



Knowledge Management in Business Intelligence projects: State of the Art

Maria A Blanco Uribe*, Karen P Duran Vivas, Francisco E Sarmiento Devia and Victoria E Ospina Becerra

Colombian School of Engineering, Julio Garavito Bogotá D.C., Colombia

***Corresponding Author:** Maria A Blanco Uribe, Colombian School of Engineering, Julio Garavito Bogotá D.C., Colombia.

Received: March 02, 2023

Published: March 24, 2023

© All rights are reserved by **Maria A Blanco Uribe., et al.**

Abstract

This article presents the state of the art of methodologies based on knowledge management applied to business intelligence implementation projects, exposing the risks of failure in software development projects where the early stages of the development cycle, requirements gathering and design have greater impact. The research carries out an analysis of the documentation associated with aspects that reduce the impact of risk factors such as knowledge transfer and benefits management at the organizational level, contextualized in the development of software implementation projects where communication between the parties and their collaborative participation plays an important role, still these approaches doesn't considers the differential factors associated with business intelligence implementation projects and their implementation teams, deducting that the proposal of a new methodology is necessary

Keywords: Knowledge Management; Software Implementation; Software Development; Requirements Management; Software Design; Knowledge Transfer

Introduction

Due to the fourth industrial revolution, the importance of information and data at the organizational level has been evident, and beyond data and information, the knowledge and wisdom that can be extracted from them [1]. Over the years the phrase "knowledge is power" gains more and more strength, and with it the systems that allow us to manage and store large volumes of data and, above all, generate visualizations that support decision making in public and private organizations [2]. This is how Business Intelligence (BI) solutions have become increasingly popular, supporting the improvement of business efficiency thanks to their ability to provide flexible and meaningful reports that help to have a better understanding of information and making better decisions. It has been identified that the implementation of these systems is not conventional (such as operational and transactional systems), but is closer to the implementation methodologies of systems such as ERP (Enterprise Resource Planning).

The implementation of these systems is not limited to the acquisition and implementation of software or hardware systems, it must go through a process of analysis and alignment of the technology with the organization to ensure its use [3]. However, despite the great capabilities of business intelligence tools and opportunities for improvement they offer at the organizational level, the risks of their implementation are usually very high and have failure rates associated with factors such as resource availability, user participation, vision and scope of the project and team skills [4-6].

It has been shown that the introduction of methodologies associated with knowledge management has managed to reduce these risk factors. This article seeks to expose the state of the art of knowledge management within the framework of business intelligence, starting with a look at business intelligence and knowledge management, showing their interaction in Implementation projects as complementary areas through knowledge transfer and benefits management, and ending with future conclusions and work.

Business intelligence

According to Howson, Business Intelligence (BI) is understood as the set of technologies and processes that allow people at different levels of the organization to access, interact and analyze information to manage the business, improve performance, identify areas of opportunity and operate efficiently [7]. Wang refers to business intelligence as the set of applications and techniques for collecting, accessing, and analyzing large volumes of data for the organization to make effective decisions [8]. That is, in organizations, the main role of business intelligence is to provide information at various levels of organizations when needed, improving timely decision making.

Phases for the implementation of BI projects

Being tools that seek to support the improvement in vision at the organizational level and efficiency in processes, they should be aligned with the strategy of the organization, consider quality standards and present information visually so that their capabilities are used to the maximum, preventing it from becoming an island of information. For this reason, methodologies were developed for the successful implementation of BI Systems such as the one proposed by the Kimball Group [9], see figure 1, where the different stages are evidenced. that are carried out in a BI tools implementation project consisting of the following main tasks.

