeit in Europa: Das Amerikanische Rezept," *Berliner Debatte*, **4/5**: 50-67.
7. P. Conceição, P. Ferreira, James K. Galbraith (1999), "Inequality and Unemployment in Europe: The American Cure," *New Left Review*, **237**(September/October): 28-51.
8. P. Conceição, M. V. Heitor (1999). "On the Role of the University in the Knowledge Economy," *Science and Public Policy*, **26**(1): 37-51.
9. P. Conceição, M. V. Heitor, P. Oliveira, (1998), "University-based Technology Licensing in the Knowledge Based Economy," *Technovation*, **18**(10): 615-625.
10. J. Caraça, P. Conceição, M. V. Heitor, (1998), "A Contribution Towards a Methodology for University Public Funding," *Higher Education Policy*, **11**(1): 37-58.
11. P. Conceição, D. V. Gibson, M. V. Heitor, S. S. Shariq (1998), "The Emerging Importance of Knowledge for Development: Implications for Technology Policy and Innovation," *Technological Forecasting and Social Change*, **58**(3): 181-202.
12. P. Conceição, M. V. Heitor, P. Oliveira (1998), "Expectations for the University in the Knowledge Based Economy," *Technological Forecasting and Social Change*, **58**(3): 203-214.
13. P. Conceição, D. V. Gibson, M. V. Heitor, S. S. Shariq (1997), "Towards a Research Agenda in Knowledge Policy and Management," *Journal of Knowledge Management*, **1**(2): 129-141.

14. A. Caseiro, P. Conceição, D. F. G. Durão, M. V. Heitor (1996), "On the Development of Higher Engineering Education in Portugal and the Monitoring of Admissions: a Case Study," *European Journal of Engineering Education*, **21**(4): 435-445.

- P. Conceição, J. K. Galbraith, P. Bradford (accepted for publication). "The Theil Index in Sequences of Nested and Hierarchic Grouping Structures," *Eastern Economic Journal*.
- P. Conceição, D. V. Gibson, M. V. Heitor, G. Sirilli (eds.), (forthcoming in 2001), "Knowledge for Inclusive Development: The Challenge of Globally Integrated Learning and Implications for Science and Technology Policy", *Technological Forecasting and Social Change*.
- P. Conceição, D. Hammil, P. Pinheiro (forthcoming), "Innovative Science and Technology Commercialization Strategies at 3M: A Case Study," *Journal of Engineering and Technology Management*.
- P. Conceição, M. V. Heitor (forthcoming), "Towards a University Agenda on Engineering Policy and the Management of Technology," *International Journal of Technology Policy and Management*.

Invited Academic Communications

- Center for the Study of Spatially Integrated Social Sciences, University of California Santa Barbara, Expert Meeting on Inequality and Equity, November 12-14. 2000. [http://www.csiss.org/meetings/equity/conceicao.htm]
- P. Conceição (presenter), P. Ferreira, James K. Galbraith, "Inequality and Unemployment in Europe: The American Cure", *The Macrodynamics of Inequality in the Industrialized and Developing Countries*, The Jerome Levy Economics Institute of Bard College, October 28-29, 1999 Annandale-on-Hudson, New York.
- P. Conceição, Roberto Carneiro "Learning-by-Doing and Formalized Learning: A Case Study of Contrasting Development Patterns in the Portuguese Industry," *Skills Seminar Series*, Centre for Economic Performance, London School of Economics, November 27 1998, London, UK.
- "A Phenomenological Description of Lower Hybrid Current Drive in a Tokamak with the Standard Configuration", JET, April 22 1992, Oxford, UK.

Chapters in Books

1. P. Conceição, M. V. Heitor (2001). "Universities in the Learning Economy: Balancing Institutional Integrity with Organizational Diversity," in D. Archibugi, B. Lundvall (eds.), *The Globalizing Learning Economy*, Oxford: Oxford University Press.
2. P. Conceição, M. V. Heitor (2000), "Knowledge, Technology, and Innovation for Development", in P. Conceição, D. Gibson, M. V. Heitor, S. S. Shariq (eds.), *Science, Technology, and Innovation Policy: Opportunities and Challenges for the Knowledge Econnomy*, Westport and London: Quorum Books: 1-18.

3. P. Conceição, M. V. Heitor, P. Oliveira, F. Santos (2000), "On the Socio-Economic Development of the Research University", in P. Conceição, D. Gibson, M. V. Heitor, S. S. Shariq (eds.), *Science, Technology, and Innovation Policy: Opportunities and Challenges for the Knowledge Econnomy*, Westport and London: Quorum Books: 99-118.

4. P. Conceição, D. F. G. Durão, M. V. Heitor, F. Santos (1999), "Contexto de la Universidad", *Manual "Gestion Estrategica Universitaria: Processos Administrativos y Financieros"* (Handbook for University Strategic Management: Financial and Administrative Processes, in Spanish), Santiago, Chile: CINDA- Centro Interuniversitario de Desarrollo.

5. P. Conceição, M. V. Heitor, P. Oliveira (1999), "On the Need of New Mechanisms for the Protection of Intellectual Property of Research Universities", in A. Inzelt, J. Hilton (eds.), *Technology Transfer : from Invention to Innovation*, Boston, MA Dordrecht, London: Kluwer Academic Publishers (NATO ASI Series 4 [Science and Technology Policy]/19): 69-85.

- P. Conceição, P. Ferreira, James K. Galbraith (forthcoming in 2001), "Inequality and Unemployment in Europe: The American Cure", in James K. Galbraith and Maureen Berner (eds.), *Inequality and Industrial Change: A Global View*, Cambridge University Press: Cambridge, UK; New York.

- P. Conceição, James K. Galbraith (forthcoming in 2001), "A New Kuznets Hypothesis: Theory and Evidence on Growth and Inequality", in James K. Galbraith and Maureen Berner (eds.), *Inequality and Industrial Change: A Global View*, Cambridge University Press: Cambridge, UK; New York.

- P. du Pin Calmon, P. Conceição, James K. Galbraith (forthcoming in 2001), "The Evolution of Industrial Earnings Inequality in Mexico and Brazil", in James K. Galbraith and Maureen Berner (eds.), *Inequality and Industrial Change: A Global View*, Cambridge University Press: Cambridge, UK; New York.

- P. Conceição, James K. Galbraith (forthcoming in 2001), "Constructing Long and Dense Time-Series of Inequality Using the Theil Index", in James K. Galbraith and Maureen Berner (eds.), *Inequality and Industrial Change: A Global View*, Cambridge University Press: Cambridge, UK; New York.

- P. Conceição, M. V. Heitor, F. Veloso (forthcoming in 2001). "Knowledge, Technology and Innovation Systems for Inclusive Development," in P. Conceição, D. Gibson, M. V. Heitor, G. Sirilli, F. Veloso (eds.), *Knowledge for Inclusive Development*. Westport and London: Quorum Books.

- P. Conceição, M. V. Heitor (forthcoming in 2001). "Sustainable Societal Learning: A Discussion of the Role of the University," in P. Conceição, D. Gibson, M. V. Heitor, G. Sirilli, F. Veloso (eds.), *Knowledge for Inclusive Development*. Westport and London: Quorum Books.

- P. Conceição, D. Gibson, M. V. Heitor, C. Stolp, (forthcoming in 2001). "Innovation and Knowledge for the Globalized Learning Economy," in P. Conceição, D. Gibson, M. V. Heitor, C. Stolp (eds.), *Systems and Policies for the Global Learning Econnomy*, Westport and London: Quorum Books.

- J. Nordskog, D. Gibson, P. Conceição, J. Burtner, (forthcoming in 2001). "Incubating and Sustaining Learning and Innovation Poles in Latin America and the Caribbean," in P. Conceição, D. Gibson, M. V. Heitor, C. Stolp (eds.), *Systems and Policies for the Global Learning Econnomy*, Westport and London: Quorum Books.

- P. Conceição, M. V. Heitor (forthcoming in 2001). "Learning through interaction: Perspectives for the University," in J. Bento, J. Duarte, M. V. Heitor, W. Mitchell (eds.), *Collaborative Design and Learning: Competence Building for Innovation*. Westport and London: Quorum Books.

- P. Conceição, D. Gibson, M. V. Heitor (forthcoming in 2001). "Collaborative Training for Technology Commercialisation and Enterprise Internationalisation," in J. Bento, J. Duarte, M. V. Heitor, W. Mitchell (eds.), *Collaborative Design and Learning: Competence Building for Innovation*. Westport and London: Quorum Books.
- P. Conceição, M. V. Heitor (forthcoming in 2001). "Building a Manifesto for Engineering Education Renewal," in M. V. Heitor (ed.), *The Glass Chair*. Lisbon: IST Press.

Working Papers

- P. Conceição, James K. Galbraith (1998), *Constructing Long and Dense Time-Series of Inequality Using the Theil Index*, University of Texas Inequality Project Working Paper No. 1; available at: http://utip.gov.utexas.edu. Also available as The Jerome Levy Economics Institute Working Paper No. 259: http://www.levy.org/publications/pubmainset.html.
- P. du Pin Calmon, P. Conceição, James K. Galbraith, V. Garza Cantu, A. Hibert (1999). *The Evolution of Industrial Earnings Inequality in Mexico and Brazil*, University of Texas Research Project Working Paper No. 5; available at: http://utip.gov.utexas.edu.
- P. Conceição, P. Ferreira, James K. Galbraith (1999), *Inequality and Unemployment in Europe: The American Cure*, University of Texas Inequality Project Working Paper No. 11; available on the Internet at: http://utip.gov.utexas.edu.
- P. du Pin Calmon, P. Conceição, James K. Galbraith (1999). *Inequality and Industrial Change in Brazil*, University of Texas Research Project Working Paper No. 12; available on the Internet at: http://utip.gov.utexas.edu.
- P. Conceição, P. Ferreira (2000). *The Young Person's Guide to the Theil Index: Suggesting Intuitive Interpretations and Exploring Analytical Applications*, University of Texas Inequality Project Working Paper No. 14; available on the Internet at: http://utip.gov.utexas.edu.
- P. Conceição, J. K. Galbraith, P. Bradford (2000). *The Theil Index in Sequences of Nested and Hierarchic Grouping Structures*, University of Texas Inequality Project Working Paper No. 15; available on the Internet at: http://utip.gov.utexas.edu.
- J. K. Galbraith, P. Conceição, Hyunsub Kum (2000). *Inequality and Growth Reconsidered Once Again: Some New Evidence from Old Data*, University of Texas Inequality Project Working Paper No. 17; available on the Internet at: http://utip.gov.utexas.edu.

Refereed Proceedings of International Conferences

1. P. Conceição, James K. Galbraith (2000), "Technology Adoption and Inequality: Empirical Evidence from a Selection of OECD Countries", Proc. of the *33rd Annual Hawaii International Conference on Systems Sciences*, 4-7 January, Wailea, Maui, Hawaii.
2. J. Ehrenfeld, P. Conceição, M. V. Heitor, P. Vieira (1999), "Towards Sustainable Universities: Challenges for Engineering Education in the Learning Economy", Proc. of the *3rd International Conference on Technology Policy and Innovation*, 31 August- 2 September, LBJ School of Public Affairs, The University of Texas at Austin, Austin, Texas.

3. P. Conceição, P. Ferreira (1999), "The Young Person's Guide to the Theil Index: Suggesting Intuitive Interpretations and Exploring Analytical Applications", Proc. of the *3rd International Conference on Technology Policy and Innovation*, 31 August- 2 September, LBJ School of Public Affairs, The University of Texas at Austin, Austin, Texas.

4. P. Conceição, D. Hamill, P. Pinheiro (1999), "Innovative Science and Technology Commercialization at 3M: A Case-Study", Proc. of the *3rd International Conference on Technology Policy and Innovation*, 31 August- 2 September, LBJ School of Public Affairs, The University of Texas at Austin, Austin, Texas.

5. P. Conceição, M. V. Heitor, P. Oliveira (1998), "Realities and Perspectives of Industrial R&D: A Study of the Portuguese Reality in the European and Global Contexts", Proc. of the *32th Annual Hawaii International Conference on Systems Sciences*, 5-8 January, Wailea, Maui, Hawaii.

6. P. Conceição, M. V. Heitor (1998), "A Knowledge Centered Model of Economic Development: new Roles for Education, Science and Technology Policies", Proc. of the *2nd International Conference on Technology Policy and Innovation*, 3-5 August, Fundação Calouste Gulbenkian, Lisbon, Portugal.

7. P. Conceição, J. W. Amos (1998), "Global Interactions for the Sustainable Growth of Local Business", Proc. of the *2nd International Conference on Technology Policy and Innovation*, 3-5 August, Fundação Calouste Gulbenkian, Lisbon, Portugal.

8. P. Conceição, B. M. Fossum, M. V. Heitor, S. M. Kearns, C. Vedovello (1998), "Opportunities and Challenges for Long Distance Education on the Commercialization of Science and Technology: A Case Study", Proc. of the *2nd International Conference on Technology Policy and Innovation*, 3-5 August, Fundação Calouste Gulbenkian, Lisbon, Portugal.

9. P. Conceição, M. V. Heitor (1998), "Learning-by-Living: The Hidden Contribution of Universities to Economic Development", Proc. of the *31st Annual Hawaii International Conference on Systems Sciences*, 6-10 January, Hawaii.

10. P. Conceição, M. V. Heitor, P. Oliveira (1997), "Reasonable Expectations for the University in the Age of the Knowledge-Based Society", Proc. of the *1st International Conference on Technology Policy and Innovation*, 2-4 July, Macau.

11. P. Conceição, M. V. Heitor, P. Oliveira (1997), "Capitalizing on Intellectual Property: the Challenges for the Development of European Universities", Proc. of the *1st International Conference on Technology Policy and Innovation*, 2-4 July, Macau.

12. P. Conceição, M. V. Heitor, J. R. Felizardo, F. Veloso (1997), "On the Definition of a Public Policy Towards the Financing of Technology Infrastructures", Proc. of the *30th Annual Hawaii International Conference on Systems Sciences*, 7-10 January, Wailea, Maui, Hawaii, USA.

13. P. Conceição, A. Pina, J. R. Felizardo (1994), "Programmes for Supporting New Entrepreneurial Ventures: Lessons to Be Taken From Portugal", Proc. of the *24th European Small Business Seminar 1994*, 21-23 de September, Bled, Slovenia.

14. P. Conceição, M. Brusati, P. Froissard, C. A. F. Varandas (1992), "A Phenomenological Description of Fast Electrons Induced by LH Waves in Tokamaks", Proc. of the *International Conference on Plasma Physics*, 29 de June-3 de July, Innsbruck, Austria.

Invited Contributions to Journals

1. P. Conceição, M. V. Heitor, David V. Gibson (1999), "Knowledge Transfer and Application Key for Growth", *Research-Technology Management*, **42**(1): 7-8.

Portuguese Journals (* refereed)

1. P. Conceição, M. V. Heitor (1998), "Perspectivas sobre o Papel da Universidade nas Economias Baseadas no Conhecimento", *Colóquio Educação e Sociedade*, Nova Série, No. **2**, March (published by Fundação Calouste Gulbenkian, Lisbon, Portugal): 70-98.
2. P. Conceição, Syed Z. Shariq (1998), "The Emerging Role of Universities in the Digital Economy - Preliminary Observations on the Patterns of Demand for Knowledge and Challenges and Opportunities Facing Universities in the 21st Century", *Colóquio Educação e Sociedade*, Nova Série, No. **2**, March (published by Fundação Calouste Gulbenkian, Lisbon, Portugal): 99-109.
3. P. Conceição, M. V. Heitor, P. Oliveira (1998), "A Universidade, a Inovação e a Difusão do Conhecimento: o Contexto da Protecção da Propriedade Intelectual", *Técnica, Revista de Engenharia* (published by IST, Technical University of Lisbon, Portugal).
4. ***** J. M. G. Caraça, P. Conceição, M. V. Heitor (1997), "Perspectivas sobre o Financiamento das Universidades: Portugal no Contexto Internacional", *Estudos de Economia*, **XVI-XVII**(4), (published by ISEG, Technical University of Lisbon, Portugal): 477-492.
5. P. Conceição, M. V. Heitor, P. Oliveira, F. Santos (1997), "Valorização das Actividades de I&D no Processo de Inovação Industrial", *Documenta*, **2**(February), (published by Fundação das Universidades Portuguesas, Lisbon, Portugal): 68-79.
6. ***** J. M. G. Caraça, P. Conceição, M. V. Heitor (1996), "Uma Perspectiva sobre a Missão das Universidades", *Análise Social*, **31**(139), (published the University of Lisbon, Portugal): 1201-1233.
7. P. Conceição, D. F. G. Durão, M. V. Heitor (1994), "O Ensino da Engenharia em Portugal e a Opção de Desenvolvimento do Instituto Superior Técnico", *Ingenium, Revista da Ordem dos Engenheiros*, **81**(November/December).
8. P. Conceição, D. F. G. Durão, M. V. Heitor (1994), "Posicionar o Instituto Superior Técnico para o Início do Século XXI", *Técnica, Revista de Engenharia*, **2**/94(September) (published by IST, Technical University of Lisbon, Portugal).

Communications in International Conferences (* refereed)

1. *J. K. Galbraith, P. Conceição, Hyunsub Kum (2001). *Inequality and Growth Reconsidered Once Again: Some New Evidence from Old Data*, *Association for Comparative Economic Studies Annual Meeting*, New Orleans, January 6-8.
2. * P. Conceição (1999), "A Re-Examination of the Patterns of Inquality Evolution Across a Selection of OECD Countries, 1970-1995," *21st Annual APPAM Research Conference- Public Policy Analysis and Management: Global and Comparative Perspectives*, November 4-6, Washington, D.C., USA.

3. P. du Pin Calmon, P. Conceição, James K. Galbraith (1999). "Inequality and Industrial Change in Brazil," Proc. of the *13th Brazilian Congress of Economists and the 7th Congress of the Association of Economists from Latin-American and the Caribbean*, September 13-17, Rio de Janeiro, Brazil. **This paper was rated as one of the top eight submissions to the event**.

4. P. Conceição, M. Heitor (1999), "Re-Examining the Role of European Universities in the Learning Economy," *European Socio-Economic Research Conference*, 28-30 April, Brussels, Belgium.

5. * D. V. Gibson, P. Conceição, S. Tankha, J. Norkskog, J. Burtner (1999), "Incubating Learning and Innovation Poles in Developing Regions Worldwide", *Portland International Conference on Management of Enginneering and Technology*, 25-29 July, Portland, Oregon, USA.

6. P. Conceição, J. K. Galbraith (1998), "Constructing Long and Dense Time-Series of Inequality Using the Theil Index", *INFORMS Seattle 1998 Meeting-Partnering for Global Technology Management*, 25-28 October, Seattle, USA.

7. P. Conceição, Manuel V. Heitor, P. Oliveira, C. Vedovello (1998), "Learning Through Interaction: A Perspective for Research Universities", *Conference on Innovation, Creation of New Businesses and Jobs*, 18-19 May, Luxembourg.

8. P. Conceição, Manuel V. Heitor (1998), "Implementing a Globally Linked & Entrepreneurial MOT Program: the Case of the Instituto Superior Técnico", *INFORMS Montreal 1998 Meeting-Bridging Continents and Cultures*, 26-29 April, Montreal, Canada.

9. P. Conceição (1997), "Policies to Efficiently deal with Knowledge and Common Pool Resources", *INFORMS Dallas Meeting: The Evolving Synergy OR/MS and Digital Technology*, 26-29 October, Dallas, USA.

10. P. Conceição, M. V. Heitor, (1997), "Linking the Instituto Superior Técnico Globally through Technology Innovation", *Portland International Conference on Management of Engineering and Technology- PICMET-Innovation in Technology Management: the Key to Global Leadership*, 27-31 July, Portland, and USA.

11. P. Oliveira, P. Conceição, M. V. Heitor, S. Thore (1997), "An Integrated Approach to Foster the Assessment and Utilization of University R&D results", *EURO-INFORMS Joint International Meeting- OR/MS for the Next Millennium*, 14-17 July, Barcelona, Spain.

12. ***** P. Conceição, D. V. Gibson (1997), "Measuring the Meaning and Effectiveness of Technology Transfer: the Case of the NSF Science and Technology Centers", *1st International Conference on Technology Policy and Innovation*, 2-4 July, Macau.

13. ***** P. Conceição, F. Veloso (1997), "The Portuguese Industrial Development Strategy Revisited", *1st International Conference on Technology Policy and Innovation*, 2-4 July, Macau.

14. P. Conceição, M. V. Heitor, P. Oliveira (1997), "Technology Innovation: Globalization and the Challenges of Internationalization- The IST/IC^2 Institute Partnership", *INFORMS Meeting: Managing Services in the next Millennium*, 4-7 May, San Diego, USA.

15. A. Caseiro, P. Conceição, D. F. G. Durão, M. V. Heitor (1995), "On the Development of Engineering Higher Education in Portugal and the Monitoring of Admissions: a Case Study", *7th International Conference on Assessing Quality in Higher Education*, 21-23 July, Finland.

NON ACADEMIC PUBLICATIONS AND COMMUNICATIONS

- ***Colóquio Educação e Sociedade* – Nova Série** (published by Fundação Calouste Gulbenkian, Lisbon)
  - "Que Será de Nós, Leitores, na Era Digital?,". **Review of the book**: JAMES J. O'DONNELL (1998), *Avatars of the World: From Papyrus to Cyberspace*. Cambridge, MA: Harvard University Press.
  - "História das Civilizações: Porque é que alguns são tão ricos e outros tão pobres?," October 1998: 213-220. **Reviews of the following books**: Jared Diamond (1997), *Guns, Germs and Steel: The Fates of Human Societies*, W. W. Norton & Company; Alfred W. Crosby (1997), *The Measure of Reality: Quantification and Western Society, 1250-1600*, Cambridge University Press; David S. Landes (1998), *The Wealth and Poverty of Nations: Why Some Are so Rich and Some so Poor*, W. W. Norton & Company.
  - "Perplexidades nas Universidades Norte-Americanas: Como Interpretar e Como Responder aos Reptos de Mudança?," March 1998: 254-259. **Reviews of the following books**: Bill Readings (1996), *The University in Ruins*, Harvard University Press; Christopher J. Lucas (1996), *Crisis in the Academy- Rethinking Higher Education in America*, St. Martin's Press; *Dædalus- Journal of the American Academy of Arts and Science* (1997), **126**(4).
- ***Ideias&Negócios***, monthly Portuguese magazine with one of the widest audience, since June 1998.
- ***Digital Forum***, Internet Magazine at http://www.digital-forum.net, Regular contribution titled "Visto da América" [Seen from America] since March 2, 1999.

