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Managing knowledge – the importance of databases in the scientific production

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Abstract

The process of knowledge management results from the need to survive in a world dominated by innovation, and the need for its management is based on the creation of value. Knowledge is a process that occurs in three steps: creation, exploitation and maintenance. This steps lead to the creation of new knowledge, that in turn are feed by relations created among disciplines. This knowledge must be shared, and organizations shall find a way to do it in order to survive. So, databases might be a solution to promote creation of value and scientific production.

In this research one has done a review of state of the art, being this one an evaluation method that allows deepening about the subject, answering for the purpose of this paper. The question that is to answer is the following: what is the importance of databases in the scientific production? Collecting papers about subjects as knowledge management, databases and other, was the point of departure to get to a conclusion about the posed question.

In this study one can conclude that the objective is to create an automatic database that manage knowledge properly so that users just have to use it in a simple and quick way. Related to this, databases exist, but still present several limitations as for example involving manual work such as experts' validation. Although the impact of databases is not studied by literature, transdisciplinarity suggests that it would be favorable to scientific quality production: if we consider network as an enabler of scientific production, and if we consider databases a form of networking, it leads us to think that it would contribute to scientific quality production too.

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1. Keywords: Knowledge management, databases, interdisciplinarity, multidisciplinarity, transdisciplinarity, scientific production, innovation

1. Introduction

The process of knowledge management results from the need to survive in a world dominated by innovation, and the need for its management is based on the creation of value and competitiveness of organizations. Knowledge is a process that has to be captured, processed and reused to create new knowledge. It has to be created, exploited and maintained so that it can be used as organization's strategy [1]. To do so, interdisciplinarity, multidisciplinarity and transdisciplinarity contribute in this process, especially in the construction of new knowledge [2]. Managing knowledge is a complex matter because information is present on a large variety of data. Knowledge can be a critical and strategic factor and the key to competitiveness and success in highly dynamic environments, such as problem – solving facilitator. However, the demand for each time more intelligent systems obliges that knowledge has to be captured, processed, reutilized and disseminated so that it can accomplish each time more difficult tasks. Knowledge itself is already difficult to capture and explain, and these tasks become even more difficult in fields where data and models come in a wide variety of formats and scales or in systems in which adding value is not easy to get. Although the challenge of dealing with knowledge is an old problem, it is perhaps more relevant now than ever. The reason is that of joining the history of artificial intelligence with databases shows that knowledge is a critical point for a good performance of intelligent systems [1]. Already in the 1980's literature pointed a variety of theories of knowledge where they all pointed to the strategic importance of knowledge-based aspects and consequently the creation of knowledge has become the focus for practioneers and scholars [1]. Some models to explain knowledge creation emerged like the one of Nonaka and Takeuchi [1] in 1995, relating tacit knowledge with explicit knowledge as product of relations of socialization, externalization, internationalization and combination, but they weren't the only ones: academic research has developed a variety of micro models for knowledge creation organization [3].

Transdisciplinar research, after more than 20 years of design and development began to address epistemological challenges, taking advantage of research-action, and to new paradigms, such as the process of co-producing knowledge between scientific and non - scientific involving the coproduction of systems, targets, and knowledge transformation [4].

The aim of this work is to present a review under the theme of knowledge management, specially the contribution of databases in scientific production. The work is divided into the following parts: introduction, development, discussion and conclusions. In the introduction one presents a framework to the subject of research, in the development are defined some concepts related to knowledge, the importance of relations and network in the production of knowledge, knowledge construction and databases, and at last the importance of databases in the scientific production. Discussion and conclusions end this review.

2. Development

2.1. Knowledge – relations between disciplines.

Regarding the theme, it is appropriate to present some concepts. Knowledge is the information combined with experience, context, interpretation and reflexion. It's a high form of information value that is ready to be applied in decisions and actions [5]. The distinction between knowledge and information is that knowledge is fundamentally a question of cognitive abilities, while information assumes the form of structured and formatted data which remain inert and passive until be used by someone with the necessary knowledge to interpret and process them [6].

Knowledge management is the systematic process of creating, maintaining and encouraging an organization so that this one uses knowledge in the best way to get competitive advantage or get high performance in a sustainable way, which objectives allow the creation and sharing of knowledge [7]. Knowledge management is an approach to the management of the company (organization), in which knowledge has a fundamental and central role, bringing tools of the different functions and disciplines of management (human resources, quality management, operational management, marketing, etc.) [7].