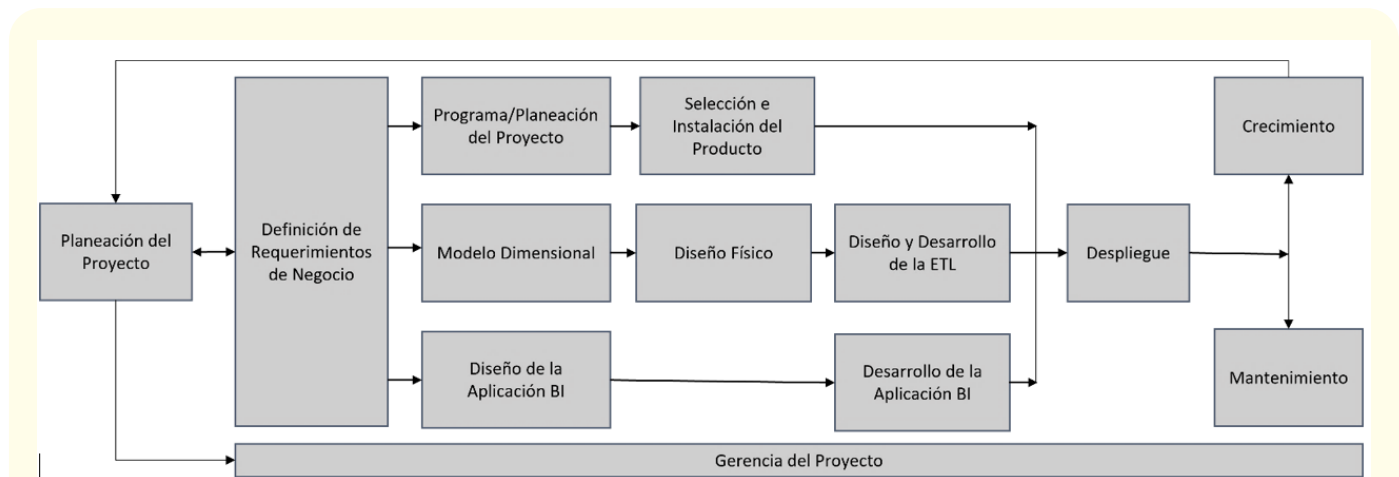


Figure 1: Life cycle of successful DW/BI projects. Own elaboration.

Information collection: Seeks to identify the information sources, data collection and its integration through ETL (Extraction, Transformation, Load) processes.

- Information management: Item related to database technologies, multidimensional models, etc.
- Visualization and distribution: Functionalities related to the construction of reports and reports.
- Analysis of information.
- Management of decisions taken.

The process of implementing business intelligence tools could be summarized below.



Figure 2: BI Systems Implementation Process summarized. Own elaboration.

As evidenced in Figure 2, the process begins with the requirements gathering phase necessary to establish the guidelines that will be used in the design of the tool at various levels, then an implementation and/or development phase, Continuing with the phase of deployment or commissioning of the system, and finally the phase of continuous improvement where new requirements are generated on the implemented system returning to the stage of lifting requirements, all this Of course encapsulated in the project management. What we can show is that these generalized stages apply to software implementation and development projects such as ERP tool implementation processes [10].

However, despite the fact that there are methodologies and good practices seeking to conclude BI systems implementations successfully that organizations try to follow in the best possible way, it has been identified that the requirements gathering and design phases can define the project success or failure of these projects, since these define the base line, agreements, constraints and guidelines that will be used in the application development or configuration. A study conducted in 2016 [11] ensures that in 70% of the software projects the requirements were difficult to identify and that in 54% of those projects they were not clear or well organized, in addition to other problems associated with the difficulty and challenge of describing requirements in a natural language, the different types of requirements and levels of detail, and the constant change in scope and requirements during the project. In 2014 the Standish Group report [12] revealed that within the failure factors of a software project 13.10% were due to incomplete requirements, 12% to lack of user involvement, 9.9% unrealistic expectations and 8.7% to the constant change of requirements. Other failure factors are associated with the knowledge of the implementing team and the team of experts by the target organization. This lack of experience generates false expectations in the target customer or organization, problems in the design of the solution and delays in the delivery of the products [13].

