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Analysis of the individual competences contributions to innovation management based on methodological triangulation

Análise das contribuições das competências individuais para a gestão da inovação com base na triangulação de métodos de pesquisa

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Abstract: The present article analyzes the contributions of individual competences to innovation management in two companies showing a strategic focus on innovation and that have competency management systems under implementation. In this research, data analysis relies on methodological triangulation, which combines the definition of theoretical concepts with the use of qualitative and quantitative methods. A literature review was conducted on the elements of individual competence and innovation management to guide the definition of research variables and the construction of a proposal for a comparative analysis between the two companies. The main evidences found in the literature review, case studies and surveys, highlight the importance of practices that stimulate the development and management of individual competences in improving business activities for innovation management. Based on the results of the study, it is possible to propose a taxonomy to integrate individual competences and innovation management that can be classified into three stages: Basic integration, Intermediate Integration and Full Integration.

Keywords: Individual competences; Innovation management; Case study; Survey; Taxonomy.

Resumo: *Este artigo analisa as contribuições das competências individuais para a gestão de inovação, em duas empresas com foco estratégico de inovação e com sistemas de gestão de competências em implantação. A análise de dados conta com a triangulação de métodos que combina a definição de conceitos teóricos com o uso de métodos qualitativos e quantitativos. Para tanto, faz-se uma revisão bibliográfica sobre os elementos de competência individual e de gestão de inovação para guiar a definição de variáveis de pesquisa e a construção da proposta de uma análise comparativa das duas empresas. Conforme evidências principais da revisão bibliográfica, dos estudos de casos e das surveys, ressalta-se a importância das práticas que estimulem o desenvolvimento e o gerenciamento de competências individuais a fim de melhorar as atividades empresariais para a gestão da inovação. Os resultados do estudo permitem propor uma taxonomia para a integração entre as competências individuais e a gestão de inovação está embasada em 3 estágios: Integração Básica, Integração Intermediária e Integração Plena.*

Palavras-chave: *Competências individuais; Gestão de inovação; Estudo de caso; Survey; Taxonomia.*

1 Introduction

Individual competence management models seek to integrate accumulated human capacity with the work process practice over time, proving to be an important and dynamic model to be integrated in innovation management.

A competency framework is typically seen as a link between human development and business strategy, aligning a company's strategic objectives with its key human resource management processes (Le Deist & Winterton, 2005).

The main purpose of individual competence management is to transfer important attributes such as skills and knowledge to people who do not have them through training or job rotation to allow new experiences in work situations (Sandberg, 2000).

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First and foremost, the company must define its strategic and organizational competencies, then define the specifications of the products or services it offers, so that it can finally plan the individual competence prospects required for each specific activity.

Through feedback on results, supervisors and employees are able to identify the individual competences needed for the activities performed, and the professional development required for innovation management.

In this context, and in order to conduct a more thorough investigation, the present paper aims to analyze the contributions of individual competences to innovation management in two companies showing a strategic focus on innovation management and with competency management systems under implementation. To that purpose, data analysis relies on the methodological approach known as triangulation.

The article is divided into sections. The first presents the theoretical reference on the fundamentals and evolutionary issues of the main concepts used in empirical research: individual competences and innovation management. The second identifies the main methodological aspects used for a more thorough investigation of the research problem, both in the qualitative and quantitative analyzes. The third presents the analysis and discussion on the results of the case studies and internal surveys carried out, investigating the relationship between previously defined variables. Finally, the last section highlights the conclusions of the research obtained through the methodological triangulation of individual competences and innovation management.

2 Which are the contributions of individual competences to innovation management?

Due to market challenges, companies seek to expand their dynamic capabilities to develop new products that are powerful sources of competitive advantage, as such products are representative of renewal, growth and adaptation to market changes (Marsh & Stock, 2006).

The work context and learning situations promote the development of competences, which does not only add value to the individual but also to the organization (Fleury & Fleury, 2001). Thus, the great challenge lies not in using the competency model itself, but in creating people management practices that can make use of employees' competences as a core source of innovation (Zarifian, 2003).

Individual competences must be analyzed as differential factors in innovation management. After all, the process of developing new products or services is a dynamic problem-solving process that integrates knowledge and experience gained over time (Brown & Eisenhardt, 1995). The way companies build and manage individual competences is a key factor in the development of new products and in their success in adapting to market changes (Marsh & Stock, 2006).

This study is important because it emphasizes the idea of innovation management as a determining factor in the placement of emerging economies in the world economic ranking in the context of (i) market internationalization (Fleury & Fleury, 2003; Llor, 2007) and (ii) the development of competences directly related to market needs (Drejer, 2000; Drejer & Riis, 1999; Hagan, 1996; Mansfield, 2004; Schuler & Jackson, 2005; Schroeder et al., 2002). Due to the theoretical gap for this integration, this paper proposes to investigate how the development of individual competences may influence the performance of innovation activities in companies.