Invited Communications

- "Learning and Innovation Poles in Latin America," *Workshop on Current Initiatives in Latin America and the Caribbean,* IC^2 Institute, UT-Austin, April 16, 1999, Austin, Texas.
- "Tacit and Codified Knowledge: Managing a Double Edged Sword", *ISDM'98- International Seminar On Document Management*, 10-11 November 1998, Centro Internacional de Tecnologia de Software, Curitiba, Brazil.
- P. Conceição, B. M. Fossum, S. Kearns, "IC^2 Institute Masters of Science in Science and Technology Commercialization", *Conference on Strengthening Graduate Education in Science and Engineering: Promising Practices and Strategies for Implementation*, National Science Foundation and National Institute for Science Education, 29-30 June 1998, Washington, DC.
- P. Conceição, M. V. Heitor, J. R. Felizardo (1997), "Striving for Global Networked Entrepreneurship: the IIMPACT Program", *Technopolis 97- An International Conference on Metropolitan Concentrations of Knowledge-Based Industries*, 9-12 September, Ottawa, Canada.
- P. Conceição, F. Veloso (1996), "A Training Approach Towards the Development of Key Competencies on Technology Management", *17th Annual National Business Conference: The Management of Intellectual Capital and Innovation*, 24-26 de January, Hamilton, Canada.
- P. Conceição, M. V. Heitor, F. Santos (1995), "Improving the Value of R&D Activities in the Innovation Process of the European Industry", *BRITE-EURAM'95 Conference*, 11-13 October, Vienna, Austria.

ORGANIZATION OF CONFERENCES AND MEETINGS

June 2001	Program Committee, *5th International Conference on Technology Policy and Innovation*, Delft, The Netherlands.
January 2001	Co-Chair of a Minitrack at the HICSS-34, *Hawaii International Conference on Systems Sciences*, January, Wailea, Maui, Hawaii.
August 2000	Chair of the Program Committee, *4th International Conference on Technology Policy and Innovation*, Curitiba, Brazil.
May 2000	Co-Organizer of the Research Seminar: *Towards a Learning Society: Innovation and Competence Building with Social Cohesion for Europe*, within the program of the Portuguese Presidency of the European Union, Lisbon, Portugal.
September 1999	Chair of the Program Committee, *3rd International Conference on Technology Policy and Innovation*, Austin, Texas.
October 1998	Session Chair, "Implementing the Global Classroom: Science and Technology Commercialization", *INFORMS Seattle 1998 Meeting-Partnering for Global Technology Management*, Seattle, USA.
October 1998	Session Chair, "Inequality and Economic Development: Understanding the Challenges and Opportunities for Global Technology-Based Growth", *INFORMS Seattle 1998 Meeting-Partnering for Global Technology Management*, Seattle, USA.
August 1998	Program Committee, *2nd International Conference on Technology Policy and Innovation*, Lisbon, Portugal.
Nov. 1997- Dec. 1998	Co-Coordinator, with Prof. Manuel V. Heitor (IST), Eng. José Rui Felizardo (CPIN), and Dr. Syed Shariq (Stanford University), of the IMPACT Program - Innovation and Internationalization of Firms through the Application and Commercialization of Technology. Program organized by IST, the IC^2 Institute, with the support of the Portuguese Ministry of the Economy.
October 1997	Session Chair, "Knowledge for Development: Management and Policy Initiatives", *INFORMS Montreal 1998 Meeting-Bridging Continents and Cultures*, Montreal, Canada.
October 1997	Session Chair, "Technology Management and Sustainable Development", *INFORMS Montreal 1998*, Montreal, Canada.
July 1997	Program Committee, *1st International Conference on Technology Policy and Innovation*, Macau.
April 1996	*The Green Paper on Innovation and the Universities' Mission*, video-

	conference between the IC^2 Institute-UT Austin, the NASA Ames Research Center-Sunnyvale, California, and IST, Lisbon.
March 1995	Scientific Coordinator of the 'Short Intensive Course' on the *Role of Science and Technology Activities in the Improvement of Industries' Competitiveness*, under the auspices of the Board of European Students of Technology-BEST, IST, Lisbon.

OTHER

November 1998 - December 2000	Member of the Executive Commission of PAPS- Portuguese American Post-Graduate Society, an association of Portuguese graduate students in American universities with more than 200 members. Web site: http://web.mit.edu/ferreira/www/paps

References in the Press and other sites:

- *The Guardian*:

http://www.guardianunlimited.co.uk/Archive/Article/0,4273,3908940,00.html

- United Nations Development Programme:

http://www.undp.org/poverty/initiatives/wider/wiid_measure.htm

- *The Wilson Quarterly*, Spring 2000, pages 104-105.

Curriculum Vitae

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Estado Civil: Divorciado.

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Qualificações Académicas:

1997-98 **Post-Doutoramento em Gestão da Tecnologia**
Carnegie Mellon University, EUA.

1993-97 **Doutor em Economia (*Ph.D.*)**
London Business School, University of London.
Título da dissertação: "An Empirical Study of Entry, Innovation and Diffusion in Industrial Clusters."
Equivalência concedida pela Universidade Técnica de Lisboa a 30 de Junho de 1998.

1985-90 **Licenciatura em Economia**
Universidade Católica Portuguesa, Lisboa.

Experiência Profissional e Científica:

Desde 2/99 Instituto Nacional do Transporte Ferroviário
Director-coordenador da Área de Economia

Desde 9/98 **Instituto Superior de Gestão**

Professor Auxiliar Convidado

Lecionando a cadeira anual de Economia II.

Desde 5/98 **Instituto Superior Técnico**

Professor Auxiliar Convidado

Lecionando as cadeiras trimestrais de Análise Empresarial e Políticas de Desenvolvimento Industrial no Mestrado em Engenharia e Gestão da Tecnologia.

2/98-2/99	**Ministério da Economia** **Adjunto do Gabinete do Secretário de Estado da Indústria e Energia.**
9/90-8/93	**Universidade Católica Portuguesa** **Assistente** Faculdade de Ciências Económicas e Empresariais Tendo lecionado as cadeiras de Economia Industrial, Economia da Regulação e Concorrência, Finanças Públicas, Macroeconomia, Estatística e Modelos de Optimização e Decisão.
9/89-8/93	**Universidade Católica Portuguesa** Investigador

II Centro de Estudos Aplicados (CEA)

Áreas de Especialização:

Economia Industrial; Economia e Gestão da Inovação; Economia da Regulação e Concorrência.

Associações Profissionais:

Membro da EARIE (European Association for Research in Industrial Economics).

Membro da Royal Economic Society.

Membro da J. A. Schumpeter Society

Línguas:

Inglês - Cambridge Proficiency Certificate - Nível A.

Françês - Conhecimentos Gerais.

Outros:

Vencedor do concurso Gestão 88, organizado pelo Jornal Expresso, como membro da equipa Interhotel I - AIESEC - Universidade Católica, durante o 3º ano de licenciatura.

Publicações:

- "Do Innovations Diffuse Faster within Geographical Clusters?" *Internacional Journal of Industrial Organization*. 18(3), 2000.
- Industrial Clusters and the Diffusion of New Technologies". *Paper* aceite para publicação em *Technology Forecasting and Social Change*.
- "A Comparison of Clustering Dynamics in the US and UK Computer Industries", com Peter Swann. *Journal of Evolutionary Ecnomics*, Vol. 9, 1999.
- "The diffusion of Process Innovations: A Selective Review." *The International Journal of the Economics of Business* 6(1), 1999.
- "Clusters, Innovation and Growth: a Survey of the Literature." Em *The Dynamics of Industrial Clusters: a Comparative Study of Computing and Biotechnology*, Peter Swann, Martha Prevezer and David Stout (eds.), Oxford University Press, 1999.
- "Do Firms in Clusters Innovate More?" com Peter Swann. *Research Policy* 27(6), 1998.
- "Industrial Clusters and Technological Innovation." *Business Strategy Review*, 6/96.
- "Industrial Clusters and Innovative Performance: a Survey of the Literature." Centre for Business Strategy Working Paper Nº 156 (6/95), London Business School.

Apresentações em Conferências:

- 3ª Conferência Internacional sobre Política Tecnológica e Inovação, University of Texas at Austin, 30 de Agosto a 2 de Setembro, 1999.
- 2ª Conferência Internacional sobre Política Tecnológica e Inovação, fundação Calouste Gulbenkian, 3-5 de Agosto, 1998.
- 2ª Conferência da SPIE (Sociedade Portuguesa de Investigação em Economia), Universidade Católica Portuguesa, Lisboa, 16-18 de Junho, 1997.
- Congresso Anual da Royal Economic Society, University of Staffordshire, Reino Unido, 24-27 de Março, 1997.
- 23ª Conferência da EARIE (European Association for Research in Industrial Economics), Austrian Institute for Economic Research, Viena, 7-10 de Setembro, 1996 - *chair* da sessão sobre "Economics of Large Firms."
- 6ª Conferência da Joseph A. Schumpeter Society, Royal Institute of Technology, Estocolmo, 3-5 de Junho, 1996.
- 22ª Conferência da EARIE (European Association for Research in Industrial Economics), Université de Nice-Sophia Antipolis, França, 6-9 de Setembro, 1995.
- 3ª Workshop da EMOT (European Management of Organisations in Transition), University of Reading, Reino Unido, 14-16 de Maio, 1995.

***Curriculum Vitae*: Francisco Miguel Rogado Salvador Pinheiro Veloso**

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Main Scientific Field: Technology and Operations Management
Other Scientific Areas of Interest: Supply Chain Management; Industrial Policy

Academic Degrees:

- PhD in Technology, Management and Policy, Massachusetts Institute of Technology (MIT), January 2001
- MSc. in Economics and Management of Science and Technology, Instituto Superior de Economia Gestão, Technical University of Lisboa, 1996
- Five Year Diploma in Physics Engineering, Instituto Superior Técnico, Technical University of Lisboa,1992

Present Position: Post Doctoral Research Associate at MIT and IST (joint post-doc)

Previous Positions:

- Research Assistant, Materials Systems Laboratory, Massachusetts Institute of Technology, 1997-2000
- Research and Development Manager, ITEC - Instituto Tecnológico para a Europa Comunitária, 1994 –1996

Prizes:

- MIT award for excellence and leadership in technology and policy (1998)
- JNICT-ISEG best student award for the MSc.in economics and management of S&T

Main Publications:

1. Veloso, F. and Fixson, S., Make-Buy Decisions in the Auto Industry: New perspectives on the role of the supplier as an innovator, Technological Forecasting and Social Change, Forthcoming in 2001
2. Veloso, F., The automotive supply chain: Global trends and Asian perspectives, Asian Development Bank Working Paper, Forthcoming
3. Veloso, F. and Soto, J., Incentives, Infrastructure and Institutions: Perspectives on Industrialization and Technical Change, Technological Forecasting and Social Change, Vol 66 (1), January 2001
4. Veloso, F. and Roth, R. New technologies in emerging markets: understanding technology, market and policy constraints to the adoption of advanced technologies. Proceedings of the 34th Annual Hawaii International Conference on System Sciences, Maui. Hawaii, January 2001
5. Veloso, F., Henry, C., Roth, R., Clark, J. Global Strategies for the Development of the Portuguese Autoparts Industry. Lisboa: IAPMEI, May 2000.
6. Veloso, F. Henry, C. and Roth, R. Can Small firms leverage global competition? Evidence from the Portuguese and Brazilian Automotive Supplier Industries. Proc. of the 4th Intl. Conference on Tech. Policy and Innovation, Curitiba, Brazil.

CURRICULUM VITÆ

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DADOS PESSOAIS

- Nascimento 15 de Março de 1957, Rio de Janeiro - Brasil
- Nacionalidade Portuguesa
- Família Casado desde 1985, pai de dois filhos

resumo profissional

- Gestor de Projectos de Desenvolvimento Científico e Tecnológico. Actualizado com os Mecanismos de Financiamento à Investigação Tecnológica no Ambiente Português, Europeu e Brasileiro. Docente Universitário. Ph.D.. M.Sc.. 20 anos de Experiência como Profissional na Área da Investigação Básica e Aplicada Unix. Windows. Inglês. Francês Técnico.

AcTIVIDADES Actuais

- Investigador no Laboratório de Termodinâmica Aplicada, Dept. de Engenharia Mecânica, Instituto Superior Técnico, com actividades de pós-doutoramento no Laboratório de Combustão e Propulsão, Instituto Nacional de Pesquisas Espaciais do Brasil, desenvolvendo investigação básica na área de caracterização e monitoração de escoamentos com reacção, associados aos sistemas de combustão das indústrias de processos.

ACTUAIS ÁREAS DE INTERESSE

- Gestão de Desenvolvimento Tecnológico nas áreas relacionadas à geração e utilização de energia oriunda da queima de combustíveis fósseis, envolvendo as etapas de Previsão, Investigação e Inovação Tecnológica.
- Actividades de investigação na área da Gestão Ambiental, com a incorporação sistemática de factores de custo e da engenharia dos processos da conversão, da distribuição e da utilização de energia na avaliação do impacto ambiental gerado ao longo da vida útil de um determinado produto ou processo.

Formação Académica

- Grau de Doutor pelo Instituto Superior Técnico - UTL, com estudos na "Caracterização da Interacção entre Chamas em Sistemas de Múltiplos Queimadores", no Laboratório de Combustão, DEM/IST, sob orientação do Prof. Catedrático Manuel de Valsassina Heitor, com o grau de “com Louvor e Distinção por Unanimidade”, Dezembro de 1995.
- Equivalência ao Grau de Mestre, concedida pela Universidade Técnica de Lisboa, em Abril de 1994.
- Equivalência à Licenciatura em Engenharia Química, concedida pelo Instituto Superior Técnico, com grau de 14 (em 20) pontos, em Dezembro de 1990.
- Grau de Mestre em Engenharia Química na Coordenação dos Programas de Pós-graduação em Engenharia da Universidade Federal do Rio de Janeiro (COPPE-UFRJ) - RJ/Brasil, tendo defendido tese em 21 de Março de 1985, na área de transferência de calor em sólidos, sob orientação do Prof. Dr. Cirus Hackenberg, Ph.D.
- Curso de Engenharia Química na Universidade Federal do Rio de Janeiro - RJ/Brasil, com grau de 7.3 (em 10) pontos, de 1975 a 1979.

Outras Qualificações

- Inglês Fluente; Francês e Espanhol, Leitura Técnica;
- Membro da Ordem dos Engenheiros de Portugal, desde 1991.
- Sócio efectivo da Associação Brasileira de Ciências Mecânicas, desde 1989.
- Membro do Conselho Regional de Engenharia Química, Secção 3, RJ - Brasil, desde 1980.

Actividades EXERCIDAS

- Actuação nos Projectos
  - CLEAN-GLASS - *Low-NOx Cost Effective and Gas Combustion Technology for Glass Furnaces*; no âmbito do Programa BRITE/EURAM-III, liderado pela multinacional francesa do vidro Saint-Gobain.
  - Coordenador do Projecto de Cooperação Internacional Portugal - Brasil, IST-INPE, "*Câmaras de Combustão Pulsante para um Ambiente Limpo*", no âmbito de acordos de cooperação entre a JNICT/Portugal e a CAPES/Brasil, 1996-1998.
  - Coordenador do Projecto de Cooperação Internacional Portugal - Brasil, IST-INPE "*Desenvolvimento e Implementação de Técnicas Tomográficas para a Análise de Chamas*," no âmbito de acordos de cooperação entre a JNICT/Portugal e a FAPESP/Brasil, 1998-2000.
  - Coordenador do Projecto K-LEAN – *Knowledge-Based Strategies for Clean Hand-Made Glass Manufacturing*, no âmbito do Programa Europeu EUREKA, liderado pela companhia Portuguesa de produção de vidro NEOVIDRO, envolvendo a participação de empresas Germânicas e instituições acadêmicas de Macau e do sudoeste Chinês.
  - *LCA-AUTO - ECO-GESTÃO NO CLUSTER DO AUTOMÓVEL EM PORTUGAL BASEADA NA ANÁLISE DO CICLO DE VIDA*, no âmbito do Programa Português PRAXIS XXI. Proposta de projecto envolvendo questões ambientais na industria automobilística, com ênfase na aplicação da metodologia LCA no processo de fabrico e utilização do veículo Volkswagen Sharan.
- Gestor do Projecto "**POLISERCOOP**", relacionado à re-integração social de ex-doentes mentais, no âmbito do Programa INTEGRAR, Medida 3, financiado pelo Fundo Social Europeu. Período de 1998-1999.
- Organização do Seminário "Ambiente e Desenvolvimento Sustentável: Perspectivas e Políticas para o Desenvolvimento Regional", financiado pela Comissão Européia, dirigido à Administração Pública Portuguesa.
- Co - Docente na Disciplina "Métodos Instrumentais de Análise e Controlo em Energia e Ambiente", no Mestrado em Engenharia Mecânica, IST.
- Actividades de Investigação, a nível de Pós-Doutoramento, com o projecto "Desenvolvimento e Optimização de Tecnologias da Energia e do Ambiente para a Indústria de Processos", especificamente no âmbito do tema científico *"Sistema Avançado de Diagnóstico de Chamas Turbulentas através da Reconstrução Tomográfica de Imagens Digitalizadas Incorporando Caminhos Ópticos em Planos Cruzados"*, no Departamento de Engenharia Mecânica, IST.
- Investigador no Projecto - BRITE-EURAM AERO CT 920035 - PDF/CFD Based Methods: Development and Validation for Low Emissions Combustor Technology", de 01/92 a 06/95.
- Gestor da Divisão de Dinâmica de Fluídos, Grupo de Armas, Instituto de Pesquisas da Marinha (IPqM) - RJ/Brasil, actuando na gestão de projectos em propulsão sólida, a liderar uma equipa de 13 investigadores entre mestres, graduados e técnicos. Este projecto envolvia, nomeadamente, actividades de engenharia reversa de propelentes sólidos e de pirotécnicos dos mísseis utilizados pela Marinha Brasileira, de 06/87 a 08/89.
- Consultor Técnico da Soares Indústria Comércio Ltda - RJ/Brasil, actuando no desenvolvimento tecnológico de novos produtos na área de borracha para fins alimentícios e farmacêuticos, de 05/88 a 08/89.
- Responsável Técnico do Grupo Soares - RJ/Brasil (indústrias Soares e Soares-Nippon Ind. e Com. Ltda), das áreas de borracha para utensílios farmacêuticos e de tubos de PVC termo-contráctil, respectivamente. Actuando ainda como coordenador da implantação de sistemas de informatização nas duas empresas, de 07/87 a 04/88.
- Director Técnico da firma ULTRA-FIN Ind. e Com. Ltda - RJ/Brasil, a actuar na gestão da produção de sistemas de espumas poliuretanicas, e na informatização do sistema de contabilidade em geral, de 09/85 a 02/88.
- Gestor da Secção de Estudos Básicos da Divisão de Sistemas de Propulsão do Instituto de Pesquisas da Marinha (IPqM) - RJ/Brasil, como gestor técnico do Projecto Propelente Sólido, visando aquisição de tecnologia em fabricação de propelentes sólidos tipo composite, de 02/80 a 12/86.
- Engenheiro Químico aprovado no Exame de Selecção para o curso de Formação de Pessoal em Tecnologia Nuclear/79, conforme convénio entre NUCLEBRÁS e a COPPE/UFRJ - RJ/Brasil, classificado em 6º lugar.
- Estágio na firma de consultadoria Promon Engenharia S/A - RJ/Brasil, tendo actuado na área de fermentação alcoólica da mandioca, além de outros projectos na geração de energia pela conversão de biomassas, de 01/79 a 12/80.
- Estágio sob orientação do Prof. David Nicodem, no Depto. de Química Orgânica (Fotoquímica) da UFRJ - RJ/Brasil, com Bolsa de Iniciação Científica do Conselho de Ensino de Pós-Graduação-CEPG-RJ, de 03/77 a 12/78.
- Estágio sob orientação do Prof. Delmo S. Vaitsman, no Depto. de Química Analítica da UFRJ - RJ/Brasil, com Bolsa de Iniciação Científica do Conselho de Ensino de Pós-Graduação-CEPG-RJ, de 03/75 a 06/78.

Orientações

- Orientador do Eng. Pedro de Campos, Eng. da Ford do Brasil, Tese de Mestrado sob o título "A gestão do ciclo de vida do automóvel: da Venda ao fornecimento contínuo de soluções de transporte", Mestrado de Gestão do Meio-Ambiente, Universidade de Taubaté, SP, 2000.
- Orientador da Enga. Rosimeire A. Lucca Goncalves, Enga. de Segurança de Trabalho da Volkswagen do Brasil, Tese de Mestrado sob o título "Avaliacao dos efeitos socio/economicos da implantacao de uma desmontadora de automoveis na regiao de Taubate", Mestrado de Gestão do Meio-Ambiente, Universidade de Taubaté, SP, 2000.

- Orientador da Enga. Rose Maria Santos, Enga. de Qualidade da Cebrace do Brasil, Tese de Mestrado sob o título "Implantação da Norma ISO14040 numa Indústria de Vidro Plano", Mestrado de Gestão do Meio-Ambiente, Universidade de Taubaté, SP, 2000.
- Co-orientador do Eng. Mec. Juliano Cardoso, Tese de Mestrado sob o título "Investigação da Estrutura de Chamas Difusivas utilizando um Queimador de Jatos Opostos", Mestrado em Engenharia Aeroespacial, INPE/LCP-SP, 2000.
- Co-orientador do Eng. Mec. Rodrigo Cunha, Tese de Mestrado sob o título "Influência das Condições de Queima de Uma Chama de Gás Natural/Ar na Destruição de Resíduos Líquidos Nitrogenados em um Incinerador Vertical", Departamento de Energia, FEG/UNESP-SP, 1999.
- Co-orientador do Eng. Mec. Robinson Teixeira, Tese de Mestrado sob o título "Desenvolvimento de Algoritmos Tomográficos em Planos Cruzados", Departamento de Engenharia Elétrica, FEG/UNESP-SP, 1999.
- Co-orientador do Eng. Mec. Duarte Pupo Correia, Tese de Doutorado "Desenvolvimento e implementação de Sensores Avançados, baseados em Procedimentos Tomográficos, para a Monitorização e Controlo de um Forno de Vidro ", Departamento de Engenharia Mecânica, IST.
- Co-orientador do Eng. Mec. José Nuno Carranca, Tese de Mestrado "Optimização da metodologia de análise do ciclo de vida e sua aplicação ao estudo das embalagens", Departamento de Engenharia Mecânica, IST.
- Orientação de projectos de final de curso:
  - Aluno Pedro Gonçalo do Amaral Diogo Maia, "Caracterização experimental da influência da geometria do conjunto queimador/conduta de ar de uma fornalha laboratorial de paredes quentes nas emissões de poluentes", projecto de final de curso de 1998.
  - Aluno Jaime Manuel Caldeira Gato, "Actuação Acústica de Chamas sem pré-mistura", projecto de final de curso de 1995.
  - Aluno Henrique Koenders, "Interacção de Chamas Múltiplas sem pré-mistura com actuação acústica", projecto de final de curso de 1995.

