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Original Article

Strategic alignment of knowledge management and value creation: implications on to an oil and gas corporation

Implicações do Alinhamento Estratégico da Gestão do Conhecimento na Geração de Valor: um Estudo na Indústria de Óleo e Gás

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Abstract

The research explores and describes if and how the patterns of value creation of a Brazilian state-owned corporation from the oil and gas industry are reflexes of the subjects' perception on strategic alignment of knowledge management. The design adopts data obtained through a survey applied to Knowledge Workers — employees assigned as internal consultants — of Petróleo Brasileiro S.A. (PETROBRAS) and the study development uses parametric and non-parametric statistics and multivariate analysis. The findings indicated that the subjects perceive the strategic alignment of the knowledge management from three different points of view, with reflexes in the perception on the corporate value creation: the balanced profile — extraordinary corporate value creation — the adjusted profile — moderate value creation — and the misaligned one — unsatisfactory value creation.

Keywords: Strategy; Knowledge management; Value creation; Intellectual capital

Resumo

A pesquisa explora e descreve se e como os padrões de criação de valor de uma corporação estatal brasileira da indústria de óleo e gás refletem a percepção dos sujeitos sobre o Alinhamento Estratégico da Gestão do Conhecimento. O procedimento adota dados obtidos por meio de pesquisa aplicada aos Trabalhadores do Conhecimento — funcionários designados como consultores internos — na Petróleo Brasileiro S.A. (PETROBRAS) e a operacionalização usa estatísticas paramétricas e não-paramétricas e análises multivariadas. Os resultados indicaram que os sujeitos identificam o alinhamento estratégico da gestão do conhecimento de três pontos de vista diferentes, com reflexos na percepção sobre a criação de valor corporativo: o perfil equilibrado — criação corporativa de valor superior —; o perfil ajustado — criação de valor moderado — e o desalinhado — criação de valor insatisfatório.

Palavras-chave: Estratégia; Gestão do Conhecimento; Criação de Valor; Capital Intelectual

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Introduction

The "cognitive era", based on the economy of intangibles, leveraged the growth of the dynamics and complexity of the economic sectors, determining new management mindset for organizations, based on three drivers: (i) speed, with changes in real time; (ii) connectivity, associated with forms and means of communication; (iii) intangibility, related to the increase in the relevance of intangible assets that have revolutionized the way organizations are managed (Davis & Meyer, 1999; Edvinsson & Malone, 1997).

Thus, to rapidly adapt to industry fluctuations, defining consistent paths, and minimizing the compromise of their commitments — sometimes difficult to achieve path dependences (Ghemawat, 1991, 2005) — firms faced the development of specific skills to become flexible, expeditious, and assertive in order.

The concept of management effectiveness was reviewed, with the strategic positioning (Porter, 1980, 1985, 1990) and the existence and ownership of differentiated resources (Barney, 1986, 1991) — that determined the competitive power of organizations (Vasconcelos & Cyrino, 2000) — were gradually shaded by the ability of firms to permanently configure and reconfigure dynamic capabilities (Barney, 2001; Teece, Pisano, & Shuen, 1997) and to improve their core competencies (Prahalad, 1997; Prahalad & Hamel, 1990, 1995, 1998) to achieve competitive advantages and go for the search for the superior value creation (Rezende, 2006).

Performance in the processes of development and improvement of intangible assets, capabilities and competencies (Barney, 1991; Collis & Montgomery, 1997) is directly associated with firms' abilities to intensify their learning processes in search of creativity and innovation (Azevedo, 2013).

Intellectual capital — as the main input (Stewart, 1998, 2002; Sveiby, 1998) — and knowledge management — as the driving force behind the creation and re-creation of these essential resources (Nonaka & Takeuchi, 1997; Proença, 1999) — are bold elements to improve decision making and the effectiveness of permanent organizational learning (Barney, 2006; Pedersen & Dalum, 2004).

The Strategic Alignment of Knowledge Management — a mechanism for improving the capabilities of intellectual capital and the frontiers do organization development (Fleck, 2005; Mohr, 1982) — must have purpose, intensity and direction, so that the value creation proposal is aligned with the needs of the Business (Lopes, 2013; Rezende, 2006), acting as a link between "what" the company thinks and traces its strategy — strategic thinking — and the creation of value (Proença, 1999; Whittington, 2002).

In this context, the Strategic Alignment of Knowledge Management was pointed out as the core of the strategic discussions of organizations, showing that the generation of value to sustain competitiveness would be associated with: (i) Strategic Thinking — responsible for the purpose and process of direction; (ii) the development of Enabling Contexts — physical, mental and virtual spaces, made available and intentionally operational, for the creation and re-creation of knowledge; (iii) Cognitive Surpluses — competencies (knowledge, skills, attitudes, values and experiences that exceed those required by the organizational positions defined in the company structure) that can and should be identified, mobilized and trained to enable superior performance and extraordinary value creation for the business (Alvarenga Neto, 2008; Lopes, 2013; Nonaka & Takeuchi, 1997; Rezende, 2006; Shirky, 2011; Whittington, 2002).

The framework modeled by Strategic Thinking, Enabling Contexts, and Cognitive Surpluses grounded the epistemological and ontological formulation of the archetype Strategic Alignment of Knowledge Management — which served as the guiding thread for the development of the present study.

So, the main objective of this investigation was to characterize how the subjects' perceptions about the possibilities of the Strategic Alignment of Knowledge Management (SAKM) are reflected in the standards of value creation of a Brazilian state-owned oil and gas corporation — chosen for its importance, complexity and convenience in the access to the subjects of the research — despite the recently voluntary layoff incentive plan in the company, that ended up generating staff shutdown on the part of these knowledge workers. For that, an intracorporate survey was applied, focusing on the set of knowledge workers of the firm.

