FutureJournal

FUTURE STUDIES RESEARCH JOURNAL: TRENDS AND STRATEGIES

PROFUTURO: FUTURE STUDIES PROGRAM
Scientific Editor: James Terence Coulter Wright
Evaluation: Double Blind Review, pelo SEER/OJS
Review: Grammatical, Normative and Layout
Received in: 08/20/2015 Approved in: 11/13/2015

# A Model to Support Decision Making in the Idea Management Domain

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## RESUMO

Taking into account the global competitiveness, innovation has become a challenge for organizations. Idea management is an integral part of the innovation process and it is presented as an essential factor for achieving success. Due to the volume and sudden peaks in submissions of ideas, the appropriate analysis and the allocation of resources for investment are important issues to be addressed. The objective of this paper is to present a model for the management of ideas based on ontology and cluster analysis in order to maximize resources for investment in ideas. So as to demonstrate the model feasibility it was prepared a dataset comprised of fifty-five ideas collected from the Starbucks® site. These ideas were then stored in the domain ontology and were used as subsidies for the cluster analysis and for the building of a knowledge base. As a result, it was identified groups with similar ideas that, when analyzed, foster a greater potential for observation and may indicate patterns and trends that can assist in decision making.

**Key-words:** Innovation Management. Idea Management. Ontology. Cluster Analysis.

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# Um Modelo para Auxiliar na Tomada de Decisão no Domínio de Gestão de Ideias

## ABSTRACT

Diante da competitividade global, inovar tornou-se um desafio para as organizações. A gestão de ideias é parte integrante do processo de inovação e apresenta-se como um fator essencial para obtenção de sucesso do mesmo. Devido ao volume e aos picos repentinos de submissões de ideias, a adequada análise e a destinação de recursos para investimentos são questões importantes a serem tratadas. O objetivo deste trabalho é apresentar um modelo para a gestão de ideias baseado em ontologia e na análise de agrupamento visando maximizar os recursos para investimentos em ideias. De modo a demonstrar a viabilidade do modelo elaborou-se um conjunto de dados de cinquenta e cinco ideias coletadas a partir do site da empresa Starbucks®. Estas ideias foram então armazenadas em uma ontologia de domínio servindo de subsídio para a análise de agrupamento e a construção de uma base de conhecimento. Como resultado, foram identificados grupos de ideias semelhantes que ao serem analisados promovem um maior potencial de observação e, podem indicar padrões e tendências que auxiliem na tomada de decisão.

**Palavras-chave:** Gestão de Inovação. Gestão de Ideias. Ontologia. Análise de Agrupamentos.

## 1. INTRODUCTION

The competitiveness present in the global market scenario causes the organizations to seek to invest in innovative products and/or services. When developing the innovation process, products are created, aiming to reach new markets in pursuit of the competitive advantage maintenance (Reid & Brentani, 2004). However innovation is not a trivial process.

According to Trott (2012) innovating means to spend investment in the process of ideas generation, in the development of technologies and processes and also in the manufacture and marketing of a product. Through new ideas it is possible to create new products and develop the innovation process (Witell, Löfgren & Gustafsson, 2011). According to Vygotsky (2007) the main raw material present in the society is the knowledge as well as the capability to produce innovative ideas.

Barbieri, Álvares and Cajazeira (2009) state that the ideas are the basis of the innovation process. According to Brem and Voigt (2007) ideas make up the raw material of the process. Endesley (2010) also adds that "the heart of the innovation is the generation and the test of new ideas". However, organizations that develop innovations as a source of competitive strategy must be prepared for the ideas creation and management (Barbieri, Alvarez & Cajazeira, 2009).

The ideas management is an integral part of the innovation process and can represent the starting point of this process, assisting in the identification of opportunities feasible and credible to be implemented by a particular organization (Björk, Boccardelli & Magnusson, 2010; Vandenbosch, Saatcioglu & Fay, 2006). According to Sint et al. (2010) and Xie and Zhang (2010) through the ideas management it is possible to increase the companies productivity, to benefit the creation of new products and to improve the processes carried out in the organization, minimizing costs and maximizing the competitive advantage maintenance.

The process of managing ideas presents itself as a promising sector for the software development industry for collecting and organizing suggestions that may catalyze innovations in products and services (Westerski & Iglesias, 2011). The ideas management systems present

themselves as an alternative to manage this process. The main purpose of it is to provide tools that make possible the evaluation of the collected ideas and elect, for implementation, only the best ones (Westerski, Iglesias & Rico, 2010). According to Conry-Murray (2010), the growing interest in idea management systems has motivated communities to develop platforms for the purpose of integrating the innovation process to the software process.

However working with innovative ideas promotes challenges. Amongst these it may be mentioned the selection of the most relevant ideas that are capable of being implemented and the funds' investments (Sint et al., 2010). Another key point is how to enhance the idea management process and make it more efficient and faster due to periods with large information overload for the software system (Sint et al, 2010; Westerski, Iglesias & Rico, 2010; Westerski & Iglesias, 2011).

The objective of this work is to develop a model to assist in the decision-making process and in the selection of ideas to be implemented. With this knowledge formalization, the goal is to promote a positive impact assisting on the Ideas Management Process.

According to Fernandes et al. (2011), there are few existing computer tools to support the innovation process, and the technologies present in the Semantic Web, such as the ontologies, represent a great potential for the area.

In order to elucidate the proposed article, an exploratory research was carried out, seeking grounds in a literature review to emphasize the methods used and to set the foundation of a model of ideas treatment. From this, a prototype was developed and applied in a scenario to demonstrate the proposition efficiency. In this sense, it is used a domain ontology modeled with a focus on the semantic reasoning through rules and the application of a clustering process based on a textual analysis.

The next sections of this article are organized as follows: Section 2 will deal with the concepts related to the innovation process, ideas management, ontology and the clustering process. Section 3 will present the model developed for the ideas management process. The results of the model application are detailed in Section 4 with their respective assessments that aim to present alternatives for a better resources

distribution, in a general way, in the Ideas Management. Finally, Section 5 will present the final considerations.