CURSOS E CONFERÊNCIAS

- XX Simpósio de Gestão e Inovação Tecnológica, São Paulo-Brasil, 17-20 Novembro 1998.
- 2st *International Conference on Technology Policy and Innovation",* Lisboa, Agosto 1998.
- EUREKA meets ASIA, EUREKA Programme Brockarage Seminar, Maio 1998.
- "Life Cycle Approaches to Production System", NATO A.S.I. Course, Portugal, Junho 25-28, 1995.
- Simpósio FÓRUM ISO9000, Instituto Portugues da Qualidade, Lisboa, 23-24 Maio 1995.
- Seminário em "Transferência e Gestão de Tecnologia", ministrado pelo Dr. David V. Gibson - IC^2 Institute, Austin, University of Texas, Instituto Superior Tecnico, Lisboa - Portugal, 12-16 Dezembro 1994.
- Curso em "Team Building", ministrado pelo Dr. Jerry Vorpahl - J.Perry Corp., Instituto Superior Tecnico, Lisboa-Portugal, 20-27 Novembro 1994
- Curso de Instabilidade em Combustão, NATO A.S.I. Course, Espinho, Portugal, Agosto/1993.
- Seminário "Laser Applications for Mechanical Industry" 17th NATO A.S.I. Course, Erice, Sicilia, Italia, Abril/1992.
- Seminário "Image Analysis as Measuring Technique in Flows", Euromech Colloquium 279, Delft University of Technology, Delft, Holanda, Julho/1991.
- Seminário "Heat Transfer in Radiating and Combusting Systems", 17th Eurotherm Seminar, Cascais, Portugal, Outubro/1990.
- Organizador do "Grupo de Estudos em Inteligência Artificial", no Instituto de Pesquisas da Marinha, RJ-Brasil, 1989.
- "5º Simpósio Brasileiro de Inteligência Artificial", Natal-RN/Brasil, Novembro 1988.
- Curso de "Banco de Dados Relacionais e Centros de Informaçâo", ministrado pelo Sr. Breogan Gonda Vasques, Diretor de Tecnologia de Banco de Dados da SCI-Sistemas, Computação e Informática; e de "Fundamentos de Bancos de Dados", ministrado pelo Sr. Jorge Marmion Stus, analista de sistemas da SCI-Sistemas, Computação e Informática,no Rio de Janeiro/Brasil, de 22 a 24/06/87.
- Curso de "Administraçâo e Conservaçâo de Energia na Indústria", ministrado pelo Dr. Rocco Fazzolare, promovido pela SCI-Sistemas, Computação e Informática, no Rio de Janeiro/Brasil, de 19 a 22/08/80.

Artigos PUBLICADOS

1. Artigo "Non-Premixed Turbulent Jet Propane Flames", submetido à *Experimental Thermal and Fluid Science*, Março 2000.
2. Artigo "Characteristics of Nitric Oxide Formation Rates in Turbulent Non-Premixed Jet Flames", *Combustion and Flame*, **120**, pp. 383-391 (2000).
3. Artigo "Advanced 3D Emission Tomography Flame Temperature Sensor", submetido à *Combustion, Science and Technology*, Novembro 1999.
4. Artigo "Influence of Burner-port Geometry in Hydrocarbon Oxidation and NO_x Formation Mechanisms in Methane/Air Flames", submetido à *Combustion, Science and Technology*, Julho 1999.

5. Artigo “Life Cycle Analysis as a Business Strategy for the Process Industry”, *J. of the Brazilian Soc. Mechanical Sciences*, **XXI(2)**, pp. 322-331, 1999.
6. Artigo “Characteristics of Turbulent Heat Transport in Non-Premixed Jet Flames”, submetida à *Combustion and Flame*, Janeiro 1999.
7. Artigo “On the Analysis of Propane Jet Diffusion Flames in Mutual Interaction”, Combustion, Science and Technology, **141**, 37-57, 1999.
8. Artigo “On the Analysis of the Temperature Dissipation in a Turbulent Jet Propane Flame”, *Experimental Thermal and Fluid Science*, **18**, 116-121, 1998.
9. Artigo “*On the Turbulent Transport Characteristics of Non-Premixed Jet Flames in Mutual Interaction*”, J. of the Brazilian Society of Mechanical Sciences, **XX(2)**, 164-178, 1998.
10. Artigo “Temperature and Related Statistics in Turbulent Jet Flames”, *Experiments in Fluids*, **24**, 118-129, 1998.

Trabalhos Apresentados em Eventos

1. Artigo “Free Radical Imaging Techniques applied to Hydrocarbon Flames Diagnosis”, a ser apresentado no Millenium International Symposium on Thermal and Fluid Sciences, Setembro 2000, XI'AN/CHINA.
2. Artigo “Flame 3D Tomography Sensor for In-Furnace Diagnostics”, *28th (Int.) Symposium on Combustion*, Agosto 2000.
3. Artigo “On the Characterization of Air/Fuel Mixture Distribution through C_2/CH Light Intensity Ratio in a LPP Combustor”, *15º Congresso Brasileiro de Engenharia Mecânica*, Águas de Lindóia-SP, Brasil, Dezembro 1999.
4. Artigo “Efeito da Frequência e da Amplitude de Oscilação no Formato de Chamas Pré-Misturadas Pulsadas”, *15º Congresso Brasileiro de Engenharia Mecânica*, Águas de Lindóia-SP, Brasil, Dezembro 1999.
5. Artigo “Efeitos da Divergência dos Raios de Luz na Análise Tomográfica de Chamas”, *15º Congresso Brasileiro de Engenharia Mecânica*, Águas de Lindóia-SP, Brasil, Dezembro 1999.
6. Artigo “Análise de Chamas por Tomografia – Resultados Preliminares”, 7º Congresso Brasileiro de Engenharia e Ciências Térmicas – ENCIT98, 3-7Novembro 1998.
7. Artigo "Life Cycle Analysis for Technology Assessment in the Process Industry", *1st International Conference on Technology Policy and Innovation"*, Macau-China, 2-4 Julho 1997.
8. Artigo(Poster) “Temperature Fluctuations and Dissipation in a Turbulent Jet Propane Flame “, *10º Simp. On Turbulent Shear Flows*, The Pennsylvania State Univ., EUA, August 14-16, 1995.
9. Artigo (Poster) “Interaction of Multiple Jet Propane Flames“, *no 25º Simpósio (Int.) de Combustão*, Irvine, EUA, Agosto/1994.
10. Artigo “Velocity and Temperature Characteristics of Jet Diffusion Flames in Mutual Interaction”, *no 7º Simpósio Internacional de Aplicações de Técnicas de Diagnóstico a Laser*, Lisboa, Portugal, Julho/1994.
11. Artigo “The Thermal Characteristics of Turbulent Hydrocarbon Flames in Mutual Interaction”, *XI Congresso Brasileiro de Engenharia Mecanica*, São Paulo, Dezembro 11-13, 1991.
12. Artigo "Solid Propellant Rocket Motor Design : An Intelligent Approach", *26th AIAA/ASME Joint Propulsion Conference*, Orlando-Florida/USA, 07/90.
13. Artigo "Projeto de Motores a Propelentes Sólidos : Um Sistema Inteligente", *III Workshop de Combustão e Propulsão*, realizado em Lorena- SP/Brasil, 12/89.
14. Artigo "Contaminação de Produtos de Borracha com Nitrosaminas Voláteis Cancerígenas", *8º Congresso Brasileiro de Tecnologia de Borracha*, São Paulo/Brasil, de 18 a 20/09/89.
15. Participação no "5. Simpósio Brasileiro de Inteligencia Artificial", realizado em Natal-RN/Brasil, 11/88.
16. Artigo "Modelo de Contorno Livre Estacionário Convectivo Radiante para a Queima de Propelentes Sólidos do tipo 'Composite'", *1º Encontro Nacional De Ciências Térmicas - ENCIT86*, São José dos Campos-SP/Brasil, em 12/86.
17. Artigo "Modelo de Contorno Livre Estacionário Convectivo Radiante para a Queima de Propelentes Sólidos do tipo 'Composite”, *2º Congresso Nacional de Ciências Térmicas*, México, 10/85.
18. Artigo "Aspectos da Utilizaçâo de Polímerosem Propelentes Sólidos Tipo Composite", conferência proferida no Instituto de Macromoléculas da Universidade Federal do Rio de Janeiro - IMA/UFRJ, no Rio de Janeiro/Brasil, em 18/09/85.
19. Artigo "Identificaçâo de Ditizonatos Metálicos por Cromatografia em Camada Fina", *29a. Reunião Anual da Sociedade Brasileira para o Progresso da Ciência-SBPC/77*, Brasil, 1977.

Artigo "Análise Cromatográfica do Sub-Grupo do Arsenio", *28a. Reunião Anual da Sociedade Brasileira para o Progresso da Ciência-SBPC/76*, Brasil, 1976.

RESUME

Personal Data

Name: Sergei Ivanovich Shtork
Date of Birth: March 2, 1961
Place of Birth: Krasnoyarsk Region, Russia (former USSR)
Citizenship: Russia
Marital status: married, has a daughter

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Objective

Postdoctoral (or equivalent) research position in fields of experimental fluid dynamics, thermophysics, heat and mass transfer, power installations modelling.

Education

- Ph.D in Physics and Mathematics from the Institute of Thermophysics SB of RAS, 1994 (December 28).
  PhD work tittle: "Experimental Study of Vortex Structures in Tangential Chambers".
  Advisor: Prof. S.V. Alekseenko

- Degree in Physics from the Physics Department of the Krasnoyarsk State University, 1983.
  Diploma work tittle: "Waves Formation in Falling Liquid Films".
  Advisor: Prof. S.V. Alekseenko

Professional Experience

- Senior Researcher, Research Associate, Research Engineer at the Institute of Thermophysics SB RAS, Novosibirsk, Russia, 1989-present.
- Junior Researcher at the Siberian Thermotechnical Institute SibVTI, Krasnoyarsk, Russia, 1988-1989.
- Junior Researcher and Research Engineer,) at the Krasnoyarsk State University KGU, Krasnoyarsk, Russia, 1983-1988 (1984-1985 - compulsory military service, Penza region, Russia).

Current Research Interests

Aerodynamics of combustors, experimental methods (LDA, PIV, Flow Visualisation, etc.), two-phase flows, hydrodynamics of vortex flows, large-scale coherent structures, turbulence, vortex breakdown, waves on vortex filament, falling liquid films and rivulets.

Research skills

Knowledge of methods of aerodynamic and hydrodynamic experiment:

- LDA;

- PTV with semiautomatic images processing;
- PIV;
- flow visualisation with use photo and video recording;
- schlieren visualisation of flow with non uniform temperature field;
- shadow method for thickness measurement of liquid films and rivulets;
- measurements of velocity and wall shear stress by means of electrochemical method;
- hot wire anemometry;
- temperature measurements;
- measurements of velocities and pressures by pneumoprobes with pressure transducers;
- using different types of flow rate meters (rotameters, standard diaphragms, vortex flowmeters, turbine meters, etc.).

Working with ADC and computer programs for data analyse performed in our laboratory (C++/LabView software for MS DOS/Windows95)
Working with standard applications for Windows95/98 (Grapher, Winsurfer, MathCAD, CorelDraw etc.)
Knowledge of elements of programming on Fortran and C/C++.

Awards and Honours

- Honorary degree of Senior scientist, Institute of Thermophysics SD RAS, (1999).
- RFBR (Russian Foundation for Basic Research) research Grant N 96-01-01667, as principal investigator, (1996-1997).
- Travel Grant of the RFBR N 97-01-10900, (1997).
- INTAS-RFBR research Grant N 95-IN-RU-1149, as participant, (1997-1999).
- Research Grants of the RFBR N 94-02-05812, N 95-02-04617, N 96-15-96815, N 97-05-65254, as participant, (1994-1999).
- First prize of the Institute of Thermophysics Competition for Fundamental research work “Helical Vortices in Swirl Flow”, as teem member, (1997).
- Prizes of the All-Union Conferences of Young Researches (1988 - Novosibirsk; 1989, 1991 - Moscow, Russia).
- Prize of the Physics Department Competition of Young Specialists, Krasnoyarsk State University, Russia (1988).

Teaching Experience

- Research mentor for BS and MS students of the Novosibirsk State University, 1996-present.
- Served as assistant of tutor in student lab practice (methods of thermophysical experiment) at Physics Department of KGU, 1985-1988.

Recent selected PUBLICATIONS

1. Alekseenko S.V., Kuibin P.A., Okulov V.L., Shtork S.I. Helical Vortices in Swirl Flow. JFM, 1999, vol. 382, pp. 195-243.
2. Markovich D.M., Semenov V.I., Serant F.A., Shtork S.I. Experimental aerodynamics modeling and geometry optimization of gas furnace E-160. 1999 (abstract submitted to the 5th European Conference on Industrial Furnaces and Boilers, INFUB 2000, Portugal).
3. Shtork S.I., Cherny I.S. Experimental Study of Integral Characteristics of Swirl Gas-Liquid Flow. Trans. Intern. Symp. “Actual Problems of Physical Hydroaerodynamics” Novosibirsk, Russia, 19 - 23 April 1999, p. II - 108.
4. Alekseenko S.V., Kuibin P.A., Okulov V.L., Shtork S.I. Theory of Helical Vortices. Proc. of IUTAM-Symp. on Dynamics of Slender Vortices, 1-3 September 1997, Aachen, Germany KLUWER Ac. Pub. 1998
5. Alekseenko S.V., Shtork S.I. Traveling Vortex Breakdown. Tech.Phys.Lett., 1997, Vol. 23(11), pp.868-869.

6. (1997) Helical vortices in power engineering, in N.V. Medvetskaya and R.S. Gromadskaya (eds.), *The Physics of Heat Transfer in Boiling and Condensation*, Institute for High Temperature, Russian Academy of Sciences, Moscow, pp. 471-476.
7. Alekseenko S.V., Kuibin P.A., Markovich D.M., Shtork S.I. Wave flow of rivulet along outer surface of an incline tube. Proc. of the 4th World Conference on Experimental Heat Transfer, Fluid Mech. and Thermodynamics, 1997, Brussels, June 2-6, V. 2, pp. 1233-1239.
8. Alekseenko S.V., Markovich D.M., Shtork S.I. Wave flow of rivulet along outer surface of an inclined tube. Proc. of the 4 th Int. Workshop "Electrochem. Flow Measurements - Fundamentals and Applications". 17-20 March, 1996, Lahnstein. Germany. Poster 1.7.
9. Alekseenko S.V., Markovich D.M., Shtork S.I. Wave flow of rivulets on the outer surface of an inclined cylinder. Physics of Fluids, 1996, V.8, N 12, pp. 3288-3299.
10. Alekseenko S.V., Kuibin P.A., Okulov V.L., Shtork S.I. Stationary Helical Vortex with Changing Helical Symmetry. Dokl. Akad. Nauk, 1995. V. 345. N 5. pp. 611-614 (in Russian).
11. Alekseenko S.V., Licht W., Markovich D.M., Nakoryakov V.E., Shtork S.I. Rivulet flow on outer surface of an inclined cylinder. Proc. 2nd Int.Conf. on Multiphase Flow. April 2-7, 1995. Japan, Kyoto. V.1, pp. IP1-35 - IP1-39
12. Alekseenko S.V., Licht W., Markovich D.M., Shtork S.I. Wave flow of rivulet on outer surface of an inclined cylinder. Two-Phase Flow Modelling and Experimentation 1995. Proc. of the First Int. Symp. Rome, 9-11 October, 1995. V 1, pp.211-217
13. Alekseenko S.V., Kuibin P.A., Okulov V.L., Shtork S.I. Large-Scale Vortex Structures in Intensively Swirling Flows. Proceeding of the conf. "Experimental and Numerical Flow Visualization". 13-18 August, 1995. Hilton. U.S.A. ASME 1995. FED-Vol. 218. pp.181-188.
14. Alekseenko S.V., Shtork S.I. Experimental Observation of Vortex Filament Interaction. JETP Lett., 1994, Vol. 59, No. 11, pp. 775-780.
15. Alekseenko S.V., Kuibin P.A., Okulov V.L., Shtork S.I. Characteristics of Swirl Flows with Helical Symmetry. Tech.Phys.Lett., 1994, Vol. 20(9), pp.737-739.
16. Alekseenko S.V., Shtork S.I. Swirling Flow Large-Scale Structures in a Combustor Model. Russian J. of Engineering Thermophysics. 1992. V.2(4). P.231-266.

Some REPORTS

1. Markovich D.M., Shtork S.I., Semenov V.I. et al. Experimental modelling of aerodynamics of Boiler E-160 for GES N 1 MosEnergo. Contract work for ZAO “SibKOTES”, Institute of Thermophysics, Novosibirsk. 1998 (in Russian).
2. Alekseenko S.V., Markovich D.M., Shtork S.I. et al. Development of algorithm and calculation program for three dimensional modelling of combustor chamber aerodynamics. Contract work for SibVTI, Registartion N 0189.0053394, KGU, Krasnoyarsk, 1990 (in Russian).
3. Alekseenko S.V., Markovich D.M., Shtork S.I. et al. Development of mathematical model for complex simulation of combustor process at burning of Kansk-Achinsk coals. Contract work for SibVTI, Registartion N 81094952, KGU, Krasnoyarsk, 1985 (in Russian).
4. Alekseenko S.V., Markovich D.M., Shtork S.I. et al. Theoretical and experimental modelling of aerodynamics and heat and mass transfer in combustor chambers. Contract work for SibVTI, Registartion N 0186.0046026, KGU, Krasnoyarsk, 1984 (in Russian).

CURRICULUM VITAE

VAYALAKKARA SIVADAS

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Kerala, **India**

***Date of Birth**:* 28.07.1963

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Academic Degrees

Doctor of Philosophy (Ph.D.) in Engineering**, Department of Civil Engineering, Indian Institute of Technology-Bombay, India – January 1995. Thesis entitled *"Experimental Investigation on Incompressible Non-circular Turbulent Jets in Uniform Cross-flow using Laser Techniques"***

Master of Science (M.Sc.) in Oceanography, School of Marine Sciences, Cochin University of Science and Technology, India – January 1986. Passed with First-Class and secured Second Rank

Bachelor of Science (B.Sc.) in Mathematics, University of Calicut, India – 1983. Passed with Distinction

Scholarships and Achievements

Portuguese Science and Technology Foundation (FCT) Fellowship, 2000

German Academic Exchange Service (DAAD) Fellowship, 1991

Council of Scientific and Industrial Research (CSIR) Fellowship, 1987

Biographical profile appeared in the 17 th (Millennium) and 18 th Editions of ***Marquis Who's Who in the World***

Main Research Area

Experimental Fluid Mechanics related to Sprays and Turbulent Jets

Other Research Area of Interest

Image-processing relevant to Environmental Fluid Dynamics

Research Experience

From January-2000 onwards working in the area of sprays especially on liquid film disintegration studies at the Thermodynamics Laboratory, IST-Lisbon. The studies are part of the Low-NO_x project of the European Union.

From 1995 to 1997 worked as research associate at the National Aerospace Laboratories-Bangalore on applications of image processing techniques relevant to aerodynamics.

From 1987 to 1995, as a CSIR-Fellow at IIT-Bombay and DAAD-Fellow at German Aerospace Research Establishment-Gottingen, carried-out doctoral studies in Transverse Turbulent Jets utilizing optical diagnostic techniques.

Publications

1. V. Sivadas, B.S. Pani, K.A. Butefisch, G.E.A. Meier, Flow Visualization Studies on Growth of Area of Deflected Jets, Experiments in Fluids 23, pp.105-112, Springer-Verlag 1997

2. V. Sivadas, B.S. Pani, K.A. Butefisch, Laser Diagnostics of Transverse Turbulent Jets, Accepted for publication in the Journal of Flow Visualization and Image Processing, Begell House Inc., New York 2000

3. V. Sivadas, B.S. Pani, K.A. Butefisch, Non- Circular Turbulent Jets in a Cross-Flow, Proceedings of Seventh International Symposium on Applications of Laser Techniques to Fluidmechanics, Vol. I, pp.7.3.1-7.3.6, Lisbon 1994

4. E.C. Fernandes, M.V. Heitor, V. Sivadas, Towards Controlled Liquid Atomization, Proceedings of Tenth International Symposium on Applications of Laser Techniques to Fluidmechanics, Paper 31.7, Lisbon 2000

II. Technical Annex

a) Mission

- *Laboratory of Thermofluids, Combustion and Environmental Systems*
- *Laboratory of Technology Policy and Management of Technology*

b) Research Team Experience

c) Research Topics and Sample Results

- *Laboratory of Thermofluids, Combustion and Environmental Systems*
- *Laboratory of Technology Policy and Management of Technology*

d) Other Activities: Transfer and Diffusion of Knowledge

- Advanced Training
- International Conference Series
- Workshops
- Main Editorial Activities

e) Recent Publications

- *Laboratory of Thermofluids, Combustion and Environmental Systems*
- *Laboratory of Technology Policy and Management of Technology*

a) Mission

The activities of the Centre are multidisciplinary, linking basic and applied research to technology development, and focused on the issues of sustainability, namely in terms of the needs to secure the quality of the environment, together with the management of energy resources and the economic development. To achieve these objectives, the activities of the Centre are directed towards leading-edge developments and to promote the learning ability of graduate engineering students with the following specific goals:

- To improve knowledge in advanced fields of strategic technologies with emphasis on **turbulent mixing and combustion processes**, which have the potential to optimise the environment and the rational use of energy in industry;

- To develop and use **advanced techniques** for the analysis, monitoring and control of processes at laboratory and industrial scale, the later including **technology and risk assessment**.

- To promote the exchange of knowledge in advanced technologies for the **optimisation of industrial processes**, including the **management of technology and innovation,** as a way to promote competitive advantages at the corporate level;

- To derive **science and technology policies** and **innovation strategies**, namely in terms of environmental protection, rational use of energy and economic growth.

In this context, besides the development of basic research in energy and environmental-related processes, the Centre thus undertakes interdisciplinary research involving technology and policy, promoting ways in which industrial development can proceed in a sustainable and socially responsible manner.

In order to achieve these objectives, the Centre is organized in two main laboratories, as follows:

- **LABORATORY OF THERMOFLUIDS, COMBUSTION AND ENVIRONMENTAL SYSTEMS**

- **LABORATORY OF TECHNOLOGY POLICY AND MANAGEMENT OF TECHNOLOGY**

The following paragraphs summarize the mission and the research areas in each of the laboratories above.

LABORATORY OF THERMOFLUIDS, COMBUSTION AND ENVIRONMENTAL SYSTEMS

Mission:

- To improve knowledge in advanced fields of strategic technologies with emphasis on **turbulent mixing and combustion processes**, which have the potential to optimise the environment and the rational use of energy in industry;

- To develop and use **advanced techniques** for the analysis, monitoring and control of processes at laboratory and real scales.

- To promote the exchange of knowledge in advanced technologies for the **optimisation of industrial processes and environmental systems**

Main Research Areas:

The Laboratory is organised on the basis of Research Areas, which include a range of projects. These projects provide the necessary external funding, namely from national and international funding agencies and/or private companies. The following is a list of the main Research Areas, under which the most important activities under development are presented.