Theoretical framework and conjectures

The ad hoc conception of "Strategic Alignment of Knowledge Management" arises from discussions that have been carried out over the last decades on the essentiality of knowledge as the engine of flows and main resource of inventories of organizational value, emerging, according to Serenko and Bontis (2013), from the seeding works of Westerman, Senior, Schumpeter, Penrose and Polanyi — respectively on the years of 1768, 1836, 1912, 1958 and 1958 — but also, and principally, from Drucker's (1959) concentrating research lenses, giving rise to the expression knowledge workers.

For Saint-Onge (1996), in environments with shortened business cycles, the appropriation and application of tacit knowledge would be the main drivers of value creation based on intellectual capital, provoking discussions on how to integrate and align knowledge, the cognitive surplus, to the strategic alternatives that are anticipated by the firms.

Zheng, Yang, and McLean (2010), given a survey applied to 301 organizations, affirm the importance of knowledge for greater adherence among culture, systems, structure, strategy, and performance, increasing the importance attributed to enabling contexts for the development of competences and establishing competitive advantages.

Bolisani and Bratianu (2018) reinforce the importance of aligning knowledge to the creation of organizational value given the scarcity of tangible assets being displaced by the inflow of available intangible resources, leading to new options on strategically thinking about business evolution.

So, the framework of the Strategic Alignment of Knowledge Management derives from the composition and interdependence among (i) the design of the organizational strategy — strategic thinking; (ii) the intention and capacity of organizations to

develop and make available their enabling contexts; and (iii) the effectiveness with which they identify, mobilize and potentiate their cognitive surpluses (Lopes, 2013; Vasconcelos & Cyrino, 2000; Whittington, 2002).

Strategic thinking is essential in that it enables choices about how firms compete, concentrating efforts and resources on transforming distinctive competencies into competitive advantages to reinforce value creation in their business (Ansoff, 1977; Andrews, 1971 with Wilk, 1997, 1999).

However, formulating and implementing organizational strategies is not an easy task and has been mobilizing scholars over the years (Barney, 2001, 2006; Porter, 1996; Teece et al., 1997; Vasconcelos & Cyrino, 2000).

In addition to being necessarily congruent with the strategic thinking of organizations, value creation is fundamentally linked to intangible assets, organizational capabilities, and competencies, as well as to the skills that companies possess to operate them efficiently — strategic management of knowledge (Proença, 1999).

In order to efficiently manage such "unique" firm's resources in accordance with the VRIO (Barney, 2001, 2006), organizations need to develop — strategically and effectively — knowledge spirals (Nonaka & Takeuchi, 1997) based on artifacts to stimulate and to mobilize competences and, on the edge, to map and to potentiate Cognitive Surpluses (Lopes, 2013; Shirky, 2011).

Effectively, Enabling Contexts can represent special environments (physical, virtual, mental, cognitive, behavioral) to innovate — capturing tacit knowledge, discovering potential talent and generating new knowledge for business — thus forming a link with Cognitive Surpluses (Alvarenga Neto, 2008; Lopes, 2013).

Cognitive Surpluses need to be interpreted as differentials that derive from the set of free time, energy, and talent that, if used collectively and collaboratively, favor great achievements, even if from isolated efforts (Lopes, 2013; Shirky, 2011).

Lopes (2013) proposes that cognitive surpluses represent knowledge, skills, attitudes, and interests that certain people possess to perform activities that even exceed those anticipated for the organizational positions they occupy. It goes on to say that if organizations can map, mobilize and leverage these competencies, they may represent differentials to sustain competitive advantages, becoming a determining element for the definition of strategic thinking of the company

In order to investigate the possibilities and types of Strategic Alignment of Knowledge Management and its relationship with patterns (form and intensity) of value creation, the framework represented in Exhibit 1 was formulated, aiming to use the archetype as a reference model for future studies, whether in other oil and gas industry organizations or in complex companies from other industries.

Thus, the analytical reference model included the three elementary constructs — "Strategic Thinking", "Enabling Contexts" and "Cognitive Surpluses" — and a grid of performance evaluation to characterize, in multiple dimensions, "Value Creation".

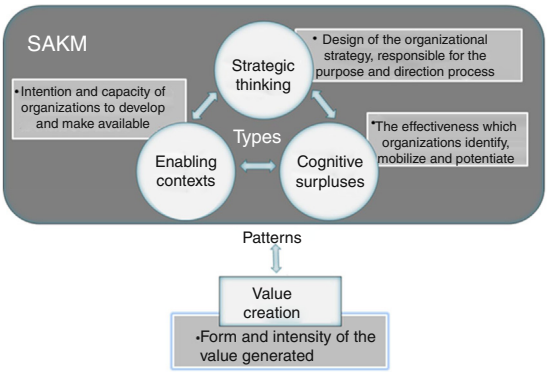

Exhibit 1. Strategic alignment of knowledge management model.
Source: Own elaboration.

The first construct, Strategic Thinking, contemplated the studies of Whittington (2002) covering four generic perspectives for determining the strategic thinking bias of the observed organization.

The conception of Enabling Contexts and Cognitive Surpluses, derived from the discussion proposed by Lopes (2013) focusing on the ontological, epistemological and temporal dimensions of the Knowledge Spiral (Nonaka & Takeuchi, 1997), in the "Ba" or environments for the sharing of competencies (Nonaka & Konno, 1998; Takeuchi & Nonaka, 2008; Von Krogh, Ichijo, & Nonaka, 2001) and the cognitive dimensions (Shirky, 2011).