Knowledge management

In order to understand knowledge management, the concept of the word “knowledge” is first investigated. Davenport and Prusak define it as the “Mixture of experiences, values and information contextualized from and applied by individuals” [14], Biggs and Tang define it as the set of ideas and thoughts that a person possesses to make decisions.

Alavi presents it as the understanding gained through experience or study [16], and Nonaka and Takeuchi’s definition exposes knowledge as information created and organized, framed in the commitment and beliefs of the one who presents it. possesses [17]. Knowledge that resides in people is known as tacit knowledge, understood as knowledge that involves the experiences and technical skills that reside in a person, and explicit knowledge is that which is can transmit, communicate and distribute [18]. Likewise, Biggs and Tang classify this knowledge as declarative-prepositional (Know-what), procedural (Know-how) and functional (Know-when) [15]. Considering the above definitions we can conclude that knowledge includes the set of contextualized information based on the experience of those who possess it.

Knowledge management becomes fundamental in organizations allowing to generate sets of strategies that facilitate the increase of productivity and efficiency of processes by identifying, storing, generating and using knowledge to obtain value. For knowledge management, different models or variations of the models already defined have been established, some of the knowledge management models that were taken as a basis for research are listed below, considering their level of citation and value:

- **The conversion model (Nonaka and Takeuchi):** Considers the processes of socializing, externalizing, combining and internalizing knowledge [17].
- **The Alavi and Leidner model:** It encompasses the creation, storage and retrieval, transfer and application of knowledge [16].
- **Arthur Andersen’s model:** Includes the processes for creating, identifying, collecting, applying, and sharing knowledge. Models such as Andersen’s are fundamental in the analysis of decisive actors for the generation, storage, access and transfer of knowledge in organizations [19].

Through knowledge management and document management, the risks associated with the implementation processes of software solutions have been reduced [18], methods based on knowledge management have proven to be more effective than traditional ones [20], they have also been carried out approaches from the use of ontology-based systems for requirements gathering processes [21], however there is no consensus on the methodology applied in the implementation of BI systems with their particularities and specific challenges, nor how to transfer knowledge between stages.

Knowledge management and business intelligence projects

The stages of requirements survey and solution design are usually the most critical stages in BI solution implementation projects [22], they are the ones that involve more time and effort for the implementing team and the client or end user. These stages can become a determining factor of success or failure, and despite the different existing methodologies the problems associated with understanding the client's need, alignment with their organizational objectives and the Compliance with business requirements at operational and functional levels [23].

In the requirements survey stage, problems have been identified associated with the difficulty with which the end user expresses their needs to the implementing team and the level of user involvement in the project. On the side of the implementing team is the difficulty of understanding the business and the way in which the client's need is covered by the system to be implemented [11].

That is why several investigations have been carried out associated with the success of the implementation of software solutions focused on change management, risk management. and the management of project resources for a better term [5,23,24], and within this approach is the implementation of knowledge management [25,26], where methodologies and strategies that include the management of Knowledge in each of the stages of the project improving the quality of the product delivered and supporting the reduction of risks associated with the processes of implementation. However, this management is oriented to a traditional implementation process where the technical or functional consultants who are responsible for developing the requirements are not mentioned. specific to the client (which must be aligned to their business processes), the considerations that should be taken into account for the taking of technical and functional requirements, and their level of detail in the documentation, so that the teams generate the product that the client expects, reduce the number of iterations and not generate false expectations that produce discomfort and lack of confidence in the know-how [27] of the implementing team.

Knowledge management has been shown to encourage team members to reference past experiences and avoid falling into the same mistakes or problems of the past, benefiting technical consultants by sharing better practices, and managers, to be able to efficiently measure the knowledge of the organization. However, this

lack of explicit knowledge has exposed problems associated with organizational memory, which allows knowledge to be retained in the absence of organizational repositories where knowledge rests explicitly, or companies where such information exists but is not applied effectively or a good management documents stated by Aurum [28] in his article, where it is evident that the technical staff are mostly oriented to obtain knowledge through practice (Learn-by-doing) that Attending rigorous trainings where no sources of knowledge are identified, knowledge rests on certain people or team leaders and one of the most important drawbacks: communication skills, is difficult for them Express their ideas and the way they do things to others and even more to "non-technical", this hinders the stages of design and implementation of solutions, since team leaders usually have limited availability and dependence on their accompaniment makes bottlenecks are generated and consequently delays in the response times of the technical team.

