

Application of Business Intelligence in the decision making process of a clinical analysis company

Aplicación de Business Intelligence en el proceso de toma de decisiones de una empresa de análisis clínicos

MORALES-HERNANDEZ, Maricela†*, ARREOLA-JARQUIN, Wualfred, DIAZ-SARMIENTO, Bibiana and RAMON-AVENDAÑO, Jeovani

Tecnológico Nacional de México/Instituto Tecnológico de Oaxaca. Departamento de Sistemas y Computación. Avenida Ing. Víctor Bravo Ahuja No. 125 Esquina Calzada Tecnológico, C.P. 68030

ID 1st Author: *Maricela, Morales-Hernandez* / ORC ID: 0000-0002-3521-2041, CVU CONACYT ID: 731036

ID 1st Coauthor: *Wualfred, Arreola-Jarquín* / ORC ID: 0000-0002-5072-8142, CVU CONACYT ID: 864310

ID 2nd Coauthor: *Bibiana, Diaz-Sarmiento* / ORC ID: 0000-0003-4350-6311, CVU CONACYT ID: 820776

ID 3rd Coauthor: *Jeovani, Ramon-Avenidaño* / ORC ID: 0000-0002-4827-038X, CVU CONACYT ID: 937441

Received June 27, 2018; Accepted November 05, 2018

Abstract

Currently, Business Intelligence (BI) applies in different ways, in order to obtain knowledge of organizations based on the transactional data they have accumulated. This article presents an application of the BI tools that was developed for a clinical analysis company. This application has a dashboard that provides a support tool in the decision-making process. The dashboard includes different KPIs (Key Performance Indicators), such as (1) Studies sold by category, branch, month and year, (2) Total sales by year, month and branch, (3) Total sales of employees by branch, year and month, and, (4) Number of clinical studies requested by medical institutions. This will contribute to the aforementioned company having elements that provide knowledge on the behavior of the company, and, thus make the best decisions that lead to a successful operation. The used methodology is the PSP / TSP standard, which proposes strategies, aimed at improving the quality and productivity of software development projects and thus speed up compliance with the goals, guaranteeing customer satisfaction.

Business Intelligence, Dashboard, Decision making

Resumen

El termino Business Intelligence (BI) o Inteligencia de Negocios actualmente es aplicado de diferentes formas para obtener conocimiento de las organizaciones con base en los datos transaccionales que han acumulado. En este artículo se presenta una aplicación de las herramientas de BI que se desarrolló para una empresa de servicios de análisis clínicos, a la que se le presenta un tablero de mando (Dashboard) con el objetivo de tener una herramienta de apoyo en la toma de decisiones. El resultado es un tablero de mando que incluye diferentes KPI (Key Performance Indicator), tales como (1) Estudios vendidos por categoría, sucursal, mes y año, (2) Ventas totales por año, mes y sucursal, (3) Ventas totales de empleados por sucursal, año y mes, (4) Cantidad de estudios clínicos solicitados por instituciones médicas. Esto contribuirá a que la empresa tenga elementos que aporten conocimiento sobre su comportamiento y así, tomar las mejores decisiones que la lleven a una operación exitosa. La metodología utilizada se basa en el estándar PSP/TSP, el cuál propone estrategias enfocadas a mejorar la calidad y productividad de los proyectos de desarrollo de software y así agilizar el cumplimiento de las metas, garantizando la satisfacción del cliente.

Inteligencia de Negocios, Tableros de control, Toma de decisiones

Citation: MORALES-HERNANDEZ, Maricela, ARREOLA-JARQUIN, Wualfred, DIAZ-SARMIENTO, Bibiana and RAMON-AVENDAÑO, Jeovani. Application of Business Intelligence in the decision making process of a clinical analysis company. Journal-General Economics. 2018. 2-3: 20-27.

* Correspondence to Author (email: moralesh.maricela@gmail.com)

† Researcher contributing first author.

