Optimization of Data Management through a Web System based on Business Intelligence and Agile Kanban Methodology

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Abstract: - The collection of information through a questionnaire for planning purposes played an important role in defining the requirements of the web system, functioning as a fundamental basis for the next step in the software development phase. The application of the Kanban way of thinking has proven to be effective in managing work, supported by greater openness during the system creation phase. The surveys and interviews carried out show that the initiative is important and necessary to improve decision-making and processes. The incorporation of Kanban principles is based on an exhaustive analysis using tools such as PHP, Bootstrap and MySQL to facilitate the process and achieve maximum efficiency. Through the web-based system, it is possible to centralize information, allowing its access and management in real time. Business intelligence is also used to perform in-depth analysis, helping to identify patterns and potential opportunities for improvement. It was considered appropriate to choose the Kanban methodology due to its collaborative and incremental approach, ideal for adapting to change and providing constant value. The results confirm the solidity of our methodology and the relevance of the choices made in the development of this web application based on Business Intelligence and Agile Kanban Methodology.

Key-Words: - Agile Kanban, Data management, Business Intelligence, Strategic Decision Making, Web based system.

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1. Introduction

Currently, data vital to your operations is stored in spreadsheets, leading to sporadic failures and unwarranted document collection. We suggest implementing a web-based system that uses business intelligence and the effective Kanban methodology to address this problem. In the modern enterprise, digitization and effective data analysis are crucial to maintaining a high level of efficiency and informed judgment, which will provide management with timely and accurate details for strategic decision making. Ecuadorian companies urgently need innovative solutions, as demonstrated by cases such as those that highlight the shortage of analytical tools. To address operational issues such as inadequate training and order management, a paradigm shift and adoption of more efficient methods is essential.

The focus is on creating a web-based system that can manage information with the help of business intelligence and the agile Kanban methodology. To do this, the theory has been studied in depth and tools such as interviews and surveys have been used. And the resulting web system will use Kanban principles for effective data management. Implementing an innovative web-based system backed by business intelligence and Kanban will not only improve operational efficiency but also facilitate informed decision making in the enterprise.

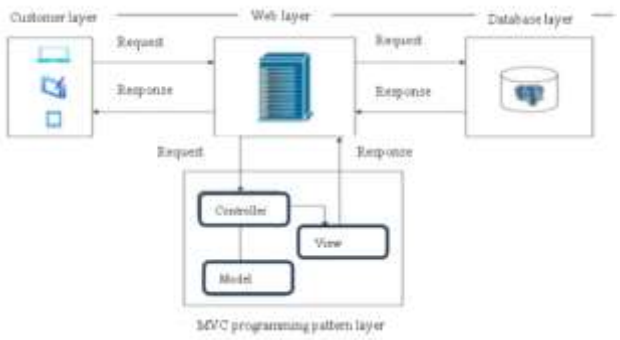

Fig. 1. Program architecture diagram

2. Theoretical framework

The successful implementation of new management methods, as in the case of the proposed web application, requires reflection on essential principles related to people, systems and information [1]. The incorporation of these tools implies a change of direction and is structured in four fundamental classes.

2.1. System

A system is a component, and the composition of systems results in the emergence of a System of Systems to achieve a goal [2]. In the web domain, the definition extends to the web system, where the components that are organized seek to achieve a specific objective.

2.2. Web system

A web application is a specific way of using a client/server, which is standardized in relation to clients (browsers) and servers (web servers) and in the communication protocol (HTTP). This implies a functional and accessible organization, without the need for additional development by the application creator [3].

2.3. Business Intelligence

Business intelligence emerges as a new approach to help companies collect valuable information to improve their performance [4]. This is achieved by creating concrete and reliable information.

2.4. Information systems architecture

Information systems architecture organizes and structures information, applying models such as Model/View/Controller (MVC) to separate application logic and facilitate development and maintenance [5].

2.5. Web Architecture

It allows the design and development of applications where the discipline that orders and determines the information and structural content of a website is applied, according to the needs and preferences of the audience, with the aim of guaranteeing users the final quality of the product and the full satisfaction [6].