Discipline is the set of specific knowledge that have their own characteristics in the field of education, training, of the mechanisms, methods and materials [8].

Interdisciplinarity is the interaction that exists between two or more disciplines, being able to integrate mutual managerial concepts to a simple communication of ideas. It is the mutual exchange and reciprocal integration enters various sciences [8].

Multidisciplinary is the overlap of different disciplines, sometimes with no apparent relation between them and that it occurs when solving a problem requires obtaining information from one or more of the sciences or knowledge. Transdisciplinarity is a higher step of interdisciplinarity that not only affects interactions or reciprocities but relationships within a total system [8]. They assume a global interaction of the various sciences and can occur at three levels: Interdisciplinarity, multidisciplinary, transdisciplinarity, as shown in the figure 1[8].

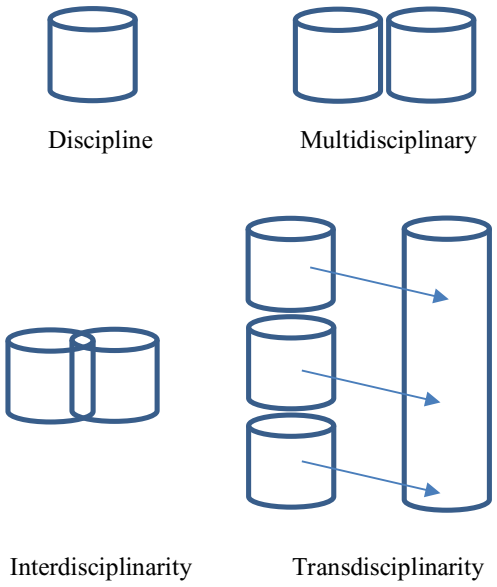

Fig.1. Disciplinary, multidisciplinary, interdisciplinary and transdisciplinary knowledge – boundaries.

In what concerns relations between disciplinarity, multidisciplinarity, interdisciplinarity and transdisciplinarity knowledge, one can see in figure 1 that it has to do with boundaries. In multidiscipline, boundaries are distinct, in interdisciplinarity boundaries begin to overlap or merge, and new sub disciplines are formed by close association. In transdisciplinarity knowledge "transcends" boundaries, one discipline becomes dominant, having on its edges other disciplines.

A transdisciplinar approach of the knowledge management model proposes a transition into the actual model of transdisciplinarity that accepts knowledge as highly active and dynamic and evolved in maturity since early stages of research. It is only possible if the research team adopts a clear and integrated set of disciplinar and transdisciplinar discovery to produce knowledge. Structural characteristics need to be identified, to present models that can be used by scientific policies, as different types of knowledge and its needs of integration. It also needs to define the maturity levels to manage transdisciplinar emerging knowledge [1].

2.2. The importance of relations and network in the production of knowledge.

Collaboration leads to a creation of a new knowledge by using communication tools in order to establish a new understanding which helps the participants to achieve their objectives. Collaboration can be successfully supported by providing a knowledge sharing environment and communication facilities [13].

Knowledge sharing is defined as "individual/organization that obtains access to any individual's own and other knowledge", the most common activity of knowledge management where many researchers set it as positively related with the organization performance by increasing organization's resources [13].

The knowledge sharing process includes both the creation and the transfer of knowledge trough different means such as documentation or communication among individuals, groups and organizations. Knowledge management is fundamentally about people not technology. However, there is no way that one can share knowledge effectively