Introduction

Currently almost all micro and medium companies have databases that store data about their activities and their collaborators through different computer programs. So it is logical to think that such data can be refined, grouped, treated and analyzed to extract information that helps in the decision making of the company (Conesa y Curto, 2010).

This article shows a computer solution based on the concepts of Business Intelligence to improve and support the decision making process of a clinical analysis company in the city of Oaxaca de Juárez, Oaxaca, Mexico. Using the databases with which it already has, the objective of this work is to implement business intelligence tools and techniques, as a support for management decision making ensuring the quality of the software. You can define Business Intelligence or BI (Business Intelligence) as the set of strategies focused on the administration and creation of knowledge about the environment, through the analysis of existing data in an organization or company. The objective of business intelligence is to offer knowledge to support business decisions (Libros científicos, 2015).

The aforementioned solution consists of a set of management reports and a control of controls or dashboard, with the main indicators for the company (KPI) are: total sales by year, month, branch, among others. A strategic dashboard or dashboard is defined as "a graphic representation of the main indicators (KPI) that intervene in the achievement of business objectives, and is aimed at making decisions to optimize the strategy of the company" (Elósegui, 2014); it can also be conceptualized as a panel in which the performance indicators of any organization appear (Alabarta and Martínez, 2011).

On the other hand, a KPI is a metric that is linked to an objective of the company (Kerzner, 2017). However, KPIs are rarely reported and communicated in a way that gives people enough information and puts it into context. The resulting ambiguity and confusion create doubts that make decision-making and learning almost impossible (Marr, 2015), which is why it is very important, in addition to selecting key indicators, to have a deployment platform that is visible to who make the decisions in the company.

A Business Intelligence system is formed by different elements such as ETL - Extract, Transform and Load -, OLAP - On-Line Analytical Processing -, Reports, among others, but the main one is the Data Warehouse or data warehouse (Curto, 2012).

According to Curto in his book Introduction to Business Intelligence, data warehouse is a repository of data that is usually constituted by a relational database, however, it does not follow the structure of it, but rather it is a database denormalizada allowing to optimize the consultations.

Therefore, in a BI project based on the data warehouse, the business process, the views for the business process and the quantifiable measures associated with them must be identified. So applying this idea must have: the table of facts, the dimension and the metric, under this perspective has worked in this article.

In order to develop the above, the methodology PSP ((Personal Software Process) and TSP (Team Software Process) was used in order to have quality in the software produced. The PSP methodology is very demanding and demanding, but this process allows us to model, build and to be able to implement a software development that complies with the times required by the clients, as well as being able to define a project that can be completed with the assigned budget, all these factors allow implementing successful developments (Flores, 2016).

On the other hand, TSP has phases where a series of guidelines is described to help to make a good software development by the work team. These phases in agreement with Humphrey, in his book "Introduction to the Team Software Process", are:

- Launching
- Strategy
- Planning
- Requirements
- Design
- Implementation
- Tests
- Post Mortem (Humphrey, 2004).

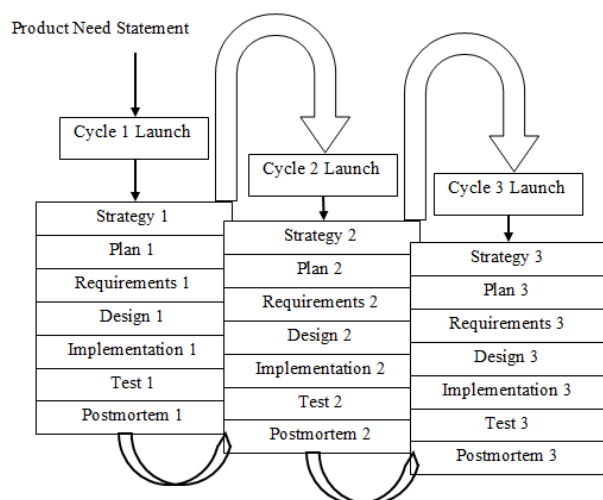


Figure 1 Structure and flow of TSP

Source: (Humphrey,2004-Own translation)

Figure 1 shows the phases previously listed and as observed, the cycles or iterations are these phases applied subsequently.