- **Turbulent Mixing: application to two-phase flows**
  - Liquid disintegration and spray development for engine flows
  - Turbulent Dispersion in Two-Phase Flows

- **Turbulent combustion**
  - Advanced diagnostics for mixing studies and combustion analysis
  - Improved understanding towards Lean Combustion – application to gas turbine combustors
  - Shear-layer control and vortex-flame interaction
  - Non-premixed flame propagation in single and interacting combustion systems

- **Industrial burning equipment and energy systems**
  - "Low-emissions" combustion strategies: design, monitoring and control of burning systems
  - Tomography and advanced sensors for industrial combustion systems
  - For the Glass Industry: The NOVOVIDRO project

- **Fire propagation and risk assessment**
  - Fire Propagation: physical modeling of forest fire and compartment fire
  - Technological Risk Analysis and Support to the National Service for Civil Protection

- **Environmental physics**
  - Momentum, Mass and Heat transfer in the atmospheric boundary layer over and within plant canopies.
  - Carbon Balance of Eucalyptus Plantations in Portugal – towards the Kyoto Forest
  - The optimisation of climate conditions inside greenhouses for crop production

LABORATORY OF TECHNOLOGY POLICY AND MANAGEMENT OF TECHNOLOGY

Mission:

- **To develop and use** advanced research methodologies **for the analysis of techno-economic systems.**

- To promote the exchange of knowledge in advanced technologies and the **management of technology and innovation** for the **optimisation of industrial processes,** as a way to promote competitive advantages at the corporate level;

- To derive **science and technology policies** and **innovation strategies**, namely in terms of environmental protection, rational use of energy and economic growth

Main Research Areas:

The Laboratory is organised on the basis of Research Areas, which include a range of projects. These projects provide the necessary external funding, namely from national and international funding agencies and/or private companies. The following is a list of the main Research Areas, under which the most important activities under development are presented.

- **Systems for Knowledge Creation, Diffusion and Usage**
  - Higher Education Policy and Management: main research results
  - S&T and Innovation: Competences and Performance

- **Learning Economy: Institutions, Technological Change and Employment**.
  - Towards a "Learning Society": avenues for S&T policy research
  - Technological Change and the challenges for Regional Development
  - Technology and Economic Inequality

- **Environment, Energy and Industrial systems: Management and Policies for Industrial Ecology**
  - Fostering Life-cycle analysis for industrial ecology: the automobile industry
  - Environmental Policies
  - Energy Resources and the Competitiveness of the hand-made glass sector

- **Management of Technology and Innovation: Technology Commercialisation**
  - Collaborative learning and virtual teaming
  - Fostering entrepreneurship at the University

b) Research Team Experience

The R&D activities included in the present research programme have derived from those developed within the scope of the Combustion Laboratory of the Mechanical Engineering Department of I.S.T. for a number of years, which have been extended with the aim to integrate competencies at the level of technology policy and advanced socio-economic research methods. This is because the successful development and subsequent exploitation of energy and environment technologies requires, apart from improved knowledge of basic thermo-fluid mechanics, the understanding of policy issues and innovation strategies, in a context which promotes the sustainable development. The ultimate goal is to improve the process of industrial assimilation of knowledge, through a stepwise and interactive approach considering the overall values chain associated with industrial and corporate processes.

This is considered in the context of this research group with emphasis on the improved knowledge of turbulent and combusting processes that allow the rational use of energy and minimises environmental impacts. In addition, the activities developed in the last years have been planned on the basis that the most important challenges in maximising the impact of Science and Technology, S&T, on the well-being of nations, is to understand and maximising the complex processes that underlie world-class S&T research, commercialisation and management, including the protection of intellectual property and the integration of knowledge in a context of enhanced economic wealth and shared prosperity.

The concepts presented above are the result of a strong involvement of this group in a considerably large number of European R&D projects since 1986. These projects have been developed in the scope of national projects and the BRITE/EURAM, Science, STEP, Environment, Joule and Esprit Programmes of the European Commission, as well as an increasing involvement with Portuguese and European industry. Apart from the national sectors of glass and crystal, R&D links have been established for a number of years with major European aeronautical companies (Rolls Royce, SNECMA, TURBOMECA, MTU, Rolls-Royce- BMW) and process industries (Saint Gobain). Briefly, the work evolve from basic research on turbulent fluid mechanics and combustion, namely through several master and doctorates programmes. Moreover, the research work has gained considerably from the successive organisation of the Intl. Symposia on Applications of Laser Techniques to Fluid Mechanics, which have been held in Lisbon since 1982. The symposia have contributed significantly to promote a series of international contacts and research activities in international cooperation.

More recently, the development of competencies in the area of science, technology and innovation policy has been successfully achieved following three main lines of development, namely: i) advanced training of young researchers in leading American universities, through PhD. Programmes in leading and emergent topics; ii) launching of the M.Sc. programme at IST on “Engineering Policy and Management of Technology” at 1998, which has allowed to train young people in new areas of education at IST and promote new links with Portuguese companies; and iii) the organization of the Intl. Conferences on Technology Policy and Innovation, which were launched in Macau in July 1997 and carried out in Lisbon, in August 1998 and in Austin, Texas, in September 1999 and will be followed by similar conferences in Curitiba, Brazil, in the summer of 2000 and in Delft, The Netherlands, in 2001.

c) Research Topics and Sample Results

c1) Laboratory of Thermofluids, Combustion and Environmental Systems

Main topics studied during the reporting period in the areas of ***Thermofluids, Combustion and Environmental Systems*** are as follows:

TOPIC: Advanced diagnostics for mixing studies and combustion analysis

Linear imaging of laser Rayleigh scattering was developed and used to acquire instantaneous information about the scalar field that enables the quantification of scalar dissipation. As a result, scalar dissipation distribution can be associated to the evolution of the Reynolds stresses along turbulent flows and related to the location of large-scale structures, which are identified with the locus of maximum vorticity.

The techniques were applied to the analysis of an axisymmetric coaxial jet of CO_2 (Re_i=15000) and air (Re_o=50000). The results characterise the turbulent structure of a coaxial jet flow, including the effect of large-scale motions on turbulent mixing. Single-point measurements were complemented with new information on the scalar dissipation rate, and the use of PIV has allowed for the identification of large-scale structures and the quantification of the vorticity field. The evidence is that the positive local peaks in the distribution of shear stress for r/d≈1 correspond to an annular vortex structure. This annular vortex structure dominates turbulent mixing and is related with positive vorticity (counter-clockwise). In addition, the results have established the presence of large-scale structures that occur in the inner mixing layer of the jet studied due to shear instability in the wake of the inner pipe wall. These structures are seen to grown linearly in the plane of the measurements as they convect for downstream locations. During their growth, the corresponding intensity vorticity level decreases, as predicted by transport and diffusion vorticity theorems.

Sample publications:

- Ferrão, P., M. V. Heitor, M.F. Matos, R. K. Salles (2000) "Turbulent Scalar Mixing in Coaxial Jet Flows". Turbulence and Shear Flow Phenomena. September 12-15, Santa Barbara, California. Publicado em: Turbulence and Shear Flow-1, pp. 785-790, eds. Sanjoy Banerjee and John K. Eaton, Begell House.

TOPIC: Improved understanding towards Lean Combustion – application to gas turbine combustors

http://in3.dem.ist.utl.pt/laboratories/comb.html#2

Flame-turbulence interactions have been studied making use of advanced optical and probe diagnostics (Ferrão & Heitor, 1998) and extended to the analysis of practical flows, making use of:

- Mechanisms of shear-layer control and vortex-flame interaction (Fernandes & Heitor, 2000);
- Liquid-sheet desintegration for air-blast atomizers (Fernandes, Heitor & Sivadas, 2000);
- Analysis of NOx formation rates (Caldeira-Pires & Heitor, 2000);
- Development of tomographic sensors for industrial systems(Caldeira-Pires, Duarte & Ferrão, 2000);

The details of the various research topics are analysed in the following paragraphs. Application to gas turbine combustion has being achieved through detailed experiments in a laboratory model of a lean-premixed prevaporized combustor operated at atmospheric pressure. The experimental results show low NO_x emissions and high fuel efficiencies for lean conditions subjected to high turbulence swirl flows in the combustor.

The effect of the residence time is not relatively important in lean-flames for temperatures below 1400ºC, which can be used to optimise the fuel efficiency of the combustor. A good control of the equivalence ratio of the mixture and of the air preheating is necessary to assure lean stability close to the flammability limit, as well the use of high turbulence swirl flows. For lean-flames close to the flammability limit (temperatures below 1300ºC), the contribution of "thermal" and "prompt" NO formation to the total NO_x formed was found to be relatively small. The N_2O pathway can be the dominant route to NO formation under these conditions. Sample results have been submitted for publication by Paulo Anacleto and Manuel Heitor (2000), *"A laser doppler analysis of the impact of flow boundary conditions on the performance of a model lean-premix combustor"*.

TOPIC: Shear-layer control and vortex-flame interaction

The experimental analysis of vortex-flame interactions and naturally-pulsed premixed turbulent flames have been studied making use of optical and probe diagnostics and including the time-resolved correlation of velocity, temperature, pressure and light emission signals.

Results obtained in a flame stabilised in a wake of bluff-body located on a velocity acoustic antinode show that the instantaneous flame structure, based on the analysis of electronically-excited decay of C2 radicals, is composed by two, inner and outer, main regions. The inner flame, behaves as a typical bluff-body stabilised flame, although the influence of a strong unsteady flowfield results in appreciable spatial and temporal deformations. The inner flame acts as a periodic ignitor source of the second reactive structure present, which is considered here as an outer flame. This outer flame front emerges radially at an axial location of about 0.6R, followed by a vertical movement towards the rear stagnation point. This process is accompanied by large fluctuations in the axial and radial velocity components of the flow, with the two flame regions separated by the zone of maximum axial velocity. The time-resolved analysis show that both ensemble average flame fronts occupy successively regions where temperature exhibit high radial gradients, and large temperature fluctuations. In general the results quantify the time resolved process of turbulent mixing along a full pressure cycle in a pulsed flame and suggest that the cycle-resolved nature of the momentum flux may be represented, at least qualitatively, by gradient hypothesis. On the other hand, the nature of the cycle-resolved (i.e. phase averaging) turbulent heat flux shows zones of either gradient and non-gradient characteristics, which appears to be influenced by the temporal evolution of the streamline curvature along a cycle of flame oscillations.

TOPIC: Liquid disintegration and spray development for engine flows

The disintegration process of a flat liquid film has been studied by means of different visualisation techniques and optical diagnostics. the aim is to provide a controlled shear flow in the presence of which the liquid film is disintegrated in a way that allows to study the basic phenomena typical of airblast atomisation for different strain levels.

The manner in which the liquid film disintegrates into drops depends upon the operating conditions. However, the principal cause of instability is due to the interaction of the film with the surrounding atmosphere whereby rapidly growing waves are imposed on the liquid surface. Disintegration occurs when the wave amplitude reaches a critical value and fragments of sheet are torn off. The fragments rapidly contract into unstable ligaments under the action of surface tension and drops are produced as the latter subsequently break down. The process seems to be strongly dependent on the "energy" associated to the air flows. The results show that the deterioration of the liquid film is associated with a periodic process mainly dependent on the air velocity, and demonstrate that the gas-to-liquid momentum ratio is the key parameter in the atomization process. Unstable periodic phenomena were seen to be present for all flow conditions within a certain range of liquid velocity. For high liquid velocities there are two main zones of dense spray region: the "intact inner layers" of the liquid film itself, and the dispersed flow region at the surface of the "liquid film".

Sample publications:

- Heitor, M.V., and Sivadas, S. (2000). "Liquid Film Break-up in a Model of a Prefilming Airblast Nozzle". Atomisation and Sprays, submitted.
- Carvalho, I.S. ,Heitor, M.V. and Santos, D. (2000). "Liquid Film Desintegration", Atomization and Sprays, submitted.

TOPIC: Non-premixed flame propagation in single and interacting combustion systems

Turbulent jet propane flames have been analysed aiming at further understanding of turbulent structure in non-premixed slow-chemistry combustion systems.

The results quantify that velocity-temperature correlation tends to exhibit zones of non-gradient turbulent heat transfer. Conditional sampling and averaging is employed to investigate the statistical characteristics of turbulent transport processes of the scalar. In addition, the conditional analysis reported herein demonstrates that counter-gradient contribution remains strong even in those regions of the flow where velocity-temperature correlations are in the gradient sense. A further analysis shows that this result can be extended to characterise mixture fraction flux within the region analysed and highlights the necessity that prediction of such quantities must be based on a second moment model closure rather than on an effective viscosity.

The analysis has been extended o the study of multiple flames at different degrees of interaction, making use of arrangements of 3 and 5 non-premixed flames.

Sample publications:

- Caldeira-Pires, A. and Heitor, M.V. (2000). "Temperature and Related Statistics Measurements in Turbulent Jet Flames". *Experiments in Fluids*, **24** (4), pp. 118-129.
- Caldeira-Pires, A. and Heitor, M.V. (2000). "Experimental Characterization of non-premixed turbulent jet propane flames". *Experimental Thermal and Fluid Science*, **23**, pp. 115-132.
- Caldeira-Pires, A. , Heitor, M.V. and Carvalho, J. A. (2000). "Characteristics of Nitric Oxide Formation Rates in Turbulent Nonpremixed Jet Flames". *Combustion and Flame*, **120**, pp. 383-391.
- Caldeira-Pires, A. and Heitor, M.V. (2000). "Characteristics of Turbulent Heat Transport in Nonpremixed Jet Flames". *Combustion and Flame*, accepted for publication.

TOPIC: "Low-emissions" combustion strategies: design, monitoring and control of burning systems

The influence of burner-port geometry in the mechanisms of hydrocarbon oxidation and NO_x formation have been analysed in laboratory and semi-industrial flame conditions with the ultimate goal of promoting the use of clean combustion systems in practical environments. To achieve these objectives, the Combustion laboratory includes a semi-industrial furnace and a range of burner facilities for detailed combustion studies.

Laboratory analysis of a 50kW industrial-type methane-fired burner was investigated experimentally. Imaging and tomographic reconstruction techniques were used to assess the effects of port geometry on visible flame length and C_2 chemiluminescence distribution in the recirculation zone. Unconfined conditions have been characterised for methane and propane flames. C_2 emission analysis of propane flames suggests that there is a compromise between the penetration velocity of the fuel jet into the recirculation zone at the burner-port surface and the hydrocarbon concentration within this zone. In the case of methane flames, low fuel jet velocities allow very rich conditions in the recirculation zone and lead to methane oxidation through a pyrolysis mechanism. Higher velocities mean that methane oxidises via a path including dissociation into free radicals, though a further increase in jet velocity tends to push the flame to extinction. In-furnace measurements were performed from a refractory-lined vertical furnace for an excess air level of 10%. Results for mean temperature and mean concentration of major chemical species are presented for methane flames produced from a two-benchmark configuration. NO_x concentration results revealed that NO formation is closely connected with the dissociation process, suggesting that the prompt-NO_x mechanism is more important than hitherto supposed.

Sample publications:

- A.Caldeira-Pires, D.P. Correia, P. Lacava, P. Maia and M.V. Heitor (2000), "Influence of Burner-port Geometry on Hydrocarbon Oxidation and NO_x Formation Mechanisms in Methane/Air Flames", submitted to *Combustion and Flame*.

TOPIC: Tomography and advanced sensors for industrial combustion systems

A new tomography sensor for combustion systems has been developed and applied to non-premixed flames in laboratory, semi-industrial and industrial furnaces.

The major innovative feature of the new sensor consists on its ability to overcome the limitations of emission tomography techniques for sooty flames, as it enables the compensation of radiation extinction effects inside the flame. The emission data is combined with a soot radiation extinction model for the evaluation of local properties, thus avoiding the need for a background calibrated radiation source, as no transmission measurements are required. The combination of tomographic reconstruction with pyrometry techniques, for an axissymmetric-unconfined flame, provided high accuracy temperature measurements. These measurements were compared with fine-wire thermocouple data, thus confirming the adequacy of the current approach.

The new sensor was evaluated on a laboratory furnace at IST, and then in the IFRF semi-industrial furnace (in Ijmuiden, The Netherlands) and in an industrial glass furnace in Germany. The analysis made use of the colour-pyrometry technique to assess the 3D-temperature field of soot particles generated inside the flame. These results have confirmed the adequacy of the technique developed and the importance of considering flame absorption and wall radiation effects in emission tomography applications.

Sample publications:

- D.P. Correia, P. Ferrão, and A.Caldeira-Pires (2000) "Flame 3d tomography sensor for in-furnace diagnostics". 28th International Symposium on Combustion. July, 30th to August, 4th; University of Edinburgh, Scotland.

TOPIC: Fire Propagation: physical modeling of forest fire and compartment fire

The physical modeling of forest fire behaviour has been carried out based on two-dimensional models of fire spread across a bed including wind combined with slope conditions. In addition, the characterization of forest fire propagation in a pine needles fuel bed was also performed in the context of a Master's degree dissertation.

The forest fuel bed is a typical porous medium whose characteristics (shape and size of the particles, bulk density, packing ratio) modify the gas flow behind and ahead of the flame. In this context, current work coordinated by João Ventura and José Miguel Mendes Lopes includes the study of the following parameters: *i)* the variation of pressure drop with the main properties of the medium (fuel type, bulk density, packing ratio), and *ii)* heat transfer within the fuel bed, leading to the determination of the convection coefficient and its dependence on the main properties of the medium.

A computer code to simulate surface forest fire behaviour in heterogeneous terrain is being developed and optimised to run in a simple PC platform, but in a way which is compatible with GIS (ARCVIEW). It computes the burned area shape and evolution, as well as local results on rate of spread, flame length, fire line intensity, reaction intensity, and local times of beginning and end of propagation. It is based on FIRE1 from BEHAVE, and uses cellular automata to extend the use of FIRE1 to heterogeneous terrain and heterogeneous meteorological conditions.

Compartment fires have also been analysed, namely in terms of propagation and smoke venting.

Main publications include:

- Morandini F, Balbi J-H, Santoni P-A, Ventura J, and Mendes-Lopes J M : "Two-dimensional model of fire spread across a bed including wind combined with slope conditions", submitted to Int. J. of Wildland Fire

- Mendes-Lopes J, and Água C : "SPREAD – um programa de autómatos celulares para a propagação de fogos florestais", Silva Lusitana, Vol. 8, N. 1, pp. 33-47, 2000

TOPIC: Technological Risk Analysis and Support to the National Service for Civil Protection

Geographical Information Systems have been adapted and used to characterize natural risks in Portugal, with particular reference to the south and the zone of Alentejo. A plan of work in close collaboration with the National Service for Civil Protection is being coordinated by *João Ventura* in the following areas:

- Continuing training of the staff of the *National Service for Civil Protection* on technology-based hazards;

- To support specific studies and emergency plans;

- Consulting on specific aspects related with technology-based azards.

In addition, risk assessment of "Transportation of Dangerous Substances in Portugal" has been initiated aimed to characterize the flow of dangerous substances in the Portuguese territory and to gather information to assist emergency management of accidents, which may occur in this kind of transportation.

TOPIC: Carbon Balance of Eucalyptus Plantations in Portugal – towards the Kyoto Forest

"The assumption that increasing CO2 concentration in the atmosphere may result in global warming led to theKyoto Protocol (UNFCCC) that if signed will establish a legally binding commitment to reduce greenhouse gas emissions. In its article 3, the Protocol considers that biological sources and sinks (namely forests) can be used by the industrialised countries to meet the commitment to reduce greenhouse gas emissions by 5% below the 1990 levels, within the commitment period of 2008-2012. In spite of a controversy about the characterisation and the definition of the activities of afforestation, reforestation and deforestation_, it is obvious that most Eucalyptus globulus plantations in Portugal may belong to the so-called _Kyoto forests_, i.e. afforestation or reforestation since 1990.

Managed forests accumulate carbon both in biomass and in soil organic matter, at least during the tree growing phase until harvest or disturbance occurs. Plantations may accumulate carbon at a very high rate, especially when composed of fast-growing tree species installed on previously agricultural land with low carbon content. This is often the case of eucalypt plantations in Portugal, where they cover more than half a million hectares. The short rotation of harvesting and the use of the above ground biomass for pulp and paper, however, tend to reduce the impact of these ecosystems in longer-term carbon sequestration. In that case, soils may be a major storage compartment, if properly managed.

The work performed in this area under the coordination of Gabriel Pita was aimed to:

- Quantifying the net ecosystem carbon exchange through the continuous measurement of surface flux of carbon dioxide using the eddy covariance method,

- The quatification of carbon stocks by the inventory of biomass components and changes in soil carbon storage along a chronosequence of eucalypt plantations in Herdade da Espirra.

- To extrapolate the results found for carbon sequestration in the main site, across a range of soil and climate conditions in Portugal.

TOPIC: Momentum, Mass and Heat transfer in the atmospheric boundary layer over and within plant canopies.

In order to understand the mechanisms by which environmental factors and agronomic treatments interact to influence water use, photosynthesis, and water use efficiency, it is necessary to measure exchanges of energy and mass over a crop surface. The study and characterisation of turbulent fluxes is necessary to understand the transfer mechanism between the atmospheric boundary layer and different soil surfaces. This work is being coordinated by Gabriel Pita and is aimed to study the development of theoretical-experimental knowledge from the spatial and temporal variability of turbulence and their implications on the evaluation of the vertical heat and mass fluxes above canopies.
The methodology to be used is of interdisciplinary nature, involving the scientific areas of fluid mechanics, instrumentation, physical ecology and agricultural sciences. The data related to the turbulent fields above canopies with variable roughness are suitable of adaptation to other surfaces, related with the problems already mentioned.The main objectives are:
i) Evaluation of the vertical mass and heat fluxes in the boundary layer, between the canopy and the atmosphere
ii) Experimental characterisation of the spatial and temporal structure of turbulence.

In the first group of objectives it is necessary to proceed in surfaces representing different degrees of roughness, to a characterisation of the turbulent velocity field, as well to the detection of possible coherent structures, associated with the different types of canopies and to evaluate their importance in the transfer processes.

The measurement of the energy budget components: natural and forced convection, leaf transpiration and total evapotranspiration, soil heat conduction and radiative budget from the surface layer under study is a process of experimental optimisation of the eddy correlation and energetic methods whether in the selection of the parameters to search for a rapid characterisation of the ecosystems, whether in terms of optimisation of the sensors application methodologies and their respective sampling rates.

TOPIC: The optimization of climate conditions inside greenhouses for crop production

The optimisation of climate conditions inside greenhouses for crop production, in terms of the radiation, temperature, mass (water vapour and CO2) and flow fields, led to the development of new methods of climate control as well as to the development of new cladding and screening materials. The potential benefits deriving from the use of screens in protected horticulture have been increasingly recognised in recent years. Therefore the use of both thermal and screening materials have been widely used (mainly in the Northern Europe) since they can both contribute to:

- Improvement of the quality of the products since they contribute to homogeneous radiative and temperature fields;

- Reduction of the energy consumption, both for heating and cooling purposes, decreasing the production prices; thermal screens is an effective mean of reducing night time heat loss and shading screens control the input of solar radiation.
    - Reduction of the chemical pesticides in the control of insect borne diseases.

In Portugal, the use of these materials is starting to be commonly used but no scientific strategy and control methodology adapted and suitable for our climatic conditions have been established yet. A new approach of the optimazation of the use of both thermal and shading screens is needed for our particular climatic conditions, in order to increase the crop production and quality without increasing the energy consumption. The winter conditions in Portugal, though normally mild when compared with the conditions in the northern European countries, have quite often situations of frost formation " geada negra" that can destroy the entire crop, if no heating is provided; on the other hand the overheating observed during a long period of the year inside greenhouses, due to the excess of solar irradiation, is a serious limiting factor for the use of greenhouses during a significant time period of the year, making the greenhouse use still expensive and very inefficient.