Through institutional models of competence management, it is possible to identify important individual competences for coping with complex situations, since "the competent being" depends on (i) the impact of the effects of the professional activity, (ii) the knowledge applied and developed at work and (iii) the mobilization of resources for decision making.

Upon obtaining the individual competences required for each operation, the company can identify potential innovators, as well as train and manage its human resources through (i) a change in attitude regarding advice, (ii) employee performance evaluation, (iii) career management, (iv) payment systems and (v) motivational practices. All such activities may facilitate or hinder competences that are maintained or fostered in the company (Sandberg, 2000).

3 Competency models

For a long time, the subject of competence remained in a field restricted to experiences conducted by leading companies and discussions made by specialists. General mechanisms in the field of human resource management were not questioned. From 1980, it became apparent that the combination of knowledge and technical skills with social skills allowed the development of some key competences, mainly in the production sphere (Zarifian, 2001).

According to Ebóli (2001, p. 110):

> The paradigm shift in business management, i.e., the transition from Taylorist/Fordist administration to flexible management, had a very strong impact on the behavior of organizations. Vertical and centralized structures give way to horizontal and largely decentralized ones. The rigid division between mental and manual labor tends to be eliminated; fragmented and standardized tasks become integral and complex, thus requiring, at all levels of the organization, people with the ability to think and perform various tasks at the same time.

It is possible to notice that the new style of people management focuses on the competence and outcome of human work and imposes profound changes in structure, systems, policies and practices. In addition, human resource policies cease to be passively integrated with business strategies and become an integral part of this strategy.

According to Le Boterf (2003), there are currently two competence management "models" that interfere in organizational practices: model 1, based on the Taylorist-Fordist conception, and model 2, based on the concept of knowledge economy.

In model 1, competence is limited to the execution of operations according to the prescription, and conduct is based on expected and observable behaviors. In model 2, a competent professional is one who can act, i.e., who is able to take initiatives. Conduct is not reduced to standardized behavior (Le Boterf, 2003).

Such development in competence management accompanies the development in work organization methods. The first methods focused more on the technical approach; from the 1980s, quality management procedures and the logic of the economy of services were included in vocational training. Today, on the other hand, individual competence management values the entirety of working conditions and the search for results (Le Boterf, 2003).

As pointed out by Zarifian (2001), there is still great difficulty to move from classic administration, organized by job posts, to competency management. This is due to three main reasons. First is the fact that the socially accepted view of "work" has not really changed; the influence of the Taylorist model still prevails, without any prospects of a new referential. Second, is the fact that the position of the professional in the professional relationship system and organization has not changed significantly. The totality of the framework of activities escapes the professional. Finally, the third reason is the fact that professionals cannot be considered individually or collectively competent without a considerable and effective transfer of power to their benefit.

Recent studies present competence management as a possibility to develop individual competences in companies with more flexible and participative work structures, well-defined and widespread organizational values and a focus on organizational learning (Bitencourt, 2004; Fleury & Fleury, 2004).

Since the innovative capacity of a company is, in part, embedded in its workforce, qualified employees are considered a key resource for innovation activities; without this, companies cannot master new technologies, let alone innovate (OCDE, 2007).

Such ability may be explored according to the way the professional mobilizes his or her "stock" of competences in a dynamic and specific context. To that purpose, the current article considers individual competence to be the sum of an individual's knowledge, skills, attitudes and results, directly linked to the work context and market needs.

For the specific purpose of result analysis, the concept of individual competence involves four elements: knowledge, results, skills and attitudes, as indicated in Chart 1 (Dutra, 2001, 2004; Fleury, 2001). These elements are detailed in research variables based on (i) a study on competence management models proposed by Le Boterf (2003), (ii) the main difficulties pointed out by Zarifian (2001) and (iii) other relevant issues discussed in international studies on Human resource management practices and innovation management.

4 Innovation management

Companies have increasingly focused on innovation management in search for opportunities to renew their growth potential in the market. They feel the need to combine creativity with more efficient processes. Thus, there is a greater alignment between operational plan and strategic plan when defining "what to do, why and when to innovate" (Roussel et al., 1992).

Silva et al. (2014) emphasize that innovation management models encompass a set of stages and decisions that can be flexibly formatted in the context of the project or organization, from the conception of the idea to the complete development of an opportunity.

Thus, innovation management depends on specific contextual factors that will guide the flexibility of strategic choices according to current demand patterns (Ortt & Van der Duin, 2008). This study explores the importance of such contextual factors based on studies on the generations of innovation management, namely: the 4 generations, by Niosi (1999); the 5 generations, by Rothwell (1992); and the 3 generations, by Roussel et al. (1992).

Based on the contributions by the aforementioned authors, and in order to establish research elements in this study, three stages to illustrate the main evolutionary characteristics of innovation management in companies are presented. The first stage comprises the twenty years subsequent to World War II, when innovations were driven by new technologies to meet social demands (Rothwell, 1992).