## 2. THEORETICAL FRAMEWORK

The theoretical framework of this article is focused on the following topics: the innovation process, the ideas management, the ontology and the clustering process.

### 2.1 INNOVATION PROCESS

Innovation has become a crucial factor to support the organization in the market (Gibson & Skarzynski, 2008) which represents a complex mechanism capable of transforming processes into competitive advantages (Bautzer, 2009). There is no consensus on the meaning of the term innovation (Chesbrough, 2006). The OECD (*Organization for Economic Co-operation and Development*) in 2010 defined innovation as: "the implementation of a product (good or service) new or significantly improved, or a process, or a new marketing method, or a new organizational method in business practices, in the organization of the workplace or in the external relations".

Trott (2012) presents the term innovation as the process of generating ideas, development of technologies, manufacturing and marketing of a product and the development of a process. Authors like Baregheh, Rowley and Sambrook (2009) define innovation as the process in which the organization, from the ideas, develop new or improved products, services or processes, with growth in mind, seeking to compete and reach advantages for achieving success in the market.

According to Artz (2010) the term innovation is related to the development of products or services commercially viable. For the authors, there needs to be the distinction of the invention process from the innovation process. The term invention would involve the development of new ideas being closely related to the number of patents, while the term

innovation is about originating profitable results through the ideas execution.

According to Tidd, Bessant and Pavitt (2005) innovation management is "the process of planning, allocation, organization and coordination of essential factors for the achievement of groundbreaking results". In the view of Gambatese and Hallowell (2011), the innovation process involves different components and activities in order to originate new ideas and turn them into reality.

Innovation promotes the movement of the results of investment in research and development, either internally or externally to the organization (Badawy, 2011). Activities that make intensive use of knowledge, such as education, innovation and R & D, support the pillar of economic growth (Cicyt, 2007), either in the organizational environment or globally.

Innovation is intrinsically dependent on the organizational environment, requiring the fostering for the onset of creative ideas and their possible deployment (Tidd, Bessant & Pavitt, 2005). However, the construction and maintenance of the organizational environment is necessary, because only then the innovation management will effectively achieve success.

## 2.2 IDEAS MANAGEMENT

Ideas are considered as the main raw material of the innovation process (Brem & Voigt, 2007). The competence of the organizations in the generation of innovations requires a continuous demand for ideas, aiming to develop new technologies, products and services (Bessant et al., 2005). To be adapted to the real changes and to the insertion context is essential in the current market scenario (Govindarajan & Trimble, 2012).

The ideas management is at the *front end* of the innovation, which is understood as the core of the innovation management (Bothos, Apostolou & Mentzas, 2012), and represents a crucial process for increasing the productivity of organizations (Sint et al., 2010). The ideas management also represents real value for organizations, as it is considered the starting point of the innovation process and because it provides aid in the identification of

opportunities (Björk, Boccardelli & Magnusson, 2010; Vandenbosch, Saatcioglu & Fay, 2006).

In accordance with Sint et al. (2010), Westerski and Iglesias (2011), and Xie Zhang (2010), Poveda, Westerski and Iglesias (2012) from the ideas management it is possible:

- Increase the organizations productivity;
- Improve the processes performed in the organization;
- Encourage the creation of new products;
- Minimize costs;
- Maintenance of the organizational competitive advantage;
- Generate commercial value through the ideas;

The opportunity to generate new ideas can emerge from the internal partners (employees) or also from the external ones such as suppliers and consumers (Boeddrich, 2004). Interaction among the organization's partners is fundamental to the innovation process and hence for the favoring of setting up the ideas (Björk & Magnusson, 2009; Blohm et al, 2011.).

Ideas need to be assessed according to criteria such as investment, benefits, innovation capability and strategic relevance to the company (Sint et al., 2010). In a recent study Magnusson, Netz and Wästlund (2014) identified the three main criteria for the ideas selection which are: Originality, which represents the issue of newness and innovation; Value for the User representing the users perspectives on the deployment of the idea or service and whether it will generate value for them; and finally the criterion of Manufacturability, representing the producer perspective about the ease with which the service can be implemented and produced. The authors also identified through research, two new criteria such as the idea or the service strategic fit and the issue of profitability that the idea will be able to lead.

However, according to Westerski and Iglesias (2011), among the steps of the managing ideas process, the one with the highest relevance is the assessment of the data, also being the most problematic. For Westerski; Dalamagas; Iglesias (2013), the great challenges of the area involve:

- The information overload through the large volume of ideas submitted;
- Sudden peaks of ideas submissions;
- The redundancy of ideas;
- Large amounts of trivial ideas;
- Huge human effort required during the idea management process;

## 2.3 ONTOLOGY

As presented in Borst (1997), the term ontology is sourced in the philosophy, which is related to the being or to the types of existence. In artificial intelligence the term is associated with the way in which an AI system should reason to execute specific useful task.

Based on Gruber (1995) and Borst (1997), the authors Studer, Benjamins and Fensel (1998) presented the following definition: "ontology is the formal and explicit representation of a shared conceptualization". In accordance with Guarino (1998), ontology is a way to define a vocabulary to describe certain reality. For Neches et al. (1991) ontology defines the basic terms and relationships involving the vocabulary of a particular area as well as the rules for combining terms and relationships defining the vocabulary extensions.

Ontologies allow performing the knowledge representation by means of terms and definitions about the concepts related to a given domain, promoting the representation of the semantic relationships, and not only the syntactic relationship of the data. When developing ontology it is necessary to describe the categories and objects as well as the relationships between the data involved (Lula & Paliwoda-Pękosz, 2008). Ontology has the exploration and representation capability of semantic and conceptual relationships of the terms belonging to a particular domain (Silva et al., 2009). The use of ontologies makes possible the capability of reasoning, analyzing and operating about the stored knowledge.