within an organization or in large geographically dispersed one without the use of technology, but knowledge sharing is not enough to solve the problem of managing knowledge. Collaborative research activities represent the main process of collaborative work within a community of researchers working within groups, and exchange research information during research activities. Using collaborative tools to motivate sharing lacks of integrity property, where the exchanged research information and knowledge scattered. Workflow management helps to distribute knowledge in a organization in a more consistent, repeatable and reliable fashion, and allow to integrate all information [13].
When considering relationships between scientists one can state that researchers who invest resources in obtaining several and frequent bonds have the ability to generate a great impact, although it doesn't increase the number of publications. This suggests that the width and depth of relations that are developed among scientists in the effort to publish, can bring a diversity of ideas that result in high quality publications and can be the result of a growing division in the academic work which may require collaboration at interdisciplinary a multidisciplinary level [9]. Collaboration in research is important and should be promoted, embendness that results from scientific collaboration matters: points to an insight of how the initiatives that welcome collaboration in research can take into account the relational, structural and cognitive dimensions of social capital. This suggests that there is an interesting exchange in the interdisciplinary work related to the same centrality of networking, while bringing disciplines and moving towards a central position contributes to an output. It also shows that there is a clear exchange between quality and quantity in the productivity of the research when one invests in the leverage of network assets and that the most productive researchers and collaborators are most likely to publish individual papers. Surprisingly, the international collaboration seems not to significantly affect future outputs and impact as announced in other studies. It's known that embendness of networking can be much different depending on the specific area of knowledge [9].
Information and communication technologies have a significant impact in activities based in knowledge. This technologies, among people with different skills and abilities easy the access and sharing of knowledge [3]. Going in this path, transdisciplinar knowledge management is a strategy of research that must be planned since a working line formulation, which social benefits depend on a variety of issues. A maturity model combines strong bonds of knowledge management which is directed to social benefits of transdisciplinar knowledge. This model is highly flexible and it may be adapted to any research environment. A balanced approach of traditional interdisciplinary and multidisciplinary knowledge is used, although focused in stretching disciplinar knowledge, the goal is to maximize each one benefits, considering key areas, processes, technologies, and products to shape the best way of using them. Here, the model can be extended from traditional to global, to reach a transdisciplinar knowledge management produced in any research activity [3]. Transdisciplinarity also seen as a way of opening research to non-academic partners so that social determination can occur. Interdisciplinary and transdisciplinar knowledge generation is being addressed to social ends: even the European Committee in the Horizonte 2020 program provides 30 billion euros to a inter and transdisciplinar research program called "Tackling Societal Challenges", a seven year project. Also education was affected by the fact that a young person can have a vast set of professions in his/her career, in a global transformer society. Transdisciplinar education is becoming a necessity [10].

2.3 Knowledge construction and databases

The construction of knowledge databases based on the knowledge process construction is a critical point for the good performance of intelligent systems. The process begins by having data at disposal, this data are selected and targeted so that preprocessing is easier. Data become preprocessed, suffer a transformation, are mined, become knowledge pattern or model and after, knowledge process is concluded [1]. Figure 2 shows how the process of knowledge construction occurs:

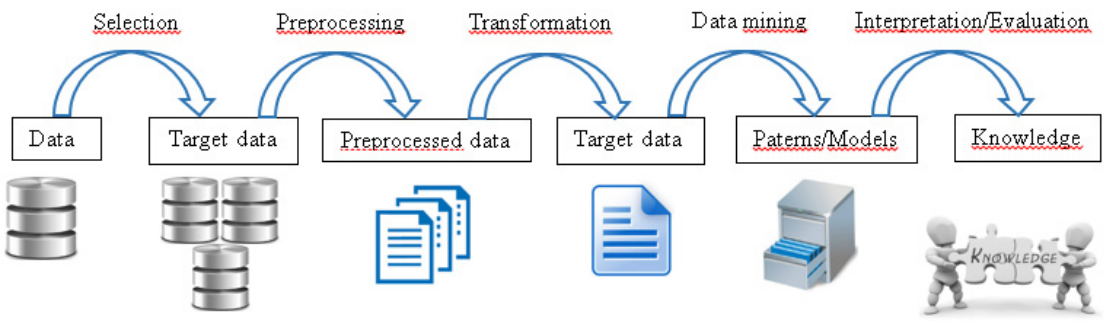

Fig.2. Knowledge process.

The construction process is divided into three stages: the creation of knowledge, the use of knowledge and the maintenance of knowledge. In the first point, one can subdivide into the acquisition of knowledge, where one extracts concepts and relationships between text and document concepts using any terminology that involves natural language, processing techniques and applies statistical or symbolic techniques to extract relations between terms and concepts; the knowledge representation, that consists on to promoting a formal specification of a knowledge domain, making a logical use to represent concepts, concepts properties, relationships among concepts and rules of that knowledge domain; the conditions and constraints of knowledge formation and formally specified organizations; the storage and handling of large databases that consists on drawing of a physical and logical medium, in which the users and repositories of knowledge can be supported in order to store and share knowledge. This involves a standardization of knowledge communications where metadata and annotations should be taken into account. Each data base respects a scheme, concept, paper, among others. The adoption of a data storage technology as a key method to address this issue is an idea adopted among possible solutions. With regard to the second step, the same author subdivides into knowledge reasoning which consists on inferring a logical consequence of a group of connections. The function of a "reasoner" is to generate a set of mechanisms with which to work so that he process a set of terms and concepts that represent de knowledge of the world. Through reasoning it is possible to derive facts that are not explicitly expressed in the database. Knowledge recovery helps the users to find applications or software they need in a database through consultation, navigation and / or exploration. The goal is to allow that the information returns in a structured way, consistent with the human knowledge processes, in opposition to a simple list of items. The traditional information retrieval organizes the information through indexation, however, the recovery of knowledge pretends to organize the information by indicating connections between different elements, and knowledge sharing (exchange of knowledge units so that each one has access to knowledge that doesn't have) [1].