2.6. Backend and Frontend

The backend deals with data access and application logic, while the frontend involves direct user interaction with technologies such as HTML, CSS, and JavaScript. It is a set of skills necessary to write software [7].

2.7. Structure

Frameworks, such as Bootstrap, standardize and structure system code, reducing development time and making maintenance easier [8].

2.8. Software development methodologies

The Kanban methodology, derived from the Lean methodology, reduces the information system, since it is not necessary to prepare a detailed plan for the subdivision of production or for each process. Rather, it is enough to inform the final assembly line or terminal process [9].

2.9. BI Energy

Power BI was used to efficiently combine, analyze and visualize data [10].

Below, the results of research that support decision making based on artificial intelligence systems and hybrid systems through data management are described in detail.

2.10 Decision support systems

The mentioned system only analyzes organizational, technical, management and similar aspects, but other aspects contained in the human element as an organizational asset do not receive any attention [11]. The decision support system (DSS) has been developed based on the information management system [12] to provide support for decision making through employee performance and systems [13].

The following describes some general information that reveals the importance of decision support systems.

Zhai et al. [14] found satisfactory results when they used decision support systems in the context of agriculture 4.0 that allow selecting supply points. Products from selected supply points; Delivery Vehicle Selections; Route programming for delivery vehicles. And lead time scheduling, historical data, and strategies contain valuable information that can improve the quality of future decisions.

Similar results were reported by Wu et al. [15] who developed a clinical decision support system for severity risk prediction and classification of COVID-19 patients using a machine learning model, nomogram and online calculator could be helpful to access at the beginning of serious and critical illnesses among patients with COVID-19 and classification at the time of hospital admission.

In this same order of ideas Dalzochio et al., [16] applied a machine learning system for predictive maintenance in Industry 4.0 using a large amount of data involved in predictive maintenance and real-time monitoring demand to deal with problems related to latency, scalability and network bandwidth. Similarly, Rai et al., [17] used machine learning in manufacturing applications and industry 4.0, environment, for failure prediction in the manufacturing industry.

While Govindan et al., [18] used the decision support system for demand management in healthcare supply chains considering epidemic outbreaks during the COVID-19 pandemic, finding that the efficiency of the proposed approach was measured in the real world using data from four users and the results showed the effectiveness and accuracy of the proposed approach.

2.11 Kanban and artificial intelligence

The goal of implementing Kanban in project management is to optimize workflow efficiency, improve collaboration, and promote continuous improvement. Kanban v provides a visual representation of tasks and their progress, offering a real-time view of the entire project, optimizing processes as revealed by the findings cited below:

Kim et al., [19] found that the application of Kanban improves agility by providing a visual representation of tasks by optimizing the workflow and promoting adaptability in dynamic situations, however García and Wong [20] point out that there is resistance for cultural reasons to the adoption of Kanban in various organizational settings, although de Patel and Patange [21] demonstrated the impact of Kanban in improving communication and collaboration fostered by the use of Kanban boards, which It leads to greater efficiency and team satisfaction, which is why various researchers highlight the importance of Kanban and artificial intelligence to improve the operational efficiency of industries.

For example, Lanza et al., [22] evaluated the applications of the Kanban system in nursing or pharmacy health services, demonstrating the benefits caused by the implementation of this system. Fierro et al., [23] attribute the results to real-time information that allows optimal management of the workflow in internal processes, providing daily visualization of the status of operations.

In this same sense, Braglia et al., [24] point out that the Rolling Kanban methodology. In the context of a domestic equipment manufacturer, it allows to effectively overcome certain limits and criticalities encountered, while Anandya et al., [25] that the Kanban method used in the development of a simple accounting information system leads to improvements in effectiveness. of data processing, financial transaction calculations and reports which meet the demands of potential users of the Small and Medium Enterprise (MSME) system, finally Matsuo and Barolli [26] reported that the IoT sensor management system Using Agile-Kanban is a technique to develop software and manage work efficiently in the industrial field.