Kobashi (2007) also corroborates the previous statement and stresses that ontologies provide the necessary basis for the reasoning about the objects of a particular domain. This occurs due to the fact that the

knowledge representation specifies the objects behavior and their relationships (Kobashi, 2007).

According to Gómez-Perez (1999) ontology includes not only the terms that can be specified, but also those that can be obtained through inference rules. The meta-information present in the semantic can, for example, group ideas into categories, assist in the search and even assessment of ideas, drawing the most heavily discussed ideas or ideas that have been rated as the best by the set of users (Hüsig & Kohn , 2011).

## 2.4 CLUSTER ANALYSIS

Deal effectively and quickly with the idea management process becomes a challenge because there are periods with large information overload for the system (Sint et al, 2010; Westerski Iglesias & Rico, 2010; Westerski & Iglesias, 2011). Sint et al. (2010) mention the challenge of finding the most relevant ideas in face of the volume of ideas.

The studies aimed at the data clustering meet certain objectives because they provide information about the degree of similarity or difference between two or more objects (Vasconcelos et al., 2007). Cruz and Carneiro (2006) state that the cluster analysis is presented as one of the best alternatives to perform analysis and interpretation of data.

Cluster analysis, in other words, the discovery and interpretation of groups of objects with similar properties and/or behavior, is one of the most common operations in the exploration and analysis of various types of data (Andrienko & Andrienko, 2009). According to Jain, Murty and Flynn (1999), the cluster analysis consists of the organization of a set of patterns (usually arranged in vectors or in multidimensional spaces) in groups according to a degree of similarity.

The clustering technique is useful because it assists in the analysis of large volumes of data, since it allows the analyst to consider groups of objects rather than individual objects. For Andrienko and Andrienko (2009) clusters may also be useful for other purposes such as the detection of unusual objects, which may require a special investigation. The results can be used for any purpose, for example, in the decision making. The analysis constitutes the fundamental part of the process, because it is through the

interpretation of the clusters by a human analyst that such clusters acquire meaning and value.

There are different methods to carry out the data clustering process. The distinction among the methods is related to the type of result to be obtained and by the different ways of defining the proximity between an individual and a cluster already formed, or between any two clusters (Vasconcelos et al., 2007).

In a dataset, for example, the same idea can be recurring at the basis, appearing numerous times, though with different specificities. In a meta-analysis one can identify groups (*clusters*) of similar ideas, pointing to possible patterns and trends. Separately these ideas may not be interesting, but the potential increases when they are grouped. Or if the same idea appears several times in the database, it can point to a possible demand for this type of service (Magnusson, Netz & Wästlund, 2014). The authors emphasize that the clusters formation is a factor that influences during the ideas evaluation on the part of the experts.

The implementation of a module in which the information obtained during the research process, can be visualized in the clusters format, will be able to cause the experts to interpret in a better way the ideas collected in the organization (Poveda, Westerski & Iglesias, 2012).

## 3. PROPOSED MODEL

The competition among organizations has been promoting a constant search for innovative ideas. As previously mentioned, the idea management produces challenges when assessing the data, representing the critical point in the process, due to the volume of submissions or also by the triviality of ideas. For this purpose, it is presented in this work a model to assist in identifying innovative ideas and hence in the decision making process. **Erro! Fonte de referência não encontrada.** presents the model.

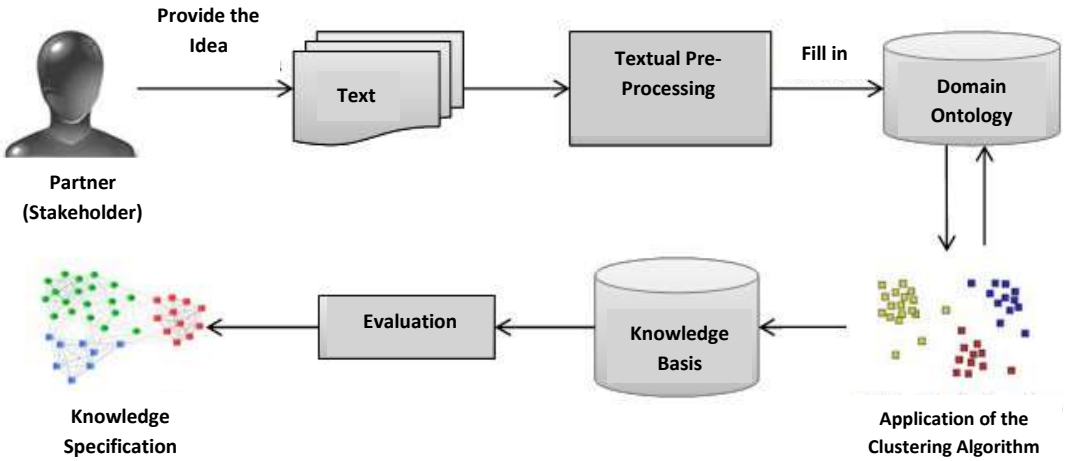


**Figure 1 – Proposed Model**

Source: Authors

The first step presented in the model comprises the database filling. The organization employee provides his ideas arranged in the textual format, namely a non structured format. Subsequently it is conducted a textual preprocessing for the text adequacy to a semi-structured format, putting it on the XML standard. This phase has the purpose of transforming the proposed ideas in a language understandable to the computing means.

In a subsequent phase it is carried out the reading of the files in XML format containing the ideas proposals, as well as the files indexation through a document indexing library, in this case, Lucene Apache®.

```
<DOCUMENT
        ID = ""
        TITLE = ""
        DAY = ""
        MONTH = ""
        YEAR = ""
        IDEA = "" >

        <AUTHORS>
                <ITEM NAME = ""/>
        </AUTHORS>

        <CATEGORIES>
                <ITEM DESCRIPTION = ""/>
        </CATEGORIES>

        <KEYWORDS>
                <ITEM DESCRIPTION = ""/>
        </KEYWORDS>

        <VOTES AFFIRMATIVE = "" NEGATIVE = "" NEUTRAL = ""/>

        <COMMENTS>
                <ITEM COMMENT = "" NAME = "" RATING = ""/>
        </COMMENTS>
</DOCUMENT>
```

**Figure 2 – Document XML**

Source: Authors

As shown in **Erro! Fonte de referência não encontrada.** some characteristics are obtained from the documents, among them the title of

the idea; the day, month and year that the idea was posted; the name(s) of the author(s); the category in which the idea is included; the keywords; the number of votes and the comment(s) that the idea received. The keywords were taken when reading the documents.