Thus, the theoretical framework was developed to explore the perception of the subjects about the intentionality of the observed organization in making available and administering Enabling Contexts and the intensity with which it identifies, mobilizes and potentiates its Cognitive Surpluses (Alvarenga Neto, 2008; Lopes, 2013).

The Value Creation performance grid had the purpose of identifying the perception of the subjects about the existence of patterns (form and intensity) of value creation, through the possibilities and types of Strategic Alignment of Knowledge Management, mapped on the components of the economic, intellectual and socio-environmental capitals that follow the logic of Intellectual Capital Management and Intangible Assets as drivers of value creation (Cavalcanti, Gomes, & Pereira, 2001; Edvinsson & Malone, 1997; Price, Stoica, & Weaven, 2013; Rezende, 2014; Rodríguez & Díaz, 2004; Stewart, 1998; Sveiby, 1998; Tigre, 2006).

The conjecture dynamic encompassed suppositions and hypothesis to support and enable the investigation of the question "to what extent do the possibilities and types of Strategic Alignment of Knowledge Management — based on the relationships among Strategic Thinking, Enabling Contexts and Cognitive Surpluses — is determinant for value creation in a Brazilian state-owned corporation of the oil and gas industry?" (Table 1).

Methodological procedures

To deploy conjectures and hypothesis, the investigation paradigm was the functionalist of the Social Sciences studies,

Table 1
Conjectures and hypothesis.

SUPPOSITION	[S_1]	Strategic thinking, enabling contexts and cognitive surpluses, constitutive elements of the strategic alignment of knowledge management, and value creation are reliable (internally consistent) and correlate significantly so that the score of one influences directly those of others.
HYPOTHESIS	[$H_{0,1}$]	It is not possible to characterize distinctly the subjects of the research regarding the existence of significant interdependence relations among strategic thinking, enabling contexts and cognitive surpluses and the value creation.
SUPPOSITION	[S_2]	The strategic alignment of knowledge management is determined by the interdependence relations among strategic thinking, enabling contexts and cognitive surpluses.
HYPOTHESIS	[$H_{0,2}$]	It is not possible to characterize distinctly the perception of the subjects regarding to the existence of different strategic alignments possible arrangements.
SUPPOSITION	[S_3]	The patterns (form and intensity) of value creation derive from the possibilities and types of strategic alignment of knowledge management — interdependence relations among strategic thinking, the management of enabling contexts and the use of cognitive surpluses.
HYPOTHESIS	[$H_{0,3}$]	It is not possible to characterize distinctly the perception of the subjects on the existence of distinct patterns of value creation from the hierarchical clusters of the strategic alignment of the knowledge management.

Source: Own elaboration.

insofar as there was a concern to explain in a practical, systematic, concrete and rational way (Burrell & Morgan, 1979) to what extent the possibilities and types of Strategic Alignment of Knowledge Management — based on how the corporation intentionally manages its enabling contexts and mobilizes and potentiates its cognitive surplus — determines patterns of value creation.

The option for the quantitative approach considered a previously established plan with specific hypotheses and defined variables (Godoy, 1995), used to test objective theories, whose verification could be performed through instruments that can be analyzed by statistical and mathematical procedures and models (Creswell, 2007).

The design of the research attempts to the standards proposed by Vergara (2007): bibliographic, exploratory — investigation and analysis of the relations among Strategic Thinking, Enabling Contexts and Cognitive Surplus (stakes of the Strategic Alignment of Knowledge Management) — and also describes patterns of Value Creation. This classification is convergent with the proposed by Gil (2002, 2006), which exposes that the essence of descriptive research lies in the discovery of the characteristics of a particular population or phenomenon or the establishment of relations between variables.

In order to reach the objectives, the survey procedure was chosen, inasmuch as a quantitative description of attitudes and opinions of a defined sample was obtained to obtain specific information from the subjects (Malhotra, 2006), using structured and closed questionnaire, as instrument for data collection, with the intention of promoting generalizations from the sample (Babbie, 1990 with Creswell, 2007).

Each item of the survey corresponds to a categorical variable on a six points Likert scale (1–6), adopted because it can be treated statistically as an interval observation metric — Kerlinger (1964). The six points scale is an option of the research project under development by the LABCAI,[1] leading the subject to assume a position of agreement or disagreement with the studied phenomenon (Malhotra, 2006) — based on a horizon of five years — in which there is greater possibility of expressing the variation of perception, initially allowing the respondent to assume whether he agrees or disagrees with the researched proposition to immediately express the degree of intensity — totally, very or little — (Rezende, 2006).

The observed organization was Petróleo Brasileiro S.A. — Petrobras corporation —, a state-owned mixed economy company that participates in the energy industry, focused on the oil and gas industry.

The corporation is a publicly traded company — with more than 800,000 shareholders and approximately 65,000 employees — operating in the exploration and production, refining, commerce, transportation, petrochemical, distribution of derivatives, natural gas, electricity, gas — chemistry, and biofuels.

The study population consisted of 1835 internal consultants (junior, full and master advisors, classified by their organizational skills), of whom 213 became the research sample subjects.

The internal consultants hold "knowledge, skills or mastery of technologies and methods", which perform differently in activities considered essential and strategic, guaranteeing high performance solutions for the business in search of competitive advantages — so, that makes them genuine knowledge workers (Cardoso, Cameira, & Proença, 2001).

During the time of the survey, Petrobras experienced a voluntary resignation plan of workers that sought to observe transition period so that the eligible could carry out the transfer of the necessary knowledge to avoid discontinuity — aspect that assumes greater importance given the essentially cognitive nature of the internal consultants.