2.12 Development of the DW/BI system

DW/BI systems are designed, developed and used to support the analytical needs of various departments or business areas within an organization, allowing business users to communicate with each other and with the development team, this was possible because n In recent years, the Internet has evolved towards Internet 3.0, in which data is encoded in a way that allows it to be shared, reused and, most importantly, become machine readable [27].

The development of these systems has been successfully applied in areas of research and application, such as biology or computer science, so DW/BI systems can improve the quality of

knowledge from structured data, which has been observed with the findings described below;

Halim et al. [28] used the implementation of data warehouse and business intelligence (DW/BI) successfully in the banking sector using the analytical hierarchy process (AHP) and Yulianto et al., [29] point out that this system employs four procedures which are preparation, integration, analysis and visualization to build a management system at the enrollment level, which has been used by Moreira et al. [30] in the development of the monitoring and compliance tool for the Portuguese National Science Foundation.

2.13 Milk Run System

In a milk run system, routes, schedules, and the type and number of pieces to be transported are assigned to different tasks. The benefits of using such a system include increased efficiency of the overall logistics system as well as substantial potential savings in environmental and human resources along with notable cost advantages related to inventory and transportation costs [31,32,33], where the problems of milk run systems [34] can be seen as a special case of the vehicle routing problem (VRP) [35,36].

Generally, milk run approaches are adopted to run fixed routes with fixed pickup and delivery time slots that run according to fixed cycles [37]. In addition, the delivery time is longer due to multiple deliveries; In other words, there is a high probability that the last stations reached will be served with a delay [38], due to the high complexity due to the volume of information to be shared and the large number of constraints that must be satisfied [39], however, various investigations reveal the importance of the Milk-run system.

Kochańska et al., [40] implemented the Milk Run concept that significantly improved the transport of components to the analyzed area, which is due according to Burganova et al. [41] to shorter transportation times of material to the job site and ultimately faster delivery of the finished product to the market and customer satisfaction. The most important scientific and professional benefits for this study consist of the application of the aforementioned methods.

For their part, Esmizadeh and Mellat [42] managed to reduce delivery costs and route flexibility by using the milk run system to mitigate the effects of interruptions; Therefore, Gotthardt et al., [43] conclude that digitalization technologies can be used to improve efficiency in the supply chain, which in the opinion of Fedorko, et al., [44] is achieved because they are able to identify the occurrence of failures and critical points within a specific delivery process based on a Milk Run system.

2.14 The shop floor

In the literature, several definitions and alternative points of view can be found for the concept of OFS [45,46], which is defined as an integrated management system that facilitates communication [47], performance control and the implementation of lean methods which constitutes a central management instrument in the context of lean manufacturing [48] and in general, is a precondition for the implementation of lean systems, defining an organizational framework with standardized processes and activities that take place in the factory [49].

OFS is defined as a closed-loop process to observe problems in situ and understand and eliminate their underlying causes which has been used in broad fields of manufacturing industries [50,51], as described in next results presented:

Lee et al., [52] showed the benefits of the implementation of the workshop in integrated cyber-physical networks and commercial applications, while Alves et al., [53] used augmented reality for industrial quality assurance: which had a significant impact on the execution time of the procedures meanwhile Zhang et al., [54] demonstrated that the proposed improved multi-fidelity simulation-based optimization method is well applied in solving large-scale problems and outperforms other simulation-based optimization methods.

The importance of OFS is ratified by Manghisi et al., [55], through its use in the agri-food industry where high-level monitoring plays an important role in the field of prevention, where in the opinion of Corallo et al., [56] a digital-physical synchronization is a driving factor in smart manufacturing, and the adoption of digital twin solutions is a sustainable strategy to monitor, analyze and improve operational performance in real time using OFS.

2.15 Hybrid intelligent system

A hybrid model allows evaluating spatially distributed objects, which integrates developed fuzzy colored Petri nets, models of deterministic, stochastic

and fuzzy knowledge bases, and the manifestation logic of their interaction. The development makes it possible to increase the probability of making decisions while reducing the dimension of the model by expanding the color function and the spatial data visualization function. Alternative methods and tools for operational analysis in information technologies, the importance of which is demonstrated by the following findings.