In concomitant phase to the indexation process the population of the domain ontology occurs directed to the ideas management. The ontology was developed as a means of representation of the domain knowledge. It was not identified in the literature and in researches carried out over the web any ontology with the capability of inference accomplishment through rules and with support to the clustering process. **Erro! Fonte de referência não encontrada.** presents the developed ontology. The major classes correspond to the idea itself, represented in the figure by the class *Idea*, and class *Cluster* responsible for storing the result of the clustering process. The main data properties of the class *Idea* are the title of the idea, the description of the idea, the date of submission of the idea and an identifier. The class *Cluster* contains an identifier, the description of the group, and through the property of objective *hasIdea* all the ideas that are present in a particular cluster are connected. This connection is carried out after the execution of the ideas cluster process. Via inference the descriptors or keywords are also assigned to the group, descriptors or keywords that define it. The rule responsible for the inference says: If an idea has a descriptor **x** and the same idea belongs to a group (cluster) **y**, then the group (cluster) **y** possesses as descriptor **x**.

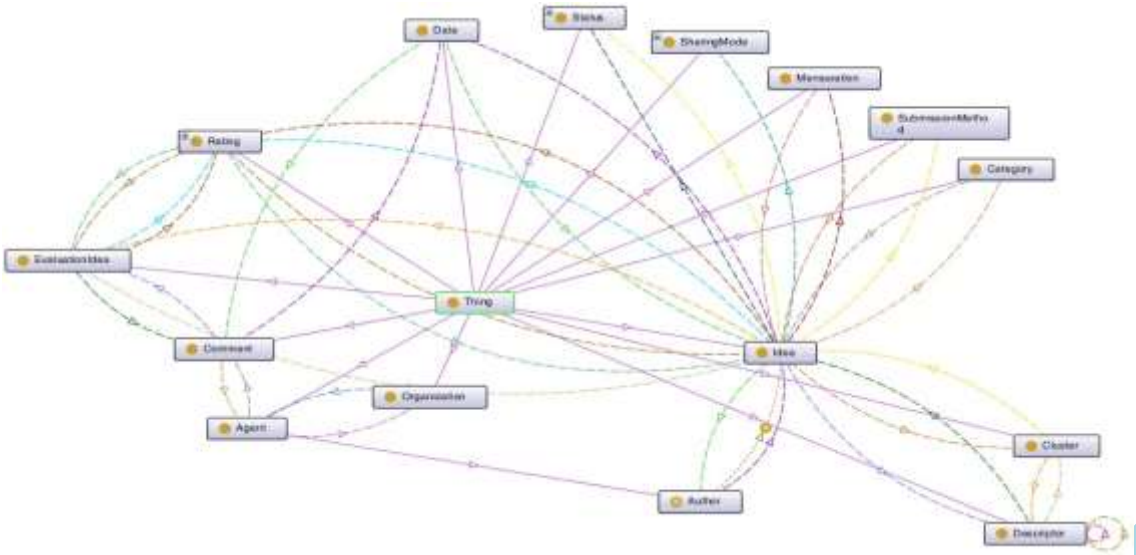

**Figure 3 – Ontology developed for ideas management**

Source: Authors

In the clustering stage it was used the Lingo algorithm available in the Carrot project²[1] for the visualization of the clusters formed as a result of the ideas. According to the project site, the Carrot² is a library with a set of apps to build up a mechanism of research results grouping whose aim is to organize the research results into topics, fully automatically and without external knowledge such as taxonomies or pre-classified content.

The Lingo algorithm is applied in the cluster formation process. According to Osinski and Weiss (2004) the difference of Lingo compared to other algorithms is at the time of the cluster description because it tries to find the best term that serves for the identification of a particular clustering. According to Carpineto et al (2009), Lingo has four stages which are: (1) pre-processing excerpts; (2) extraction of the phrases that most occur simultaneously; (3) the insertion of labels in clusters and (4) the allocation of contents in the clusters. Given the concern of the algorithm in defining the best description for the cluster and as the objective of the work is to promote a better visualization of the idea management domain, Lingo presents itself as a good alternative.

After the clustering process, all data are stored in the ontology forming the knowledge basis and then allowing the assessment by a domain expert about the same, in other words, the result obtained by applying the algorithm feeds back the domain ontology. In the stage of the knowledge specification, the data analysis is carried out seeking to identify patterns and trends that may assist when choosing the ideas for implementation. The data stored in the ontology serve as a support for the generation of networks/maps that help in the domain understanding, making up the knowledge basis. In general the networks interconnect the most important terms, which represent the clusters labels, with the ideas belonging to the cluster.

## 4. PRESENTATION OF RESULTS

The construction of the application scenario involved the collection of

[1] http://project.carrot2.org/

55 (fifty-five) ideas, randomly, present on the website of Starbucks®[2] in order to highlight the company relationships and market trends. The choice of the Starbucks® base happened for reasons of structuring the ideas arrangement format, as well as for the fact that Starbucks® had been used in other scenarios studies involving the domain of ideas management as in the studies of Westerski, Dalamagas and Iglesias (2013). The period of collecting and extraction of data to compose the database occurred at the end of 2014.

The category chosen for application of the algorithm was the domain of new technologies. For all the collected ideas it was constructed a corresponding XML document, prepared manually, aiming the textual semi-structuring. The structure of the XML document can be observed in **Erro! Fonte de referência não encontrada.**.