The IT system for the submission of the survey questionnaire — period of 02.242015 and 06.03.2015 — was the EVAL, internally certified by Petrobras.

The hypothesis development used quantitative computational support procedures such as Statistical Package for Social Sciences and Microsoft Excel, as follows: (i) survey application; (ii) database creation; (iii) transposition of the perception scale (categorical) to a discrete numerical one; (iv) descriptive statistics computation; (v) normality test computation;

[1] LABCIAI Laboratory of Artifacts and Practices of Knowledge Management, Intellectual Capital and Intangible Assets, Research Group listed on the CNPQ directory.

(vi) constructs score computation based on the average of the variables; (vii) computation of Cronbach's Alpha reliability for the surveyed constructs; (viii) Interdependence Rho tests; (ix) Ward method hierarchical clusters analysis; (x) testing of mean/variance differences between clusters variables — MANOVA and ANOVA, in order to identify if they are similar internally and dissimilar externally; (xi) accomplishment of non-parametric Mann–Whitney *U* tests with the objective of comparing the differences between paired clusters, verifying if they are different two to two and Wilcoxon Signed-Ranks for the measurement and comparison of the distances between the means of the internal variables to clusters.

Findings and analysis

The sample of 213 subjects, 84% of men and 16% of women, executes activities of the internal consultants defined as follows: (i) applying knowledge: in proactive action with the knowledge they have for the results of the unit, participating in the research and development of projects and activities, guiding other employees in the execution of works Related to its field of knowledge, creating differentiated solutions for the Company, developing and implementing new technologies and technical methodologies; (ii) transmit knowledge: promoting the dissemination of knowledge of its specialty, in order to disseminate it within Petrobras; and (iii) improving knowledge: maintaining continuous improvement through the expansion of knowledge in the specialty. The demographic characteristics are in Table 2, that shows adherence with the entire observed organization, with considerable experience (67% of employees with more than 15 years of the company) and seniority (11% above 15 years) — 52% of them are engineers.

Measures of central tendency and dispersion were computed in order to favor the process of analysis and to improve the consistency of the occurrences investigated (Bussab & Morettin, 2002) and, afterwards, it was verified if the data of the sample attends the Gaussian probability distribution (Hair, Black, Babin, Anderson, & Tatham, 2009).

Table 3 presents the descriptive statistics and the results of the Kolmogorov-Smirnov test (Corrar, Paulo, & Dias Filho, 2007), used to confirm the Gaussian character of the distribution — since it has 213 observations, that is, beyond the minimum recommended in the face of the characteristics of this study – 80 cases (Roche, Forsyth, & Maher, 2007).

The Cronbach's Alpha (Table 4) demonstrated that the integration of the variables forming Strategic Thinking (ST), Enabling Contexts (EC), Cognitive Surpluses (CS) and Value Creation (VC) are satisfactory (Hair et al., 2009) or as high reliability, according to the evaluation model proposed by Freitas and Rodrigues (2005). The three descriptive constructs were considered consistent for the sample studied, confirming the framework proposed by Lopes (2013). The Value Creation grid — here introduced as exploratory — also reached a good score of reliability. The results of these tests support the consistency of the hypothesis development.

Table 2
Internal consistency of hierarchical clusters.

Time (years)	Sample allocation	
	Organization	Consulting
Under 15	33%	89%
Between 15 and 24	8%	7%
Over 25	59%	4%

Source: Own elaboration.

The development of the Hypothesis [$H_{0,1}$] through Pearson's Rho parametric correlation test, investigated internal characteristics of the Strategic Alignment of Knowledge Management archetype — "there is no significant interdependence relationship among Strategic Thinking, Enabling Contexts and Cognitive Surpluses and the Value Creation" — (Table 5). The findings point to significant associations — ranging from moderate to good (Cohen, 1988 with Figueiredo Filho & Silva Júnior, 2001; Dudey & Reidy, 2005 with Figueiredo Filho & Silva Júnior, 2001). So is reasonable to reject [$H_{0,1}$] in favor of the alternative hypothesis, and there is a support to affirm that "there are significant interdependence relations among Strategic Thinking, Capacitive Contexts and Cognitive Surpluses and Organizational Value Creation".

The development of [$H_{0,2}$] — "it is not possible to characterize distinctly the perception of the subjects regarding the existence of different Strategic Alignments possible arrangements" — observes the simultaneous perception of the subjects on the constructs that focus on the maturity of Strategic Thinking, the consistent existence of Enabling Contexts, and the intentional activation of Cognitive Surpluses. The procedure sought to identify similarities and dissimilarities among the perceptions of the subjects and achieved the identification hierarchical groupings mutually exclusive — determined about the constructs variables that constitute the archetype Strategic Alignment of Knowledge Management.

To do so, we used the Ward Square Euclidean Distance Method, the Analysis of Variance (ANOVA and MANOVA) — to confirm the existence of distinct clusters — and the Mann–Whitney *U* Test, which computes the similarity of the symmetric distributions between paired clusters two to two.

By the application of the Ward method, $p < 0.05$, the existence of at least three hierarchical clusters was identified, each one of which was composed of 69, 86 and 58 subjects, confirmed by tests ANOVA and MANOVA — aiming to verify the existence of inter clusters dissimilarities and distinctive pattern of intra cluster constructs (Table 6).

Table 7 presents descriptive statistics of the constructs in each cluster. From the computed construct scores for each subject, we tested (non-parametric Mann–Whitney *U* Test), mean differences between the components of the Strategic Alignment of Knowledge Management "engine", and it is reasonable to state that the clusters obtained by the processing are "two to two" distinct one another (Table 8).