Amiri et al., [57] applied a hybrid intelligent genetic algorithm and ANN to investigate the severity of accidents with fixed objects among car drivers, determining which hybrid model performs better with respect to the basis that the developed ANN has a better performance, which coincides with what was pointed out by Barkhordari, et al. [58] who evaluated the efficiency of intelligent hybrid models in predicting the interfacial bond strength of fiber-reinforced polymer concrete, the results showed that among the hybrid models studied, the RUN-ANN algorithm is the most accurate model.

For his part, Al Mashhadany [59] who did a simulation using virtual reality technique with MATLAB Var. 2019, demonstrated that with optimized hybrid intelligent controller they allow the robot parameters to be verified through direct and inverse kinematics, Li et al., [60] also studied the applications of artificial intelligence in the development of oil and gas using the network BP's neural algorithm, which is the most used AI algorithm in oil fields, however, to achieve better performance in optimizing the oil development plan, it must be combined with other algorithms; ANN being the most suitable for identification and diagnosis, with the disadvantage that AI algorithms depend too much on data and ignore the physical relationships between various parameters. Furthermore, dynamic AI research is far from sufficient, so Olan et al., [61] suggest that the implementation of AI technologies alone is not enough to improve organizational performance.

3. Methodology

3.1 Type of Research

Practical approach. This program delves into the problems of a local company trying to find viable IT solutions. The point of view we take is based on using the knowledge gained to provide viable solutions.

The fundamentals of Documentation. The study of bibliography plays an important role in collecting scientific data that serves as a basis for the creation of software. This procedure gives us the ability to choose the most cost-effective tools, ensuring a firm foundation for the software.

Synchronization with reality. Field research turns out to be a fundamental piece to collect the notions of the director of the organization, who knows perfectly well the management of information within the company.

3.2 Structured methods for a specific result

Hypothetico-deductive approach. We base the design of our project on a feasible hypothesis, examining the different needs that the company has to find an answer through information technologies.

Breakdown and synthesis of the analysis. We take an analytical-synthetic approach to break down needs into more manageable chunks. This gives us a broad understanding of the needs and helps us develop and run a web-based system.

3.3 Research Practices for Successful Implementation

Direct interviews. Interviews with the company manager to obtain first-hand information on the methods and ensure the successful implementation of the web-based information system.

Exploratory surveys. Conducting specific questionnaires to find out the deficiencies that ensured a precise understanding of the problems to be solved.

Population and sample: Strategic details. We developed an information management system based on a total population of 200 clients.

Table 1. Population

Population	Indicators
Clients	200
Total	2"

We calculate the sample size (n) considering factors such as standard deviation, confidence level and sampling error, resulting in a value of: 65, using the formula:

$$n = \frac{3{,}84 * (0{,}25) * 200}{(0{,}01) * (200 - 1) + (3{,}84) * (0{,}25)} = 65{,}08$$

4. Analysis and discussion of results

4.1. Interview with the director of the organization: An immersion in business reality

The conversation with the manager clarified doubts about the fundamental problems that the company has in the management of its information. The fundamental requirements for a web system are defined, highlighting the importance of migrating from a human perspective to a more intelligent way of thinking to have greater control over the operation of a company.

4.2. Company X-ray: survey results

Question No. 1. Challenges of information management

Result: 95% of respondents identify information management as a crucial challenge, while 5% have a different perception.

Question No. 2. Knowledge of Business Intelligence

Result: 95% of the participants demonstrate familiarity with the concept of business intelligence, which reveals a high degree of knowledge on the subject.

Question No. 3. Importance of a Web System for Information Management

Result: 95% recognize the importance of a web system to improve business processes, indicating a clear demand for operational improvements.

Question No. 4 to 7. Positive Impact of the Web System on Decisions, Market Understanding, Service Improvement and Competitive Advantage

Result: In each of these questions, 95% support the positive statement, underlining the optimistic perception of the impact of the Web system.

Question No. 8. Possibility of ordering products through the Web.