The last step occurs with the knowledge sharing that encompasses knowledge meta modeling. Meta modeling might be considered an adding descriptions process about how a database is built that means that to formalize specifications, a central data repository relating to other data, origin, use and format must be attended. This repository is accessed by several software modules from the database, such as a query optimizer, transaction processor or a report generator.

Integrating knowledge is considered a process of new information incorporation into what already exists through an interdisciplinary approach. This process involves determining how the new information will interact with the existing one, how will new information be accommodate and how should be modified to gather the one that already exists. Besides, this information can be used beyond words lexical correspondence and operate at a concept level when compared to specific concepts. Validation is the last step that ensures that something is correct or according to a certain pattern. The final objective of this step is to submit the databases to experts in a determined subject and it is a critical process in databases maintenance [1]. To do a summary, one presents Table 1[1]:

Table1. Summary of concepts in the knowledge management field.

Knowledge creation	Knowledge exploitation	Knowledge maintenance
Knowledge aquisition	Knowledge reasoning	Knowledge meta modeling
Knowledge representation	Knowledge retrieval	Knowledge integration
Knowledge storage and manipulation	Knowledge sharing	Knowledge validation

There are questions that one can't still answer, related to databases and knowledge construction that have to do with efficiency and effectiveness: how to support the complete big databases life cycle so that computer systems can explore and evaluate human being in decision making as an expert or how is automatically generated knowledge in big databases or how is knowledge collection and interpretation done in a cheaper way (nowadays it's too expensive because actualization methods are manually done). This means that databases systems are not, in its majority, optimized, presenting many challenges [1].
As an example, to be attracted to the research centres, international researchers must be able to find, in few clicks, all the data they need about research areas, publications, ongoing projects, research staff involved, vacancies, support given. All this information must be integrated, updated, and in English. The authors of [14] state that, related to a certain Italian research centre, the update of the "funded projects" webpage, as well as the matching between the competences of international incoming researchers and faculty members' ones is now processed by an officer [14]. This shows the importance that was given by this research centre in managing knowledge and its reflection in attracting international researchers.

2.4 The importance of databases in the scientific production.

Knowledge sharing improves the richness of communications and so performance measurement is needed [11]. The time cycle reduction in sharing knowledge was developed by Hult and Ketchen [11] associated to dyadic performance from the point of view of speed, quality, cost and flexibility. It is suggested that knowledge transfer produces benefits in terms of increased cost efficiency and quality. Knowledge sharing is very useful in creating value. In this context, knowledge management can be used as an effective approach to achieve knowledge sharing among supply network partners. Literature does not consider human performance in terms of creativity, entrepreneurial growth, staff performance, staff satisfaction, etc. Knowledge management adoption influences the knowledge management systems that support knowledge management development. Literature should explore the factors that affect knowledge management practices: there is a lack of papers concerning human, cultural, technological and specific factors in a dyadic way and in a supply network. Papers should also explore knowledge storage and knowledge application in dyadic and supply network dimensions [11].
In what concerns the support of knowledge management adoption it's an issue that also needs as more extensive analysis, both in the supply network and dyadic relations, so that some questions may be answered such as: How do knowledge management systems support knowledge management adoption? In this one they point out that knowledge management systems need more extensive analysis to improve the different phases of knowledge management. Even human performance that is influenced by this management is not analyzed by literature. This also means that the relation customer-supplier in the exchange of knowledge is not deepened by literature [11].
The possibility of enabling organizations to attain higher performance levels and to experience several solutions to competitiveness problems are related to information technology and strategic decision-support systems as a decisive contribution to knowledge management efficiency. It's a model to be improved in order to include new actors and to consider a wider set of technical tools, which could help on achieve knowledge management efficiency levels. In a future, the importance of factors that affect intelligent agents, the use of technical tools and the knowledge manager attitude toward managing knowledge are fundamental to succeed. The knowledge manager shall do an effort to improve towards information technologies and a strategic decision-support systems and internal and external intelligent agents must be integrated in the organization strategy [12].
Changes in research and innovation during the last few years have been prompted mainly by events which affected our economy and society. To contrast our continent decreasing competitiveness, Europe has strengthened investments in Research and Innovation, first with the 7.th Framework Programme and subsequently with Horizon 2020 [10]. This situation lead Rubbia G., Franco C., Pellizzon D., Nannipieri L., [14] to do an inquiry about research support in terms of information system. The conclusion that they obtained was that some institutions adopted a unique information system composed by different modules, in which several and different software are in use, in some cases even not integrated. Most represent functions and are a repository of research outputs, the database of publications and the database of projects. This inquiry also permitted to conclude that interviewees expressed the need for great integration between different information platforms and software programs in use in different offices, as well as greater interoperability and integration of information, which is variously managed as a main institutional window and communication tool [14].