It focuses on small technological advances grounded in scientific knowledge and engineering. Companies rely on qualified people, adequate facilities, investment in research aimed at commercially viable results and enjoy unused technological potential, substantial growth, and good profits (Roussel et al., 1992). Research and development activities are the basis for innovation management because such activities are organized in project centers defined by technical and scientific discipline.

In the second stage, management practices are embedded in innovation management by means of cost control and individual project benefits in

Chart 1. Studied individual competence variables.

Individual competences		Source	Description
Knowledgement	PK Prospective Knowledge	Walsworth & Verma (2007), Marsh & Stock (2006), Dutra (2004).	Identify future requirements and needs of products and services.
	TK Technical Knowledge	Damanpour (1991), Dutra (2004), Marsh & Stock (2006).	Hold specific technical knowledge for the development of research projects.
	DK Diagnostic Knowledge	Damanpour (1991), Dutra (2004), Marsh & Stock (2006).	Have the ability to break limiting paradigms and identify opportunities for improvement.
Results	GI Generation of Ideas	Koc (2007).	Have the ability to consider ideas in order to achieve the expected results.
	EP Experiences and Perspectives	Koc (2007).	Combine employees' different experiences and perspectives in work processes.
	PM Performance Management	Walsworth & Verma (2007), Moore et al. (2002).	Monitor the performance achievements of the objectives of innovation activities described in the company's strategic plan.
Skills	IVP Integrated Vision of Processes	Koc (2007), Damanpour (1991).	Identify the intersection points between research projects or processes in which they operate.
	UI Use of Information	Katou & Budhwar (2006), Damanpour (1991), Dutra (2004).	Prioritize actions that respond to organizational needs in an attempt to solve problems.
	EC Effective Communication	Walsworth & Verma (2007), Damanpour (1991).	Be able to express opinions and information in a clear, logical and objective way.
Atiitudes	LD Leadership	Walsworth & Verma (2007), Katou & Budhwar (2006), Damanpour (1991), Brown & Eisenhardt (1995), Dutra (2004)	Prioritize the group's synergy in work processes, in an attempt to avoid competitiveness among people.
	TW Teamwork	Walsworth & Verma (2007), Laursen & Foss (2003), Dutra (2004), Brown & Eisenhardt (1995).	Share knowledge with the work team.
	PART Participation	Laursen; Foss (2003), Damanpour (1991).	Participate in important decisions in research projects.

order to monitor progress in achieving objectives. However, projects are still individually managed rather than managed in their collectivity (Roussel et al., 1992). Research and development activities seek internal collaboration between the different areas of the company (Niosi, 1999) and are grounded in values of potential technology development that may have a strategic impact in the long term. In turn, new contextual factors such as marketing, state-of-the-art technology, project control, market responsiveness, entrepreneurial culture, among others, have become crucial to innovation management (Rothwell, 1992).

The third stage of innovation management can be classified as a conceptual model that fosters productive work relationships and shared professional positions, which in turn enable the best use of individual competences in the work team (Roussel et al., 1992).

Basically, the model of the third stage seeks to identify the intersection between technical opportunity and the commercial necessity or opportunity pointing to a greater influence in the market. Values and research projects have a direct focus on the access of products and services to final consumers which, in this research paper, is represented by the integration of management activities in organizational culture, research and development and technology transfer.

However, companies find it hard to insert themselves in the last innovation management generation (Roussel et al., 1992) as, in practice, it is still very difficult to link the science and the technology developed in research projects with the company's strategic concerns regarding the access of products and services in the market.

Thus, it is understood that innovation management depends on the flexibility of the company to improve or generate new products and services that foster competitive advantage (Santos, 1999) through the coordination of individual competences in teams

and using matrix structures in search of long term results (Schuler & Jackson, 2005). Innovation management depends on evolutionary forces, and so it is always necessary to adhere to different practices in order to meet current demand expectations (Ortt & Van der Duin, 2008).

Consequently, in this research paper innovation management is characterized by the set of activities capable of creating conditions within a company that facilitate the effective resolution of multiple challenges with high levels of uncertainty (Tidd et al., 2008).

In innovation management, the type of innovation or who is involved in decision making is not questioned (Tidd et al., 2008), but rather what processes need to be carried out by the company to develop particular forms of behavior that will guide the work routine and foster innovation.

In addition, innovation management involves three elements: research and development, innovation culture, and technology transfer. These elements are defined based on variables highlighted in theoretical and empirical references in order to be thoroughly investigated, as described in Chart 2.

5 Methodology

The present study uses the methodological approach of data analysis, which combines the definition of theoretical concepts with the use of qualitative and quantitative methods, known as triangulation. The main justification to use methodological triangulation is the aim to achieve greater reliability in data analysis and in the validation of research results (Cunningham et al., 2000; Modell, 2005; Shah & Corley, 2006).