The development of the work was planned in three iterations and the obtained products are: management reports and a strategic dashboard. Reports means collecting and presenting data so that they can be analyzed. When you talk about reports in Business Intelligence (BI), you are talking about two things. The first is a strictly defined report. The second is "inform" in a more general meaning (Logi Analytics, 2018).

It is important to emphasize that managerial reports can group data from different sources and concentrate them in a single one, and its added value lies in the fact that management reports are obtained from data extracted in real time, which assures the interpreter that it is they are generating at the moment they are being consulted.

JasperSoft Studio was mainly used for scheduling management reports, since with this tool, you can access various data sources such as Big Data, CSV, JDBC, JSON, XML, and even create custom data sources (JasperSoft Community, 2018).

ClicData was also used, an online Business Intelligence tool to manage databases and generate dynamic reports through modern connection systems. The reports are fed information that is extracted from platforms such as Excel templates, google templates, databases and others (ClicData, 2018).

To manage all the processes that correspond to the database we worked with MySQL, a database management software that includes the most complete set of advanced functions, management tools and technical support to reach the highest levels of scalability, security, reliability and uptime (MySQL, 2018).

The development environment used was Netbeans 1.8, since in this environment it quickly and easily develops desktop, mobile and web applications with Java, JavaScript, HTML5, PHP, C / C ++ and more. In addition, NetBeans IDE is free, open source and is moving to the "Apache Software" Foundation (NetBeans, 2018). It was also used as a programming language, Java.

Problem Statement

Throughout the life of a company, the data it stores about the processes it handles, from operational to managerial levels, grow considerably and it is necessary to process them to convert them into useful information that can support the decision-making process.

The case presented in this paper, a clinical analysis services company, in which the following problems are identified, is not the exception:

- Lack of standardization of data, which results in lack of integrity (redundancy or omission).
- Difficult to adapt with new versions of the transactional software they use.
- It is complicated to predict future values from raw data.
- It is unknown aspects of the company that arise from the knowledge of the data, once these are in the proper format for analysis and interpretation.
- Lack of information elements of the company's performance for the decision-making process.

Proposed Solution

Based on the problem identified in the company of clinical analysis services, it is proposed to apply the concepts of Business Intelligence (BI), to present to the company a set of management reports and a strategic dashboard (dashboard) with the main key performance indicators (KPI-Key Performance Indicator).

MORALES-HERNANDEZ, Maricela, ARREOLA-JARQUIN, Wualfred, DIAZ-SARMIENTO, Bibiana y RAMON-AVENDAÑO, Jeovani. Application of Business Intelligence in the decision making process of a clinical analysis company. Journal-General Economics, 2018

These KPIs were defined by the company, according to what its administrators considered relevant for the strategic dashboard.

Methodology

For the development of managerial reports and a command control board that provides key information to the company, in real time, about its operation, supporting with these tools the decision making process, the PSP methodology was used (Personal Software Process) and TSP (Team Software Process). Planted three iterations for the application of the phases shown in figure 1.

Development

To develop the solution proposed to the clinical analysis company, as mentioned above, the TSP methodology was used, so once the requirements were analyzed, it was divided into three iterations or cycles, which are:

Iteration 1: Generation of management reports using the JasperStudio tool.

Iteration 2: Creation of strategic dashboard.

Iteration 3 Incorporation of two additional submenus to the dashboard.

In all three iterations, the phases illustrated in Figure 1 were applied.