These factors are evident in the technical teams of implementation of BI solutions, taking into account that these consultants not only require knowledge associated with the languages of the different tools, they must also have technical and functional knowledge of the solution, and understanding the business-level approach where the solution should be designed and implemented. These teams demonstrate the barriers associated with the outsourcing and concentration of knowledge [29] and the specialization of staff, making the consultant's position not flexible.

To say that anyone else can perform it temporarily or permanently depending on him to a large extent. These factors are maximized by the high turnover of personnel [30] in software solution implementation companies due to the high demand for experts in the area of BI solution implementations. Due to the popularity of the solutions in the market [3], this rotation of the personnel of the area explicitly affects the performance of the team when a member decides to leave the organization, since the tacit knowledge associated with the projects carried out is lost, which is commonly known as "knowledge leakage" [31], causing support processes or development of new requirements to be stressful for the team and affect response times.

Studies have been found that have successfully applied the introduction of systems based on ontologies [22], [27], seeking to develop what they called organizational knowledge architecture

based on Collaboration through the use of knowledge management systems based on ontologies, defining semantics and creating knowledge repositories that promote its reuse in new projects where the stored knowledge was identified and externalized through the application of the spiral methodology of the knowledge [17]. Strategies associated with the use of fuzzy logic were also introduced in the analysis of the requirements delivered to the implementing team [32].

However, these studies do not cover the need for the externalization of empirical knowledge, nor how to measure the level of knowledge or the quality of stored knowledge. Additionally, not all organizations are in a state of maturity that allows them to implement a complex system without the risk that it becomes an information island and is not used properly.

In order to establish the strategies that allow us to outsource this knowledge, we must delve into the issues associated with knowledge transfer and benefits management.

Knowledge transfer

Knowledge transfer is understood as the processes associated with organizing, creating, capturing and distributing knowledge to ensure its availability to future users, in which communicative processes are involved and the problems associated with tacit knowledge that resides in people, processes and subnetworks are evidenced. at the organizational level [33].

The process of gathering requirements can be understood as a process associated with the problem of knowledge transfer more specifically to the process of “personalization”, as well as the process of designing systems associated with the “coding” mechanism [34]. Where what is sought is to outsource different knowledge at the level of processes of organizations, technological processes and contexts in which the processes are developed. The image below seeks to illustrate the communicative process based on the roles proposed by Szulanski [35].

Table 1 describes the knowledge transfer models and methodologies that best suit our requirements survey and design processes.

It can be concluded that to achieve an effective knowledge transfer you must have at least 4 stages, context where it is in-

Methodology	Description	Stages
WIIG Model – Knowledge transfer [36,37]	Model of transfer and use of knowledge within organizations. It proposes that there are different ways of knowledge transfer depending on the nature of knowledge . Knowledge only generates value if it is organized and Structured.	Knowledge building Knowledge Compilation and Transformation Distribution of knowledge Application of knowledge
Meyer and Zack [38]	Model oriented to the design and development of information products.	Acquire (Quality of sources) Refine Store Distribute (Frequency and distribution) Present and use
Bukowitz and William (Framework) [39,40]	Model based on finding how organizations generate, maintain, and expand the store of knowledge to generate value.	Get Use Learn Contribute
Szulanski [35]	Knowledge transfer in 4 states that are affected according to transfer barriers .	Initialization Ramp-up Implementation Integration

Table 1: Knowledge transfer models. Own elaboration.

tended to identify the context and current state of the organization. “How-to” where strategies based on knowledge management are defined to establish an action plan. Application, where the action plan is implemented and results are obtained against the baseline; and finally continuous improvement, where it seeks to evaluate the results and generate the pertinent adjustments to the model.