Thorough qualitative research coupled with rigorous quantitative research may lead to many advantages in understanding and applying results, and in complying with reality (Shah & Corley, 2006). To achieve that, it is necessary to construct a consistent theoretical basis to analyze the qualitative and quantitative results.

Aiming to compare the contributions of individual competences in innovation management, two companies presenting different characteristics are analyzed (Chart 3).

The target population consisted of people from the surveyed companies that participate in innovation management activities. Two non-probabilistic samples were constructed based on the spontaneous answers

Chart 2. Studied innovation management variables.

Innovation Management		Sources	Description
Research and Development	PSA Alignment between processes and strategy	Laursen & Foss (2003), Cooke (2007).	Define the internal processes according to previously defined organizational strategies.
	MULT Multifunctionality	Laursen & Foss (2003), Walsworth & Verma (2007), Brown & Eisenhardt (1995).	Be flexible to different activities and teamwork.
	IS Information Sharing	Laursen & Foss (2003), Walsworth & Verma (2007), Cooke (2007).	Encourage communication and exchange of experiences.
Organizational Culture	OE Organizational Environment	Hailey (2001), Lau & Ngo (2004).	Encourage an entrepreneurial organizational environment.
	VO Organizational Values	Hailey (2001), Lau & Ngo (2004).	Encourage innovative behavior in the daily work routine.
	IEL Internal and External Liaison	Hailey (2001), Lau & Ngo (2004), Danneels (2002).	Enable the flexibility of innovation objectives in order to adapt to market needs.
Technology Transfer	APS Access to Products and Services	Cribb (2009), Walsworth & Verma (2007), McFadzean et al. (2005).	Ensure greater access of products and services to the public.
	PAT Patents	Damanpour (1991), Hall (2004).	Stimulate public concessions to exploit innovation in a commercial manner.
	PUBL Publications	Cribb (2009), Cooke (2007), Hall (2004).	Disseminate the results of innovation through technical and/or scientific information.

Chart 3. General characteristics of companies surveyed.

Company	Location	Field Of Activity	Share Control	Strategic Focus
Company A	São Carlos Unit	Agribusiness	Public National	Research and Development
Company B	Rio Claro Unit	Industrial	Multinational	Excellence in products and services

to an internal survey conducted with employees A (N = 54) and B (N = 51), separately. The data were collected between June 2007 and June 2008.

5.1 Qualitative phase: materials and method

The first phase is qualitative and exploratory, and relies on two empirical case studies. Instruments used for data collection in the qualitative phase are: bibliographic surveys; interviews with people having practical experience in the problem under study; and institutional materials.

Data processing is based on the material obtained from the theoretical basis and companies surveyed. Results are discussed taking into account the ideas expressed by the subjects, as well as the latent content in such ideas, using the descriptive and interpretative aspects in consonance with the proposed theoretical material as reference.

Thus, the analysis of the results is based on questions that guide the study. Such questions help clarify what will be investigated (Triviños, 1992) and are used to guide the interviews and allow better structuring of the data analysis (Yin, 2001).

However, the research requires a more thorough data analysis, and to that end the specific strategy of explanation construction is used to analyze the data of the case study by constructing an explanation on the analysis of the two case studies (Yin, 2001).

First, the specific characteristics of the companies surveyed are highlighted; next a comparative analysis is carried out in order to investigate the existence of the most important common points in the case studies with regard to the influence of individual competences on innovation management.

5.2 Quantitative phase: materials and method

The second phase is quantitative and descriptive, and intends to verify the information in the qualitative case study. In order to refine the study on individual competences and innovation management, a survey was used as a method to collect primary data from individuals directly involved in the company's innovation activities.

The reliability of the questionnaire is guaranteed by the pre-test analysis of the questionnaire based on the 21 variables of the survey and shows a Cronbach's Alpha (α) of 0.817. Such a level of reliability indicates the respondents' understanding of the questions and coherence when answering them, and that measurements are free of random errors (Freitas & Rodrigues, 2005, Hair et al., 2005).

For the verification of results, individual competence variables are defined as independent, innovation management variables as dependent, and multiple correspondence analysis (MCA) and cluster analysis (CA) are used.

Multiple correspondence analysis (MCA) reduces the amount of data to be analyzed and allows the simultaneous analysis of a larger number of variables, in a small space and with the least possible amount of information (Cunha, 2000). Not only does MCA graphically represent the categories of the variables – individual competences and innovation management – but it also represents the sample individuals, in this case companies A and B.

According to Kaciak & Louviere (1990), the best graphical representation of the MCA is achieved by using two nominal categorical variables – *yes* and *no*. Thus, the 7-point scale used in the questionnaire was grouped into two response categories: one represented by points 1 to 4, defining the non-interest in the theme (discordance), and the other represented by points 5 to 7, defining the interest in the theme (agreement).

The dichotomous data are inserted in a Burt table (companies versus variables) highlighting all the individuals and their respective answers to each of the criteria, and identifying the number of times each category was cited in relation to the others. In the perceptual map of the MCA, the distance between the similarities of companies A and B are shorter.