In the first iteration, the diagram illustrated in figure 2 was used to guide the development of managerial reports

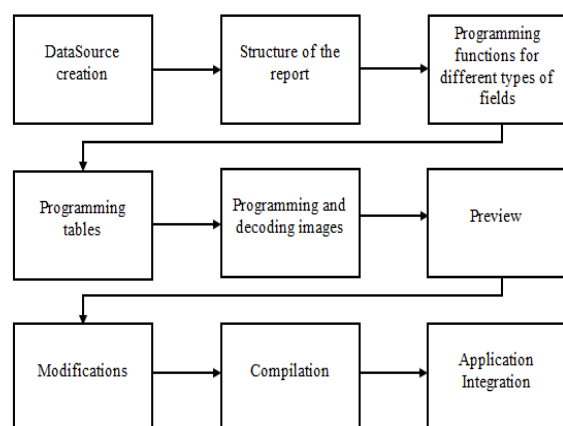


Figure 2 Development of Iteration 1

Source: Own Elaboration

As shown in figure 2, the data source (DataSorce) was created, from which the report takes the data, configuring aspects such as the URL of the source and the name of the source, among others; Subsequently, the structure of the report is elaborated using Java-specific functions for information processing; Likewise, the tables corresponding to the database used in each report were specified, the relevant images are added, considering the colors that the company has defined as part of their identity. Once this part has been worked on, making the relevant modifications according to the client's requirements, the management reports are integrated into the application, which show information in real time.

The management reports obtained in this first phase are shown in table 1. Each one of the reports prepared contains the most relevant data of its category. Thus, for example, in the case of branches, you get the name, address, hours of operation, responsible for it, etc. Information that contributes to improving the daily activities of the company.

Report	Report category	Subtotal
Employee	Data	2
	Report	
Documents	Data	2
	Report	
Branch offices	Data	2
	Report	
Business groups	Data	2
	Report	
Company	Data	2
	Report	
Organizational structure	Class of documents	9
	Branch class	
	Levels	
	Posts	
	Records	
	Work routes	
	Document type	
	Types of Branch	
Taxes	Data	2
	Report	
Total		21

Table 1 Reports obtained in Iteration 1

Source: Own Elaboration

In the development of Iteration 2, the account was created on the ClicData platform, the Data Loader software was downloaded and configured, which allows data to be uploaded to the server of the aforementioned platform.

The connection to the database was created through a connector for MySQL, the data structures were imported and created to the ClicData platform, the main menu of the dashboard was created, and submenus with information were created as: number of studies sold by branch, year and month and total sales by branch, year and month. You can see in figure 3 the diagram of the activities for the iteration or cycle. This diagram starts with the creation of an account on the platform until the URL is released. And it is in this second iteration where the extraction of data from various sources presented in the same strategic dashboard was worked.

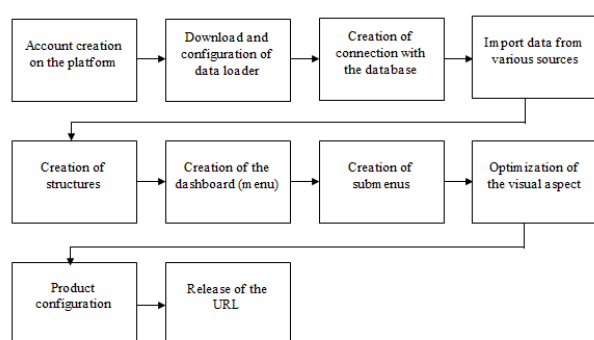


Figure 3 Development of Iteration 2

Source: Own Elaboration

It is important to mention that the model of the database used to extract the information has more than 50 tables, however, not all the tables of the model were integrated into the reports, only those that contain key data.

For Iteration 3, the activities described in figure 4 were carried out, the data structures were adapted to meet the specified requirements. We also worked with the provision of visual elements in the work area of the dashboard, creating the corresponding submenu, added graphs associated with the data, giving the format in color, size, fonts, graphic types, etc.

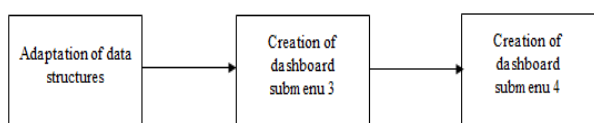


Figure 4 Development of Iteration 3

Source: Own Elaboration

Results

The obtained results presented in this article are divided into two sections:

- Management reports, which are listed in table 1.
- Strategic dashboard.

a Management reports

Figure 5 shows the report template that was programmed and configured, as you can see it is generic and all the reports listed in table 1 will have the same format. It should be noted that this template can be adapted to any company, changing logos and data, it is presented only to illustrate the aspect of the reports.



