Competences for environmental performance in a Brazilian oil company

Giuliano Orlando Hippertt* and
Osvaldo Luiz Gonçalves Quelhas

Laboratory of Technology,
Business Management and Environment – Latec,
Department of Engineering,
Fluminense Federal University,
Rua Passo da Pátria, 156-Sala 329ª-Bloco E, Escola de Engenharia –
UFF, São Domingos – Niterói – RJ/CEP 24210-240 – Brasil
E-mail: giulianoh@petrobras.com.br
E-mail: quelhas@latec.uff.br
*Corresponding author

Eduardo Shimoda

Faculty of Production Engineering,
Department of Production Engineering,
Cândido Mendes University,
Rua Anita Peçanha, 100. Parque São Caetano –
Campos dos Goytacazes – RJ/CEP: 28030-335 – Brazil
E-mail: eduardo_shimoda@ucam-campos.br

Sergio Luiz Braga França

Laboratory of Technology,
Business Management and Environment – Latec,
Department of Engineering,
Fluminense Federal University,
Rua Passo da Pátria, 156-Sala 329ª-Bloco E, Escola de Engenharia –
UFF, São Domingos – Niterói – RJ/CEP 24210-240 – Brasil
E-mail: sfranca@latec.uff.br

Abstract: The objective of this research is to identify organisational competences that impact the environmental performance of organisations. The case analysed is the oil refining in Brazil. A case study is adopted as a research strategy, with a qualitative and a quantitative approach, using bibliographical and field research, including the use of a questionnaire followed by a descriptive statistics analysis. The sample, defined in a non-random convenience is composed of 18 experts with experience in environmental management in the refining area. It was identified 29 competences as important for environmental performance. It is concluded that these competences are broadly distributed in different areas of the company, not being limited to the environmental management division. Most competences are in the tactical level (51.7%). With the exception of management competences related to the

implementation of policies, licensing and environmental standards, the ten most important competences are related to operations and manufacturing technologies.

Keywords: environmental management; environmental education; environmental performance; green human resource management; management system; environmental management system; EMS; sustainability; sustainable development; refining and transportation of oil E oil products; competences.

Reference to this paper should be made as follows: Hippertt, G.O., Quelhas, O.L.G., Shimoda, E. and França, S.L.B. (2012) 'Competences for environmental performance in a Brazilian oil company', *Int. J. Environment and Sustainable Development*, Vol. 11, No. 4, pp.321–338.

Biographical notes: Giuliano Orlando Hippertt holds a MSc in Management Systems at Fluminense Federal University since 2012, certified as a Project Management Professional (PMP) by PMI in 2011. He has been working at Petrobras S.A. since 2006 holding different positions such as Project Manager and HR Development Manager, in the head quarter, and as the Head of Corporate Support, in Petrobras Europe Ltd., London. He is also the Brazilian representative in ISO TC 176/SC 3 Committee to develop the standard ISO 10018 – guidelines on people involvement and competence.

Osvaldo Luiz Gonçalves Quelhas was the President of the Brazilian Association of Industrial Engineering – ABEPRO in 2006 and 2008 and the Vice-President of the Brazilian Society of Knowledge Management in Rio de Janeiro in 2010. Currently, he is the Head of the Research on Development of sustainable index for the oil and gas sector as well as the Latec at UFF. He is the Coordinator of the Professional Masters on Management Systems of the Department of Industrial Engineering at UFF, a Professor in the Master and Doctoral program in Civil Engineering in the areas of civil production management, management systems with emphasis on sustainability (environment, social responsibility and safety at work).

Eduardo Shimoda received his Bachelor degree in Animal Science at Federal University of Viçosa, MSc and DSc degrees in Animal Production at the State University of North Fluminense (UENF). He leads the Masters in Operational Research and Computational Intelligence (POIC) at Cândido Mendes University, Campos. He is a Professor of the Masters program in Production Engineering and Regional Planning/Management of Cities and works with statistics applied to education and agriculture. Moreover, he is a consultant of the Foundation for Support of Science and Technology of Espírito Santo.

Sérgio Luiz Braga França received his Bachelor degree in Civil Engineering and his DSc degree in Civil Engineering with emphasis on management, production, quality and sustainable development at UFF. He specialises in health and safety at work at UFF, Leader Auditor in Environmental Management System (BVQI) and judge of Rio Quality Award (PQRio). He is a Professor of the Department of Civil Engineering at UFF, Research and Professor at Latec-UFF. Since 2006, he plans and runs P&D projects on sustainability, quality, social responsibility, safety at work and product design.

1 Introduction

Brunacci and Philippi (2005) argue that the era of winning economic development without restriction and at the expense of environmental damage no longer remains. However, it remains in some organisational cultures. The report of Brundtland (1987) mentions that the 'social organisation' with the technology is two key areas to achieve a sustainable form of development. In this line, a cleaner production requires new attitudes, knowledge and competences for all professionals (Unnikrishnan and Hedge, 2007). Thus, the ability of a country to follow paths towards sustainable development is determined largely by the ability of its people and its institutions, as well as its ecological and geographical conditions (United Nations, 1992). The capacity building of a country includes its resources and its human, scientific, technological and institutional competences (United Nations, 1992).