The similarities result from determining the adequate dimensionality of the MCA and of the analysis of the joint coordinates of the variables. Such data explain the information returned by the axes and the analysis of the results.

Cluster analysis (CA), on the other hand, gathers the similar characteristics of the two companies surveyed. The formation of the clusters follows the hierarchical procedure that operates in the stepwise style to form an entire interval of clusters. The interpretation of clusters uses the *Ward* method as it tends to result in clusters of approximately equal sizes due to the minimization of their internal variation until all

are contained in a single cluster, represented in a dendrogram or tree graph (Hair et al., 2006).

Therefore, all innovation management and individual competence variables are considered in the research grouping so that the results of the MCA can be verified and to create a taxonomy of the results.

It is worth noting that the proposed taxonomy meets the purpose of the statistical technique used, cluster analysis (Hair et al., 2006), and a natural tendency of the applied social sciences to classify objects of study into categories (Adams et al., 2011).

6 Qualitative phase

6.1 Company A's profile

Company A is a decentralized regional research unit linked to the Ministry of Agriculture, Livestock and Supply. Created in 1975, it has several research programs that involve the areas of beef cattle, dairy cattle, equines and forage farming. Research projects are proposed in each area in an attempt to meet the demands for competitive technological solutions for the benefit of society.

It was possible to verify that company A is increasingly concerned with the future requirements and needs of its user products and services. Therefore, it bases itself on specific technical knowledge for the development of research projects and on the breaking of paradigms for the development of competitive competences.

Since 2006, Company A has been working on a pilot competency mapping project to be implemented in all of its other decentralized units. Such project aims to develop and validate a methodology for the quantitative and qualitative assessment of the staff in the decentralized units in alignment with the technological innovation results. The balance of this project will guide the policies on hiring, moving and training people.

Among the practical initiatives of the pilot project to develop the individual competences required for the work, it is possible to highlight the policy on people management, which focuses on new challenges faced by the unit: the renewal of staff, redefinition of roles and professional re-qualification.

Specifically in relation to training practices, company A offers many opportunities to enrich technical and scientific competences as well as competences in conformity with organizational values in order to encourage professional development and people's abilities to carry out their occupational roles creatively and with initiative.

Guidelines to all innovation management monitoring are established in Company A's strategic plan, elaborated by its Executive Board and prepared according to analyzes and consultations to researchers and external experts.

Through testimonies from researchers and employees from the research development support area and by referring to institutional documents, it is possible to highlight that Company A's organizational culture is based on well-defined values, on its mission, and on organizational principles established in its strategic planning.

Issues related to organizational culture reflect the organization's entrepreneurial environment. By consulting the institutional site it is possible to notice that the company really points to trends by making available scientific publications, services, news of events and research developed in its Units.

The company's innovation strategies focus on research and development activities aimed at efficiency and competitiveness in beef cattle and dairy cattle management in the Southeast region. Results are also guided by the objectives established in the strategic plan of the Unit, and by work goals regarding the innovation of its products and services.

6.2 Company B's profile

Company B is a multinational company that operates in five continents, with factories in 30 countries. The company began its activities in Brazil in 1969. Currently its products are certified by the ISO 9002 and the ISO 14001, and are technological solutions derived from fiberglass characterized as composites.

With regard to individual competences, Company B favors employee retention by offering them an environment that promotes creativity; valuing teamwork; creating opportunities for professional growth; and empowering employees through internal and external training.

The individual competence management model established in the company is still linked to job descriptions and cannot be considered individual. The competency matrix is in the process of being implemented, and will make it possible to determine the current competences of each employee and the competences that shall be developed in the work processes. The final establishment of the competency matrix is a priority for Company B so that it can outline its next training plan.

To that end, the concept of individual competence used for the construction of the competency matrix is represented by the group consisting of knowledge, skills and attitude. The company seeks to develop employee knowledge through training; skills through the practical application of acquired knowledge; and finally attitude by encouraging employees' willingness to cooperate.

It is clear that the company perceives the relationship between individual competences and innovation management, as it shows practical initiatives for the development of competences that are specific to work routines. The first initiative relates to training focused on developing each employee's skills; the

second refers to incentive programs to reward the generation of ideas through a promotion program and a program that enables employee innovation and creativity.

Organizational values and practices drive employees' innovative behavior. Consequently, the creation of a market and of new technologies aiming at competitive advantage guide the company's research and development (R&D) activities.

The innovation activities relate to the routines of the engineering and product development departments with a special focus on the manufacture of products and the provision of services according to the viability to meet its consumers' needs.

Product and service innovation conducts the strategic guidelines towards the growth of Company B, there is a constant search for product and service excellence and for customer satisfaction.

6.3 Comparative analysis of the case studies

Comparing the studies on companies A and B, it is possible to see that their practices are focused on innovation capacity. As Company A aims to develop knowledge and technologies for the benefit of society, it places a great focus on research and development activities. Numerous research projects and services are developed aiming at meeting the specific needs of competitiveness and development of the region where it is located.