However, as mentioned by Szulanski [35], people do not transmit knowledge without meaningful motivation, it is therefore, approaches at the level of benefits management should also be evaluated.

Benefits management

According to Davenport and Prusac [14], knowledge functions as a market, where those involved transmit knowledge through

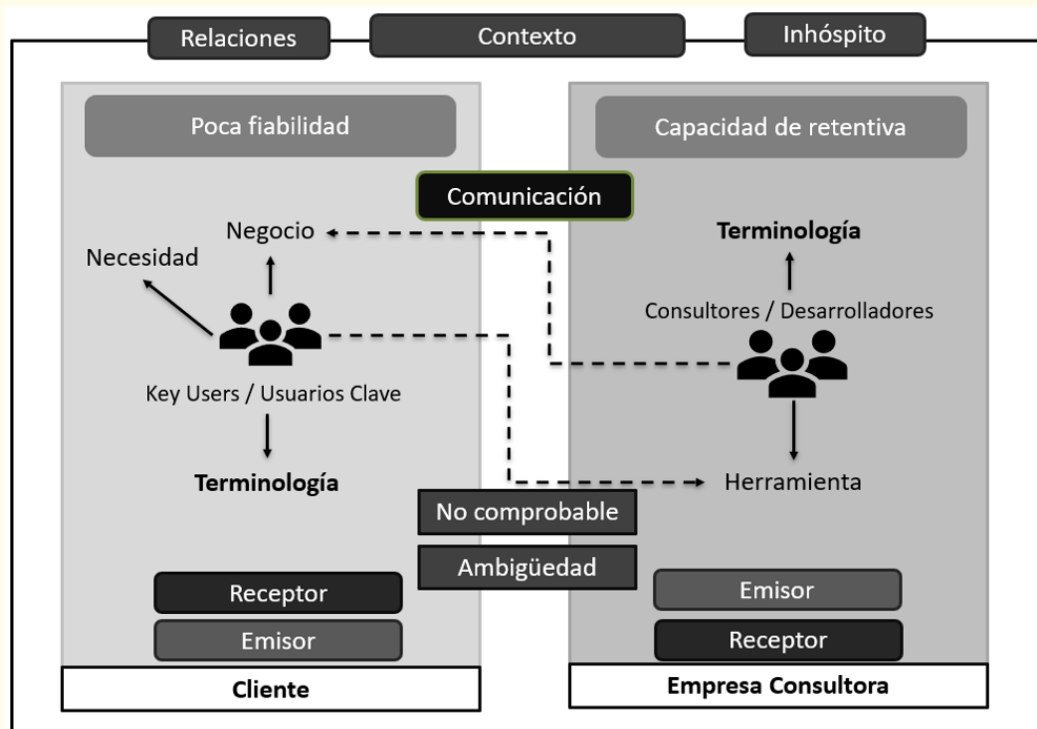


Figure 3: Communicative process in systems implementation based on the Szulanski transfer process. Own elaboration.

motivation, where factors such as reciprocity, reputation and altruism are involved. It is sought that people evolve to more altruistic motivations oriented by the pleasure associated with helping and not by material goods, these types of motivation are known as intrinsic and extrinsic motivations.

Intrinsic motivations are defined as immaterial motivators associated with altruism, philanthropy, recognition, and visualization; extrinsic motivations are associated with material motivators such as bonuses and increases [41]. Extrinsic motivators generate results in the short term, but they are not sustainable for the organization, while intrinsic motivators are maintained in the long term and encourage the attitude to change over time thanks to positive personal experience and participation in change. However, if the organizational environment is not adequate for the implementation of this type of benefits, the expected results will not be achieved [42].