Most of the times 'capacity' is understood as an ability, training or stage before competency and 'competency' is considered as the transformation of these capacities into actions in the company (Bitencourt, 2009). The definition of competency adopted by this work is the one described by Parry (1996): "knowledge, abilities and attitudes combined, which greatly affects a work if correlated with performance, and that can be measured with well accepted parameters and improved through training and development. The "capacity development" is defined as a process by which individuals, organizations and societies to obtain, strengthen and maintain the ability to set and achieve their own development objectives over time" (UNDP, 2009). As part of this development, Perron et al. (2006) highlight the importance of environmental education organisations has been well established in the literature. Employees should understand how they can contribute to sustainability efforts approved by the organisation. An effective strategy for a better environmental performance requires that all employees of an organisation should be aware of their natural systems and functioning, as well as understand their effects on business performance. This understanding allows employees to participate and improve the performance of environmental management (Perron et al., 2006).

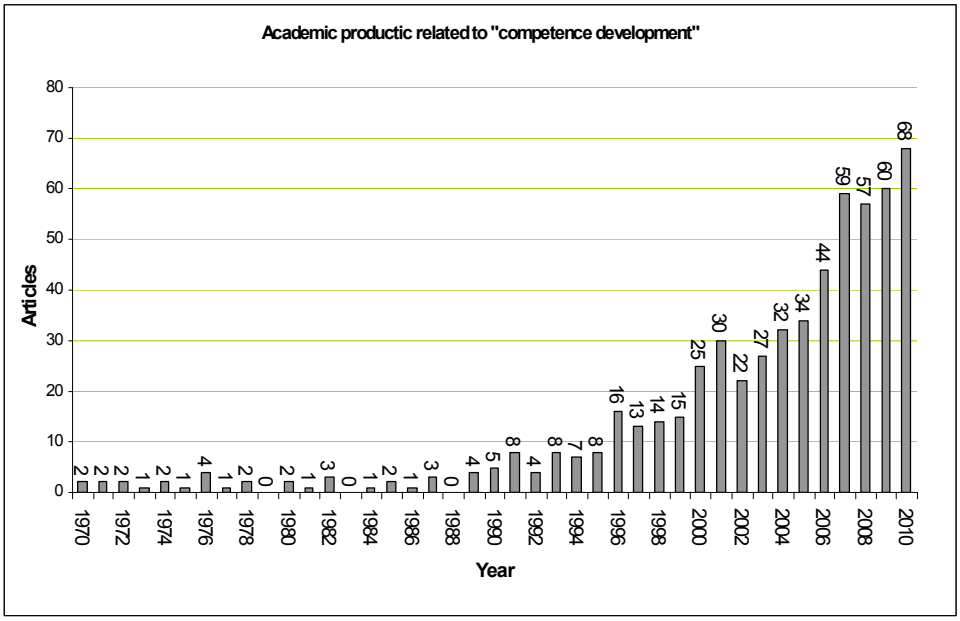
To clarify the approach of this scenario and to define the case to be studied here, different activities in the oil industry are analysed, with an emphasis in refining, due to its environmental relevance. Mariano (2001) state that the petroleum refining segment can be, and often is inevitably destructive to the environment, it has the potential to affect it at all levels: air, water, soil, and consequently all living beings that inhabit the planet. Directly related to the refining, transportation of oil and oil products in Brazil, mainly maritime, can cause serious environmental impacts (Silva, 2004).

In this context, this work is based upon bibliographical and field research in order to link competences development to improve the environmental performance of the refining and transportation of oil and oil products in order to identify these competences and their relative importance. The aim of this work is to contribute to the development of studies related to the competences that impacts the environmental performance of organisations in this area, which is known for its high potential of environmental impact (Mariano, 2001). The research is justified by the low interaction between environmental management and people's management in the reality of organisations (Jabbour and Santos, 2006).

An exploratory research on the internet in December 2010 in the Scopus database identified the volume of production of academic knowledge on 'competences development' and 'environmental education', and verified the low amount of specific

productions for the oil industry. The query terms were used in English to increase the range of research to other countries. The term 'environmental education' has been researched for their relevance to the development of competences with a focus on environmental issues (Unnikrishnan and Hedge, 2007). It was identified in Scopus, the record of 2,889 articles, only 21 (0.7%) related to oil. The related graphic is displayed in Figure 1.

Figure 1 Academic production on 'competence development', data found at Scopus in 20/12/2010 (see online version for colours)



Source: Data from Scopus

1.1 Research problem formulation

Despite a large number of companies that have introduced different environmental management systems (EMSs), aiming to improve the environmental performance, the effectiveness of the results has not been universal (Perron et al., 2006). The recent history of environmental management demonstrates strong focus more on procedural and technological factors, while, there is a gap in the management of human factors correlated (Wehrmeyer, 1996). The interaction between the practices of human resource management and environmental management in general is not only theoretical, however, is scarce in the organisational context (Jabbour et al., 2008). The application of an EMS may not be sufficient to ensure the improvement of environmental performance of an organisation. A new philosophy must be established on the ability to identify and analyse the critical elements of management, to define corrective actions and to do what is planned (Iraldo et al., 2009). Human factors, among them the development of competences, are an integral part of the process of implementing EMSs, an instrument

directly related to the environmental performance. In this context, the identification of competences related to the environmental performance of organisations is the central problem of this research. The central question of this research is: which competences support the improvement of business environmental performance of the refining and transportation of oil and oil products.