Therefore an optimisation of the use of screens (thermal and shading) in greenhouses is urgently needed and the following scientific and technical objectives are being developed under the coordination of Gabriel Pita:

a. Establishment of control algorithms to optimise the use of screens inside greenhouses in conditioning the microclimate ;
b. Establishment of the optimum strategies of using the screens both in winter and summer periods;

To reach the foregoing objectives, the following specific aims have to be achieved:

I) The energy budget of the greenhouse will be evaluated, with and without screen, and the effect of the screen in the total greenhouse energy balance will be quantified.

II) Modelling the dynamical behaviour of the greenhouse climate with screens and its effect on the physiological behaviour and development of the crop.

C2) Laboratory of Technology Policy and Management of Technology

Main topics studied during the reporting period in the areas of ***Technology Policy and Management of Technology*** are as follows:

TOPIC: Higher Education Policy and Management: main research results

http://in3.dem.ist.utl.pt/laboratories/policy.html#1

1. Building a conceptual framework for the Research University through institutional integrity and organizational diversity: Reforming European Univerities
    - Conceição, P., and Heitor, M.V. (2000), in :"The Globalising Learning Economy: Major Socio-Economic trends and European innovation Policy". Oxford University Press
    - Conceição, P., and Heitor, M.V. (2000), in: "Knowledge for Inclusive Development", QUORUM BOOKS

2. Policies and strategies for Portugal: Protecting the intellectual property - fostering institutional integrity

- Caraça, J., Conceição, P., and Heitor, M.V. (2000), Higher Education Policy, June 2000.
- Conceição, P., Heitor, M.V. and Oliveira, P.(1999), In "Technology Transfer: from invention to innovation", Kluwer Publ.

3. Towards Sustainable Universities - environmemtal education in place!:

- Ehrenfeld, J. R., Conceição, P., Heitor, M.V. and Vieira, P. (2000).

TOPIC: **S&T and Innovation: Competences and Performance**

http://in3.dem.ist.utl.pt/laboratories/policy.html#6

1. Main evaluation exercises carried out with the colaboration of IN+ researchers:

- Evaluation of Portuguese Research Units in 1999-2000, as conducted by the Portuguese Science and Technology Foundation:
  Final report coordinated by Manuel Heitor available at http://www.fct.mct.pt/unidades/relatorio/

- Community Innovation Survey applied to Portugal in 1999, as conducted by the Portuguese Observatory of Science and Technology:
  Final report coordinated by Pedro Conceicão available at
  http://www.oct.mct.pt/pt/actividades/inquerito/index.htm
  See book published by CELTA publishers, Lisboa (in portuguese)

2. Analysis and main publications:

- Engineering and technology for Innovation in Portugal: a study on the dynamics of technological change - A prospective study 2000-2020, by Pedro Conceicão and Manuel Heitor

In view of the current economic context, in which innovation is a key driving force for the sustainable development, what are the challenges faced by Engineering and Technology in Portugal to enhance and nurture innovation? This broad question has motivated this work, within the national effort considered under the project "ET2000, Engineering and Technology 2000 – a prospective study for 2000-2020".

The understanding of *innovation* adopted in our work encompasses **the way in which firms and entrepreneurs create value by exploiting change**. Change can be associated with technological advances, but also with modifications of the regulatory framework of an industry, shifts in consumers tastes, changes in the demographic makeover, or even major alterations of global geopolitics. To choose such an ambitious definition of innovation presents important challenges. First, it calls for an analysis of many economic, social and political issues. Our effort cannot attempt to deal with these issues comprehensively. We will rather attempt, throughout the full report but especially in this summary, to discuss important trends that are likely to influence the environment in which Portuguese firms conduct their business, and, consequently, determine the conditions and opportunities for innovation. The choice of such an ambitious definition of innovation limits equally the extent to which clear-cut solutions and recommendations to enhance the innovative performance of Portugal can be provided. Our hope is that by raising and discussing some selected questions and concerns we contribute to a better awareness of possible weaknesses and potential strengths of the Portuguese system of innovation.

The work includes four main parts, as follows. *First* we look at the international **context and dynamics**, and this is found to be particularly important due to the relative small dimension of Portugal, which limits any foresight study if the external environment is not clearly understood. In addition, we define a **conceptual background** for the work based on recent research and current understanding of innovation for Portugal, and building on the systemic view of the emerging role of *systems of innovation and competence building* for the development of our society. The discussion frames the issue of the need to promote "***inclusive development***", that is, of the need for a process of

development that includes every citizen in any region, as a problem that goes beyond the creation of conditions to generate knowledge. The most important problem concerns the *sharing and diffusion of knowledge*, and efforts should be channeled towards the understanding of the conditions for globally integrated learning processes. ***Learning***, in this context, reflects the idea of sustained knowledge creation and diffusion, and we contend that the challenge is to make this a feature of the entire global economy. In this context, we established that national or regional learning depends on the existence of ***social capital***, which is defined by *networks* and by *institutions*. Institutions govern the interactions among the nodes of the networks, be the nodes composed of people or of organizations (firms, universities, and local government, for example).

Second, we characterize the **knowledge base** in Engineering and Technology, through a detailed analysis of the demand and supply of human capital, investments in critical infrastructures, and knowledge levels in Engineering and Technology. **Dynamic factors** in knowledge utilization and diffusion are also characterized trough analyzing the evolution of the structure of the economy, foreign direct investment, the development of new technology based firms, NTBF´s, and the management of knowledge at the corporate level. The second part of the report concludes with the analysis of **regional asymmetries and dynamics**, and with the characterization of **social cohesion**, measured in terms of wage differentials among industrial sectors and the services.

Third, we select a set of challenges and **exogenous factors** that we feel are important opportunities to promote innovation for Portugal. This includes the emergence of the information society and the life sciences, but also the liberalization of the energy and transport sectors, the increasing importance of merges and acquisitions, the new context of some traditional sectors (e.g. hand-made glass), and the need to guarantee the sustainable development, namely in terms of the new opportunities brought by the requirements of integrating environmental factors with socio-economic values.

Fourth, and last, we discuss **strategies and change for innovation**, concluding with a set of **recommendations**. The analysis encompass the discussion of reference terms and scenarios for innovation in Portugal, and include clear strategies at four main levels, namely: i) towards a new **institutional framework**, mainly in terms of organizational restructuring, networking and employment protection and market regulation; ii) balancing institutional integrity and organizational diversity in the **higher education system**; iii) **knowledge strategies** at the corporate level; and iv) perspectives for alternatives forms of **financing innovation**. The recommendations are listed in terms of a *proposal for innovation plans for Portugal*.

The main results of our work are briefly presented in this summary report in three parts, as follows: i) The context, briefing Part 1 of our full report; ii) facts, findings and assumptions, summarizing Parts 2 and 3 described above; and iii) strategies and recommendations, as a summary of Part 4 of the full report.

- "Mapping S&T competences in Europe: building on the Portuguese experience of evaluating S&T excellence", by Pedro Conceição and Manuel Heitor

As the importance of knowledge creation and diffusion is increasingly recognized as a major driver of economic growth, this paper raises questions on how to establish the conditions to identify S&T excellence and to make better use of that excellence within the emergence of a *European Research Area.* Our research is focused on the Portuguese experience in evaluating research excellence, which is discussed in terms of the need to increase the impact of European research efforts by strengthening the coherence of research activities and policies conducted in Europe. We argue that although traditional S&T indicators, as well as innovation statistics, show Portugal towards a weak performance, with relatively weak input indicators, but also being the least innovative European country in manufacturing, there is evidence of poles of research excellence, as demonstrated by international peer review with international criteria. These poles are critical nodes of networks of excellence if a true European Research Area is to be built with a European dimension, in a way to

favour inclusive development. This is a critical requirement for a process of shared prosperity across Europe following local specific conditions, which requires understanding both the features of knowledge-induced growth in rich zones, as well as the challenges and opportunities for late-industrialized and less favoured zones. The related implications for mapping research excellence in Europe are the need to consider decentralized capacities (at national and/or regional levels), together with international criteria, to identify poles of research competences, and to built networks of excellence, as **enablers of new competences and excellence** in the coming decades.

TOPIC: **Towards a "Learning Society": avenues for S&T policy research**

http://in3.dem.ist.utl.pt/laboratories/policy.html#2

We have attempted to systematically develop research projects intended to contribute to an improved understanding of innovation patterns, with the specific aim of contributing to the analysis of different challenges for public policy research in the context of the emerging importance of knowledge for development, including:

1) balancing innovation and diffusion;
2) beyond the excludability of software;
3) deepen the conceptual framework establish through the interactive model of innovation, making use of policy measures;
4) promoting wetware and software interaction; and
5) the need for the inclusive development.

The dynamics of technological innovation, together with competence building and social cohesion, has been considered with attention focused on the ability to build "social capital" towards a learning society. Main results have been published by Conceição et al. (1998, 2001) in *Technological Forecasting & Social Change, Volumes 56 and 66.*

While much attention has been devoted to digital technologies, a more fundamental change at the start of the new millennium is the increasing importance of knowledge for economic prosperity and the emergence of a learning society. The ways new competencies, namely in conventional engineering, economics and management, may positively influence the development of a country and/or region depend on the institutional framework, which is currently particularly determined by regulation policies and the process of market liberalization. Again, this calls for the need to promote education and research in technology policy and related challenges are presented and discussed in a context where innovation should be understood as a broad social and economic activity within the framework of the learning society, as reported by Conceição et al. (2001), Technological Forecasting & Social Change, vol 67(2).

TOPIC: **Technological Change and the challenges for Regional Development:** Building social capital in Less Favored Regions

http://in3.dem.ist.utl.pt/laboratories/policy.html#5

In view of the current socio-economic context, in which innovation is a key driving force for the sustainable development, which challenges are facing technology-based development and cooperation, in a way to contribute for regional policies that stimulate localized learning, innovation and indigenous development within Less Favored Regions, LFR's? This broad question has motivated the present research, which considered the development of case studies in selected Portuguese regions, including the North, Algarve and Lisbon, and included international comparisons. It is argued that value-based networks have the potential to

make both public trajectories for the inclusive development of society, but require effective public investments in intangible structures and the use of new metrics for knowledge. The analysis builds on the concept of social capital, as a relational infrastructure for collective action, in a context much influenced by a dynamic of change and a necessary balance between the creation and diffusion of knowledge.

Sample publications:

- Technological Change and the challenges for Regional Development: building social capital in Less Favored Regions
  by Pedro Conceição, Manuel Heitor and Robert Wilson

- NAG: Norte, Abruzzo and Galicia. A Benchmarking Exercise
  by Alexandra Campino, Jorge Monteiro and Danilo Rubini

- LISBON AND TAGUS VALLEY REGION - An Econometric Analysis
  by Ana Galvão, Ângela Canas, Rita Ferreira and Paulo Ribeiro

- The Algarve: Fate and Will
  by Paulo Silva Pedro Borges de Almeida

TOPIC: **Technology and Economic Inequality**

Technological Innovation, economic development and income inequality have been increasingly discussed and the analysis has suggested the need to develop either advanced research methodologies, or improved empirical analysis, for better understand possible linkages among the various issues, as well as improved policies and strategies. The work has been performed in close collaboration with the UTIP – University of Texas Inequality Project, and focus on the Theil statistics. In fact, the calculation of income inequality from survey data is an exacting business; it requires ranking individuals (or families) into groups of equal size and exact ordering on the income scale. But there is another statistic, originating with the econometrician Henri Theil, that can be computed from almost any type of grouped data, even if incomes within the groups overlap. This is Theil's T statistic, and the realization that it can be computed from industrial data sets is the basis for the work to be considered.

At the empirical level, and using extensively the analytical OECD databases on employment and wages, the work brougth together a rich data set that conveys how the recent rise in inequality in some of the most developed countries is associated to the levels of technology intensity of their industries. The ultimate goal is to discuss the extent to which the higher the technology intensity of industries, the stronger this association is.

TOPIC: **Fostering Life-cycle analysis for industrial ecology: the automobile industry**

http://in3.dem.ist.utl.pt/laboratories/policy.html#3

The design and development of optimised end of life vehicles, ELV, processing systems have been considered, addressing the whole life cycle of car components, in an industrial ecology perspective. Their contribution to promote scale factors associated with increased recycling rates in a small country, as Portugal, has been particularly studied. Life Cycle Activity Analysis, LCAA, has been developed and used for the economic and environmental optimization of critical infrastructures, including the analysis of the Portuguese used tire market.

Sample publications:

- F. Freire, P. Ferrão, C. Reis and S. Thore (2000) “Life Cycle Activity Analysis applied to the Portuguese used tire market”. Total Life Cycle Conference of the SAE, Society of Automotive Engineers-USA. April 26-28, Detroit, Michigan, USA. “Best paper award”.

TOPIC: **Environmental Policies**

http://in3.dem.ist.utl.pt/laboratories/policy.html#4

1. Environmental Policies for Portugal

A prospective study for 2000-2020, coordinated by Paulo Ferrão and performed under the project "Engineerinng and Technology 2000"

2. Environmental Policies for Europe – application to the car industry:

Over the last 30 years, the automobile has become one of the most important consumer products in industrialized society and yet it is discarded within a relatively short time, typically between nine and thirteen years.

In line with recent European Commission initiatives, an IPP-Integrated Product Policy approach is to be considered in the automobile sector. IPP addresses the whole life cycle of a product, and seeks to avoid shifting environmental problems from one phase of the product life cycle to another, in particular, amongst raw materials producers, components manufacturers, OEMs- Original Equipment Manufacturers, car owners, repair shops, dismantlers, materials recyclers and shredders.

It is clear that the results of a Life Cycle Assessment identify the use phase of the life cycle as a major contributor for the environmental impacts over the complete life cycle, for a significant number of environmental impact categories.

Reis I. (1998), performed a life cycle assessment of a VW Sharan, 1.9 l diesel engine vehicle (which travelled 200000 kms during its life) and has evaluated the relative contributions of the production, use and end-of-life processing, namely, recycling/landfill phases, considering the Portuguese infrastructures for ELV processing. The results show that greenhouse effect (global warming), acidification, eutrophication and summer smog, are clearly dominated by the fuel consumption and subsequent emissions, during the use phase of the vehicle.

However, the production phase has a major direct impact in other environmental categories, namely, heavy metals, winter smog and solid emissions, and therefore cannot be underestimated.

The environmental impacts associated with the use phase are essentially dependent on the fuel burnt, on the vehicle use and on the engine performance and car weight. In this study, aimed at analyzing the suppliers within an ecologically aware automotive sector, the engine performance is not crucial and emphasis is given to the material fluxes associated to the life cycle of the automobile, which is increasingly relevant at European level.

In this context, it is clear that the main driving force for ELV processing infrastructure optimization consists on EU legislation, at the present under the form of a proposal for a Directive on end of life vehicles.

In this context, dismantling constitutes a key operation in ELV processing, as after dismantling, the reuse, recycling and recovery of dismantled products is made possible. However, in principle, there are two main strategies to reach these aims and especially to solve the problems caused by the light fraction of the automotive shredder residue (ASR), currently going to landfill:

1. Dismantling ELV's, which allows a genuine identification of the car parts or materials used in the vehicles.
2. Upgrading the technologies available for processing the light and heavy fraction of the automotive shredder residue, by developing separation technologies and finding recycling possibilities for the products gained from the separation.

The next paragraphs present some principles and practices whose adoption, at an EU level, were considered to contribute to improve the environmental performance of the automotive suppliers sector in the European Union:

- An Annual Ownership Tax on vehicles constitutes an essential motivation for the hand over of the vehicle to a certified dismantler.

- The implementation of an annual ownership tax has therefore the following advantages:
- Contributes to improve the reliability of data on circulating vehicles
- Provides an incentive for the hand over of the vehicle to a certified dismantler to get a Certificate of Disposal
- Promotes the renewal of the fleet of vehicles
- May promote the reduction of exhaust gas emissions, if the taxes are associated with the level of pollutants emitted.

The disadvantage of the implementation of such a tax is that it may be unpopular. A compromise could be therefore the implementation of such a tax accompanied by the reduction of the automobile tax. An information campaign should be therefore made to clarify such implementation.

- The strategy for dismantling cars more effectively requires an identification of the plastic parts in the car industry. Plastic parts have to be easily identifiable and thus they can be sorted and recycled directly, and although this identification is current practice for plastic parts above the weight of 100 g, a common coding system is not adopted by the industry, and this results in increased complexity for sorting activities.
- The current text of Art. 8 of the Commission's Proposal for a Directive on End of Life Vehicles (COM97-358 final) requires a Member State to ensure that car manufacturers and their suppliers use common component and material coding standards for those components and materials which are suitable for re-use and recovery. In this proposal the European Commission commits itself at promoting the preparation of appropriate European standards relating to the identification and codification of components and materials (included plastics). However, this standards are missing and their contribution for increasing plastics recycling quotas may be very important.
- One of the main drawbacks in plastics recycling in different member states consists in the scarcity of used plastics to be recycled, and this often compromises the economic feasibility of the plastic recycling industry. The automotive industry may provide a significant contribution to promote this market, by requesting a small percentage of recycled materials to be included in their plastic components, thus promoting the need for recycled plastics and, simultaneously, by providing the availability of the raw materials as obtained during the dismantling processes.

A good example is provided by Daimler Chrisler, as reported on the on-line magazine devoted to the automotive industry, the ai-online.com, where it is claimed that DaimlerChrysler is requiring plastic-parts suppliers to add as much as 30% recycled content to future components. The plan is seen as the auto industry's most stringent and far-reaching recycling standard.

Plastic parts suppliers will have to provide 20% recycled content, by weight, in the year 2000. For 2002 and beyond, the required recycled content climbs to 30%.

- The establishment of targets for minimum recycled content for each material type in new automobiles which do not envisage specific parts, but the vehicle as a whole, are foreseen to contribute significantly to promote recycling activities in the economy and, as a consequence, the recycling targets established for ELV´s.

The quantification of the targets for the recycled content for plastics should be based on a detailed study considering the economics of dismantling, including the identification of priorities considering the parts to be dismantled, their weight and the cost of this operation, and the logistics associated to the recycling.

These activities could be further promoted, during a specific period, by reducing the automotive taxes for vehicles including minimum recycled materials contents.

TOPIC: **COLLABORATIVE LEARNING AND VIRTUAL TEAMING**

http://in3.dem.ist.utl.pt/laboratories/policy.html#8

How can universities foster innovation and the creation of new business and jobs, helping to transform organizations to address the challenges of science and technology commercialization in a global economy? This broad question has motivated research and development work at IN+, which has been performed on the basis on the current understanding of the new challenges raised by the advent of the learning economy.

In the emerging socio-economic context, the required combination of expertise in a productive manner breaks with existing concepts of time, space, mass and behavior. In fact, current technological systems are complex, and carry many levels of cultural meaning. In this context, the renewal of education and training systems is based on the idea that technological innovation is chiefly a social activity and that technical education with a multidisciplinary orientation provides an important role in the critical acceptance and social embedding of technical innovation outputs.

This has been possible due to advances in information and communications technologies, which have increased the ability of networking. We consider learning networks, that is, networks that lead to self-

reinforcing learning cycles. The technologies used include video-teleconference and other Internet based GroupWare. In this context, "virtual teams" have been associated with the emergence of distributed cross-organizational arrangements, which involve people from different organizations who work in different places. The result is the process of entrepreneurial education, through which the acquisition of new knowledge is followed by living and experiencing entrepreneurial environments, in order to facilitate the creation of new knowledge. The goal is to establish a learning triangle, integrating academic, vocational and experimental activities. The following case studies have been prepared during the reporting period:

- A CASE STUDY: The Glass Chair - a project for competence building
- A CASE STUDY: The IMPACT Program - a project fostering entrepreneurship in a international context

TOPIC: **Fostering entrepreneurship in Universities**

The role of universities has been expanding beyond the traditional functions of teaching and research. Often as a result of society's demands, but as often as a consequence of the internal dynamics of the institution, universities are becoming active players in fields as diverse as promoters of regional development and incubators of start-up ventures. Our aim, in this context, is both to study the process and to become actively engaged in this broadening of the university's mission. We are especially interested in the process and dynamics of entrepreneurship. Also of relevance is intellectual property protection, which we view with a perspective of strengthening the impact of European universities, through the preservation of the institutional integrity of universities. This view has been analysed in the context of a technology transfer model that represents the interactions between universities and the market. The analysis is presented with the background of the new growth theories, which differentiate knowledge from objects, namely in terms of the level of exclusion and rivalry in consumption. As a consequence, various elements that are to be considered in the decision to protect intellectual property have been discussed and policy implications for the European universities derived. The key idea relates to the rationale for undertaking intellectual property measures at universities, namely as a complement to traditional types of research and as an effort to clarify the role of the university (defining the boundaries of academic activities), but, above all, as a critical element to promote the diffusion on new products in the market place.

Sample Publications:

- Conceicão, Heitor and Oliveira (1999), Technovation
- Conceicão, Heitor and Oliveira (1999), In "Technology Transfer", Kluwer Publ.

d) Other Activities: Transfer and diffusion of knowledge

To achieve the R&D goals previously defined, the activities developed through IN+ include a range of other activities regarding the transfer and diffusion of knowledge, namely: i) advanced training; ii) organization of leading international conferences; iii) Workshops; and iv) editorial activities. These activities are briefly summarized in the following paragraphs.

d1) Advanced Training

The research staff has been particularly involved in promotion of learning environments and advanced training in the areas of engineering policy and management of technology and science and technology commercialization. Two main educational programs and a series of short training courses have been developed as follows:

- ***M. Sc. in "Engineering Policy and Management of Technology", at IST - Technical University of Lisbon, http://in3.dem.ist.utl.pt/master/***

The program aims at training qualified professionals and at promoting the creation and diffusion of knowledge in Engineering Policy and Management of Technology. The program will contribute to the development of strategic leadership and the implementation of innovation policies, promoting the role of engineering, science and technology on the sustainable development of society. The program integrates post-graduate education and research activities, fostering the student's entrepreneurial skills and promoting competencies that will allow students to approach complex and non structured problems.

The first edition of this M. Sc. Program started in January 1998 under a grant of the Portuguese-American Foundation for Development, FLAD, which contributed to enhance links with major US universities, including the University of Texas at Austin. The program was awarded with a Fullbright rotating chair, starting on September 1998, for two years.