Conclusions and Future Work

It can be concluded that, in the processes of implementation of business intelligence tools, the stages of requirements gather-

ing and design can define the success or failure of the project; Although there are various methodologies and good practices, there are problems associated with incomplete requirements, lack of user involvement and generation of unrealistic expectations that affect the development of the project and its successful completion. Different approaches have been made from knowledge management in software implementation projects where an improvement in processes has been seen, however, these approaches and tools do not have in It tells the organizational context, the specific challenges in the processes of implementation of BI tools, or the challenges associated with the outsourcing of knowledge.

Regarding the outsourcing of knowledge, different models have been generated to involve knowledge transfer strategies and benefits management, in order to convert tacit knowledge into explicit knowledge, however, it was not found literature that evidenced the application in the implementation processes of BI tools. However, it should be noted that, depending on the nature of these implementation projects, the methodologies and strategies applied for other types of systems, such as ERP, could be validated in the process of implementing BI tools.

It is necessary and valuable to generate and implement a methodology that implements knowledge management in the phases of requirements and design of a project for the implementation of BI tools based on the analysis of the risk factors found through the use of strategies and tools associated with the Knowledge transfer, communication and benefits management, which allows building an organizational memory and improving implementation processes that solve the following unknowns: How to integrate knowledge management to improve requirements gathering processes and design in the implementation of BI tools? How to extract the knowledge of the most experienced (wise) technical consultants to build an organizational memory? How do we ensure the quality and value of knowledge in the organization? For this, a methodological commitment composed of four phases is made, the first of them focused on the identification of the organizational context, the next stage is the planning where the strategies and tools are defined that are based on the transfer of knowledge, the quality of information, benefits management plans, Methodologies used and communication allow to design an action plan, for later in the third phase execute a pilot plan for a certain period of time to a representative group and collaborators, and finally there is the continuous improvement where the results obtained are evaluated and decisions are made for the improvement of the model.

This methodology will be part of the future work of this research.

Bibliography

1. M Ghobakhloo. "Industry 4.0, digitization, and opportunities for sustainability". *Journal of Cleaner Production* 252 (2020): 119869.
2. Ö Işık, *et al.* "Business intelligence success: The roles of BI capabilities and decision environments". *Information and Management* 50.1 (2013): 13-23.
3. W Yeoh and A Koronios. "Critical success factors for business intelligence systems". *Journal of Computer Information Systems* 50.3 (2010): 23-32.
4. G S Kearns and R Sabherwal. "Strategic Alignment Between Business and Information Technology: A Knowledge-Based View of Behaviors, Outcome, and Consequences". 23.3 (2014): 129-162.
5. N A El-Adaileh and S Foster. "Successful business intelligence implementation: a systematic literature review". *Journal of Work-Applied Management* 11.2 (2019): 121-132.
6. D Arnott. "Success Factors for Data Warehouse and Business Intelligence Systems" (2008).
7. C Howson. *Successful Business Intelligence: Secrets to Making BI a Killer App.* (2008).
8. H Wang and S Wang. "A knowledge management approach to data mining process for business intelligence". *Industrial Management and Data Systems* 108.5 (2008).
9. R Kimball, *et al.* *The Data Warehouse Lifecycle Toolkit* (2008).
10. T M Somers and K Nelson. "The impact of critical success factors across the stages of enterprise resource planning implementations". *Proceedings of the Hawaii International Conference on System Sciences* (2001).
11. A Hussain, *et al.* "The Role of Requirements in the Success or Failure of Software Projects". *International Review of Management and Marketing* 6.S7 (2016): 11-13.
12. Standish Group. "The Standish Group Report". (2014).
13. U Jayawickrama and S Yapa. "Factors Affecting ERP Implementations: Client and Consultant Perspectives". *Journal of Enterprise Resource Planning Studies* 1-12 (2013).
14. Davenport T and Prusak L. "Working knowledge: how organizations manage what they know". *Choice Reviews Online* 35.09 (1998): 35-5167-35-5167.
15. J Biggs and C Tang. "Teaching for Quality Learning at University". *What the Student Does.* (2007).
16. M Alavi and DE Leidner. "Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues". *MIS Q* 25.1 (2001).
17. I Nonaka and H Takeuchi. "Knowledge-Creating Company". *Knowledge-Creating Company* (1995).
18. E Serna M., *et al.* "Knowledge meaning and management in requirements engineering". *International Journal of Information Management* 37.3 (2017): 155-161.