This work covers a case study on company Petrobras, a publicly traded company founded in 1953. It has activities in 30 countries on all continents. In Brazil, the company is leader in the oil sector and ranks the third position among the international energy companies in market value according to PFC Energy's ranking. Petrobras operates in exploration and production, refining, oil and natural gas trade and transportation, petrochemicals, oil product distribution, electric energy, biofuels, and in other sources of renewable energy (Petrobras, 2010).

With an average daily output of 2.6 million of oil equivalent, Petrobras ended 2010 with 80,492 employees. Com uma produção de 2,583 mil barris de óleo equivalente de petróleo e gás natural, somando Brasil e exterior, 2,338 mil barris somente no Brasil, a Petrobrás possui um quadro de 80,492 funcionários ao final de 2010. According to the 2010 sustainability report the projects are designed considering its stakeholders in order to contribute to reduce social inequality. Moreover, the company presents an economic feasibility analysis (EVTE) for these initiatives considering several approaches like economic support, environmental protection and human rights and eco-efficiency Standards (Petrobras, 2010).

Considering these numbers and the potential of the company to transform the environment, Petrobras was the object of this research.

1.2 Purpose

The main purpose of this research is to identify competences that support the improvement of business environmental performance .The conclusions from this work can be used as a reference to the structuring of training programmes for professionals in the oil industry, considering the environmental performance. The aim of this research is to identify competences with emphasis on the environmental performance of refining and transportation of oil and oil products.

1.3 Methodology and limits

For this approach, it was used the methodology of case study since it involves a careful observation of an institution. According to Kothari (2004) a case study is an investigation of a particular unit under consideration. The method of data collection is classified as collection of secondary data since it is data that are already available in official documents and published reports. This work also uses the method of collection of data through questionnaires since a questionnaire was applied to specialists from Petrobras in order to validate the competences considered in this paper.

The data collection for research, both for the documental analysis stage and field research stage, occurs in the period 01/06/2009 to 15/08/2011 in Brazil. The document analysis is complemented by internal reports of 2009/2010 available to the researcher by the organisation studied, which operates in the refining and transportation of oil and oil products in Brazil.

1.4 Research hypotheses

Having defined the problem, the next step is the formulation of hypotheses that could solve it and that also serve to guide subsequent steps of the research project (Leedy and Ormrod, 2001). Thus, two hypotheses were formulated to answer the central research question and achieve the goals:

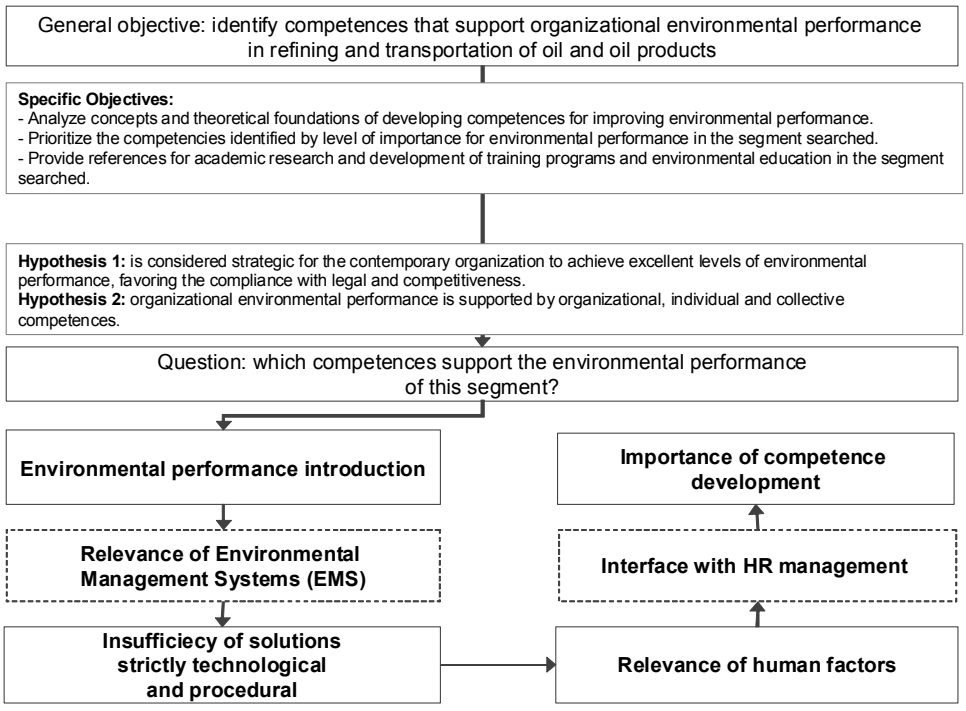
Hypothesis 1 Is considered strategic for the contemporary organisation, achieving excellent levels of environmental performance, favouring the compliance with legal requirements and competitiveness.

Hypothesis 2 Business environmental performance is supported by organisational competences, individual and collective.

2 Literature review

Figure 2 shows the flow that provides relationship between objective, research question and the topics covered in the chapter.

Figure 2 Relationship between objective/research question/topic of chapter



2.1 Business environmental performance

Jung et al. (2001) affirm that business environmental performance is given by the relationship between the organisation and the environment. Performance can be measured by the quality of its EMS, by the management of inputs and processes, the level of

innovation throughout operations to make them cleaner, combined with financial and non-financial results. The environmental performance of an industry cannot be quantified in absolute terms, in view of the diverse relationship between industrial activity and the environment. This is both a source of raw material, energy, water and other inputs, and is the depository of wastes and effluents that come out of it and where the impacts occur, positive or negative, on various environmental factors (Fiesp – Federação das Indústrias do Estado de São Paulo, 2011).