The main statistics are as follows:

- 1st edition; 1998
  Number of Applications: 42
  Number of accepted students: 19
  Number of Post-Graduation Diplomas given: 19
  Number of MSc Thesis submitted for evaluation: 14
- 2nd edition; 1999
  Number of Applications: 35
  Number of accepted students: 12
  Number of Post-Graduation Diplomas given: 10
  Number of MSc Thesis submitted for evaluation: 10
- 3rd edition; 2000
  Number of Applications: 40
  Number of accepted students: 16
  Number of Post-Graduation Diplomas given: 15
  Number of MSc Thesis submitted for evaluation: 15

The competencies to be developed in the new graduates integrate the following aspects:

TECHNOLOGICAL INNOVATION MANAGEMENT:

- technological forecast and impact; cost-benefit/cost-efficiency analysis
- technology audit, energy, environmental and organizational issues
- project management and planning
- marketing of technological products
- technological risk assessment

COMMERCIALIZATION OF SCIENCE AND TECHNOLOGY

- protection of intellectual property
- technology transfer
- identification of complementary assets

MANAGEMENT OF KNOWLEDGE AND INFORMATION

- management of telematic networks
- development of corporate information systems
- knowledge retention; valorization of resident knowledge

ENGINEERING, SCIENCE AND TECHNOLOGY POLICIES

- study of complex and non-structured problems
- integration of knowledge in multidisciplinary areas
- application of quantitative methods of analysis

MANAGEMENT AND POLICIES ORIENTED TOWARDS SUSTAINABILITY

- development and integration of industrial technologies and management systems of energy and environmental protection;
- analysis and management of environmental resources

- ***Entrepreneurial Executive Education: The IMPACT Program, http://in3.dem.ist.utl.pt/impact/***

In the area of advanced training, the Center completed in 2000 the **IMPACT** Program**,** on **"Innovation and Internationalization of companies through the Application and Commercialization of Technology"**. It consisted in an advanced training international program aimed to develop competencies/skills for the start up and development of companies with the capacity for innovation and intemationalization through the application and commercialization of technology. It includes three main vectors: specific *technical training, experimentation and interaction.*

The objective of *specific technical training* is to introduce a "learning-by-learning" component, to familiarize the participants with the formally codified knowledge in this field. The training has been carried out through a partnership between the Instituto Superior Técnico and the IC2 Institute, the University of Texas at Austin. The training modules have been attended by 20 Portuguese students (mainly entrepreneurs) in a classroom at IST. The education process includes video-conferencing sessions that correspond to the MSSTC classes, which were broadcast simultaneously from Austin The objective of the *experimentation phase* has been to add a "learning-by-doing" component to the program and, at the same time, to give an opportunity to immediately apply the concepts ministered during the training. Experimentation was carried out globally, based on technology incubators in Austin and Lisbon (respectively ATI, CPIN) and during the periods of training and at the participants' workplaces. Finally, the *interaction* activity provided to the participants an additional dimension of intemational personal contact in order to promote "learning-by-interacting". The full programme was concluded in the summer 2000.

Table: The Corporate participation in the IMPACT Programme (1998-2000)

Portuguese Company	Contact	Technical Domain	Development Status	Main Topics for Cooperation	Type of Links to be Proposed
1. STAB	**Orfeu Flores** aflores@pen.gulbenkian.pt tel. 351-297-49-96	Biotechnology	* Development phase of services * Starting-up of R&D component	* new zymotools for contaminating yeast * Bioremediation of hydrocarbones * Remote aquatic monitoring * recombinant DNA manipulation	* R&D partnership * join venture * training
2. BIOTECNOL	**Pedro Pissarra** pmp.biotecnol@taguspark.pt tel. 351-1-421 15 18 http://www.biotecnol.pt	Biotechnology	Spin-off with private funds in development phase	* Recombinant Protein Production * Metabolic Engineering * Bacterial Expression Systems * Gene therapy	* join venture establishment * financing, venture capital
3. NEURÓNIO	**Maria José Francisco** mfrancisco@impact.ist.utl.pt tel. 351-1-727-67-15	Information Systems Audiovisual Multimedia	Development and growth through internationalization	* information management * new net engineering * 3D animation, entertainment	* join venture / venture capital * Strategic alliance for joint developments
4. CRITICAL	**João Carreira** jcar@dei.ue.pt tel. 351-39-790033 http://www.criticalsoftware.com	Information Systems sub-domains: dependability	spin-off from R&D group: just started	* dependability services; fault-tolerance software products	* alliances / market * distribution
5. CONTRASTE	**Pedro Lobo** contraste@ip.pt tel. 351-1-840-34-07	Information Systems	Start up company started in 1996	* multimedia & internet software engineering * 3D modelling and animation	* know-how exchange * joint venture establishment
6. SQL	**José Guedes** sql@mail.telepac.pt tel. 351-33-400-12-12 http://www.sql.pt	Intelligent Manufactoring Systems CIM in plasties injection molding	Development phase	* injection molding plastic process * process management software	* CIM distribution * polimers R&D partnership (University group) * market
7. Reynolds & Oliveira (CPIN)	**Domingos Sousa** tel. 351-1-847-68-84 **Elsa Casimiro** ecasimiro@impact.ist.utl.pt tel. 351-1-711-61-72	Agriculture equipment	In the market for six years: development and growth through internationalization	* agricultural equipment licensing, in particular phase controlled impact shaker and pruning equipment	* technical partnership * licensing contracts * venture capital * distribution
8. MAQUISIS	**António Ferreira** maquisis@mail.telepac.pt tel. 351-53-617-838	Machinery (automation)	Development and growth trough internationalization	* automatic systems and processes	* join venture * market
9. MAGNA PEDRA	**António Nunes** antonio-nunes@mail.telepac.pt tel. 351-86-68-000	Restoration - marbles of art production (Machinery)	Project start-up	* image acquisition and 3D modelling technologies * commercialization distribution alliance	* collaboration * financing * distribution
10. LUSOPTEL	**Luis B. Ribeiro** lusoptel@mail.telepac.pt lribeiro@impact.ist.utl.pt 351-55-782-656	Optoelectronics and telecommunications	Start-up since 1997	* optoelectronics * communication technologies (optical fibers)	* technical partnerships for new applications * alliances for R&D and commercialization

d2) Organization of International Conferences

The CENTER FOR INNOVATION, TECHNOLOGY AND POLICY RESEARCH, IN+, promotes the transfer and diffusion of knowledge through the organization of major international Conferences, which have considerably contributed to diffuse knowledge worldwide, and promote the internationalisation of the Portuguese S&T system. Emphasis has been given, since 1982, to the application of laser techniques for fluid flow research, and this has contributed for the organization of a world leading conference in Lisbon every two years.

Current activities include also the analysis of socio-economic research topics, namely looking at the role of knowledge for development. This has resulted in the organization of an international series of annual Conferences around the world.

The following are the most significant events being planned:

- **10th International Symposium on Applications of Laser Techniques to Fluid Mechanics, Lisboa, July 2000**
  http://in3.dem.ist.utl.pt/conflaser/

The Symposia have contributed since 1982 for the presentation of new research on advanced techniques for flow measurement and results of significance to fluid mechanics. It has emphasized the application of laser, and other advanced techniques, to scientific and engineering investigations of fluid flow. Contributions to the theory and practice of measurement methods have been accepted where they facilitate new improved fluid mechanical investigations, and have included laser-Doppler velocimetry, LDV, phase-Doppler velocimetry, particle image velocimetry, PIV, and laser induced fluorescence and other scalar diagnostics. Non-optical techniques that provide new and reliable information on fluid flows, heat and mass transfer and complement that obtained with laser diagnostics have also been considered for the various International Symposia.

Approximately forty formal sessions, involving about 180 technical papers, have been considered in previous Symposia in the following areas:LDV Signal and Data Processing;Two-phase flows instrumentation; Multi-Point Methods; Holographic PIVM; PIV Signal and Data Processing; Scalar diagnostics; Aerodynamic Flows; Biological and Complex Flows; Free Flows and Flames; Free Surface Flows; Wall Flows; Mixers; Separated Flows; Combustion and advanced combustor concepts; Engines;Sprays for Engines; Turbomachinery; Two-Phase Flows.

These Conferences have been launched in July 1982, in Lisbon, through a close partnership involving Professors Jim Whitelaw, Imperial College, Franz Durst, University of Erlagen, Ron Adrian, University of Illinois, and Diamantino Durão, IST. Since then, the Conferences have been organized in Lisbon, every two years, based on a close collaboration between the Center for Innovation, Technology and Policy Research, IN+, of the Instituto Superior Tecnico in Portugal, and the researchers mentioned before.

Details of the past and upcoming Symposia can be found in http://in3.dem.ist.utl.pt/conflaser/. The 10th Int'l Symposium was organized in July, 2000. It brought together over 350 participants from 26 different countries, including 40 technical sessions. A book with selected and extended papers will be published through Springer Verlag, as described in http://in3.dem.ist.utl.pt/springer/.

- **4th International Conference on Technology Policy and Innovation, Curitiba, September 2000**
  http://in3.dem.ist.utl.pt/confpolicy/

Science and technology (S&T) are key global resources for wealth and job creation and for shared prosperity at home and abroad. The impact of S&T on economic development is a result of complex processes involving the interaction of business, academia, and government.National and regional innovation systems impact the effective and efficient generation, application or use, and diffusion of S&T. Increasing interest in these processes has motivated creative and innovative research and practice across a wide range of businesses and academic disciplines - from management, marketing, engineering, and economics to government, sociology, history, and law.

The main objective of this series of international conferences on Technology Policy and Innovation is to bring together leading representatives of academic, business, and government sectors worldwide to present and discuss current and future issues of critical importance for using science and technology to foster regional economic development and shared prosperity at home and abroad. Multidisciplinary perspectives are encouraged to provide state-of-the-art and useful knowledge to decision makers in both the private and public sectors - including informed and effective education, business, and government policies and strategies for the global knowledge economy.

After the 1st International Conference on Technology Policy and Innovation hold in Macau, July 2-4, 1997, with the theme "21st Century Opportunities and Challenges for Asian Science, Technology and Innovation Policy", the 2nd international conference was held in Lisbon, Portugal, August 3-5, 1998, with the theme "Knowledge for Inclusive Development". Then, the 3rd Conference was held in Austin, Texas, August 30-September 2, 1999, with the theme "Global Knowledge Partnerships: Creating Value for the 21st Century".

A serie of special issues have been published in the international journal "Technological Forecasting and Social Change" with selected and extended papers, http://in3.dem.ist.utl.pt/TFSC, and other outstanding material presented during the Conferences have been published through Greenwood Publishing Group Inc., http://www.quorumbooks.com, in a QUORUM BOOK SERIES, as available in http://in3.dem.ist.utl.pt/quorumseries/

As knowledge increasingly becomes a key strategic resource for regional as well as national economic development, there is a need to enhance our understanding of the barriers and incentives-in developed, developing, and emerging regions worldwide-for effective knowledge generation, transfer, application or use, and diffusion. In this context, the **4th Conference was organized in Curitiba, Brazil, in August 2000, focusing on "Learning and knowledge networks for development".**

These Conferences have been organized based on a close partnership between the IC2 Institute of The University of Texas at Austin, USA, and the Center for Innovation, Technology and Policy Research, IN+, of the Instituto Superior Tecnico in Portugal, but involving other major partners, as the Institute for International Studies of the Stanford University, USA, the Science and Technology Policy Research Unit of the University of Sussex, SPRU, UK, the Institute of Studies on Scientific Research of the italian National Research Council and the Delft University of Technology.

Details of the Conference organized in the summer 2000, as well as of past and upcoming Conferences, can be found at http://in3.dem.ist.utl.pt/confpolicy/.

- **<u>A research Seminar:</u> TOWARDS A LEARNING SOCIETY: INNOVATION AND COMPETENCE BUILDING WITH SOCIAL COHESION FOR EUROPE**
  Guincho, Lisboa, May 2000
  http://in3.dem.ist.utl.pt/learning2000/

OBJECTIVES: A Research Seminar to review, discuss and integrate new developments in socio-economic research on innovation, competence building and social cohesion in Europe, reflecting the Portuguese presidency priorities on innovation and social cohesion. The ultimate goal was to capture new socio-economic trends and to find policy strategies promoting learning societies through joint efforts and integrated on innovation, competence building and social cohesion.

The strategy was to organise a Seminar to review and interrelate results from the three TSER broad research areas (Science and Technology Policy Options, Education and Training; and Social exclusion and Social integration) and connect these with the objectives of the key action on socio-economic research.

WORK CONTENT: The rationale of the Seminar was defined around the concept of the "learning society". Within this framework, it has been argued that comparative advantages of countries and economies rely on the production and distribution of knowledge and learning processes, which became the most important resource in present societies. But at the same time, the increasing of globalisation processes challenges the whole traditional national institutional framework. Both these trends interrelate and interact with a changing of working patterns, new skills needs, new competence building. However the present trend may have a pervasive effect on the social cohesion of society, by potentially excluding marginal groups such as old workers, women, low skilled workers, immigrants, etc. Therefore the seminar was organised around three major interrelated thematic sessions, each of them addressing one of the above issues and trying to answer to the following questions:

Thematic session: Institutional and organisational innovation:

1. How can we use the systems of innovation approach to analyse the role that institutions can play in this new societal context?

2. How can we relate organisational change, competence building and labour market dynamics?

3. How do organisations change in the new societal context? What are the implications in the nature of work (new flexibility patterns, impact of ICT's on the organisation of work), and its impact on the quality of life?

Thematic session: New skills and competence building:

1. The relationship between competence building and education systems;

2. How should we address the problem of the low skill workers in this new societal context?

3. How do organisations manage internal competence building?

Thematic session: Social structures and changing working patterns:

1. The role of welfare systems as mediators between unemployment and work, their implications for the poverty and living standards of the unemployed and the extent to which they provide effective bridges back into work through various types of active labour market policy.

2. How can local strategies enhance social cohesion?

3. And how can we improve or change the role of public policies towards social cohesion in the new societal context?

Publications:

All the papers presented at the seminar are available at **http://in3.dem.ist.utl.pt/learning2000/,** together with the list of participants and the slides presented during the various oral presentations. In additon, a book is expected to be published by Oxford University Press in 2001.

- **Research Seminar: Collaborative Design – Competence Building for Innovation**

HANNOVER, Portuguese Pavillon, September 2000

Objective: To present and discuss programmes aimed at creating and promoting new skills through collaborative and distance learning, taking advantage of new information and communication systems, and considering transdisciplinary projects. The emphasis was on networks involving architecture and engineering students.

Approach: The Workshop was based on the discussion of case studies and recent experiences on collaborative and distance learning. The mechanisms used are **networks** linking people, particularly students, with different backgrounds, aimed at increasing their ability to cope with emerging challenges. *The first part* of the workshop was devoted to the analysis *of a* case study involving the design and construction of a glass chair. Such a chair is an appropriate case study because it constitutes a **complex product** that requires particular safety precautions, careful handling, and specific production expertise. In addition, it involves the creation of **free forms,** and promotes the development of new skills. *The second part* of the workshop included the presentation of various case studies by European and American researchers.

Background: ***The Main Case Study – a glass chair***

http://in3.dem.ist.utl.pt/glasschair/

In the emerging knowledge economies, the combination of expertise in production systems breaks away from existing concepts of time, space, and behaviour. In addition, current technological systems are complex and carry many levels of cultural meaning. In this context, the renewal of education and training systems is based on the idea that technological innovation is chiefly a social activity and that multidisciplinary technical is critical for social acceptance and embedding of technical innovation outputs.

The building-up of design capabilities involve multiple learning routes, including formal and informal processes, where design and production experience are equally important. This framework raises interesting issues in the development of design and production abilities as the focus is on *learning before doing* unlike more traditional models in which the focus is on *learning by doing.*

The learning environment provided was a global classroom consisting multiple sites distributed around the world. Such learning environments have been possible due to advances in information and communications technologies, which have increased the ability of networking by providing adequate tools in three categories of requirements: those related with time co-ordination, sharing of (virtual) space, and sharing of contents. We consider learning networks, that is, networks that lead to *self-reinforcing learning cycles*. The technologies used included video-teleconference and other Internet based GroupWare. In this context, "virtual teams" have been associated with the emergence of distributed cross-organisational arrangements, which involve people from different organisations who work at different places. The result is a process of **entrepreneurial education**, through which the acquisition of new knowledge is followed by living and experiencing entrepreneurial environments which, in turn, facilitate the creation of new knowledge. The result is a learning triangle, integrating **academic**, **vocational** and **experimental** activities.

The project brought together American students from Architecture, who were involved in the study of Free-Form Design, and Portuguese engineering students, namely from Civil Engineering and Mechanical Engineering. Civil engineering students worked in Structural Analysis, and Mechanical engineering ones worked in Product Development, Product Liability and Safety, Mould Production and Glass Slumping Process. The glass chair will be presented as a tangible result, but the important results are intangible in nature and associated with the valorisation of human and intellectual capital, in a context favourable to innovation, where learning networks play a critical role.

Publications:

All the papers presented at the seminar are available at **http://in3.dem.ist.utl.pt/hannover2000/**, together with the list of participants and the slides presented during the various oral presentations. In additon, a book is expected to be published by QUORUM BOOKS in 2001.

d3) Workshops

- **Advanced Workshops on "Science, Technology and Society" - Perspectives on Knowledge for Sustainable Development**
  IST - Lisbon, short courses (starting in November, 1999, and developed during 2000)
  http://in3.dem.ist.utl.pt/adv/workshops/

*Background and Objectives:*The Advanced Workhops will act as a forum to exchange ideas and an opportunity of scientifically discussing the global changes on the development and use of science and technology and related social and ecological consequences.

Analysis has shown that continuous technical change in business firms in modern societies require the close development of publicly funded research and associated training, so that the development of a country´s science base is socially shaped (e.g. Pavitt, 1998; Research Policy). In this context, technology is not simply a tool or aplied science, nor is science simply the result of knowledge accumulation. Rather, science and technology are characterised by their entrenchment in society, thus requiring both interdisciplinary reflection and development of real-world strategies for action.

Based on this background, Innovation has been increasingly considered as a key factor in corporate and socio-economic performance and analysis has shown the importance of decentralized industrial policy in support of wealth creation and the well-being of future generations. In this context, the implementation of the current European Framework Programme for Portugal has raised the need to carry out projects assuring a coherent development in an innovative context. In fact, European Structural and Cohesion Funds have supported over the last few years important initiatives which aim at eliminating existing deficiencies comparatively to the European average, namely regarding basic infrastructures. Now the aim is to extend the scope of this type of projects and to foster innovation and promote sustainable development.

Structure: The workshops will take place during one or two consecutive days, including only plenary sessions. Emphasis will be given to structural aspects, namely through lectures delivered by national and international experts with the purpose of introducing fundamental concepts associated with the development of Science and Technology Policies. Technical sessions include expert topics which have raised world-wide attention, with emphasis on challenges and opportunities faced by enginners and researchers and technology managers in the context of the current European innovation policy.

Beyond the Workshops: The subjects discussed during the Workshops will provide an extended debate between the participants, namely through discussion groups using internet-based communication technologies. The purpose is to develop a knowledge network which makes it easier to learn success critical factors for the design and application of Science and Technology Policies, and to spread the best practices and success cases.

Programme for 2000:

- **November, IST - Congress Center**

  Internet Economics and the Creative Destruction of Telecommunications
  Main Speakers: **Lee W. McKnight** and **About Paul Vaaler**

  A joint porganization of IN+ with Edward R. Murrow Center for International Information & Communication, Hitachi Center for Technology and International Affairs, The Fletcher School of Law and Diplomacy,Tufts University, Medford, MA, USA.

  Lee McKnight is an Associate Professor of International Communication and Director of the Edward R. Murrow Center, The Fletcher School of Law and Diplomacy, Tufts University, and a Visiting Scholar at the MIT Center for Technology, Policy, and Industrial Development.

Paul Vaaler is an Asssistant Professor of International Business and Director of the Hitachi Center for Technology and International Affairs, The Fletcher School of Law and Diplomacy, Tufts University.

- **November, IST - Congress Center**

Main Speaker: **Jean-Pierre Contzen**, European Commission

Discussants and Case studies: **Manuel Heitor, Paulo Ferrão** and **Pedro Conceição, IST**

d4) Main Editorial Activities

- **Quorum Books: International Series on "Technology Policy and Innovation"**

  http://in3.dem.ist.utl.pt/quorumseries/

A main book series was launched in 1998 through Greenwood Publishers, QUORUM BOOKS, at Connecticut, USA, as a joint initiative of The IC2 Institute of the University of Texas at Austin, and the Center for Innovation, Technology and Policy Research. The main objectives are as follows:

> **(1)** to publish leading scholarly work representing academic, business, and government sectors worldwide on technology policy and innovation; and
> **(2)** to present current and future issues of critical importance for using science and technology to foster regional economic development and shared prosperity.

General Editors:

> **Manuel V. Heitor**, Center for Innovation, Technology and Policy Research, Instituto Superior Técnico, Lisbon, Portugal
>
> **David V. Gibson**, IC2 Institute, The University of Texas at Austin, Texas
>
> **Pedro Conceição**, Center for Innovation, Technology and Policy Research, Instituto Superior Técnico, Lisbon, Portugal and IC2 Institute, The University of Texas at Austin, Texas

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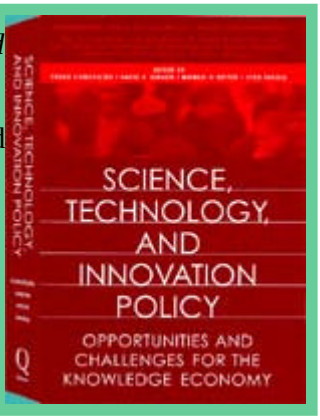
Books:

Volume I: *"Science, Technology and Innovation Policy: Opportunities and Challenges for The Knowledge Economy"*

Edited by :Pedro Conceição, David V. Gibson, Manuel V. Heitor and Syed Shariq

Publish Date: Spring 2000

ISBN: 1-56720-271-3



Forthcoming titles:

Volume II: *"Knowledge for Inclusive Development"*

Edited by: Pedro Conceição, David V. Gibson, Manuel V. Heitor, Giorgio Sirilli and Francisco Veloso

Publish Date: Winter 2000 (expected)

Volume III: *"Systems and Policies for the Globalized Learning Economy"*

Edited by: Pedro Conceição, David V. Gibson, Manuel V. Heitor and Chandler Stolp

Publish Date: Spring 2001 (expected)

- **TFSC: Special Issues on "Science, Technology and Innovation Policies"**

http://in3.dem.ist.utl.pt/tfsc/

A series of Special Issues in the International Journal *'Technological Forecasting and Social Change'*, on:"Science, Technology and Innovation Policies", have been prepared and published since 1997 with selected and extended papers from the series of International Conferences on Technology Policy and Innovation, as follows:

TFSC, Volume 66, Number 1, January 2001 (expected publication date)

Special Issue edited with selected and extended papers from the 2nd International Conference on "Technology Policy and Innovation", Lisbon, 1998

TFSC, Volume 67, Number 2, May 2001 (expected publication date)

Special Issue edited with selected and extended papers from the 3rd International Conference on "Technology Policy and Innovation", Austin, 1999

- **Springer: Series on "Laser Techniques and Applications to Fluid Mechanics"**

A series of books on ***"Developments of Laser techniques and Applications to Fluid Mechanics",*** which includes revised versions of selected papers presented at the International Symposia on Applications of Laser Techniques to Fluid Mechanics, which have been organized in Lisbon, at the Calouste Gulbenkian Foundation, since July 1982 and every two years, as described in http://in3.dem.ist.utl.pt/conflaser/.

The papers describe *Instrumentation Developments* and results of measurements of *Turbulent Shear Flows*, *Aerodynamics Flows*, *Mixers and Rotating Flows*, *Combustion and Engines*, and *Two-Phase Flows*. The papers demonstrate the continuing and healthy interest in the development of understanding of new methodologies and implementation in terms of new instrumentation.