19. P Guptara. "Why Knowledge Management Fails". (1999).
20. J Leknes and B Munkvold. "The role of knowledge management in ERP implementation: a case study in Aker Kvaerner". *ECIS 2006 Proceedings*, Jan. (2006).
21. H L Pérez-Virgen., et al. "Lifting requirements based on the knowledge of the process". *Scientific Journal* 16.2 (2013): 42-51.
22. A Barão., et al. "A knowledge management approach to capture organizational learning networks". *International Journal of Information Management* (2017).
23. P Hawking and C Sellitto. "Business Intelligence (BI) Critical Success Factors". 4 (2010).
24. S Adamala and L Cidrin. "Key Success Factors in Business Intelligence" (2011).
25. R Palanisamy. "Organizational culture and knowledge management in ERP implementation: An empirical study". *Journal of Computer Information Systems* 48.2 (2007): 100-120.
26. I Rus., et al. "Knowledge Management in Software Engineering A DACS State-of-the-Art Report".
27. YJ Chen. "Development of a method for ontology- based empirical knowledge representation and reasoning". *Decision Support Systems* (2010).
28. A Aurum., et al. "Investigating Knowledge Management practices in software development organisations - An Australian experience". *Information and Software Technology* 50.6 (2008): 511-533.
29. A Boden., et al. "Knowledge management in distributed software development teams - does culture matter?". in *Proceedings - 2009 4th IEEE International Conference on Global Software Engineering, ICGSE 2009* (2009): 18-27.
30. S Riascos and V Arias-Cardona. "Analysis of the organizational impact in the implementation process of ERP Information Systems - Case Study". *Entramado* 12 (2016).
31. C Bustelo Ruesta and R Amarilla Iglesias. "Gestión del conocimiento y gestión de la información". *PH Magazine* (2001): 226.
32. A Egesoy and A Güzel. "Fuzzy Logic Support for Requirements Engineering". *International Journal of Innovative Research in Computer Science and Technology* (2021).
33. L Argote and P Ingram. "Knowledge transfer: A basis for competitive advantage in firms". *Organizational Behavior and Human Decision Processes* 82.1 (2000).
34. MT Hansen., et al. "What's your strategy for managing knowledge?". *Harvard Business Review* 77.2 (1999).
35. G Szulanski. "The Process of Knowledge Transfer: A Diachronic Analysis of Stickiness". *Organizational Behavior and Human Decision Processes* 82.1 (2000).
36. A Barragán and A B Ocaña. "Aproximación a una taxonomía de gestión del conocimiento 65 Aproximación a una taxonomía de modelos de gestión del conocimiento". 5.1 (2009): 1697-9818.
37. KM Wiig. "Knowledge Management Foundations : Thinking about Thinking : How People and Organizations Create, Represent and Use Knowledge". (1993).
38. MH Meyer and M H Zack. "The Design and Development of Information Products". *MIT Sloan Management Review* Apr. (1996).
39. M Mohammadi Ostani and A Shojafard. "A feasibility implementation of Bukowitz and William's knowledge management model and its impact on knowledge contribute in Qom province public libraries". *Quarterly Resources and Information Services Management* 6.3 (2019): 59-68.
40. W Bukowitz and RL Williams. "The Knowledge Management Fieldbook". (1999).
41. S Reiss. "Intrinsic and Extrinsic Motivation". *Teaching of Psychology* 39.2 (2012).
42. B Frey and M VARIES PC. "Osterloh, Successful Management by Motivation". *Balancing Intrinsic and Extrinsic Incentives* (2002).