The results of the applications of the methods evidenced for the analysis of [$H_{0,2}$] allow rejecting the null hypothesis, with a confidence interval of 95%, supporting that "it is possible to characterize distinctly the perception of the subjects

Table 3
Descriptive statistics and normality test.

Topics	Average	Median	Standard deviation	Kolmogorov–Smirnov	
				Statistics	Sig
Strategic thinking					
Deliberate strategy	4.05	4	1.070	0.261	0.000
Emerging strategy	4.09	4	1.144	0.255	0.000
Profit orientation	3.42	4	1.235	0.255	0.000
Guidance for additional value	4.41	5	1.151	0.215	0.000
Shareholders' expectations balance	4.17	4	1.131	0.233	0.000
Innovation and capabilities mindset	4.44	5	1.136	0.237	0.000
Knowledge management					
Enabling contexts					
Informal sharing of knowledge	4.10	4	1.237	0.218	0.000
Physical environments for K sharing	4.52	5	1.121	0.227	0.000
Virtual solutions for K sharing	4.88	5	0.849	0.286	0.000
Mental, cognitive and behavioral approach	4.55	5	1.072	0.209	0.000
Strategy pulls HR development	4.00	4	1.106	0.231	0.000
Resource optimization focus	4.22	4	1.077	0.206	0.000
Goal seeking focus	4.33	4	1.100	0.206	0.000
Knowledge creation focus	4.50	5	1.023	0.219	0.000
Competitive advantages focus	4.25	4	1.138	0.217	0.000
Cognitive surpluses (CS)					
Artifacts for CS identification	3.78	4	1.123	0.270	0.000
Artifacts for CS registration	3.70	4	1.055	0.259	0.000
Artifacts for CS mobilization	3.89	4	1.183	0.222	0.000
Artifacts for CS improvement	3.82	4	1.127	0.244	0.000
Knowledge mindset	4.53	5	0.941	0.237	0.000
Volunteer sharing	4.20	4	1.049	0.216	0.000
Recognition of value by peers	4.53	5	1.041	0.244	0.000
Appreciation in the hierarchy	3.91	4	1.140	0.241	0.000
Mobilization by senior management	3.70	4	1.170	0.229	0.000
Value creation					
Finance capital	4.06	4	1.247	0.212	0.000
Human capital	4.15	4	1.124	0.227	0.000
Structural capital	4.02	4	1.114	0.215	0.000
Relational capital	3.88	4	1.140	0.202	0.000
Social capital	3.94	4	1.201	0.233	0.000
Environmental capital	4.14	4	1.176	0.207	0.000

Source: Own elaboration.

Table 4
Internal consistency of the constructs.

Constructs	Items	Average	Standard deviation	Cronbach'salpha	Assessment
Strategic thinking	6	4.10	0.794	0.782	High
Enabling contexts	9	4.38	0.665	0.793	High
Cognitive surpluses	9	4.01	0.810	0.895	High
Strategic alignment knowledge management	3	4.17	0.639	0.795	High
Value creation	6	4.04	0.892	0.855	High

Source: Own elaboration.

Table 5
Pearson's parametric correlation test.

Constructs	Statistics	Enabling contexts	Cognitive surpluses	Value creation
Strategic thinking	Pearson Correlation	0.594	0.534	0.672
	Sig (2-tailed)	0.000	0.000	0.000
Enabling contexts	Pearson Correlation		0.590	0.604
	Sig (2-tailed)			0.000
Cognitive surpluses	Pearson Correlation			0.513
	Sig (2-tailed)			0.000

Source: Own elaboration.

Table 6
Analysis of variance.

Strategic alignment of knowledge management	ANOVA		MANOVA	
	F	Sig.	Wilks's Lambda	Sig.
Strategic thinking	115.689	0.000		
Enabling contexts	125.096	0.000	0.217	0.000
Cognitive surpluses	157.630	0.000		

Source: Own elaboration.

Table 7
Descriptive statistics of constructs on clusters.

Framework constructs strategic alignment of knowledge management	"B" Balanced # 69				"A" Adjusted # 86				"M"Misaligned #58			
	$\bar{X}$	*s*	Min	Max	$\bar{X}$	*s*	Min	Max	$\bar{X}$	*s*	Min	Max
Strategic thinking	4.84	0.37	4.17	6.00	4.03	0.61	2.00	5.50	3.35	0.64	1.00	4.33
Enabling contexts	4.91	0.41	4.00	5.67	4.45	0.38	3.56	6.00	3.64	0.57	2.22	4.89
Cognitive surpluses	4.73	0.48	3.78	6.00	4.05	0.47	2.78	5.11	3.11	0.61	1.11	4.22
Value creation	4.71	0.79	2.33	6.00	3.95	0.60	2.00	5.00	3.37	0.81	1.33	5.33

Source: Own elaboration.

Table 8
Results from Mann–Whitney *U* tests.

Strategic alignment of knowledge management	Significance of differences between clusters		
	B – A	B – M	A – M
Strategic thinking	0.000	0.000	0.000
Enabling contexts	0.000	0.000	0.000
Cognitive surpluses	0.000	0.000	0.000
Value creation	0.000	0.000	0.000

Source: Own elaboration.

regarding the existence of different patterns of Strategic Alignment of Knowledge Management in the observed corporation".

The [$H_{0,3}$] hypothesis development — "it is not possible to characterize distinctly the perception of the subjects on the existence of distinct patterns of value creation from the hierarchical clusters of the Strategic Alignment of the Knowledge Management" — tests the predominance of some of value creation dimension within, and also within, the hierarchical clusters from [$H_{0,2}$] calculation.