According to the report supply chain decarbonisation, prepared by the World Economic Forum (2009), human activity annually generates greenhouse gases of about 50,000 tons of CO_2. It is estimated that around 2,800 mega tones – or 5.5% of the total – are from the logistics industry and transport. Environmental performance is not found at the departmental level, but the organisational, which allows tracking progress, but still leaves open the challenge of responsibility (Wehrmeyer, 1996). According to Jung et al. (2001) there are five main approaches to assessment of environmental performance's evaluation. They are:

- social responsibility/compliance
- viability of the business
- management, accounting/performance measurement
- organisational change
- others.

Jung et al. (2001) also present a classification of the main research related to the measurement of environmental performance. This classification is displayed in Table 1.

Table 1 Classification of the main research measuring the environmental performance

Author search	*Classification*
James	Impact, risk, emissions/waste, input of resources, efficiency, customer, financial measures
Nrtee	1 The rate of resource productivity
	2 Rate of release of toxic
	3 Costs of goods and disposal in relation to durability
Ditz and Ranganathan	1 Use of material
	2 Energy consumption
	3 Non-product output
	4 Release of pollutants
Ilinitch et al.	1 Organisational systems
	2 Relations with stakeholders
	3 Regulatory compliance
	4 Environmental impacts
Wells et al.	Process improvement, environmental performance, customer satisfaction
ISO 14031	Environmental performance indicator (IDA), an indicator of environmental condition (ICA): IDA is divided again in the indicator of performance management (IDG) and operational performance indicator (IDO)
KPMG	Measure the impact, extent of the taxpayer
GRI	Energy, materials, water, emissions/effluents/waste, transportation, suppliers, products and services, land use/biodiversity compliance

Source: Jung et al. (2001)

The Global Reporting Initiative (GRI) defines the key indicators for the developments of a sustainability report are those of interest to most stakeholders. These indicators are grouped into categories, covering different aspects of performance. The key aspects and indicators of the environmental category of the GRI are: materials, energy, water, biodiversity, emissions, effluents, and waste products and services, compliance (GRI, 2011)

Analysing the entire supply chain, focal companies of the supply chain can be held responsible for environmental and social performance of their suppliers. The life-cycle analysis should be performed on the input materials and products (Seuring and Müller, 2008).

Darnall et al. (2008) state that several researchers have studied the relationship between the EMS and improved environmental performance and assessed the reasons for its adoption. According to Jabbour et al. (2008), the EMS is the management tool most commonly used in business for this purpose. According to Peglau (2006 apud Sammalisto and Brorson, 2006), the EMS is composed of five main phases:

1 defining the objectives of environmental management (environmental policy)

2 understanding the means by which these goals can be achieved (planning)

3 mobilisation of organisational resources (implementation and operation)

4 application of mechanisms' control (control)

5 analysis of top management.

Darnall et al. (2008) claim that the argument of whether or not proactive environmental activities lead the company to better performance is far from being resolved.

Darnall et al. (2008) highlight that organisations are encouraged to adopt EMS for extensive reasons, such as export orientation, commitment to employee and R&D environment (as opposed to those that do only by institutional pressures) detect better overall business performance and facilities level.

2.2 Influence of human factors in environmental performance

Practical experience and a number of studies demonstrate that the commitment of managers and employees is essential for the implementation and maintenance of the EMS (Sammalisto and Brorson, 2006). Perron et al. (2006) indicate that some of the limitations of a more sustainable business approach are related to the human aspects of the organisation and changing process for the incorporation of environmentally responsible behaviours.

Wehrmeyer (1996) highlights that environmental awareness is correlated with the attitude about the environment, whether real or intended, and the participation is defined as the influence that employees have in making decisions related to corporate environmental policy.

The literature indicates that the support of human resource practices is crucial for effective environmental management, for its central position and legitimacy to promote the environmental dimension (Jabbour et al., 2008). Factors related to human resources, such as: top management support, environmental training, empowerment, teamwork, and reward systems have been identified as key elements in the process of implementing an EMS (Unnikrishnan and Hedge, 2007). However, Wehrmeyer (1996) points out that there

is a need to review the practices and purposes of HR for this purpose. Jabbour et al. (2008) corroborate this view. Wehrmeyer (1996) introduces the discussion held in the UK about the expansion of the powers of employee representatives for industrial safety in companies to also include environmental rights, such as: know the impacts of the work, participate in decisions and strategies, receive specific training and refusing, without recrimination, to undertake work potentially damaging to the environment.

Unnikrishnan and Hegde (2007) claim that ISO 14001 has made companies give more importance to environmental education. Incentives for training and evaluation are among the most important aspects of an effective environmental management programme (Wehrmeyer, 1996). Sammalisto and Brorson (2006) described a research which shows that some managers indicate as positive effects an increased awareness and improved environmental performance as a result of training. Also as an example, the European Union found that driver training programmes can generate an average fuel savings of 9% (World Economic Forum, 2009).

Milliman and Clair (apud Wehrmeyer, 1996) present the main types of environmental training programmes in the USA:

- regulatory requirements
- awareness of the employees
- the total quality management environment.

Bird (apud Wehrmeyer, 1996) asserts that the most effective way of promoting this type of training is integrating the environmental issue to existing training.

2.3 Final considerations on the literature review

The literature reviewed allows the verification of hypotheses. However, this step does not allow that the research question is answered, because the literature provides only general competences that support business environmental performance, independent of a particular segment, as the case study.