**Erro! Fonte de referência não encontrada.** presents the cloud of the main terms present in the base of ideas. It may be observed that the company name is the most cited, followed by the terms *app, windows phone, drinks* and *coffee*. By the frequency of the terms it is observed that there is a strong appeal on the part of users for mobile apps for *Windows Phone*® focused on *drinks* and *coffee*.


**Figure 4 – Cloud of the most significant terms of the set of ideas**
Source: Authors

The analysis only by the most significant terms of the set has neither greater expressiveness nor robustness because it only analyzes the frequency with which the terms are cited, contributing little for the domain

[2] http://mystarbucksidea.force.com/apex/idealist?lsi=0

understanding.

As from the cluster analysis it is possible to explore the contents of large data volumes allowing that the specialist domain can analyze groups of objects, not just a single object. Cluster analysis also helps to detect unusual objects and the results can be used for corporate decision making.

The model presented in the work promotes support for the identification of the main ideas which most occurred simultaneously that are present in the domain of analysis, thus facilitating the database visualization. The research aims to demonstrate the model effectiveness through the formation of clusters.

**Erro! Fonte de referência não encontrada.** presents the clusters obtained as from the application of the developed prototype. It can be observed that the clustering most representative is the one in green color, called *Starbucks App* for *Windows Phone*, followed by the clusters *Other Topics* (purple color), *Favorite Drink* (blue color) *Mobile App* (yellow color) and *New App* (blue color). The capitalized words correspond to the description of the cluster formed from the Lingo algorithm, and the lower case words correspond to the title of the idea.

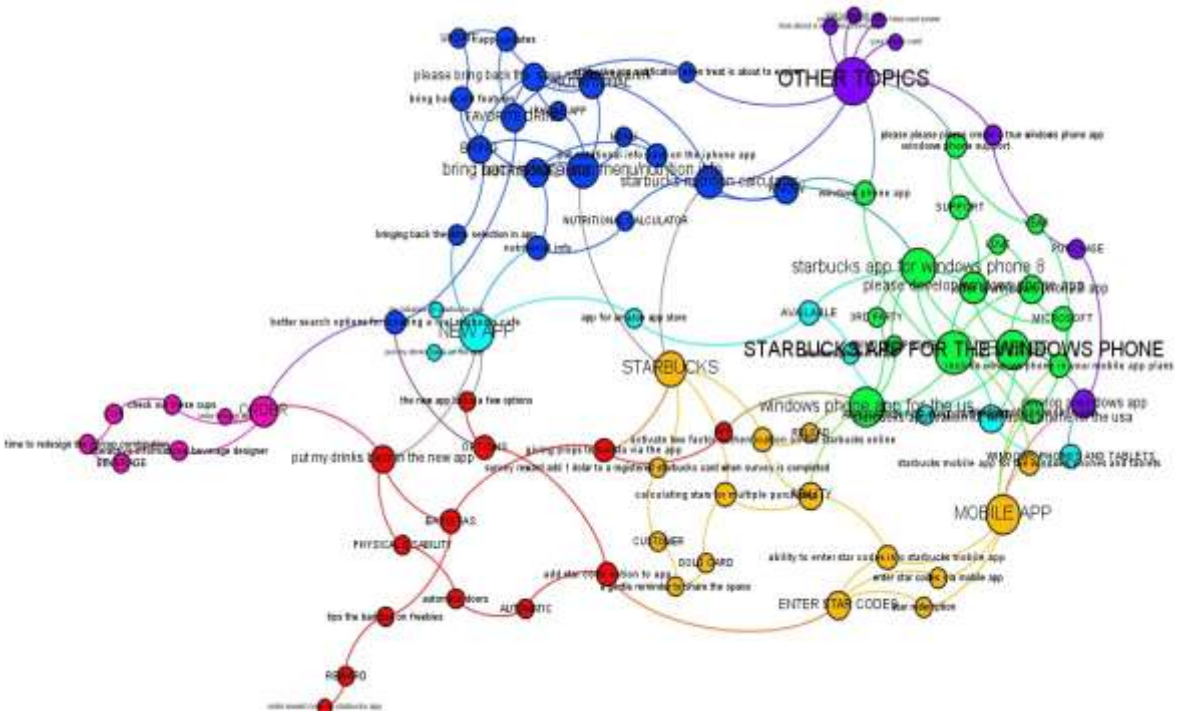


**Figure 5 – Clusters formed as from the domain of analysis**

Source: Authors

When analyzing the information expressed in the clusters formation,

there is an improved understanding of the ideas analysis domain. By the expressiveness of the clusters descriptions, visualization and interpretation are facilitated.

It can be observed that there is an appeal on the part of the community of company employees that provide ideas, for new *mobile* apps for *windows phone* mainly in version 8, evidence confirmed by the clusters in purple color, dark blue, green, yellow and light blue. It is also observed that employees wish apps focused on the term *drinks*. The nutritional issue is an important factor present in the dark blue clustering through the interest in apps that provide nutritional facts or nutritional calculators.

Through the application of the developed prototype it was observed that the five most representative terms in the domain of analysis present in **Erro! Fonte de referência não encontrada.** are:

**Table 1 - Terms which most occurred simultaneously of the domain of analysis**

| Term | Number of times they appear in the documents (ideas) |
|---|---|
| **APP** | 38 |
| **Phone** | 20 |
| **Drink** | 18 |
| **Store** | 15 |
| **Windows** | 15 |

Source: Authors

Based on the most significant terms it was decided to select the two main terms: "App" and "Windows Phone". Despite the terms *phone* and *windows* appear separate in the table, both represent the second pair of terms that most occur simultaneously in the domain.

**Erro! Fonte de referência não encontrada.** presents the clustering obtained from a query based on knowledge for projecting the image according to the search query "App".