Figure 5 Report template

Source: Own Elaboration

The reports show information generated from the databases of the clinical analysis company and allow managers and investors to have references to make decisions that impact on the business of the company, it is important to emphasize that the administrators get the data in time real and quickly of the web system that is managed as administrator, this feature gives an added value to the reports, because the information is obtained at the same moment in which the data is being generated.

Figure 6 shows an example of an employee report (the data is fictitious by agreement of confidentiality with the company). The content of the report can be modified according to the needs of the company, in this case regularly ask for the data that can be seen in figure 6, which are among others, name, address, contact telephone numbers, etc.



Figure 6 Example of an employee report
Source: Own Elaboration

b Strategic dashboard

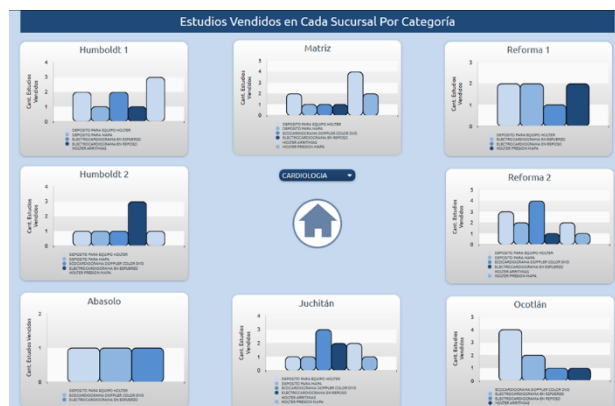
For the case of the dashboard, figure 7 shows the appearance of the main menu. In this menu we have the main KPIs of the company such as: total sales of each branch by year and month, total sales of each employee by branch and by month, number of studies sold in each branch classified by categories, etc.



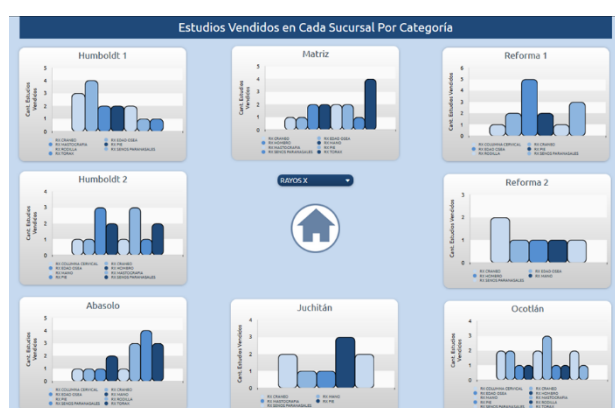
Figure 7 Main menu of the strategic dashboard
Source: Own Elaboration

Figure 1 illustrates the information that is presented to the managers of the company, for them it is easier to read the information in this format and thus be able to establish reference points on which they base their decisions.

In this case, the example is for studies sold in each branch by category, which as can be seen refers to the cardiology category, in figure 2 you can see the same graph, but for X-ray category.

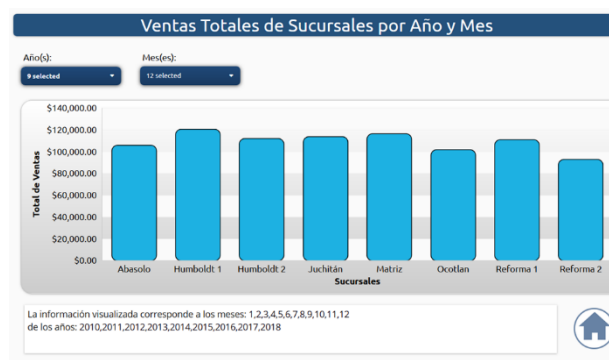


Graphic 1 Studies sold by branch for the cardiology category
Source: Own Elaboration