Below are some of the general competences identified in this step:

- UNDP (2010): To perform functions, solve problems, set and achieve goals in a sustainable way, manage institutional arrangements, leadership competences, knowledge management, compliance, involve concerned parties, analyse the situation and define a vision, to formulate policies and strategies, to budget, manage and execute.
- UN (1992): Evaluating political choices and their implementation method.
- UNESCO (1975), Belgrade Charter: Raising awareness about the environmental problem, to provide access to specific knowledge about the environment, to promote attitudes for the preservation of the environment, to develop specific competences for environmental actions, to evaluate the actions and implemented programmes, to develop local, national and international cooperation, and to promote the participation of all in solving problems.
- Sammalisto and Brorson (2006): Create and manage policies, environmental issues, procedures, instructions and reports of non-compliance of the company.

- Unnikrishnan and Hegde (2007): Develop operational efficiency, new technologies and environmental management techniques and sustainable strategies for long-term.
- Biondi (2000): Capacity of planning.
- Wehrmeyer (1996): Interpersonal skills and contacts to gain voluntary acceptance of them for the environmental message, but also the personal and organisational support to win battles.
- Friedman (1992): Comprise technical understanding of the environment, be an solicitor for ideas; appreciate the ethical understanding of the environment; have credibility; know the laws.
- James and Stewart (apud Wehrmeyer, 1996): Develop policies, coordinate, communicate, control, provide advice, manage change and strategies, teamwork, long-term environmental vision and ability to quantify the environmental performance, leadership, networking, conflict management, orientation to the business and future vision.
- The UK Institute for Environmental Management (1993): Have strategic vision, business knowledge, motivation/training/leadership, external communication, contingency planning, management competences.
- Bird (apud Wehrmeyer, 1996): For employees: to understand how environmental issues affect them and their work, their current and potential impacts on the environment, what they can do to minimise this impact. For those responsible for specific tasks related to environmental issues: what should be done in normal and abnormal operation and why, the impacts of failures in their activities for the organisation and the environment, the impact of the legal point of view individual and corporate, as their activities fall in the activities, policies and objectives of the organisation. For the manager of environmental management techniques to control the effects of the operation of the organisation on the environment, trends in environmental management and its relevance to the organisation, how to spread environmental issues in the organisation, how to stay informed and keep it; principles and environmental management practices.
- Sammalisto and Brorson (2006): Knowing the environmental policy, environmental aspects of the company, procedures, instructions and reports of non-compliance.
- Rondinelli and Vastag (2000), Beard (2000), Lozano, (1996 apud Sammalisto and Brorson, 2006): Know company policies and procedures routine and change the attitudes of individuals, creating more awareness of environmental issues.

While the mentioned authors defend the direct contribution of competences and their development to support the improvement of environmental performance, others do it by the argument that competences sustain management systems, which sustain the environmental performance. However, there is no consensus on the evidence of these contributions.

3 Field research

3.1 The studied organisation

At Petrobras, the refining, logistics, transportation and trading of oil products, oil and alcohols are mainly made by the business area called Downstream (Petrobras, 2009). Petrobras supplies almost all the Brazilian market demand for oil – about 1.847 million bpd (barrels per day) of oil and 370,000 bpd of natural gas. The downstream includes eleven refineries in Brazil with capacity to produce 1.986 million bpd, a factory of Shale, a total length of 31.089 km pipelines, 44 terminals, bases and its own fleet of 50 vessels (Petrobras, 2010).

The themes of the core and additional indicators of the environmental section, contained in the sustainability report of Petrobras, are presented in Table 2 (Petrobras, 2009).

Table 2 Environmental performance

Themes of the core and additional indicators	*2005*	*2006*	*2007*	*2008*	*2009*
Oil leaks and oil products (m^3)	269	293	386	436	254
Competences consumption (TJ)	521.61	576.76	574.14	604.33	531.37
Emissions of greenhouse gases (million tonnes of CO_2 equivalent)	51.57	50.43	49.88	58.08	63.09
Emissions of carbon dioxide – CO_2 (million tonnes)	46.59	46.13	45.37	53.54	52.92
Emissions of methane – CH4 (tons)	222.97	189.82	206.02	185.33	465.95
Emissions of nitrous oxide – N_2O (tonnes)	981.00	997.23	919.50	1.22.00	1,240.00
Atmospheric emissions – NO_x (tons)	223.12	233.54	222.65	244.50	222.04
Atmospheric emissions – SO_x (tons)	151.65	151.96	150.90	141.79	135.39
Other atmospheric emissions – including particulate matter (tons)	17.24	17.11	15.22	16.71	19.30
Withdrawal of fresh water (million m^3)	158.50	178.80	216.49	195.18	176.00
Effluent water disposal (million m^3)	159.00	164.30	172.80	181.14	197.20

Source: Petrobras (2009) sustainability report

3.2 Data obtained: competences that support the environmental performance of refining and transportation of oil and oil products

A list of competences that could potentially support the improvement of environmental performance in refining and transportation of oil and oil products was identified. This list is presented in Table 3, with their statistics references:

Table 3 General competence ranking by level of importance

Level	*Ranking*	*Competences (29)*	*Average importance level*	*Standard errors*	*General importance ranking*
Strategic	1	Manage policies, guidelines, procedures and indicators of HSEE	8.67	0.33	4
	2	Manage certifications, audits and compliance to environmental legislation	8.44	0.41	9
	3	Manage relationship with society and environmental responsibility actions	8.06	0.39	17
	4	Manage products life cycle	7.44	0.57	24
	5	Manage programmes of environmental education and awareness	7.22	0.50	27
Tactic	1	Optimise performance and efficiency of the refining park	8.89	0.33	1
	2	Monitor and develop solutions for thermal fuels and emissions systems	8.78	0.34	2
	3	Monitor and develop solutions for water, effluent and residues treatment	8.72	0.30	3
	4	Develop solutions for water consumption optimisation	8.61	0.24	5
	5	Manage licenses, grants, studies and reports on environmental impacts	8.56	0.34	6
	6	Manage operational and environmental risks	8.50	0.37	8
	7	Develop energy efficiency solutions	8.44	0.35	10
	8	Develop new units preliminary designs, final and implementation plans	8.28	0.37	13
	9	Manage adaptation, optimisation and improvement of products quality	8.22	0.38	15
	10	Develop danger analysis, contingency and environmental emergencies plans	7.83	0.41	19
	11	Manage impacted areas	7.89	0.31	18
	12	Lead people and manage recruitment, performance and recognition	7.78	0.41	20
	13	Manage procurement and performance of suppliers	7.56	0.42	23
	14	Manage actions to preserve biodiversity in areas of influence	7.44	0.42	25
	15	Manage optimisation of logistics and atmospheric emissions from transport	7.44	0.44	26
Operational	1	Control operational emergencies	8.56	0.35	7
	2	Manage leaks, spills and overflows control system	8.39	0.43	11
	3	Operate process of wastewater treatment in refining	8.39	0.41	12
	4	Operate processes of sulphur and other harmful substances recovering	8.28	0.39	14
	5	Manage reduction, handling and disposal of residues and waste	8.22	0.48	16
	6	Manage equipment maintenance, inspection and refinery turn around	7.67	0.58	21
	7	Operate process of oily and solid residues treatment in refining	7.67	0.70	22
	8	Manage handling, storage, inventory, and tracking records of oil and products	7.22	0.45	28
	9	Manage actions of coastal and ocean monitoring	7.11	0.53	29

Response in the open fields to insert additional competences or comments were registered as following:

- manage technologies' development to reduce cost and increase technological effectiveness
- use safe and updated technologies
- establish strategic objectives in HSEE, goals, deployment and monitoring results
- integrate the investment plan with the HSEE projects portfolio (energy efficiency, reusing, systems of emission's abatement, biodiversity, impacted area, alternative energy sources, etc.)
- to promote the transparency and professionalism in dealing with environmental issues
- manage the relationships with environmental services suppliers
- retention of talents and develop competences.

3.3 Data analysis

To analyse the ratings of each competency a relationship between the results of field research and literature review and documentary analysis was performed.

At the strategic level, competences that occupy the top two positions in levels of importance, with significant difference compared to others, are characterised as pillars of EMSs and, consequently, of environmental performance. According to UNDP (2010), Sammalisto and Brorson (2006) and UN (1992), it is essential that the company adequately formulate policies and strategies to achieve success in environmental issues. As for certifications, Friedman (1992) state that it is necessary to understand the technical environment, as well as know the laws related to the environment. UNDP (2010) reports it is important to involve stakeholders, as well as UNESCO (2010) that recommends people's awareness about environmental problem, the development of cooperation at local, national and international levels, as well as promoting participation of all in problem solving, what relates to the relationship with society being in the 3rd position. With a lower average and the highest standard error of this level is the products life cycle competence. This raises the question of the level of dissemination of this theme in the company. As shown in Perron et al. (2006), competence in education programmes can be analysed as a basis of support for changing environmental attitudes and for technical development in companies.

At the tactical level is positioned most of the competences that potentially impact the environmental performance (51.7%). With the highest average level of importance in all levels (8.89), optimising the performance of the refining park, is a broader, directly related to key environmental indicators, competence. Bird (apud Wehrmeyer, 1996) states that the use of techniques to control effects of operations on the environment could help performance optimisation. This was the only competence which 50% of people selected the maximum level of importance, 10. In the 2nd and 3rd positions, the competences related to the treatment of air emissions and of effluents are directly linked to two of the most controlled environmental indicators in this segment. This control is further restricted in the case of emissions, what could be related to a greater perceived

importance and a lower standard error. UNESCO (2010) recommends the development of specific technical competences for environmental actions. The water consumption optimisation, in 4th position, indicates the growing importance of this approach in this highly water and energy consuming industry. This can be seen as well in energy efficiency, in the 7th position. Both are related to GRI (2010). In the 5th position, licensing process, Sammalisto and Brorson (2006) highlight the importance of reporting non-compliance actions. With regards to operational risk management, 6th position, the Institute of Environmental Management (1993) cites that establishment of contingency planning is essential, and Bird (apud Wehrmeyer, 1996), indicates the importance of establishing risk assessment and the dissemination of environmental impacts. This competence allows the definition of parameters for setting objectives and environmental indicators that ultimately quantify the environmental performance. Developing new units, in the 8th position, which, as described by Mariano (2001), are crucial in environmental performance to be achieved by future operation units. Product quality, 9th, impacts on the indirect emissions of this industry, after final user consumption, which has restricted pollution reduction targets, as shown in the documental analysis. Safety and emergency plans, 10th, are characterised as benchmarks for control and remediation of environmental impacts. 'Managing impacted areas' lies in 11th position, with significant difference compared to the first nine with competences. This may be related to the fact that the impact has already been made, than it can only be minimised. Leading people and procurement have similar averages (above 7.5) and characterise the recognition by specialists of the importance of these competences, not specific environmental management, technological or operational competences, for the performance. This supports the greater involvement of other areas of the organisation in environmental issues as cited by Jabbour et al. (2008). The leadership is quoted by UNDP (2010) as essential to the business strategy that aims to achieve goals related to environmental issues. The biodiversity conservation value, above 7, however, in the penultimate position, may be related to a theoretical lower relative magnitude of the related impacts of this competence when compared with the others. Finally, as been complementary to refining, optimisation of logistics ranks last with 7.30.