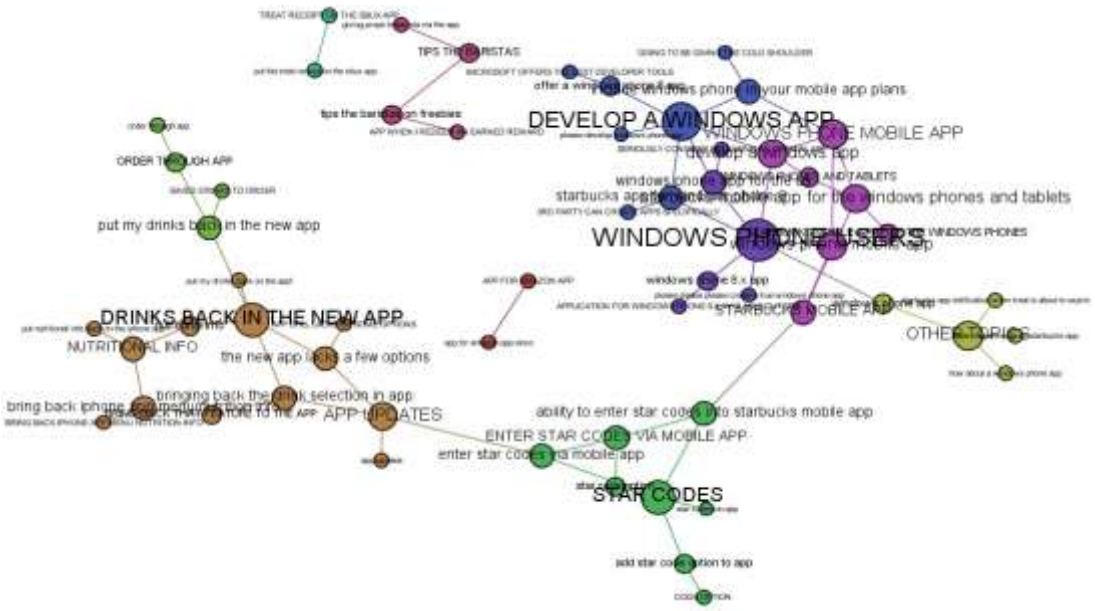


**Figure 6 – Cluster formed as from the query App**

Source: Authors

In this scenario it was identified forty documents containing the query "APP", being grouped into ten clusters. It can also be observed that related to the "App" domain the organization's employees request more apps related to the domain *"Drinks back in the new App",* represented by the clustering in brown color, the development of apps for *"windows"* presented by the clustering in dark blue and apps for user "*windows phone",* represented by the clustering in purple color which is the most representative group in the domain of analysis.

Also in the domain of *"Drinks back in the new App",* it is observed that there is a strong appeal for apps related to the nutritional issues. This information confirms what was shown in **Erro! Fonte de referência não encontrada.**, which contains the grouping of the analysis set as a whole. The grouping descriptions are related to nutritional information for apps for *iPhone* and the issue of nutritional calculation.

**Erro! Fonte de referência não encontrada.** presents the clustering obtained by applying the Lingo algorithm with the query *"Windows Phone".*

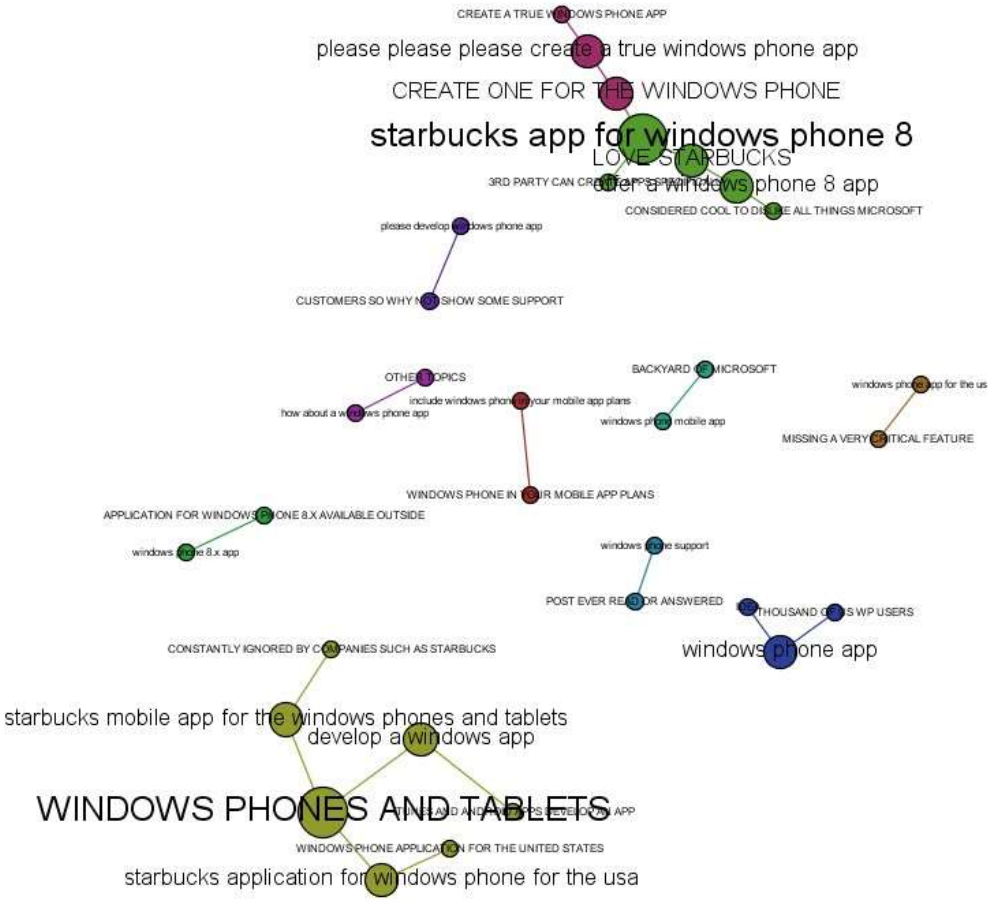


**Figure 7 – Scenario involving the classification of the query "*Windows Phone*"**
Source: Authors

In this second scenario it is identified fifteen documents containing the query *"Windows Phone",* being grouped into eleven clusters. It can be observed the relationship of this domain with the domain of mobile apps, represented in **Erro! Fonte de referência não encontrada.** by the cluster in dark blue with the term *"Windows Phone App"*.