The Wilcoxon Signed Ranks (comparison of the averages within the groupings) and Mann–Whitney *U* (comparison of the averages of each Value Creation dimension variable) compare the Value Creation variables — both for intra cluster and inter clusters, among the three clusters — Table 9, for a 90% confidence interval delimitation, because it is an exploratory approach.

The results of the tests for [$H_{0,3}$], $p < 0.10$, indicate perceptions of the subjects such that: (i) the values of the means of all dimensions in Cluster/profile Balanced are higher than the values corresponding to the averages in Cluster/Profile Adjusted that exceed the values of the correlated averages of Cluster/Profile Misaligned (Mann–Whitney *U* — comparison of the clusters in pairs) and; (ii), it has been founded the predominance of Human Capital (V_{32}) in Cluster/Profile Balanced (69 subjects); of the Human Capital (V_{32}) and Environmental Capital (V_{36}) in the Cluster/Profile Adjusted (86 subjects); and of the Environmental Capital (V_{36}) in the Cluster/Profile Misaligned (58 subjects) — Wilcoxon-Signed Ranks — and it is possible to assume the greater importance attributed to Human Capital, followed by Environmental.

So, [$H_{0,3}$] was partially rejected in favor of the alternative hypothesis "it is possible to characterize distinctly the perception of the subjects of the research about the existence of distinct patterns of value creation from the hierarchical clusters of the Strategic Alignment of the Knowledge Management".

It is worth emphasizing that part of the dimensions that make up the Value Creation construct is linked to the theoretical propositions about the management of Intellectual Capital in to organizations, this one consisting essentially of Human Capital [V_{32}], Structural Capital [V_{33}] and Relational or Client Capital (Stewart, 1998, 2002). Stewart (1998, p. 5) pointed that these are a set of essential resources for the "economic revolution". For Drucker (1999), the economic transformations in search of the superior performance of organizations would derive from this kind of value, which, if mapped and strategically managed in their value networks, develop an essential competency capable of helping to maximize their sustainable competitive advantages (Jonash & Sommerlatte, 2001).

In this context, the Strategic Alignment of Knowledge Management emerges, acting as a driving force to leverage a strong and productive interaction between Intellectual Capital, most

Table 9
Hypothesis [$H_{0.3}$] analytical framework.

Statistics			[V_{31}]	[V_{32}]	[V_{33}]	[V_{34}]	[V_{35}]	[V_{36}]
"B" Balanced	*N*	$\bar{X}$	4.68	4.90	4.87	4.62	4.52	4.68
	69	*s*	0.947	0.843	0.954	1.030	1.119	1.169
		[V_{32}]	0.100[b]	–	–	–	–	–
		[V_{33}]	0.183[b]	0.707[b]	–	–	–	–
	Topics	[V_{34}]	0.512[b]	0.010[b]	0.018[b]	–	–	–
		[V_{35}]	0.282[b]	0.004[b]	0.005[b]	0.431[b]	–	–
		[V_{36}]	0.952[b]	0.060[b]	0.112[b]	0.486[b]	0.012[b]	–
"A" Adjusted	*N*	$\bar{X}$	4.01	4.09	3.81	3.79	3.93	4.08
	86	*s*	1.111	0.821	0.833	0.935	1.08	0.997
		[V_{32}]	0.492[b]	–	–	–	–	–
		[V_{33}]	0.200[b]	0.015[b]	–	–	–	–
	Topics	[V_{34}]	0.187[b]	0.018[b]	0.882[b]	–	–	–
		[V_{35}]	0.626[b]	0.234[b]	0.410[b]	0.242[b]	–	–
		[V_{36}]	0.490[b]	0.937[b]	0.044[b]	0.015[b]	0.077[b]	–
"M" Misaligned	*N*	$\bar{X}$	3.43	3.36	3.34	3.17	3.29	3.62
	58	*s*	1.428	1.252	1.069	1.062	1.155	1.197
		[V_{32}]	0.695[b]	–	–	–	–	–
		[V_{33}]	0.751[b]	0.795[b]	–	–	–	–
	Topics	[V_{34}]	0.152[b]	0.154[b]	0.311[b]	–	–	–
		[V_{35}]	0.468[b]	0.704[b]	0.796[b]	0.302[b]	–	–
		[V_{36}]	0.421[b]	0.252[b]	0.126[b]	0.005[b]	0.047[b]	–
B – M	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]		
B – A	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]		
A –	0.016[a]	0.000[a]	0.005[a]	0.001[a]	0.001[a]	0.018[a]		

Source: Own elaboration, based on Rezende (2006).
[a] –Mann–Whitney *U* Test.
[b] – Wilcoxon-signed ranks.
[V_{31}] finance, [V_{32}] human, [V_{33}] structural, [V_{34}] relational, [V_{35}] social and [V_{36}] environmental.

notably the Soft Skills, and Value Creation (Proença, 1999; Rezende, 2006). So, intangibles raise their contributions to building the top performance of organizations.

Beyond to the basic dimensions of value creation, according to Stewart (1998), Social Capital and Environmental Capital were added as intangible assets relevant to the achievement of competitive differentials, especially for oil and gas sector organizations where there are challenging liabilities for them — due to the nature of the business — to be economically viable, socially just and environmentally sound.

In this perspective, it is fundamental that organizations understand the importance and undertake effective actions to enable the coexistence of the economic vectors (profit), social (people) and environment (planet) — triple bottom line (Brown, Dillard, & Marshall, 2006; Elkington, 2012), in its strategic plans, reinforcing its Social and Environmental Capitals and avoiding the detachment between the rhetoric and the practice of sustainable development policies.

Thus, it becomes plausible to assume that degrees of co-creation, maturity and development of the Sustainability Capabilities — Social Skills, and Environmental Skills — can contribute to the determination of distinct patterns of value creation.