Company B, on the other hand, despite also fulfilling a social role, focuses on the transfer and access of technologies, products and services to the end user. It is important that the product or service offered has a buying market and is economically profitable.

Regarding competence management, both companies implement competency mapping systems being certain of their strong interference in the success of innovation management. Such mapping intends to identify current and future individual competences needed to improve innovation capacity.

Company A prioritizes market analysis and technical knowledge, information exchange and effective communications skills, and results management based on the strategic plan. However, its attitudes are limited to sharing knowledge with the work team due to its inflexible organizational structure.

Company B, on the other hand, seeks a greater integration between its teams' technical knowledge and market diagnostic capacity, aiming to stimulate process integration and communication skills between sectors, as well as attitudes based on teamwork and strong participation. Results are evaluated and then used to address both training needs and the necessity to generate ideas.

Comparatively, the two companies encourage interaction between people, but company A suffers greater interference from the formalization of internal processes and the rigidity of its organizational structure, which directly interferes in the interaction among work teams and their participation.

7 Quantitative phase

This section presents the multiple correspondence analysis (MCA) and the cluster analysis (CA) of all variables from Companies A and B, independent of individual competence and dependent on innovation management, based on the construction of tables showing perceptual variables according to the most characteristic and important attributes of the two companies together. Such analyzes aim to compare companies and deepen the diagnosis of the research problem.

7.1 Multiple correspondence analysis of the companies studied

The MCA graphically represents the variable categories – individual competences and innovation management – as well as the individuals representing the sample, i.e. Companies A and B. These data explain the information returned by the axes and the analysis of the results.

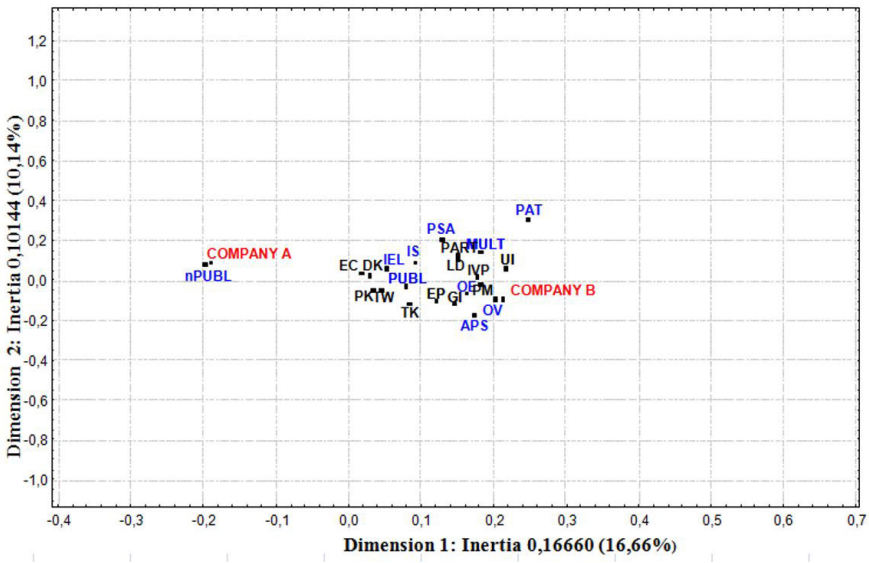
Graph 1 shows the combined analysis of the companies surveyed, the variables independent on individual competences and the variables dependent on innovation management. All graph variables are dichotomous, and the ones preceded by the letter "n" represent the variables that define the lack of interest.

Analyzing the correspondences between the variables in Companies A and B, it is possible to verify that both recognize the importance of individual competences in innovation management. The multivariate analysis also presents some evidences from the individual bivariate analysis for each company.

However, the dendogram (Graph 1) highlights the variables close to the extended map and shows that Company A is closer to the dependent variables, i.e. internal and external articulation (IEA), information sharing (IF) and publications (PUBL); and to the independent variables, i.e. prospective knowledge (PK), technical knowledge (TK), diagnostic knowledge (DK), effective communication (EC) and teamwork (TW).

Company A prioritizes technical knowledge and market analysis, information exchange and effective communication skills and results management based on its strategic plan. However, its attitudes are limited to sharing knowledge with the work team due to its inflexible organizational structure.

Company A's main aspects are the integration between innovation management elements, i.e., organizational culture, research and development



Graph 1. Expanded two-dimensional chart of the multiple correspondence analysis of companies.

and technology transfer, and human competences supported by knowledge.

Therefore, it is possible to notice that Company A is concerned with strengthening its innovation activities by strengthening the individual competences aimed at knowledge. This corroborates with Company A's main focus on the development of research projects geared to market needs, and with the main method of employee evaluation, based on the results of the projects.