In this case it is observed that the most significant cluster is the one in green color, whose description calls for the development of apps for mobile phones containing the operating system *Windows Phone*® from Microsoft®, and het developing of apps for *tablets*. Another feature of the formation of this cluster is that the employees of Starbucks® request apps for *Windows Phone*® for US users.

After the presentation of scenarios and their analysis, it can be observed that through the application of cluster analysis, patterns and

trends can be highlighted and better visualized by experts with the aim of assisting in the decision making.

## 5. FINAL CONSIDERATIONS

In this paper it was proposed a model based on ontology and on the cluster analysis to assist in the decision-making process in the idea management domain. To do so it has developed domain ontology for knowledge representation and to provide support for the semantic representation of ideas. The semantic representation helps in the process of grouping ideas into categories, in the pursuit and in the evaluation of ideas. This makes possible to draw the most heavily discussed ideas.

Through semantic it is possible to define the rules for combining ideas and their relationships, promoting the representation of relationships. The use of ontologies allows the reasoning, the analysis and the acting on the stored knowledge.

Additionally, the model considers multivalued analysis. These techniques allow evaluating a set of characteristics with respect to a population analysis. One of the multivalued analysis techniques most widely used is the cluster analysis. Cluster analysis is a technique that enables grouping objects based on the similarities of each observation. The central idea in the groups' formation is to maintain the homogeneity within the group formed and the heterogeneity between groups. With the application of clustering technique it is possible to reduce the information of a set of *"n"* individuals for information on a new set of *"n"* groups, where the *"n"* groups are significantly lower compared to the *"n"* individuals.

Given this premise it is possible to observe that through the cluster analysis it is possible to demonstrate patterns and trends with respect to the ideas present in the domain under analysis. An idea analyzed separately may possibly not present a potential for implementation, but when analyzed in conjunction with other ideas, it may show a possible trend or market demand. Clusters allow users to interpret, in a better way, the ideas collected in the organization. Being so the decision making process is

facilitated, helping experts to decide on which ideas are likely to be implemented.

The information contained in the knowledge base allow the formation and presentation of groups of ideas, enabling experts to best allocate the time spent on the analysis of trends and demands indicated by customers and employees.

With the application of the proposed model for the research scenario involving the Starbucks® Company, it was observed that there is a strong appeal for the development of *mobile* apps that use the *Windows Phone*® operating system; for apps that provide nutritional facts or also nutritional calculators, and for apps that are related to the beverage domain.

As future works it is intended to apply other clustering algorithms in order to analyze which the best approach is for dealing with textual information. In addition, it is desirable the improvement of the maps analysis produced by the clustering process through the social networking analysis.

## REFERENCES

Andrienko, G., Andrienko, N. (2009) Interactive cluster analysis of diverse types of spatiotemporal data. Acm Sigkdd Explorations Newsletter, New York, 11 (2), 19-28.

Artz, K. W., et al. (2010) A longitudinal study of the impact of R&D, patents, and product innovation on firm performance. Journal of Product Innovation Management, 27 (5), 725–740.

Badawy, M. K. (2011) Technovation - Is open innovation a field of study or a communication barrier to theory development: A perspective. Technovation, 31 (1), 65–67.

Barbieri, J. C., Álvares, A. C. T., & Cajazeira, J. E. R. (2009) Gestão de ideias para inovação contínua. Porto Alegre: Bookman.

Baregheh, A., Rowley, J., & Sambrook S. (2009) Towards a multidisciplinary definition of innovation. Management Decision, United Kingdom, 47 (8), 1323-1339.

Bautzer, D. (2009) Inovação: repensando as organizações. São Paulo: Atlas.

Bessant, J., Lamming, R., Noke, H., & Phillips, W. (2005) Managing innovation beyond the steady state. Technovation, Amsterdam, 25 (12), 1366-1376.

Björk, J., & Magnusson, M. G. (2009) Where do good innovation ideas come from? Exploring the influence of network connectivity on innovation idea quality. Journal of Product Innovation Management, Malden, 26 (6), 662-670.

Björk, J., Boccardelli, P., & Magnusson, M. G. (2010) Ideation capabilities for continuous innovation. Creativity & Innovation Management, Malden, 19 (4), 385-396.

Blohm, I., Bretschneider, U.; Leimeister, J. M., & Krcmar, H. (2011) Does collaboration among participants lead to better ideas in IT-based idea competitions? An empirical investigation. International Journal of Networking and Virtual Organisations, Olney, 9 (2), 106-122.

Boeddrich, H. J. (2004) Ideas in the workplace: a new approach towards organizing the fuzzy front end of the innovation process. Creativity and Innovation Management, Malden, 13 (4), 274-285.

Borst, W. N. (1997) Construction of engineering ontologies for knowledge sharing and reuse. Universiteit Twente.

Bothos, E., Apostolou, D., & Mentzas, G. (2012) Collective intelligence with web-based information aggregation markets: The role of market facilitation in idea management. Expert Systems with Applications, Amsterdam, 39 (1), 1333-1345.

Brem, A., & Voigt, K. I. (2007) Innovation management in emerging technology ventures: the concept of an integrated idea management. International Journal of Technology, Policy and Management, Olney, 7 (3), 304-321.

Carpineto, Claudio et al. (2009) A survey of web clustering engines. ACM Computing Surveys, New York, 41 (3).

Chesbrough, H. (2006) Open Innovation: the new imperative for creating and profiting from technology. Harvard Business School.

Cicyt, Comisión Interministerial De Ciencia y Tecnología. (2007) Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica 2008-2011, 1 (1).