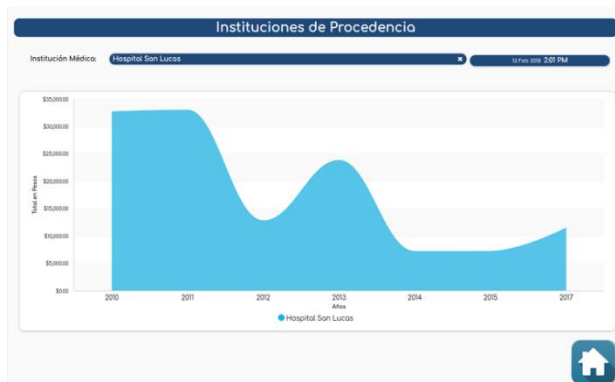
Graphic 2 Studios sold by branch for the X-ray category
Source: Own Elaboration

Figure 3 shows the total sales of branches by year and month, in this option you can configure the years that you need to show, as well as the months of those years that you need to compare.



Graphic 3 Total sales of branches per year and month
Source: Own Elaboration

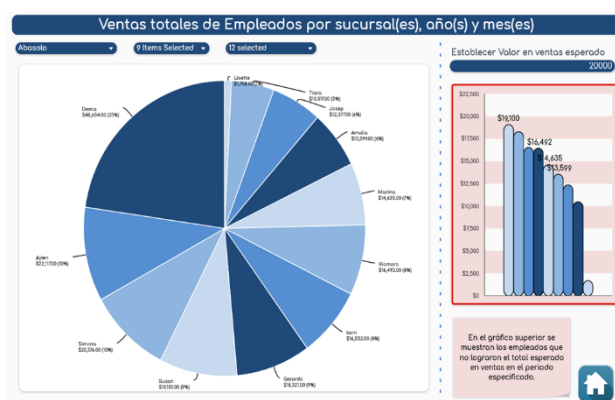
The other KPI that you have in the main menu of the dashboard is the amount of clinical studies requested by medical institutions, in this case, a graph is presented of the amount that each medical institution is generating in the company, as shown in Figure 4.



Graphic 4 Total sales by medical institution of origin
Source: Own Elaboration

The strategic dashboard also has tools to establish comparisons based on the objectives of the company, such as the total sales expected per employee of each branch, by year and month.

An example is illustrated in figure 5, as it is observed it is possible to configure an expected amount, and two graphs are generated, one in the left panel where the sales amounts of all the employees of the chosen branch are displayed, and the graph of the right panel, where only those employees that did not reach the expected value are shown. In the example, an expected value of \$ 20,000.00 pesos has been placed, and a total of nine employees do not comply with this value.



Graphic 5 Total sales of employees by branch, year and month
Source: Own Elaboration

It is also possible in this KPI, configure in addition to the branch, the year and the desired month, as shown in figure 8.

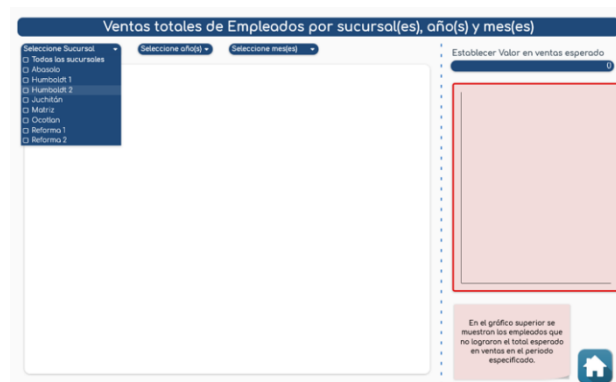


Figure 8 Submenu of total sales of employees by branch, year and month
Source: Own Elaboration

Acknowledgement

We appreciate the support and facilities for the development of this article to the National Technologist of Mexico, through the Technological Institute of Oaxaca, granting the corresponding credit to these institutions. In the same way, the collaboration and facilities of the company SmartApps Solutions are appreciated for the collaborative work developed in the solution of a real problem. And finally, we appreciate the collaboration and dedication to the authors, both professors and students in this work.