Company B, on the other hand, is closer to the dependent variables - organizational environment (OE), organizational values (OV) and alignment between internal processes and organizational strategy (PSA); and independent variables - integrated process vision (IPV), use of information (UI), generation of ideas (GI) and performance management (PM).

Company B seeks a greater integration between its teams' organizational culture and market diagnosis capacity by trying to stimulate process integration and communications skills among sectors, as well as attitudes grounded on teamwork and strong participation. Results are evaluated and then used to address both training needs and the necessity to generate ideas.

Company B's scenario reflects a clear emphasis on the indexes regarding the integration between individual competences aimed at the access of products and services to end users. It is clear that individual competences are important for generating results and to encourage interaction between work teams in Company B.

Through variable association, it is possible to perceive that the only variable close to no interest is the publications one (nPUBL). This shows that the publication of scientific papers on innovations developed by the companies surveyed must be linked to another technology transfer mechanism in order to guarantee the access of such innovations to end users.

The publication of innovation results is linked with the development of technical knowledge. According to Rogers et al. (2001), scientific articles are a relatively inefficient mechanism of technology transfer, despite being one of scientists' the main activities. Product development partnerships are more effective mechanisms of technology transfer.

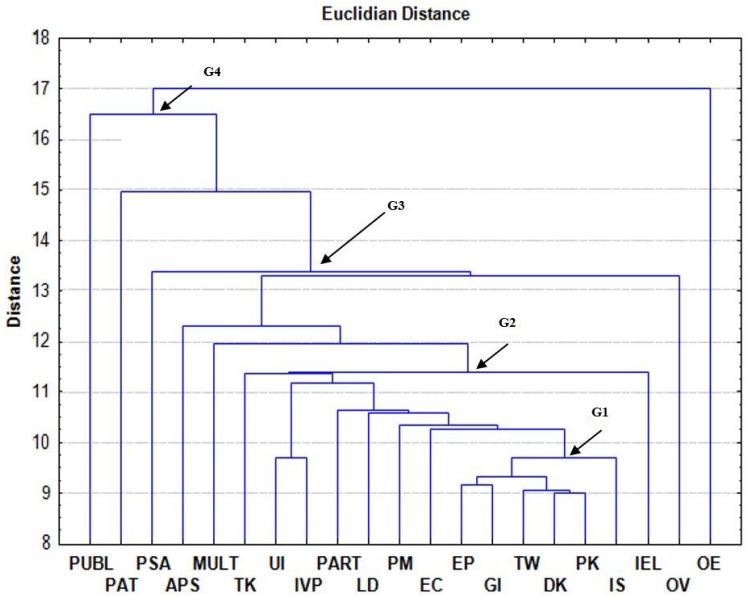
Thus, in both companies A and B, innovation management is directly linked to the success, survival and renewal of companies, especially those that operate in competitive markets (Brown & Eisenhardt, 1995).

7.2 Cluster analysis

Cluster analysis considers all innovation management variables and individual competences in order to confirm the results of the multiple correspondence analysis and to create a taxonomy of the results of the research. Graph 2 shows four large variable groups, clearly pointed out in the dendrogram.

Group 1 (G1) confirms that the most important individual competences for innovation management are strictly linked to the diagnostic knowledge of continuous improvement at work and knowledge on future product and service needs by users. Such knowledge is linked with the necessity for a work environment that privileges teamwork, collaborators' experiences and information sharing (Katou & Budhwar, 2006; Laursen & Foss, 2003; Walsworth & Verma, 2007).

Subsequently, other large groups are formed encompassing other variables. Group 2 (G2) also



Graph 2. Dendrogram of individual competences and innovation management (Ward method).

highlights individual competences linked to people's interaction at work and focuses on results obtained through innovation (Brown & Eisenhardt, 1995; Danneels, 2002; Henderson, 2006; McFadzean et al., 2005).

Group 3 (G3) shows the greatest influence of individual competences in innovation management, thus guiding strategic formulation and internal work processes (Dutra, 2004; Le Boterf, 2003; Zarifian, 2001).

Group 4 (G4) encompasses all variables and shows that technology transfer activities take place at the end of the innovation process to allow the access of the company's products and services to the market and its renewal capacity (Roberts, 1999; Et al., 2001, Peteraf, 1993).

It is therefore observed that the highlighted groups confirm the results of the multiple correspondence analysis. The associations evolve according to the companies' focus on innovation management regardless of their characteristics: size, market segment, industry, stock control, etc.

8 Contributions of individual competences to innovation management

By using triangulation analysis based on the theoretical concepts presented and the results of the research from both the qualitative and quantitative phases, it is possible to highlight a taxonomy based on three stages of integration: 1. Basic Integration, 2. Intermediate Integration and 3. Full Integration. These stages result from the influence levels of the individual competences in innovation management at the researched companies.

Chart 4 clarifies the characteristics of each integration stage; at every higher level new features are encompassed. Stage 1, Basic Integration, points to an integration only between individual competences and research and development activities. Management practices are based on the maximum use of knowledge aimed at project development and the search for results.