Conry-Murray. (2010). Can Enterprise Social Networking Pay Off? Internet Evolution. [Online]. Disponível em: http://www.internetevolution.com/document.asp?doc_id=173854&page_number=2; Acesso em: Jan, 2015.

Cruz, C. D., Carneiro, P. C. S. (2006) Modelos biométricos aplicados ao melhoramento genético. 2.ed. Viçosa: UFV, 585.

Endesley, S. (2010) Innovation in action: a pratical guide for healthcare teams. London: BMJ Books.

Fernandes, R. P.; Grosse, I. R.; Krishnamurty, S.; Witherell, P.; Wileden, J. C. (2011) Semantic methods supporting engineering design innovation. Advanced Engineering Informatics, 25 (2), 185-192.

Gambatese, J. A.; Hallowell, M. (2011) Enabling and measuring innovation in the construction industry. Construction Management and Economics, 29 (6).

Gibson, R.; Skarzynsky, P. (2008) Inovação: prioridade nº 1: o caminho para transformação nas organizações. Tradução: Alessandra Mussi Araujo, Rio de Janeiro: Elsevier.

Gómez-Pérez, A. (1999) Ontological engineering: A state of the art.Expert Update: Knowledge Based Systems and Applied Artificial Intelligence, 2 (3), 33-43.

Govindarajan, V., & Trimble C. (2012) Innovation: create far from home, win everywhere. Boston: Harvard Business Review.

Gruber, T. R. (1995) Toward principles for the design of ontologies used for knowledge sharing? International journal of human-computer studies, 43 (5), 907-928.

Guarino, N. (1998) Formal Ontology in Information Systems: Proceedings of the 1st International Conference June 6-8, 1998, Trento, Italy.

Hüsig, S., & Kohn, Stefan. (2011) "Open CAI 2.0"–Computer Aided Innovation in the era of open innovation and Web 2.0. Computers in Industry, 62 (4), 407-413.

Jain, A. K.; Murty, M. N.; Flynn, P. J. (1999) Data clustering: a review. Acm Computing Surveys, 31 (3), 264-323.

Kobashi, N. Y. (2007) Fundamentos semânticos e pragmáticos da construção de instrumentos de representação de informação. DataGramaZero - Revista de Ciência da Informação, 8 (6).

Lula, P., & Paliwoda-Pękosz, G. (2008) An Ontology-Based Cluster Analysis Framework. Proceedings Of The First International Workshop On Ontology-supported Business Intelligence, New York, 1-6.

Magnusson, P. R., Netz J., & Wästlund E. (2014) Exploring holistic intuitive idea screening in the light of formal criteria, Technovation, 34 (5–6), 315-326.

Neches, R., Fikes, R., Finin, T., Gruber, T., Patil, R., Senator, T., & Swartout, W. (1991) Enabling Technology for Knowledge Sharing. In AI Magazine, Fall.

OECD. (2010) The OECD Innovation Strategy: getting a head start on tomorrow. Paris, France.

Osinski, S. & Weiss, D. (2004) Conceptual clustering using Lingo algorithm: evaluation on open directory project data. In: INTERNATIONAL IIS: IIPWM´04 CONFERENCE, 2004, Zakopane, Poland. Proceedings…Zakopane, Poland, 369-378.

Poveda, G., Westerski, A., & Iglesias, C. A. (2012) Application of semantic search in Idea Management Systems. International Conference for Internet Technology And Secured Transactions, 230 - 236.

Reid, S. E., & Brentani, U. (2004) The fuzzy front end of new product development for discontinuous innovation: a theoretical model. Journal of Product Innovation Management, Malden, 21 (3), 170-184.

Silva, D. L., Demarques, E. A., Souza, R. R., & Lima, G. A. B. O. (2009) Ontologias e Unified Modeling Language: uma abordagem para representação de domínios de conhecimento. Datagramazero - Revista de Ciência da Informação, 10 (5).

Sint, R.; Markus, M.; Schaert, S.; Kurz, T. (2010) Ideator - a collaborative enterprise idea management tool powered by KiWi. Fifth Workshop "Semantic Wikis. Linking Data and People". Hersonissos, Greece.

Studer, R., Benjamins, V. R., & Fensel, D. (1998) Knowledge engineering: principles and methods. Data & knowledge engineering, 25 (1), 161-197.

Tidd, J., Bessant, J., & Pavitt, K. (2005) Gestão da Inovação. 3ª. Ed. Porto Alegre: Bookman, 600.

Trott, P. (2012) Gestão da inovação e desenvolvimento de novos produtos. 4. ed. Porto Alegre: Bookman.

Vandenbosch, B., Saatcioglu, A., & Fay, S. (2006) Idea management: a systemic view. Journal of Management Studies, Malden, 43 (2), 259-288.

Vasconcelos, E. S.; Cruz, C. D., Bhering, L. L.; Resende Júnior, M. F. R. (2007) Método alternativo para análise de agrupamento. Pesq. agropec. bras., Brasília , 42 (10).

Vygotsky, L. S. (2007) A formação social da mente. 7 ed. São Paulo: Martins Fontes.

Westerski, A.; Iglesias, C. A. (2011) Exploiting Structured Linked Data in Enterprise Knowledge Management Systems: An Idea Management Case Study. EDOCW. p. 395-403, IEEE Computer Society.

Westerski, A., Dalamagas, T., & Iglesias, C. A. (2013) Classifying and comparing community innovation in Idea Management Systems, Decision Support Systems.

Westerski, A., Iglesias, C. A., & Rico, F. T. (2010) A Model for Integration and Interlinking of Idea Management Systems. 4th Metadata and Semantics Research Conference (MTSR 2010), Alcalá de Henares, Spain.

Witell, L., Löfgren, M., & Gustafsson, A. (2011) Identifying ideas of attractive quality in the innovation process, The TQM Journal, 23 (1), 87-99.

Xie, L., & Zhang, P. (2010) Idea Management System for Team Creation. Journal of Software, North America, 5 nov.