Related to databases [15] gives as example of difficulties in assessing the patentability of an invention, when one needs to check many documents from different countries as possible in order to avoid infringement of the patent rights of other inventors. In [16].when comparing web search and databases searching were disappointing in terms of search details reported, presenting problems for replication. It's important for the development of knowledge in the field that future studies provide sufficient detail for replication. It is apparent as a major finding that web search engines are not at the stage of development where they could replace bibliographic databases (for example). Although their precision was on a par with the best databases, their sensitivity in retrieving material relevant to an identified scholarly topic was only at the level of the weaker bibliographic databases for the search strategy [16].
Quick, adequate and efficient results of research information directly influences the performance of researcher institutes, being one of the actors who has the main function of generating new knowledge. The quicker and complete is the information that researchers receive, most scientific products it will generate at a lower cost. However, the functions of scientific communications are no longer achieved because the number of challenges that are placed in the informational scenario that are inserted in the research institutes [17].

3. Discussion

In the reviewed literature, one can mention that managing knowledge is still an issue that needs to be deepened and that there are some open questions related to knowledge databases in what concerns effectiveness and efficiency. Questions like how to support a complete large database cycle and how can computers explore and evaluate human being in decision-making as an expert to validate information to create automatic knowledge generation are unanswered. As far as it concerns the knowledge construction, process collecting and interpreting, methods are manually done so, it is too expensive to actualize data [1]. That means that databases are not properly optimized and there is a need of transdisciplinar knowledge control so that researchers power may be balanced: this one's should have a word to say about what they agree or disagree [2]. This means that scientific community must be heard in what concerns databases.
Sharing improves the richness of communications, and knowledge management adoption influences the knowledge management supports [11]. But knowledge sharing is not enough to solve the knowledge management problem.
They all seem to agree that the managing knowledge issues should be more explored, people's contribution and influence in managing knowledge and also its contribution to improve scientific production Also databases should be improved, and this action should be measured to prove its importance in the scientific production. Some questions need to be answered: if knowledge is so important, if it is considered for every interested parts as having a central role in competitiveness and the base to create value, why isn´t it object of more attention so that every research centre has a proper way to manage it? Why don't organizations spent more time in conceiving tools for knowledge sharing?

4. Conclusions

The concern about knowledge management exists since some decades and persists, and databases creation objective is to manage knowledge automatically but the mentioned authors still point out limitations like the need of manual work, experts validation, need to be maintained, etc… this means that they are not still optimized. In terms of impact of databases in the scientific production, it is not deepened in the literature, there is a lack of study about this matter[1], but in terms of impact of transdisciplinar knowledge in scientific production, this one is recommended and so are virtual technologies that have a positive impact in the process of knowledge creation at individual and organizational levels: information and communication technologies allow knowledge exchange between geographical disperse individuals, so network is favorable to scientific quality production. Information and communication technologies support and promote transdisciplinar knowledge exchange. The transdisciplinar relation that is created among scientists should be the adopted model, essential to the production of new knowledge. Related to this structural characteristics need to be identified to create models that scientific policies can use to manage transdisciplinar knowledge [2]. All this conclusions suggest that knowledge bases might influence very positively scientific production, although they are not optimized and this result is not yet measured. If transdisciplinar knowledge contributes to better scientific production, optimized databases should help on increasing it in quantity and quality terms. The state of the art suggest that the databases optimization is an issue that must be attended, and that databases are created to deal with specific products or services.
Artificial intelligence would be a good them for research, depending on what was said about knowledge databases and networking in what concerns the objective of doing it in automatic way.

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