The prime objective of this series of Symposia has been to provide a forum for the presentation of the most advanced research on laser techniques for flow measurements, and communicate significant results to fluid mechanics. The applications of laser techniques to scientific and engineering fluid flow research have been emphasized, but contributions to the theory and practice of laser methods have been also considered where they facilitate new improved fluid mechanic research. Attention has been placed on laser-Doppler anemometry, particle sizing and other methods for the measurement of velocity and scalars, such as particle image velocimetry and laser induced fluorescence.

The series of Conferences was launched in July 1982, in Lisbon, through a close partnership involving Professors Jim Whitelaw, Imperial College, Franz Durst, University of Erlagen, Ron Adrian, University of Illinois, and Diamantino Durão, IST. Since then, the Conferences have been organized in Lisbon, every two years, based on a close collaboration between the Center for Innovation, Technology and Policy Research, IN+, of the Instituto Superior Tecnico in Portugal, and the researchers mentioned before.

The first three volumes of the series were published through LADOAN, an editorial initiative at IST launched by Professor Diamantino Durão, but since the 4th Symposium, in 1990, the bound volumes have been published through Springer-Verlag, http://www.springer.de.

During the reporting period, the following book was published:

Developments in Laser Techniques and Applications to Fluid Mechanics
Selected Papers from the 9th Intl. Symposium on Applications of Laser Techniques to Fluid Mechanics

Editors: R.J. Adrian, D.F.G. Durão, F. Durst, M.V. Heitor, M. Maeda and J.H. Whitelaw

Published by Springer Verlag, 2000

ISBN: 3-540-66738-5

• Other books published by researchers from IN+

o *Books published by researchers of IN+ through CELTA Publishers during 2000:*

- "Industrial Ecology and the Automotive in Portugal" (in Portuguese)
  Editor: Paulo Ferrão and J. Figueiredo

- "Innovation in Portugal - The 2nd Community Innovation Survey in Portugal - 1999" (in Portuguese)
  Editor: Pedro Conceição

o *Books prepared by researchers of IN+ through IST PRESS during 2000:*

- "The Glass Chair: Competence Building for Innovation"
  Editor: Manuel Heitor

e) Publications: 2000

a) Books edited

Laboratory of Thermofluids, Combustion and Environmental Systems

- Adrian, R., Durão, D.F.G., Durst, F., Heitor, M.V., Maeda, M. e Whitelaw, J.H. (2000). *Laser Techniques Applied to Fluid Mechanics*, Springer *Verlag*. (638 páginas, 600 exemplares).

Laboratory of Technology Policy and Management of Technology

- Conceição, P., Gibson, D., Heitor, M.V. and Sirilli, G. (2000). *Knowledge for Inclusive Development*. QUORUM Publ., New York.
- Conceição, P., Gibson, D., Heitor, M.V. and Shariq, S. (2000). *Science, Technology and Innovation Policy: Opportunities and Challenges for the Knowledge Economy*. QUORUM Publ., New York.
- Ferrão, P. (2000) "A Ecologia Industrial e o Automóvel em Portugal" (in Portuguese), CELTA (268 páginas, 1000 exemplares) ISBN: 972-774-092-8.
- Veloso, F., Henry, C., Roth, R., Clark, J. Global Strategies for the Development of the Portuguese Autoparts Industry. Lisboa: IAPMEI, May 2000.

Under final preparation (to be published early 2001):

- Conceição, P. And Ávila, P. (2001). "Innovation in Portugal - The 2nd Community Innovation Survey in Portugal - 1999" (in Portuguese), CELTA.
- Heitor, M.V. (2001). "The GLASS CHAIR: Competence Building For Innovation". IST Press, Lisboa.

b) Journals Edited

Laboratory of Technology Policy and Management of Technology

- Heitor, M.V., Conceição, P., and Gibson, D. (2000). Special Issue on "Science, Technology and Innovation Policies" of the Journal "Technological Forecasting and Social Change", vol 66, December

c) Papers in International Scientific Journals

Laboratory of Thermofluids, Combustion and Environmental Systems

- Caldeira-Pires, A. and Heitor, M.V. (2000). "Temperature and Related Statistics Measurements in Turbulent Jet Flames". *Experiments in Fluids*, **24** (4), pp. 118-129.
- Caldeira-Pires, A. and Heitor, M.V. (2000). "Experimental Characterization of non-premixed turbulent jet propane flames". *Experimental Thermal and Fluid Science*, **23**, pp. 115-132.
- Caldeira-Pires, A. , Heitor, M.V. and Carvalho, J. A. (2000). "Characteristics of Nitric Oxide Formation Rates in Turbulent Nonpremixed Jet Flames". *Combustion and Flame*, **120**, pp. 383-391.
- Caldeira-Pires, A. and Heitor, M.V. (2000). "Characteristics of Turbulent Heat Transport in Nonpremixed Jet Flames". *Combustion and Flame*, **124**, pp. 213- 224.

- V. Sivadas, B.S. Pani, K.A. Butefisch (2000). "Laser Diagnostics of Transverse Turbulent Jets", Journal of Flow Visualization and Image Processing, Begell House Inc., New York, 2000

Papers submitted:

- "Phase Average Analysis of an Oscillating Reacting Shear Layer"., E.C. Fernandes and M.V. Heitor (2000). Submetido à Combustion Science and Technology
- "Characteristics of a Semi-Infinite Probe-Tube for Pressure Fluctuation Measurements in Combustion Chambers "., E.C. Fernandes and M.V. Heitor (2000). Submetido ao Journal of Sound and Vibration
- P. Ferrão, A. Figueiredo and F. Freire "Modelling high-temperature thin-layer drying kinetics of olive bagasse". Journal of Agriculture Engineering Research. (publicado em 2001).
- D.P. Correia, P. Ferrão, and A. Caldeira-Pires "Advanced 3D emission advanced 3d emission tomography flame temperature sensor", Combustion Science and Technology. (aceite para publicação).
- F. Freire, S. Thore and P. Ferrão "Life Cycle Activity Analysis: Logistics and environmental policies for bottled water in Portugal", OR Spectrum Journal. (publicado em 2001).
- P. Ferrão, J. Ehrenfeld and J. Amaral "Strategies for meeting EU end-of-life vehicles re-use/recovery targets, in Portugal". Journal of Industrial Ecology, MIT Press. (Submetido em Abril de 2000; em avaliação).

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- Conceição, P., Gibson, D. V., Heitor, M.V. and Sirilli, G. (2000). "Knowledge for Inclusive Development: The Challange of Globally Integrated and Learning Implications for Science and Technology Policy", *Technological Forecasting and Social Change*, **66**, pp. 1-29, December 2000
- Caraça, J., Conceição, P., and Heitor, M.V. (2000). "Suggesting a Public Policy towards the Research University in Portugal", *Higher Education Policy*, June 2000, **13**, pp.181-201.
- P. Conceição, James K. Galbraith (2000), "Constructing Long and Dense Time-Series of Inequality Using the Theil Index," Eastern Economic Journal, 26(1): 61-74.
- P. du Pin Calmon, P. Conceição, James K. Galbraith, V. Garza Cantu, A. Hibert (2000), "The Evolution of Industrial Wage Inequality in Mexico and Brazil: a Comparative Study," Review of Development Economics, 4(2): 194-203.
- R. Carneiro, P. Conceição, A. V. Fernandes (2000), "Enabling Digital Cluster Formation in a Local Context: A Case Study of Macau," Foresight, 2(6): pages TBA.
- E. Figueroa, P. Conceição (2000), "Rethinking the Innovation Process in Large Organizations: A Case Study of 3M," Journal of Engineering and Technology Management., 17(1): 93-109.
- P. Conceição, P. Ferreira, James K. Galbraith (2000), "Ungleicheit und Arbeitslosigkeit in Europa: Das Amerikanische Rezept," Berliner Debatte, 4/5: 50-67.
- Baptista, R. (2000). "Do Innovations Diffuse Faster within Geographical Clusters?" Internacional Journal of Industrial Organization. 18(3), 2000.
- Baptista, R. (2000). "Industrial Clusters and the Diffusion of New Technologies". *Technology Forecasting and Social Change*, **66**, December 2000.

d) Papers and Chapters in Edited Books

Laboratory of Thermofluids, Combustion and Environmental Systems

- Fernandes, E.C. and Heitor, M.V. (2000) "On the extension of a laser-Doppler velocimeter to the analysis of Oscillating flames", in "*Laser Techniques Applied to Fluid Mechanics*", Eds. Adrian, R., Durão, D.F.G., Durst, F., Heitor, M.V., Maeda, M. e Whitelaw, J.H.., Springer *Verlag, pp. 383-401*.
- Ferrão, P., M. V. Heitor, M.F. Matos, R. K. Salles (2000) "Turbulent Scalar Mixing in Coaxial Jet Flows". Turbulence and Shear Flow Phenomena. September 12-15, Santa Barbara, California. Publicado em: Turbulence and Shear Flow-1, pp. 785-790, eds. Sanjoy Banerjee and John K. Eaton, Begell House.

Laboratory of Technology Policy and Management of Technology

- Conceição, P., and Heitor, M.V. (2000)."UNIVERSITIES IN THE LEARNING ECONOMY: Balancing Institutional Integrity with Organizational Diversity", in :"*The Globalising Learning Economy:Major Socio-Economic trends and European innovation Policy*", Eds. Bengt-Aake Lundvall and Daniele Archibugi, Oxford University Press.
- P. Ferrão and M. V. Heitor (2000) "Integrating environmental policy and business strategies: The need for innovative management in industry", Publicado em: Science Technology and Innovation Policy: opportunities and challenges for the knowledge economy. pp. 503-518. Eds. P. Conceição, D. Gibson, M. Heitor and S. Shariq, Quorum Books.
- J. Ehrenfeld, P. Ferrão and I. Reis (2000) "Tools to support innovation of sustainable product systems", Publicado em: Knowledge for the Inclusive Development. Eds. P. Conceição, D. Gibson, M. Heitor and F. Veloso, Quorum Books.
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- P. Ferrão (2000) "O automóvel no contexto da Ecologia Industrial", Publicado em: A Ecologia Industrial e o Automóvel em Portugal. Pp. 5-17. Paulo Ferrão e José Figueiredo (eds.). Celta Editores
- J. Amaral e P. Ferrão (2000) "Veículos em fim de vida em Portugal", Publicado em: A Ecologia Industrial e o Automóvel em Portugal. Pp. 41-55. Paulo Ferrão e José Figueiredo (eds.). Celta Editores
- P. Ferrão et al. (2000) "Fileiras de materiais e components resultants de processamento de VFV", Publicado em: A Ecologia Industrial e o Automóvel em Portugal. pp. 75-231. Paulo Ferrão e José Figueiredo (eds.). Celta Editores
- J. Amaral, P. Ferrão e S. Ladeira (2000) "A directiva europeia e o sistema nacional de processamento de VFV: consequências da sua aplicação", pp. 255-268. Publicado em: A Ecologia Industrial e o Automóvel em Portugal. Paulo Ferrão e José Figueiredo (eds.). Celta Editores

e) Publications in International Conferences

Laboratory of Thermofluids, Combustion and Environmental Systems

- D.P. Correia, P. Ferrão, and A.Caldeira-Pires (2000) "Flame 3d tomography sensor for in-furnace diagnostics". 28th International Symposium on Combustion. July, 30th to August, 4th; University of Edinburgh, Scotland.
- P. Ferrão M. V. Heitor, and R. Salles (2000). "On the accuracy of scalar dissipation measurements by laser Rayleigh Scattering", Proc. 10th Intl. Symp. On Appl. Laser Techniques to Fluid Mechanics, Lisboa, 10-13 July, 2000.
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Laboratory of Technology Policy and Management of Technology

- Bommer, M., Heitor, M., Vedovello, C. and Pissarra, P. (2000). 'Biotecnol Pharmaceutica – A case Study", Decision Sciences Institute 2000 Proceedings, Orlando Fl, USA, November, pp. 18-20.
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Laboratory of Technology Policy and Management of Technology

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- Study for the European Commission under the topic: The automotive industry, Component suppliers – current and prospective regulatory approaches.

g) Master of Science Dissertations

Laboratory of Thermofluids, Combustion and Environmental Systems

Carlos Soares — **Análise Energética e ambiental de sistemas de climatização**
Instituto Superior Técnico
Conclusion: May 2000
Supervision: P.C. Ferrão

Laboratory of Technology Policy and Management of Technology

Pedro Ferreira — **Wage Inequality and Technology: an Exploration Using the Theil Index and Industry Estimations of Technology Intensity**
Instituto Superior Técnico

Conclusion: February 2000
Supervision: M. Heitor, P. Conceição

Maria João Rodrigues — **Integration of photovoltaics in buildings**
Instituto Superior Técnico
Conclusion: June 2000
Supervision: P.C. Ferrão

Nuno Orfão — **Make-to-Stock vs. Make-to-order in Glass Manufacturing**
Instituto Superior Técnico
Conclusion: December 2000
Supervision: C. Bispo, P.C. Ferrão

i) Doctorate Dissertations

Laboratory of Technology Policy and Management of Technology

Pedro Conceição: **Growth, Technology and Inter-Industry Earnings Inequality in Manufacturing: Evidence from a Selection of OECD Countries, 1970-1990.**
University of Texas at Austin, USA
Conclusion: December 2000

IN+

Center for Innovation, Technology and Policy Research
Centro de Estudos em Inovação, Tecnologia e Políticas de Desenvolvimento

Brief Plan of Activities
(2001)

Instituto Superior Técnico

January 2001

IN+

Center for Innovation, Technology and Policy Research

Centro de Estudos em Inovação, Tecnologia e Políticas de Desenvolvimento

Brief Plan of Activities - 2001

Contents

1. **Research Team and Unit** (plan for 2001, as by December 2000)

a) Doctorate Researchers

Name	Function	Title	Insti-tution	Position	Time % for research in the Unit	Time % for research outside the Unit	Time % for other professional activities incl/ teaching
					Total = 100%		
M. Heitor	Coord/Res.	Agregado/PhD	IST	Full Professor	75	-	25
D.F.G. Durão	Researcher	Agregado/PhD	IST	Full Professor	0	-	100
P.M. Ferrão	Researcher	PhD	IST	Associate Prof.	70	-	30
M.N. Nina	Researcher	PhD	IST	Associate Prof.	30	-	70
J. Ventura	Researcher	PhD	IST	Assistant Prof.	40	-	60
J.M.Mendes-Lopes	Researcher	PhD	IST	Assistant Prof.	40	-	60
A.L. Moreira	Researcher	PhD	IST	Assistant Prof.	40	-	60
G.P. Pita	Researcher	PhD	IST	Assistant Prof.	40	-	60
E. Fernandes	Researcher	PhD	IST	Assistant Prof.	70	-	30
P. Conceição	Researcher	PhD	IST	Assistant Prof.	75	-	25
S. I. Cthork	Researcher	PhD	IST	Res. Assistant	100	-	0
S. Sivadas	Researcher	PhD	IST	Res. Assistant	100	-	0
R. Baptista	Researcher	PhD	IST	Inv.Assistant Prof.	20	-	30
A. Caldeira-Pires	Researcher	PhD	IST	Res. Assistant	100	-	0
F. Veloso	Researcher	PhD	IST	Res. Assistant	50	50	0

b) Research students and other researchers

Name	Function	Title	Insti-tution	Position	Time % for research in the Unit	Time % for research outside the Unit	Time % for other professional activities incl/ teaching
Filipe Santos	Researcher	MSc- PhD student.	IST	Assistant	-	100	0
P. Oliveira	Researcher	MSc-PhD student	IST	Researcher	-	100	0
P. Ferreira	Researcher	MSc-PhD student	IST	Researcher	-	100	0
P. Anacleto	Researcher	MSc-PhD student	IST	Researcher	50	-	50
D. Correia	Researcher	PhD student	IST	Researcher	100		0
J. P. Amaral	Researcher	PhD student	IST	Researcher	100		0
A. Rodrigues	Researcher	MSc-PhD student	IST	Researcher	100		0
Casimiro E. C. Cala	Researcher	MSc-PhD student	IST	Researcher	100		0
Jorge O. Nhambiu	Researcher	MSc-PhD student	IST	Researcher	100		0
André Silva	Researcher	PhD student	IST/ UBI	Researcher	100		0
A. Diogo	Researcher	M.Sc. student	IST	Researcher	100		0
J. Pina	Researcher	M.Sc. student	IST	Researcher	100		0
H. Meng	Researcher	M.Sc. student	IST	Researcher	100		0
Miguel Silva	Researcher	M.Sc. student	IST	Researcher	100		0
Marta silva	Researcher	M.Sc. student	IST	Researcher	100		0
Angela Canas	Researcher	M.Sc. student	IST	Researcher	100		0
Paulo Silva	Researcher	M.Sc. student	IST	Researcher	100		0
Paulo Ribeiro	Researcher	M.Sc. student	IST	Researcher	100		0
Paulo Vaz	Researcher	M.Sc. student	IST	Researcher	100		0
Rita Ferreira	Researcher	M.Sc. student	IST	Researcher	100		0
Danilo Rubini	Researcher	M.Sc. student	IST	Researcher	100		0
Renato Salles	Researcher	M.Sc. student	IST	Researcher	100		0
Ana Moita	Researcher	M.Sc. student	IST	Researcher	100		0
Mosca Francesco	Researcher	M.Sc. student	IST	Researcher	100		0
Pedro C. S. Faria	Researcher	M.Sc. student	IST	Researcher	100		0
Nuno C. Rolo	Researcher	-	IST	Researcher	50		0

Isabel Pina	Researcher	-	IST	Researcher	100		0
Ivo Veiga	Researcher	-	IST	Researcher	100		0
Paula Meireles	Researcher	-	IST	Researcher	100		0
Pedro Rama	Researcher	-	IST	Researcher	25		75
Salomé Ladeira	Researcher	-	IST	Researcher	100		0
Robert E. Leandro	Researcher	-	IST	Researcher	50		0
Miguel Panão	Researcher	-	IST	Researcher	50		0

2. Proposed Research Topics

The workplan for 2001 considers a **new organization** in **three different laboratories**, namely: *Laboratory of Thermofluids, Combustion and Energy Systems; Laboratory of Environmental Systems; and Laboratory of Technology Policy and Management of Technology.* The goal is to promote the specialization of the work performed in each of the various areas, which have different dynamics and, consequently, should be organized differently. A doctorate researcher, who will work in close collaboration with the Center coordination, will coordinate each laboratory.

LABORATORY OF THERMOFLUIDS, COMBUSTION and ENERGY SYSTEMS

This Laboratory has expertises on the basic research areas of fluid mechanics and combustion. Its activity should gathered the scientific knowledge to allow:

- The continuous fundamental approach of complex and multidisciplinary processes typical of engineering systems
- The development and optimisation of eco-burning systems
- The development of advanced diagnostic tools and related software for engineering approach and support.

The necessary external funding is provided by research projects supported by national and international funding agencies and/or private companies. The work to be undertaken in 2001 will consider the following 4 main research topics:

• Lean Combustion

Combustion under sufficiently fuel-lean conditions has the desirable attributes of high efficiency and low emissions. However, lean combustible mixtures are more sensitive to **mixing** and have lower **flame speeds**, which may enhance **flame extinction** and **instabilities** and, consequently, may narrow the stable operating windows of the existing combustion systems. Therefore, to achieve the benefits of lean combustion while meeting the demands of practical combustion systems is a difficult task, which requires the development of new approaches. In this context, the *Laboratory of Thermofluids, Combustion and Energy Systems* is intended to explore the state-of-the-art in lean combustion and its role in meeting current and future demands and constraints on practical combustion systems. The following main tasks are planning for 2001:

1) Dynamic control of turbulent shear layers

This work addresses the fundamental aspects of actively controlled flame-flow interaction process supported by the development of active control methodology to assist the use of ultra-lean combustion. To achieve these objectives the work is conducted through different tasks to allow a dynamic control of the shear layer, as follows:

a) Acoustic excitation

The study is based on the experimental analysis of turbulent lean flames stabilized by central a recirculation zone, induced either by bluff-bodies or by swirl imparted to the main flow. The flows are excited by single and multi-frequency artificial acoustic signals, in order to take full advantage of small-large scale flame-vortex interaction properties as a way to actively control and reorganize the flame structure to allow ultra lean flames to stabilize. Consequently, with the additional property of vortex merging and collective interaction processes (sub-harmonic resonance) that generates high level of turbulence intensity, the influence of multi component fuels will be tested on the stability margin and burning efficiency.

b) Control of shear strain rate through induced counter-current shear flows

The main objective of this work is to study the influence of transition between convective and absolutely unstable flows, based on imposed strain rate through variable counter current shear layers, on the turbulent mixing process. The experimental study is followed by a detailed analysis of the influences of these shear layer instabilities on the stabilization process of premixed Bunsen jet flames and on their structure.

c) Controlled swirl-induced breakdown phenomena (application to Gas Turbine combustion)

Lean premixed (LP) combustion is an emerging environmental energy technology that is being developed to reduce the emissions of undesirable combustion byproducts from gas turbines. LP combustion emits only one-tenth to one-twentieth the amount of oxides of nitrogen (NOx) as conventional methods, but development of LP gas turbine combustors presents many engineering and technical challenges. Under gas turbine conditions of high pressures and elevated inlet temperatures, LP flames are prone to instabilities and blow-off. The scientific objective of this project is to improve our understanding of LP combustion in gas turbines by elucidating the fluid mechanic processes pertaining to stability, flame propagation, and emissions. Application to gas turbine combustion will be continued through detailed experiments in a laboratory model of a lean-premixed prevaporized combustor operated at atmospheric pressure. The measurements will focus on vortex breakdown processes and characterization of recirculation zone parameters playing basic role in flame holding. Experiments will provide an information regarding impact of geometrical conditions and swirl flow parameters in LPP combustor on pollutants emissions and fuel efficiency. This will be used for the developing methods of vortex structures modification allowing combustion processes control in environmentally friendly engines.

2) Low-Power eco-burning equipment: design, monitoring and control of low-power burning systems for domestic applications

This study will focus on the full optimisation of domestic burners, using natural gas as fuel, and the geometry of the cooking recipient. The ultimate goal, towards the design and promoting the use of eco-combustion systems for domestic applications, is to burn under very lean condition, regarding the pollutant emission regulation, together with the enhancement of heat transfer to a wall (coking recipient)

• Fundamental Spray Studies

The operation of Direct Injection (GDI) engines in a stratified charge mode requires the impingement of air in the piston surface forcing the spray to collide with it forming there a liquid film. The fuel contained in this liquid film cannot be burned, being exhausted from the combustion chamber and increasing the emission of Unburned Hydrocarbons (UBHC) and the fuel consumption. In this context, the work developed here will focus on spray performance, impinging droplets on the wall and the aerodynamics of the combustion chamber.

1) Liquid disintegration and spray development for engine flows

The analysis of the disintegration process of a flat liquid film will be continued by means of different visualisation techniques and optical diagnostics. The work in 2001 will consist on a parametric study applied to better understand direct injection systems, and making use of different injection angles for the atomising air, as well as a range of externally imposed oscillations in the flow. The work will be aimed to provide a controlled shear flow in the presence of which the liquid film is disintegrated in a way that allows studying the basic phenomena typical of direct atomisation for different strain levels. The analysis will include analysis of different geometrical conditions and will be particularly applied to the study of direct injection in practical engines.