Result: 98% express the possibility of ordering products from the website, which indicates an important predisposition to digital interaction [62].

4.3. Free tools, powerful allies

The development of the web system was supported by very effective free tools: PHP as a programming language, Bootstrap as a framework and MySQL as a database.

4.4. Kanban Methodology: Guide development strategically

Equipment. The team, led by the Project Manager and the Director of the organization, together with the Development Team, established crucial synergy.

Kanban board. Three Kanban boards were used to organize tasks: “To Do,” “In Progress,” and “Completed,” each with specific dates. This visual approach facilitated transparent and effective tracking of progress.

Fig 2. To do

Fig 3. Progress

Fig 4. Completed

4.5. Tangible results: Transform data into actions.

The results of the research and the questionnaire indicate the importance of improving data management in the organization. The correct use of the Kanban technique and the chosen tools demonstrates the capacity of the point of view used during the development of the project. These results confirm the importance of using IT solutions to improve business management and obtain advantages in today's business environment.

Fig 5. Through processes.

The use of a web program for information management within a company, supported by business intelligence and the Kanban Agile Development Methodology, generates important impacts in several areas. From a technological point of view, it increases the efficiency of the operation, technology-based decision making, process automation and collaboration of the creation team, which generates an agile response to changing needs.

From a social point of view, it facilitates access to information, which increases work efficiency and promotes the idea of making work and life compatible, while increasing the quality of services, providing more effective experiences to users. From an environmental point of view, a positive effect is generated by sustainably reducing the use of paper, making the reproduction of documents unnecessary and preserving data on physiological media, contributing to the preservation of natural resources and promoting responsible business practices. This integrated approach reflects not only an internal technological transformation, but also a commitment to sustainability and continuous improvement.

Optimization of Data Management through a Web System based on Business Intelligence because users identify information management as a crucial challenge, participants demonstrate familiarity with the concept of business intelligence, recognize the importance of a web system to improve business processes, indicating

a clear demand for improvements, support the positive statement, underlining the optimistic perception of the impact of the Web system. they express the ability to order products from the website, indicating a significant predisposition to digital interaction; In particular, the application of the Kanban mindset has proven to be effective in managing work, supported by greater openness during the system creation phase, but also in its ability to create a functional and accessible web environment that is in harmony good with the needs of users whose results similar to other research have demonstrated the benefits of Kanban such as those found in this study, for example, in this sense:

Orlov et al., [63] confirmed the hypothesis that the choice of the most rational flexible methodologies for IT project management leads to an increase in financial and economic indicators of project management and the company as a whole. According to Fuentes et al [64], Kanban does not provide rules that prohibit changes to the work plan at any time. Given, so tasks in progress can be easily replaced by new ones highlighting their flexibility and adaptability, as well as the requirements of each team. In addition, it is a fundamental tool for determining control metrics.

In this vein, Sathe et al., [65] conducted an empirical study on the impact of project management constraints on agile software development comparing Scrum and Kanban, and demonstrated that the Kanban methodology emphasizes visualizing and optimize workflow and manage risks through a continuous feedback loop, which can help identify potential hazards earlier in the project lifecycle and establish mitigation techniques to address them by reducing the amount of work in progress and improving workflow, with the added benefit that the visual nature of Kanban boards also makes it easier to spot and resolve workflow bottlenecks, which can help reduce risks and ensure project execution continue.

5. Conclusions

The conclusion of our analysis points to an exhaustive theoretical investigation that resulted in the establishment of optimal conditions for the use of specialized tools in website development. The collection of information through a questionnaire for planning purposes played an important role in defining the requirements of the web system, functioning as a fundamental basis for the next step in the software development phase. The deliberate choice of the Kanban framework is based not only on its ability to effectively codify user-defined requirements, but also on its ability to create a functional and accessible web environment that is in good harmony with the requirements that users expect from it. Applying the Kanban mindset has proven to be effective in managing work, supported by greater openness during the system creation phase. Taken together, these results confirm the solidity of our methodology and the relevance of the decisions made in the development of this web application.

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