Discussion and final remarks

The current dynamic and complex environment require organizations to be prepared for the competitive fitness. They need agility, speed, and assertiveness — to be flexible (and resilient) — in the process of making strategic decisions to minimize unnecessary commitments, avoiding the assumption of trajectories that are often difficult to reverse (Ghemawat, 1991, 2005).

This condition, coupled with the need for a clear vision of the future to achieve superior performance and exceptional value generation, requires organizations to think, formulate and implement their strategies with greater care and accuracy (Whittington, 2002).

In view of the formulation of assumptions and hypotheses and the proposed exploration/description of an archetype, it was necessary to test the reliability of the research constructs, according to Table 3, which shows the values of Cronbach's Alpha coefficients for Strategic Thinking (0.782), Enabling Contexts (0.793) and Cognitive Surplus (0.896) and Value Creation (0.855), are satisfactory — $\alpha > 0.70$ (Hair et al., 2009) — or elevated — $0.75 < \alpha \leq 0.90$ (Freitas & Rodrigues, 2005).

For discussion of [S_1], a correlation test was performed using the Pearson Rho coefficient, measuring the direction and level of interdependence among Strategic Thinking, Enabling Contexts, Cognitive Surplus and Value Creation, in order to show if and how the score of one construct directly influences (direction and intensity) the score of another.

Table 5 presents the Pearson coefficient values, with 95% confidence interval, for correlations among constructs ranging from 0.535 to 0.597 and those with the evaluation grid, positioned in the range between 0.513 and 0.672. Taking into account that Pearson coefficients above 0.500 can be considered as strong

(Cohen, 1988 with Figueiredo Filho & Silva Júnior, 2001) or moderate, respectively in the intervals $0.40 < \text{Rho} \leq 0.60$ and $0.75 < \text{Rho} \leq 0.90$. So, it is reasonable to propose the existence of significant moderate-to-strong correlations among the components of the Strategic Alignment of Knowledge Management and these elements.

However, the perception of the Strategic Alignment of Knowledge Management is not necessarily uniform among the individuals, and instead of making it more consistent and resilient, could lead the organizational fabric to situations of limitation. This question tangents the discussion of organizational knowledge under the conditions of slack (Ghemawat, 1991) and was working through the hypothesis [$H_{0,2}$], rejected, for $p < 0.05$, in favor of the alternative hypothesis.

The analyses performed from groupings of subjects according to the similarity of their intra clusters perceptions and dissimilarities inter clusters favored the discussion of [S_2] on the fact that "the Strategic Alignment of Knowledge Management is determined/conditioned by the perception of interdependence relationships among Strategic Thinking, Enabling Contexts, and Cognitive Surpluses".

For the accomplishment of this discussion, the averages of the subjects' answers on the variables studied in each of the constructs were retrieved and organized in hierarchical groupings, and a possible standard was analyzed. Table 10 shows the synthesis of the findings and direction and intensity of the averages in each cluster.

The results of the inter clusters comparison of the constructs (B > A > M) support, with the 95% confidence interval, to state that:

i. The Cluster/Profile Balanced presented the highest averages of the Strategic Thinking, Enabling Contexts, and Cognitive Surpluses constructs when clusters were compared to the cluster. Therefore, it is reasonable to observe that this group presented the strongest alignment between strategy and knowledge management.
ii. The Cluster/Profile Adjusted present an intermediate alignment.
iii. In the Profile Misaligned, the lowest averages of the constructs and the performance grid were verified among the clusters, and it was possible to verify that it presented the weakest alignment between the strategy and the knowledge management — the Misaligned one.

The greater the alignment, the greater the individuals' perception of the strategy of knowledge management more clearly and, as a result, see with greater clarity the strategic behavior of the organization about:

i. Proportionality, effectiveness, and intentionality with which it makes its Enabling Contexts available.
ii. The form and intensity with which it identifies, registers, mobilizes and improves its Cognitive Surpluses.

Table 10
Resultados da Comparação dos construtos *inter clusters*.

Constructs	"B" Balanced		"A" Adjusted		"M" Misaligned
Strategic thinking	4.84	>	4.03	>	3.35
Enabling contexts	4.91	>	4.45	>	3.64
Cognitive surpluses	4.73	>	4.05	>	3.11
Value creation	4.71	>	3.95	>	3.37

Source: Own elaboration.

The findings and respective discussion allowed identify three patterns of alignment among Strategic Thinking, Enabling Contexts and Cognitive Surpluses, proposing specific logics for determining the form and intensity with which Petrobras manages its knowledge spirals. Thus, it was reasonable to assume that the interdependence relations among the three constructs influence and/or determine the form and intensity (possibilities and types) of the Strategic Alignment of Knowledge Management in the organization, signaling the conformity of the assumption [S_2].

To analyze the perception of the subjects about the assumption [S_3] — "The patterns (form and intensity) of value creation derive from the possibilities and types of Strategic Alignment of Knowledge Management — interdependence relationships among Strategic Thinking, Enabling Contexts and the use of Cognitive Surplus" — has been fundamental define which conceptual basis would be used to guide the understanding and segmentation of the organizational value creation.

In this study, we used the stratification of value drivers in Soft and Hard Skills (Rezende, 2006) — Soft ones, formed by Human Capital and Relational Capital; Hard ones, covering Structural Capital and Financial Capital —, improved by the notion of Sustainability integrating Social Capital and Environmental Capital.

Table 9 presents the perception of the research subjects, according to a model adapted from Rezende (2006), in which the three clusters/profiles were treated using the Mann–Whitney *U* mean difference tests (inter clusters analysis) and Wilcoxon Signed Ranks (intra cluster analysis).