Conclusions

For a company in full development and with a stable database, it is a priority to analyze the behavior of its activities and be able to measure its performance based on the objectives pursued, this would not be possible if you do not have the knowledge of that accumulated data, both to know the state that keeps the company, and to establish trends to the future, a tool that provides all these benefits is Business Intelligence, which through its different techniques such as data warehouse, OLAP analysis, data mining, among others supports the decision making process.

This article addresses a solution to the real problems presented by a clinical analysis company in the city of Oaxaca, which has been resolved through a set of management reports and a strategic dashboard with different performance indicators. (KPIs), which as a whole will respond to various needs of the company.

For example, being able to know the trends of their income from different branches with which they have, the performance of their employees, the loyalty of their business and private clients, among others; it will also be able to calculate the future growth to determine the best decisions for its investors, always keeping in mind to improve the services to its clients and maintain the levels of profitability of the same. The benefit obtained using these tools is reflected in the moment in which they develop their market or investment strategies, based on concrete reports and with real-time data.

It is interesting to note that business theories merge with information technologies to create solutions within the reach of micro, small and medium enterprises, and that in this information age, the competitive advantages lie precisely in obtaining knowledge of the organizations from the data they are generating day by day in their daily activities through systems that record them and that provide information in different formats, quantities and sizes to converge on a board that can easily display readable information to those who take the decisions in those companies.

The development of this work is a proposal that can be adapted to other companies in other different areas, but that seek the same objective, measure their performance levels and align their decisions with the objectives, mission and vision set forth at the time of their creation; or, to guide the course that must take once analyzed its performance, in case it is necessary to correct it.

The use of ICTs (Information and Communication Technologies) is no longer an option for organizations, it is an imperative need to stay current, hence the importance of using tools such as those presented in this article.

References

- Alabarta, E. A. y Martínez-Vilanova, R. (2011). *Cómo gestionar una PYME mediante el cuadro de mando*. España: ESIC Editorial.
- ClicData (2018). *Funcionalidades: Dashboard*. Recuperado de: <https://www.clicdata.com/es/funcionalidades/#dashboard>.
- Conesa, J y Curto, J. (2010). *Introducción al Business Intelligence*. España: El ciervo 96.
- Curto, J (2012). *Introducción al Business Intelligence*. España: Editorial UOC.
- Elósegui, T. (2014). *¿Qué es un dashboard y para qué sirve?* Blog de Marketing Online de Tristán Elósegui. Recuperado de: <https://tristanelosegui.com/2014/10/27/que-es-y-para-que-sirve-un-dashboard>.
- Flores, J. (2016). *Calidad en el software: Psp & tsp*. España: Editorial Académica Española.
- Humphrey, W. S. (2004). *Introduction to the Team Software Process*. USA: Addison-Wesley Professional.
- JasperSoft Community. (2018). *Documentation*. Recuperado de: <https://community.jaspersoft.com/>.
- Kerzner, H. (2017). *Project Management Metrics, KPIs, and Dashboards: A Guide to Measuring and Monitoring Project Performance*. USA: John Wiley & Sons.
- Libros científicos. (2015). *Modelado predictivo para la inteligencia de negocios / Predictive Modeling for Business Intelligence*. USA: EISENBRAUNS.
- Logi Analytics. (2018). *Reporting in BI*. Recuperado de: <https://www.logianalytics.com/resources/encyclopedia/reporting-bi/>.
- Marr, B. (2015). *Key Performance Indicators For Dummies*. USA: John Wiley & Sons.
- MySQL. (2018). *MySQL Enterprise Edition: Datasheet (PDF)*. Recuperado de: <https://www.mysql.com/products/enterprise/techspec.html>.
- NetBeans (2018). *NetBeans IDE: Fits the Pieces Together*. USA: NetBeans IDE. Recuperado de: <https://netbeans.org/>.