At the operational level, the competences related emergencies and leaks control have the same concept to prevent the impact, in the 1st and 2nd positions. With the same level of importance to the control of leakage with 8.39, is the competence in effluents, showing consistency with the positioning of its counterpart at the tactical level. The same occurs with sulphur recovery in the 4th position. At both levels, these two themes are among the first four positions. If those operations are performed at optimal levels, they can further optimise the potential of technologies, while failures can seriously jeopardise the environmental performance and lead to severe environmental impacts (Mariano, 2001). The waste management and the more specific competence related to refining solid residues, have an increasing level of importance in the company, in line with the relevant issue in Brazil of the national policy for solid waste been released. The equipment maintenance are related to fugitive emissions, despite not being placed among the five most important, it also has an important result, especially considering the fact that it is not an operation competency. The lower importance for handling and storage can also be related to the lower relevance of their indicators compared to the others. Finally, perhaps because of its specificity and a more passive than active in performance, the coastal monitoring is in the last position, therefore, also with an average greater than 7.

When analysing the overall ranking of importance of all the competences together, it is observed that with the exception of competences related to policies, licensing and certification, the ten most important competences are related to operations, techniques and technologies of the core process of refining, not being general environmental management competences, but rather, specific competences of the business in question.

3.4 Final considerations of the field research

Considering that the average assessment, consolidating the three levels and all individual competences, were above 7, in a 10 levels scale, it can be inferred that the competences identified are important for environmental performance, as perceived by the participants. Corroborating this conclusion, additional competences reported by respondents in the open fields only complemented the competences of the questionnaire previously provided.

At the tactical level, strategic planning is transcribed into practical plans, making it easier to establish a direct correlation of its importance for the environmental performance. The competences of this level have, in almost all cases, a character of preventing or reducing environmental risks and impacts, which may explain the higher concentration of competences.

At the operational level, the competences have a more contentious characteristic and are more related to the final operations of refining and transportation. Although its preventive approach being limited and not being executed by environmental management areas, these competences are directly related to environmental performance, in a highly impactful way, either by optimisation or fault. Having been in this highest level of standard error can be raised a discussion about the level of dissemination and consensus of environmental experts about the direct participation of those responsible for operation and maintenance of industrial processes in environmental performance.

Finally, at the strategic level, although competences may also contribute to the prevention of risks and impacts, the classification of the average importance in a lower level may be related to the fact that impacts on performance can be broader, more indirect and in a long run perspective.

4 Conclusions

Competences development and environmental performance in refining and transportation of oil and oil products were studied in a related way to answer the research question and meet the proposed objectives

Through the literature review were confirmed the first hypothesis that excellence in environmental performance favours the compliance with legal and competitiveness. The field research confirmed this conclusion in the perspective of the specific case studied. Based on the analysis of the results obtained, it can be stated that the central question of this research was answered from the presentation of competences that support the improvement of environmental performance, according to the methodological assumptions adopted. To meet the proposed objectives, beyond the analysis of theoretical foundations, have been identified, validated and prioritised the required competences. Then, using statistical analysis of the expert perception, it was possible to validate the

second hypothesis, that there are specific competences that support the environmental performance in the studied area, as well as their different levels of relative importance

With this competence selection, it becomes possible to define a scope of what can and should be trained to sustain environmental performance or improve it, featuring fully meeting of the general and specific objectives of the research. With the importance hierarchy structure it is possible to prioritise what should be trained first and with the largest investment, and where the emphasis should be in controlling the outputs.

Analysing the competency framework obtained from their processes of origin, it appears that the competences that support the improvement of environmental performance of the refining and transportation are scattered over various parts of the organisation and not concentrated in the function or management sector environment.

It is also evident that there is a correlation between the perceived level of importance of the competences and the level of relevance and control of the organisational indicators. It can be shown that the higher the significance given to a performance indicator tends to increase the perceived importance of the competences related, for example, as seen in the case of atmospheric emissions and liquid effluents observed in the case studied.

Regardless of the contribution of organisational competences to support the environmental performance being direct or indirect, this study gathered evidence to indicate that it is relevant to invest in competence development with a view to improve environmental performance. Thus, HR professionals must be prepared to support environmental management teams, strengthening this new field.

The decision not to detail more the research regarding the attitudinal and behaviour competences was due to the fact that these are already widespread and developed in the literature.

References

Bitencourt, C.C. (2009) 'A gestão por competências: uma análise da mobilização entre competências, capacidades e recursos', *Revista Brasileira de Docência, Ensino e Pesquisa em Administração*, Vol. 1, No. 1, pp.126–136.