Regarding the application of the Wilcoxon Signed Ranks and Mann–Whitney *U* tests — for the 90% confidence interval in the three hierarchical groupings of the performance evaluation grid — it was possible to discuss the supposition [S_3] according to the perception of the researched individuals/cases, as follow.

The "Balanced" profile presented a perception mainly associated with the magnified creation of value — general and simultaneous in all dimensions — with a predominance of Human Capital, pointing to a situation in which the company would already fully achieve the expected results. The individuals of the Cluster Balanced perceive an organization directed to the development of new capabilities, competences and resources with the purpose of increasing the organizational flexibility, aiming at the rapid adaptation of the organization to the oscillations of the industry (Barney, 2001; Prahalad & Hamel, 1990; Teece et al., 1997). Consistent with the strategic proposal, there is evidence of optimized knowledge management, intentionally made available and managed, balanced in tune with the enabling contexts (Von Krogh et al., 2001) and magnified through initiatives for identification, mobilization and empowerment of cognitive surpluses (Shirky, 2011) in search of new competitive

advantages. The patterns of value creation highlighted (equally across dimensions) with the assumption that the company would fully achieve the expected results. The proposed organizational design is compatible with the alignment of the presented knowledge management and with the classification of a strategically balanced organization (Rezende, 2006).

The "Adjusted" ones showed a perception associated with value creation alternating among dimensions, with a predominance of the Human Capital and of the Environmental Capital — pointing to a situation in which the company would partially achieve the expected results, with possibilities for improvement. The subjects on the Cluster Adjusted indicated an organization oriented to the development of new capabilities, competences, and resources (in a weighted way than in the previous grouping) with emerging strategies, but biased by deliberate ones (leaders and stakeholders). Thus, knowledge management in the company was organized in a more lenient way, with the intentional and proportional provision and administration of the Enabling Contexts (Von Krogh et al., 2001) and a reasonable intensity in the initiatives for the identification, mobilization and enhancement of the Cognitive Surpluses (Shirky, 2011) in search of new competitive advantages. This strategic thinking and design, within a continuum of options, is very close to the logic defined by Lopes (2013) as a traditional strategy with some traits of the emerging one. The patterns of value creation (alternation in all dimensions) with the assumption that the company partially obtains the expected results. The proposed organizational design is compatible with the alignment of the determined knowledge management and with the classification of a strategically adjusted organization (Rezende, 2006).

Finally, the "Misaligned" portrayed a perception that is mostly associated with the value creation below the desired/expected, corresponding to the predominance of importance attributed to the Environmental Capital — signaling with the possible destruction of value in some dimensions, pointing to the need to revise objectives and/or expected means. At Cluster Misaligned, the less aligned ones, respondents showed that the organization presents only a reasonable concern with the development of new capabilities, competences and resources (Barney, 2001; Prahalad & Hamel, 1990; Teece et al., 1997), with the predominance of deliberate strategies. In this way, the knowledge management presented as a characteristic the predominance of the informal sharing of knowledge to meet specific demands. This strategic thinking and design, within a continuum of options, is very close to the definition proposed by Lopes (2013) as of traditional strategic logic. The proposed organizational design is compatible with the classification of a strategically misaligned organization (Rezende, 2006).

Table 11 summarizes the results of the study, with academic and managerial implications described below.

As a whole, it was feasible to state that the pattern of value creation derives from the Strategic Alignment of Knowledge Management, that is, from the interdependent relations among Strategic Thinking, the management of Enabling Contexts and the intentional use of Cognitive Surpluses — an issue that raises the conformity of the supposition [S_3]. It was reasonable to assume that the possibilities and types of Strategic Alignment of Knowledge Management, based on the organization of Enabling Contexts and on the identification, mobilization, and improvement of Cognitive Surpluses, determine patterns of value creation in Petrobras — the delimited field/observation of this research.

Table 11
Strategic alignment of knowledge management and value creation.

	Strategic alignment of knowledge management	Value creation
Balanced	More fitness between strategy and knowledge management	The value creation happens simultaneously in all dimensions, with emphasis on Human Capital The company fully achieves the expected results
Adjusted	Reasonable alignment between strategy and knowledge management	Value creation with alternation among dimensions Partial achievement of expected results
Misaligned	Less alignment between strategy and knowledge management	Creation of value below desired Need for review of objectives and/or expected support means

Source: Own elaboration.

It is important to note that there are two dominant types of oil and gas companies: state-owned and transnational. This study focused on a Brazilian state-owned enterprise and, therefore, a complete view of the Strategic Alignment of Knowledge Management in the oil and gas industry would necessarily apply to a transnational enterprise.

As a contribution and theoretical implication, the SAKM archetype, object of study in the LABCIAI research laboratory (PPGA-UNIGRANRIO), can be replicated to deepen the discussion about the interdependence among strategy, knowledge management, and value generation. At the same time, the SAKM can be adapted for managerial applications for practitioners, to develop policy, culture and support mechanisms for knowledge management.

In this sense, it is essential that future empirical studies embrace the discussion of imbrications between organizational culture and the Strategic Alignment of Knowledge Management.

From the point of view of procedures applied to research, the main limitation of this study is the use of multivariate analysis techniques, which leads to the loss of part of the robustness of the analyzes against the use of discrete scales, but whose application has been widely accepted in the Field of Applied Social Sciences for purposes of studies that seek suggestive information (Bento & Ferreira, 1982) about the investigated phenomena.

The evolution of the SAKM may allow population studies of organizations to identify the positioning of firms in each industry regarding the relationship between knowledge and value creation.

Conflicts of interest

The authors declare no conflicts of interest.

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