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Original Article

Web System to Improve Productivity in the Operational Management of Companies

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Abstract *- Developing web applications and systems has become crucial to improving companies' operational efficiency. This article aims to present the successful application of Scrum in developing a web system designed to improve operational efficiency in a multiservice company. Scrum, known for its flexibility and adaptability, enables constant stakeholder communication and early value delivery. The article details the development process, from planning to implementing key functionalities. In addition, the results of an expert evaluation are presented, supporting the choice of Scrum and the quality of the developed system. The resulting average score of 4.51 indicates that the system has been rated "Very Good". In conclusion, this article highlights the importance of choosing the right methodology in a digital business transformation environment and how Scrum has become a solid choice for web systems development projects.*

Keywords *- Web system, Scrum, Adaptability, Digital transformation, Operational Management.*

1. Introduction

The development of web applications and systems has experienced significant growth over the last decades [1], becoming an essential activity to improve operational efficiency and optimize processes in companies and industries of various branches [2], [3]. In this context of constant technological advancement, choosing a suitable development methodology becomes a critical factor for the success of any project. Operational management has acquired a critical importance in the business world [4], [5]. With increasing global competition and rapidly evolving technology, companies face constant challenges to remain efficient and competitive. According to the American Customer Satisfaction Model (ACSI) [6], companies that provide efficient service and high-quality products tend to have higher customer satisfaction. A study by the World Economic Forum (WEF) [7] highlights that operational efficiency is considered one of the main drivers of global competitiveness. According to the consulting firm McKinsey [8], companies can save between 20% and 50% of their operating costs by optimizing processes. Digital transformation in companies has become a critical factor for competitiveness and survival in an increasingly interconnected world [9]. Companies that embrace this transformation can keep up with global trends and lead in their respective industries and markets. This involves adopting technologies that enable real-time collaboration with teams and partners worldwide, business process automation, and global supply chain optimization. Agile methodologies, known for their flexibility and focus on adaptability, have become increasingly popular in software and web systems development [10]. These methodologies promote constant communication with stakeholders and early value delivery, making them an attractive approach for many organizations seeking to remain agile and competitive in a dynamic and constantly evolving business environment. This article focuses on implementing one of the most prominent agile methodologies: Scrum, which has established itself as a solid choice for project development due to its ability to adapt to unexpected changes and its focus on early value delivery [11]. We will explain in detail how Scrum has been applied to develop a web system to improve operational efficiency in a multi-service company. The Scrum development process will be analysed throughout the article, from the initial planning and estimation phase to the implementation of key functionalities. In addition, the results of an expert evaluation aimed at determining the level of quality of the resulting system design will be presented [12]. This evaluation is based on several essential criteria: usability, design, functionality, and efficiency. It will provide valuable information on the effectiveness of the Scrum approach in web systems development. The article is structured as follows: Section 2 discusses a literature review highlighting the adoption of Scrum in the software development industry and its benefits. Section 3 focuses on the methodology, including development fundamentals and a detailed case study. Finally, Section 4 presents the results of the expert evaluation, and Section 5 shows the discussion that allows interpreting the meaning of the results and putting in context why they are important.

Section 6 presents the conclusions obtained with the development of web systems to improve productivity in the operational management of companies.

2. Bibliographic Review

The web system developed to improve operational management in a multi-service company is based on Scrum's choice of agile methodology for its development. This choice is due to the wide adoption of Scrum in the software development industry. [13] Implementing a web-based system has become a common trend to improve productivity and decision-making in various industries [14]. For [15], The main objective of this study was to identify the mechanisms through which web systems can improve operational performance in various organizations. The authors conducted a systematic literature review to collect and synthesize empirical evidence from previous studies. In their review, they found that web systems can positively impact multiple aspects of operational performance. One of the key findings of their review was that web systems improve communication and collaboration in organizations.