2) Turbulent Dispersion in Two-Phase Flows

The flow of impinging droplets in hot surfaces will be studied for monosize and polydispersed spray systems, making use of various crossflow regimes. The results will include analysis of different geometrical conditions and will be particularly applied to the study of direct injection in practical engines.

3) Combustion Chamber Aerodynamics in Spark-Ignition Engines

In this research project a study of the combustion chamber aerodynamics will be attempted, with the objective of allowing the formation of a stratified charge with minimum spray impingement in the piston surface. Geometric and aerodynamic parameters such as piston surface design, injection timing and intake flow type will be studied in a model of a real engine with moving piston boundary condition using advanced diagnostic techniques such as Particle Image Velocimetry (PIV) and Laser Induced Fluorescence (LIF).

• Advanced Diagnostics for mixing studies

1) Turbulent mixing in ducts for stable and transient conditions

Emphasis will be given to the application of forms of Particle Image Velocimetry to acquire instantaneous information about the velocity field associated to the evolution of the Reynolds stresses along turbulent duct flows for a range of conditions. Transient conditions typical of real hydraulic flows will be studied, as well as swirl confined flows. The location of large-scale structures will be identified, and the distribution of vorticity will be studied for various parametric conditions.

2) Advanced diagnostics for combustion analysis

Emphasis will be given to linear imaging of laser Rayleigh scattering, which will be used to acquire instantaneous information about the scalar field that enables the quantification of scalar dissipation. As a result, scalar dissipation distribution can be associated to the evolution of the Reynolds stresses along turbulent flows and related to the location of large-scale structures, which are identified with the locus of maximum vorticity.

3) Tomography and advanced sensors for industrial combustion systems

The new tomography sensor developed for combustion systems will be further optimized and applied to non-premixed flames in laboratory, semi-industrial and industrial furnaces.

The major innovative feature of the new sensor consists on its ability to overcome the limitations of emission tomography techniques for sooty flames, as it enables the compensation of radiation extinction effects inside the flame. The emission data is combined with a soot radiation extinction model for the evaluation of local properties, thus avoiding the need for a background calibrated radiation source, as no transmission measurements are required.

4) Acoustic sensors based on capillary tubes

Development of wave-guide acoustic sensors based on the use of capillary tube and condenser microphones. These sensors require a full analytical approach followed by experimental validation, to determine the optimised hardware geometry and final transfer function, due to thermoviscous effect on the sound propagation inside the capillary tubes. These acoustic sensors should be used for the characterization of sound pressure fluctuations in confined reactive systems, such as combustion chambers, where it is required the use of “protected” and in general relatively small microphones. “Protected” microphones are required to prevent hot gases to damage the membrane. Small

microphones are necessary to avoid interference with the sound field, allowing mid- to high-frequency spectrum range of wavelengths to be acquired, and to have a better spatial resolution.

- ## Fire propagation and Risk Assessment

1) Fire Propagation: physical modeling of forest fire and compartiment fire

Critical issues on fire propagation will be studied based on the analysis of a forest fuel bed, which is a typical porous medium, whose characteristics (shape and size of the particles, bulk density, packing ratio) modify the gas flow behind and ahead of the flame. In this context, current work coordinated by João Ventura and José Miguel Mendes-Lopes will be continued through the study of the following parameters: i) the variation of pressure drop with the main properties of the medium (fuel type, bulk density, packing ratio), and ii) heat transfer within the fuel bed, leading to the determination of the convection coefficient and its dependence on the main properties of the medium.

Besides this experimental work, a different approach will be followed by using a computer code to simulate surface forest fire behaviour in heterogeneous terrain. This code was created in 1999 and will be optimized to run in a simple PC platform in a way which is compatible with GIS (ARCVIEW).

2) Technological Risk Analysis and Support to the National Service for Civil Protection

Risk assessment of "Transportation of Dangerous Substances in Portugal" is being developed to characterize the flow of dangerous substances in the Portuguese territory and to gather information to assist emergency management of accidents, which may occur in this kind of transportation.

LABORATORY OF ENVIRONMENTAL SYSTEMS

The Laboratory is organised on the basis of Research Areas, which include a range of projects. These projects provide the necessary external funding, namely from national and international funding agencies and/or private companies. The following is a list of the main Research Areas, under which the most important activities will be developed in 2001.

• Environment, Energy and Industrial systems: Management and Policies for Industrial Ecology

1)Fostering Life-cycle analysis for industrial ecology: the automobile industry

The design and development of optimised end of life vehicles, ELV, processing systems will be continued and optimized, addressing the whole life cycle of car components, in an industrial ecology perspective. Their contribution to promote scale factors associated with increased recycling rates in a small country, as Portugal, will be particularly studied. Life Cycle Activity Analysis, LCAA, will be optimized and used for the economic and environmental optimization of critical infrastructures, including the analysis of the Portuguese used tire market.

2)Environmental Policies

National and European environmental policies will be analyzed and assed. At a national level, the analysis will be integrated in a prospective study in order to better understand the role of technology to improve national competitiveness. In line with recent European Commission initiatives, an IPP-Integrated Product Policy is to be considered. IPP addresses the whole life cycle of a product, and seeks to avoid shifting environmental problems from one phase of the product life cycle to another. The analysis at European level will be focused on the automobile industry.

• Environmental Physics

1) Momentum, Mass and Heat transfer in the atmospheric boundary layer over and within plant canopies.

The methodology to be used in this area is of interdisciplinary nature, involving the scientific areas of fluid mechanics, instrumentation, physical ecology and agricultural sciences. The data related to the turbulent fields above canopies with variable roughness are suitable of adaptation to other surfaces, related with the problems already mentioned. The main objectives are: i) Evaluation of the vertical mass and heat fluxes in the boundary layer, between the canopy and the atmosphere; and ii) Experimental characterisation of the spatial and temporal structure of turbulence.

The measurement of the energy budget components: natural and forced convection, leaf transpiration and total evapotranspiration, soil heat conduction and radiative budget from the surface layer under study is a process of experimental optimisation of the eddy correlation and energetic methods whether in the selection of the parameters to search for a rapid characterisation of the ecosystems, whether in terms of optimisation of the sensors application methodologies and their respective sampling rates.

3) Carbon Balance of Eucalyptus Plantations in Portugal – towards the Kyoto Forest

The work performed in this area under the coordination of Gabriel Pita was aimed to: i) Quantifying the net ecosystem carbon exchange through the continuous measurement of surface flux of carbon dioxide using the eddy covariance method, ii) The quatification of carbon stocks by the inventory of biomass components and changes in soil carbon storage along a chronosequence of eucalypt plantations in Herdade da Espirra; and iii) To extrapolate the results found for carbon sequestration in the main site, across a range of soil and climate conditions in Portugal.

3)The optimization of climate conditions inside greenhouses for crop production

The optimisation of the use of screens (thermal and shading) in greenhouses is urgently needed and the following scientific and technical objectives will be optimized under the coordination of Gabriel Pita: i)Establishment of control algorithms to optimise the use of screens inside greenhouses in conditioning the microclimate ; ii) Establishment of the optimum strategies of using the screens both in winter and summer periods. To reach the foregoing objectives, the following specific aims have to be achieved:

I) The energy budget of the greenhouse will be evaluated, with and without screen, and the effect of the screen in the total greenhouse energy balance will be quantified.

II) Modelling the dynamical behaviour of the greenhouse climate with screens and its effect on the physiological behaviour and development of the crop.

LABORATORY OF TECHNOLOGY POLICY AND MANAGEMENT OF TECHNOLOGY

The Laboratory is organised on the basis of Research Areas, which include a range of projects. These projects provide the necessary external funding, namely from national and international funding agencies and/or private companies. The following is a list of the main Research Areas, under which the most important activities will be developed in 2001.

- ## Systems for Knowledge Creation, Diffusion and Usage

1) Higher Education Policy and Management

Research will focus on critical question behind the issue of Reforming European Universities, including analysis of institutional integrity and organizational diversity. Main topics will include:

- The Globalising Learning Economy: Major Socio-Economic trends and European innovation Policy";
- "Knowledge for Inclusive Development".

2) S&T and Innovation: Competences and Performance

Main National evaluation exercises carried out with the collaboration of IN+ researchers will be continued, namely in terms of their detailed analysis. It will include: i) Evaluation of Portuguese Research Units in 1999-2000, as conducted by the Portuguese Science and Technology Foundation; ii) Community Innovation Survey applied to Portugal in 1999, as conducted by the Portuguese Observatory of Science and Technology.

In addition, the challenges facing innovation in Portugal will be analysed under a major prospective study to be undertaken in Portugal, in order to better understand the role of technology to improve national competitiveness.

- ## Learning Economy: Institutions, Technological Change and Employment.

1) Towards a "Learning Society": avenues for S&T policy research

As the importance of knowledge creation and diffusion is increasingly recognized as a major driver of economic growth, questions are starting to emerge on how to establish the conditions that foster the processes of knowledge sharing across countries at different levels of development. Under the broad designation of “knowledge for inclusive development,” these questions defined one of the strongest research theme to be considered at IN+ During 2000. While the idea of inclusive development entails a process of shared prosperity across the globe following *local* specific conditions, it is crucial to understand both the features of knowledge-induced growth in rich countries, as well as the challenges and opportunities for late-industrialized and less developed countries. The research will be largely grounded on empirical experiences of both developed and developing countries. The results should include an original contribution on possible roles for science and technology policy in promoting inclusive development.

2) Technological Change and the challenges for Regional Development

The development of case studies in selected Portuguese regions will be developed, including the North, Algarve and Lisbon, and including international comparisons. It is argued that value-based networks have the potential to make both public trajectories for the inclusive development of society, but require effective public investments in intangible structures and the use of new metrics for

knowledge. The analysis will build on the concept of social capital, as a relational infrastructure for collective action, in a context much influenced by a dynamic of change and a necessary balance between the creation and diffusion of knowledge.

3) Technology and Economic Inequality

Technological Innovation, economic development and income inequality have been increasingly discussed and the analysis has suggested the need to develop either advanced research methodologies, or improved empirical analysis, for better understand possible linkages among the various issues, as well as improved policies and strategies. The work will continue to be performed in close collaboration with the UTIP – *University of Texas Inequality Project*, and will focus on the Theil statistics. In fact, the calculation of income inequality from survey data is an exacting business; it requires ranking individuals (or families) into groups of equal size and exact ordering on the income scale. But there is another statistic, originating with the econometrician Henri Theil, that can be computed from almost any type of grouped data, even if incomes within the groups overlap. This is Theil's T statistic, and the realization that it can be computed from industrial data sets is the basis for the work to be considered.

At the empirical level, and using extensively the analytical OECD databases on employment and wages, the work will bring together a rich data set that conveys how the recent rise in inequality in some of the most developed countries is associated to the levels of technology intensity of their industries. The ultimate goal is to discuss the extent to which the higher the technology intensity of industries, the stronger this association is.

4) Globalization, diversification and technology capacity in the auto parts sector

The project investigates questions in technology strategy and supply chain management related to how firm strategies and capabilities interact with geography. Specifically, the project examines firm diversification and internationalization decisions and how they vary across regions and firm characteristics, especially in what concerns their technological capabilities. The research is based in a panel of firms in the automotive supplier industry, a sector that has been extremely active in product and international diversification. The project addresses three areas. The first focuses the interaction between international investment and product diversification decisions and how they relate to firm performance, looking at the role of technological capabilities in these decisions. The second investigates the distinction between international greenfield investments and mergers or acquisitions as sources of external technical knowledge. The third analyses how regional policy conditions influence these decisions.

The research work is coordinated by Francisco Veloso and has been performed in close cooperation with INTELI, Lisboa, and the Materials Laboratory at MIT, Cambridge, USA.

• Management of Technology and Innovation: Technology Commercialization

1) Collaborative learning and virtual teaming

Experiments on collaborative learning and virtual teaming will be continued, making use of partnerships with leading world institutions. The technologies to be used include video-teleconference and other Internet based GroupWare. In this context, "virtual teams" have been associated with the emergence of distributed cross-organizational arrangements, which involve people from different organizations who work in different places. The result is the process of entrepreneurial education, through which the acquisition of new knowledge is followed by living and experiencing entrepreneurial environments, in order to facilitate the creation of new knowledge. The goal is to establish a learning triangle, integrating academic, vocational and experimental activities.

2) Fostering entrepreneurship at the University

The expansion of the role of the university, namely as an enabler of entrepreneurship and the our perspective of intellectual property protection in strengthening the impact of European universities and in preserving their institutional integrity will continue to be critically analysed in the context of a technology transfer model that represents the interactions between universities and the market. The analysis will be developed under the background of the new growth theories, which differentiate knowledge from objects, namely in terms of the level of exclusion and rivalry in consumption.

3. Other Activities: Transfer and diffusion of knowledge

To achieve the R&D goals previously defined, the activities developed through IN+ will continue including a range of other activities regarding the transfer and diffusion of knowledge, namely: i) advanced training; ii) organization of leading international conferences; iii) Workshops; and iv) editorial activities. These activities are briefly summarized in the following paragraphs.

3.1 Advanced Training

- ***M. Sc. in "Engineering Policy and Management of Technology", at IST - Technical University of Lisbon, http://in3.dem.ist.utl.pt/master/***

The program aims at training qualified professionals and at promoting the creation and diffusion of knowledge in Engineering Policy and Management of Technology. The program will contribute to the development of strategic leadership and the implementation of innovation policies, promoting the role of engineering, science and technology on the sustainable development of society. The program integrates post-graduate education and research activities, fostering the student's entrepreneurial skills and promoting competencies that will allow students to approach complex and non structured problems.

The first edition of this M. Sc. Program started in January 1998 under a grant of the Portuguese-American Foundation for Development, FLAD, which contributed to enhance links with major US universities, including the University of Texas at Austin. The program was awarded with a Fullbright rotating chair, starting on September 1998, for two years.

The main data for 2001 is as follows:

- 4th edition; 2001
  Number of Applications: 41
  Number of accepted students: 19
  Starting date: 26 January 2001

- ***Entrepeneurial Education***

In the area of advanced training, the Center will launch in 2001 the **"GreenWheel.net" Program,** on *Innovation and Internationalization of companies through the Application and Commercialization of Technology*.The program will include an advanced training international program aimed to develop competencies/skills for the start up and development of companies with the capacity for innovation and intemationalization through the application and commercialization of technology. It includes three main vectors: specific *technical training, experimentation and interaction.*

3.2 Organization of International Conferences

The CENTER FOR INNOVATION, TECHNOLOGY AND POLICY RESEARCH, IN+, promotes the transfer and diffusion of knowledge through the organization of major international Conferences, which have considerably contributed to diffuse knowledge worldwide, and promote the internationalisation of the Portuguese S&T system. Emphasis has been given, since 1982, to the application of laser techniques for fluid flow research, and this has contributed for the organization of a world leading conference in Lisbon every two years. Current activities include also the analysis of socio-economic research topics, namely looking at the role of knowledge for development. This has resulted in the organization of an international series of annual Conferences around the world.

The following are the most significant events being planned for 2001

- **Preparation of the 11th International Symposium on Applications of Laser Techniques to Fluid Mechanics, July 2002**
  http://in3.dem.ist.utl.pt/conflaser/

The 11th Int'l Symposium will be organized in July, 2002, but the related organization will start in 2001. It will bring together over 350 participants and is expected to include about 40 technical sessions. A book with selected and extended papers will be published through Springer Verlag, as described in http://in3.dem.ist.utl.pt/springer/.

The Symposia have contributed since 1982 for the presentation of new research on advanced techniques for flow measurement and results of significance to fluid mechanics. It has emphasized the application of laser, and other advanced techniques, to scientific and engineering investigations of fluid flow. Contributions to the theory and practice of measurement methods have been accepted where they facilitate new improved fluid mechanical investigations, and have included laser-Doppler velocimetry, LDV, phase-Doppler velocimetry, particle image velocimetry, PIV, and laser induced fluorescence and other scalar diagnostics. Non-optical techniques that provide new and reliable information on fluid flows, heat and mass transfer and complement that obtained with laser diagnostics have also been considered for the various International Symposia.

- **5th International Conferences on Technology Policy and Innovation, September 2001**
  http://in3.dem.ist.utl.pt/confpolicy/

As knowledge increasingly becomes a key strategic resource for regional as well as national economic development, there is a need to enhance our understanding of the barriers and incentives-in developed, developing, and emerging regions worldwide-for effective knowledge generation, transfer, application or use, and diffusion. In this context, the 5th Conference will be held in Delft, The Netherlands, in June 2001, focusing on "Critical Infrastructures".

A special issues will be published in the international journal "Technological Forecasting and Social Change" with selected and extended papers, http://in3.dem.ist.utl.pt/TFSC, and other outstanding material presented during the Conferences will be published through Greenwood Publishing Group

Inc., http://www.quorumbooks.com, in a QUORUM BOOK SERIES, as available in http://in3.dem.ist.utl.pt/quorumseries/

Details of the Delft Conference, as well those organized in previous years, can be found at http://in3.dem.ist.utl.pt/confpolicy/.

3.3 Workshops

- **Advanced Workshops on "Science, Technology and Society"**
  http://in3.de m.ist.utl.pt/adv/workshops/

Background and Objectives: The Advanced Workhops will act as a forum to exchange ideas and an opportunity of scientifically discussing the global changes on the development and use of science and technology and related social and ecological consequences.

Analysis has shown that continuous technical change in business firms in modern societies require the close development of publicly funded research and associated training, so that the development of a country´s science base is socially shaped (e.g. Pavitt, 1998; Research Policy). In this context, technology is not simply a tool or aplied science, nor is science simply the result of knowledge accumulation. Rather, science and technology are characterised by their entrenchment in society, thus requiring both interdisciplinary reflection and development of real-world strategies for action.

Based on this background, Innovation has been increasingly considered as a key factor in corporate and socio-economic performance and analysis has shown the importance of decentralized industrial policy in support of wealth creation and the well-being of future generations. In this context, the implementation of the current European Framework Programme for Portugal has raised the need to carry out projects assuring a coherent development in an innovative context. In fact, European Structural and Cohesion Funds have supported over the last few years important initiatives which aim at eliminating existing deficiencies comparatively to the European average, namely regarding basic infrastructures. Now the aim is to extend the scope of this type of projects and to foster innovation and promote sustainable development.

Structure: The workshops will take place during one or two consecutive days, including only plenary sessions. Emphasis will be given to structural aspects, namely through lectures delivered by national and international experts with the purpose of introducing fundamental concepts associated with the development of Science and Technology Policies. Technical sessions include expert topics which have raised world-wide attention, with emphasis on challenges and opportunities faced by enginners and researchers and technology managers in the context of the current European innovation policy.

Programme for 2001:

- **April, IST - Congress Center**

  Topic: ***Internet Journalism***

  Main Speakers: **Alves Rosenthal, University of Texas at Austin, USA**

- **October, IST - Congress Center**

Topic: ***Internet Economics and the Creative Destruction of Telecommunications***
Main Speakers: **Lee W. McKnight** and **About Paul Vaaler**

A joint porganization of IN+ with Edward R. Murrow Center for International Information & Communication, Hitachi Center for Technology and International Affairs, The Fletcher School of Law and Diplomacy,Tufts University, Medford, MA, USA.

Lee McKnight is an Associate Professor of International Communication and Director of the Edward R. Murrow Center, The Fletcher School of Law and Diplomacy, Tufts University, and a Visiting Scholar at the MIT Center for Technology, Policy, and Industrial Development.

Paul Vaaler is an Asssistant Professor of International Business and Director of the Hitachi Center for Technology and International Affairs, The Fletcher School of Law and Diplomacy, Tufts University.

- **November, IST - Congress Center**

Topic: ***Science, Technology and Regional Development***

Main Speaker: **Jean-Pierre Contzen**, European Commission

Discussants and Case studies: **Manuel Heitor, Paulo Ferrão** and **Pedro Conceição, IST**

3.4 Main Editorial Activities

- **Quorum Books: International Series on "Technology Policy and Innovation"**

  http://in3.dem.ist.utl.pt/quorumseries/

A main book series was launched in 1998 through Greenwood Publishers, QUORUM BOOKS, at Connecticut, USA, as a joint initiative of The IC2 Institute of the University of Texas at Austin, and the Center for Innovation, Technology and Policy Research. The main objectives are as follows:

> **(1)** to publish leading scholarly work representing academic, business, and government sectors worldwide on technology policy and innovation; and
> **(2)** to present current and future issues of critical importance for using science and technology to foster regional economic development and shared prosperity.

General Editors:

> **Manuel V. Heitor**, Center for Innovation, Technology and Policy Research, Instituto Superior Técnico, Lisbon, Portugal
>
> **David V. Gibson**, IC2 Institute, The University of Texas at Austin, Texas
>
> **Pedro Conceição**, Center for Innovation, Technology and Policy Research, Instituto Superior Técnico, Lisbon, Portugal and IC2 Institute, The University of Texas at Austin, Texas

During 2001, three books are expected to be published and three additional volumes should be planned, as described in http://in3.dem.ist.utl.pt/quorumseries/

- **TFSC: Special Issues on "Science, Technology and Innovation Policies"**

  http://in3.dem.ist.utl.pt/tfsc/

A series of Special Issues in the International Journal *'Technological Forecasting and Social Change'*, on:"Science, Technology and Innovation Policies", have been prepared and published since 1997 with selected and extended papers from the series of International Conferences on Technology Policy and Innovation. The plan for 2000 is as follows:

TFSC, Volume 66, Number 1, January 2001 (expected publication date)

Special Issue edited with selected and extended papers from the 2nd International Conference on "Technology Policy and Innovation", Lisbon, 1998

TFSC, Volume 67, Number 2, May 2001 (expected publication date)

Special Issue edited with selected and extended papers from the 3rd International Conference on "Technology Policy and Innovation", Austin, 1999

- **Springer: Series on "Laser Techniques and Applications to Fluid Mechanics"**

A series of books on '**Developments of Laser techniques and Applications to Fluid Mechanics**", which includes revised versions of selected papers presented at the International Symposia on Applications of Laser Techniques to Fluid Mechanics, which have been organized in Lisbon, at the Calouste Gulbenkian Foundation, since July 1982 and every two years, as described in http://in3.dem.ist.utl.pt/conflaser/.

The papers describe *Instrumentation Developments* and results of measurements of *Turbulent Shear Flows*, *Aerodynamics Flows*, *Mixers and Rotating Flows*, *Combustion and Engines*, and *Two-Phase Flows*. The papers demonstrate the continuing and healthy interest in the development of understanding of new methodologies and implementation in terms of new instrumentation.

During 2001, one book should be published with material from the 10^{th} Symposium, which was held in Lisbon in July 2000.

- **Other Books planned for 2001:**
  - **Oxford University Press, Oxford, UK**

    "Towards the Learning Society – Innovation and Comptence Building with Social Cohesion"
    edited by Pedro Conceição, Manuel Heitor and Bengt-Ake Lundvall

  - **IST PRESS, Lisbon, PT**

    "The Glass Chair – Competence Building for Innovation"
    edited by Manuel Heitor and José Duarte

  - **CELTA Publishers, Lisbon, PT**

    "Innovation in Portugal – The 2nd Community Innovation Survey" (In Portuguese)
    Pedro Conceição and Patricia Ávila