Stage 2, Intermediate Integration, encompasses the characteristics of the previous stage, and also incorporates management activities on organizational culture based on skills and attitudes that enable innovation capacity.

Stage 3, Full Integration, encompasses all previous levels, pointing to the influence of individual competences on innovation activities, and emphasizes technology transfer activities to provide products or services in the market.

Regarding the analysis of the insertion stages of the companies surveyed, it can be noticed that the groupings formed are justified by the comparison between the qualitative results, indicated in the results of the multiple correspondence analysis (MCA), and the cluster analysis (CA).

Company A's main concern is scientific rigor in the R&D actions that have a direct interference in work methods, and consequently in the independent variables of knowledge, result and skills and in the dependent variables of research and development. Company B, on the other hand, shows a greater

Chart 4. Taxonomy of integration between individual competences and innovation management.

Variables	Innovation Management Elements	Individual Competence Elements	Characteristics	Studied Companies	Stages
OE – organizational environment PUBL – publications PAT – patents OV – organizational values MULT – multifunctionality APS – access to products and services PSA – alignment between processes and strategy	Technology transfer Organizational culture R&D Activities	Attitudes Skills Results Knowledge	Individual competence management practice fully integrated with innovation culture, research projects and access of products and services to end users	Company B	**3. Full Integration**
IEL – internal and external liaison EC – effective communication PM – performance management LD – Leadership PART – participation IVP – integrated vision of processes UI – use of information TK – technical knowledge	Organizational Culture R&D Activities	Attitudes Skills Results Knowledge	Individual competence management practice driven by innovation culture and research and development activities to allow innovative capacity	Company A	**2. Intermediate Integration**
IS – information sharing GI – generation of ideas EP – experiences and perspectives TW – teamwork PK – prospective knowledge DK – diagnostic knowledge	R&D Activities	Results Knowledge	Individual competence management practice focused on knowledge for research project results purposes only		**1. Basic Integration**

integration between more dependent and independent variables.

By analyzing the integration stages, it is possible to verify that people management practices should seek the development of individual competences (Katou & Budhwar, 2006) to enable innovation management in the company.

Innovation management helps to renew the company through its dynamic and reciprocal relations with individual competences. Companies need to be constantly renewing themselves to survive and prospect new businesses in dynamic and competitive environments, which are characterized by ever changing customer needs, technologies and competition (Brown & Eisenhardt, 1995; Danneels, 2002; Marsh & Stock, 2006).

Organizational practices focused on innovation strategies seek to turn the company into the sole a producer of products and services and offer it a competitive advantage through adaptation in the market; thus, people management practices can have a positive impact on the achievement of expected organizational performance (Katou & Budhwar, 2006).

The results of other empirical research also demonstrate the relationship between people management practices and innovative performance, such as improvements in individual competences to implement innovation activities (Katou & Budhwar, 2006).

9 Final considerations

In order to contribute with studies on the theme, the present article presents a taxonomy of the contributions of individual competences to innovation management. Based on evidence from the literature, case studies and surveys, it is possible to highlight that practices that stimulate the development and management of individual competences play an important role in improving the performance of innovation activities in companies.

The taxonomy of the integration between individual competences and innovation management points to 3 stages: Basic Integration, Intermediate Integration and Full Integration.

Each stage gathers the main variables capable of differentiating significant characteristics. Individual competence management has a positive interference in each stage, in different degrees, in accordance with the implemented innovation management activities.

In specific terms, the taxonomy shows that the integration between individual competences and innovation management evolves according to the company's strategic focus to develop its innovation activities. In other words, the company will direct important elements to the management of individual competences according to the innovation management elements applied. This is achieved through personnel management practices (recruitment, selection, training, performance evaluation, remuneration and career plan).

Thus, it is observed that individual competence management does not happen in an isolated way in the company, it is always integrated with the strategic plan, which in the specific case of this research, comprise the innovation management guidelines.

The evidence from the taxonomy presented in this paper is in alignment with the theoretical postulate on the evolution of competency management models (Le Boterf, 2003; Zarifian, 2001) and innovation management (Roussel et al., 1992).

It can be observed that the focus on innovation by the two companies is highlighted by their innovation management activities: Company A, a public company, is mainly guided by research and development initiatives; and Company B by technology transfer initiatives.

The management of individual competences in both companies is driven by the implementation of a competence mapping system to manage the attributes of employees's individual competences.

As for the limitations of the research, it is worth noting that results were based on the study of two companies only. The choice of limiting the number of studied companies to two is explained by the intention to carry out detailed analyzes and to find consistent evidence to contribute to the study on the topic. However, it is necessary to conduct studies on other companies to raise new evidence regarding the integration between human competences and innovation management, as well as to establish a dialogue between collective and organizational competences.

It is suggested that new qualitative and quantitative investigations be carried out to verify the influence of individual competences in all the management processes in a company, rather than only those related to innovation.

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