By enabling greater connectivity and access to information, these systems facilitate coordination across teams and departments, increasing efficiency and informed decision-making. At [16], the objective of this study was to compare the implementation of web systems to improve customer service, using Zappos as a sample. The approach used was quantitative, correlational in scope, and non-experimental design. The author highlights this effective adoption and application of web systems to optimize and consolidate the quality of customer service. This article is a remarkable reference, mainly because it presents clearly and supported by statistical data the significant improvement in customer service, evidenced by the high ratings given by users. While [17] focused on a specific manufacturing company case. The authors conducted a case study to evaluate how the implementation of a web system affected the company's operational performance. In this study, they found significant results that supported the usefulness of web systems. Using the web system in the manufacturing company led to measurable improvements in performance. A reduction in operating costs was observed, indicating that the web system contributed to resource and process management efficiency. In addition, a substantial improvement in production and management efficiency was reported, possibly due to task automation and better coordination between teams.

3. Methodology

3.1. Fundamentals of Development

A thorough investigation of contemporary agile methodologies was conducted to advance the current research article. The choice of one of these methodologies was based on several criteria (Figure 1), including the amount of information available, the level of knowledge of each methodology, its adaptability, and flexibility in its gradual implementation. In the context of the article, it is critical to explore how Scrum has been applied to develop this specific web system.

The Scrum development process, ranging from planning and estimation to delivery of key functionalities, is crucial in improving operational efficiency in the enterprise. Planning and estimation in Scrum involve prioritising user stories and creating the product backlog, which facilitates the organization of work in sprints. This approach ensures early delivery of functionality that is essential for operational efficiency. Based on the theoretical foundations discovered because of our research to identify the most appropriate Agile methodology for the project, Scrum has been selected with a total score of 17, accompanied by a rating on a scale of 1 to 5, as indicated in Table 1. This choice is solid and supports its implementation in the project's development.

3.2. Case Studies

In this sense, we proceeded to the execution of the selected methodology, explaining the case study of the Scrum stages applied in this project. The developed web system supports the improvement of operational efficiency in the current company.

To facilitate the understanding of the system, Figure 2 shows the structure, indicating the users who interacted with it. It also presents the information flow between the database and the application, highlighting their interactions.

3.2.1. Home

The initial step is to compile a record of all the client's needs in their product or project, covering characteristics, capabilities, and requirements. We will then proceed to organize the work team. [18], defining the 3 main roles constituting this methodology: Product Owner, Scrum master, and development team. The set of data collected at the beginning is fundamental for creating the product backlog on which the duration of each sprint will be based.

Table 1. Choice of methodologies

Methodology	Information Management	Knowledge	Adaptation	Flexibility	Points
XP	3	3	3	4	13
Kanban	3	2	3	5	13
Scrum	4	4	4	5	17
Crystal	3	2	3	4	12
Scrumban	3	2	4	4	13