Brunacci, A. and Philippi, A. Jr. (2005) 'Dimensão humana do desenvolvimento sustentável', in Philippi, A. Jr. and Pelicioni, M.C.F. (Eds.): *Educação Ambiental e Sustentabilidade*, 1st ed., Manole, São Paulo.

Brundtland, G.H. (1987) *Our Common Future*, 1st ed., Oxford University Press, Oxford.

Darnall, N., Henriques, I. and Sadorsky, P. (2008) 'Do environmental management systems improve business performance in an international setting?', *Journal of International Management*, Vol. 14, No. 4, pp.364–376.

Fiesp – Federação das Indústrias do Estado de São Paulo (2011) Available at http://www.fiesp.com.br/download/publicaçoes_meio_ambiente/cartilha_indic_ambiental.pdf/ (accessed on 10 January 2011).

Friedman, F.B. (1992) 'The changing role of the environmental manager', *Business Horizons*, Vol. 35, No. 2, pp.25–28.

GRI – Global Reporting Initiative (2011) Available at https://www.globalreporting.org/NR/rdonlyres/.../0/G31ComparisonSheet.pdf (accessed on 11 February 2011).

Institute of Environmental Management (1993) *Standards of Competence*, Edimburgh, UK.

Iraldo, F., Testa, F. and Frey, M. (2009) 'Is an environmental management system able to influence environmental and competitive performance? The case of the eco-management and audit scheme (EMAS) in the European union', *Journal of Cleaner Production*, Vol. 17, No. 16, pp.1444–1452.

Jabbour, C.J.C. and Santos, F.C.A. (2006) 'Evolução da gestão ambiental na empresa: uma taxonomia integrada à gestão da produção e de recursos humanos', *Gestão & Produção*, Vol. 13, No. 3, pp.435–448.

Jabbour, C.J.C., Santos, F.C.A. and Nagano, M.S. (2008) 'Environmental management system and human resource practices: is there a link between them in four Brazilian companies?', *Journal of Cleaner Production*, Vol. 16, No. 17, pp.1922–1925.

Jung, E.J., Kim, J.S. and Rhee, S.K. (2001) 'The measurement of corporate environmental performance and its application to the analysis of efficiency in oil industry', *Journal of Cleaner Production*, Vol. 9, No. 6, pp.551–563.

Kothari, C.R. (2004) *Research Methodology: Methods and Techniques*, 2nd ed., New Age, Jaipur.

Leedy, P.D. and Ormrod, J.E. (2001) *Practical Research: Planning and Design*, 7th ed., Prentice-Hall, Merrill/Prentice Hall, Upper Saddle River, New Jersey.

Mariano, J.B. (2001) 'Impactos ambientais do refino de petróleo', Unpublished MSc thesis, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil.

Parry, S.B. (1996) 'The quest for competencies', *Training and Development*, Vol. 33, No. 7, pp.48–56.

Perron, G.M., Raymond, P.C. and Duffy, J.F. (2006) 'Improving environmental awareness training in business', *Journal of Cleaner Production*, Vol. 14, No. 6, pp.551–562.

Petrobras (2009) *Sustainability Report 2009*, Relatório de Sustentabilidade 2009, Petrobrás, Brazil, available at http://www.petrobras.com.br/rs2009/downloads/pt/RS_0615.pdf (accessed on 14 December 2010).

Petrobras (2010) *Sustainability Report 2010*, Sustainability report based on Global Reporting Initiative's model, available at http://www.petrobras.com.br/rs2010/en/index.asp (accessed on 10 May 2012).

Petrobras, available at http://www2.petrobras.com.br/Petrobras/portugues/perfil/per_abastecimento.htm/ (accessed on 14 December 2010).

Sammalisto, K. and Brorson, T. (2006) 'Training and communication in the implementation of environmental management systems (ISO 14001): a case study at the University of Gävle', *Journal of Cleaner Production*, Vol. 16, No. 3, pp.299–309.

Seuring, S. and Müller, M. (2008) 'From a literature review to a conceptual framework for sustainable supply chain management', *Journal of Cleaner Production*, Vol. 16, No. 15, pp.1699–1710.

Silva, P.R. (2004) 'Transporte marítimo de petróleo e derivados na costa brasileira: Estrutura e implicações ambientais', Unpublished DSc thesis, Fluminense Federal University, Rio de Janeiro, Brazil.

UNDP – United Nations Development Programme (2009) Available at http://www.PNUD.org/capacity (accessed on 29 November 2010).

UNDP – United Nations Development Programme (2010) Available at http://www.content.undp.org/go/cms-service/download/asset/?asset_id=2083490 (accessed on 29 November 2010).

UNESCO (1975) Available at http://www.unesdoc.unesco.org/images/0001/000177/017772eb.pdf (accessed on 29 November 2010).

United Nations (1992) *Agenda 21: Earth Summit – The United Nations Programme of Action From Rio*, available at http://www.un-documents.net/a21-37.htm (accessed on 5 November 2010).

Unnikrishnan, S. and Hegde, D.S. (2007) 'Environmental training and cleaner production in Indian industry – a micro-level study', *Resource Conservation & Recycling*, Vol. 50, No. 4, pp.427–441.

Wehrmeyer, W. (1996) 'Greening people', *Business Strategy and the Environment*, Vol. 6, No. 1, pp.52–53.

World Economic Forum (2009) *Supply Chain Decarbonization – The Role of Logistics and Transport in Reducing Supply Chain Carbon Emissions*, Committed to Improving the State of the World, Genebra.