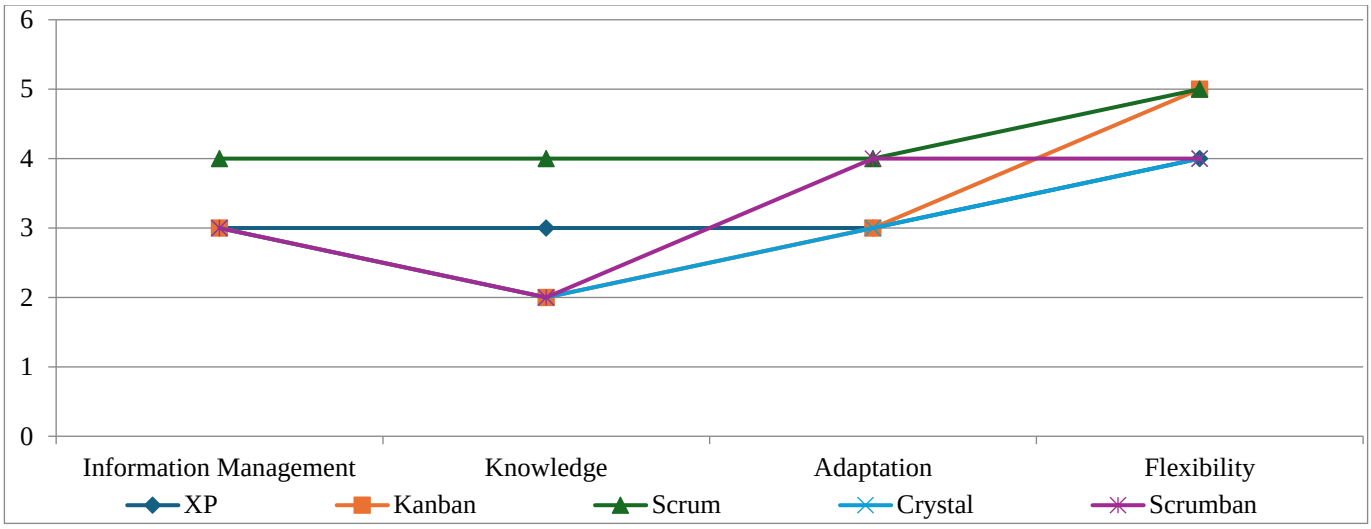


Fig. 1 Methodology chart

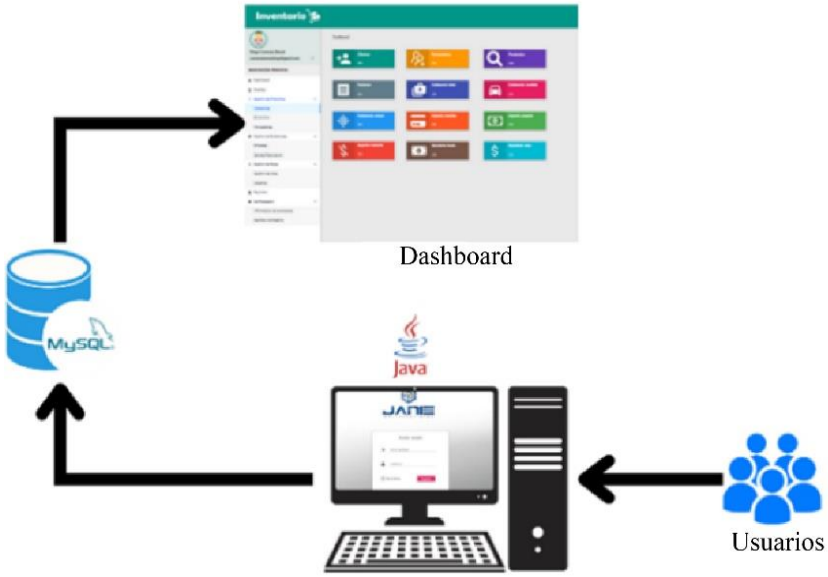


Fig. 2 System architecture

3.2.2. Planning and Estimation

The Planning and Estimation stage comprises a series of task planning and estimation procedures. These processes include the creation of user stories, the estimation of these stories, the commitment to them, the identification of associated tasks, the estimation of these tasks, and the elaboration of the Sprint Backlog. During this phase, the basis for the efficient execution of the project is established, including assigning specific tasks and determining the necessary resources.

Story Estimation and Prioritization

The stories were selected, starting with those of greatest importance to the project, i.e., those that provided the most value. Simultaneously, various tools were used to estimate the effort required for each task [19]. Once the estimation and prioritization of the user stories were completed, the user stories were validated against the story points assigned during the estimation, thus ensuring the accuracy of the estimates made.

Planning of Deliverables

After decomposing the epics and estimating and sorting the user stories by importance, they were amalgamated into the sprint, where the development of the selected user story was worked on during the team meeting in an estimated time frame. The following table was used to set up the product backlog, where the user stories were organized according to their priority and estimation [20]. In addition, Table 2 shows the various interactions in which the team participated in the project. The project consists of 14 user stories with a cumulative total of 32 story points, distributed in three sprints.

3.2.3. Implementation

In the third phase, activities are carried out mainly aimed at the initial development and modelling of the web application, using as a basis the user stories already prioritised according to the criteria established in the previous planning phase. It is important to note that each of these deliverables must meet the estimated deadlines after coordination with the Product Owner. Our project is divided into three sprints, with a total duration of 28 days.

First Sprint

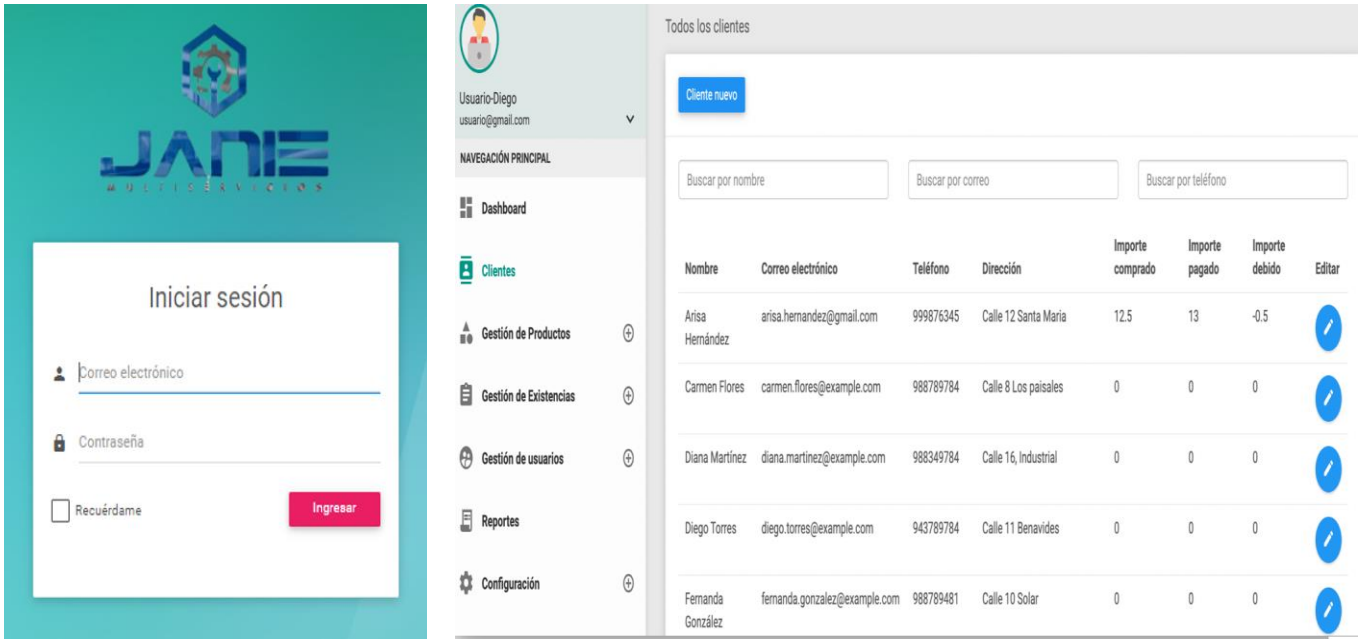
Work focused on user stories 1, 2, 3, 4 and 5 of the Product Backlog. Table 3 provides additional details on these stories, including their estimated duration and corresponding acceptance criteria. Subsequently, in Figure 3, some of the main prototypes are presented, such as user access, registration and visualisation of customer data, and registration of product and category information.

Table 2. Product backlog

No	User History	Priority	Estimate
1	As a user, I want to enter the system by logging in.	1	2
2	As a user, I want to register the data of new customers in the system using a form.	1	2
3	As a user, I want to view customer information with the amounts paid, purchased and due.	1	2
4	As a user, I want to register the information on the general categories of the products in the system using a form and the subsequent visualization of this data.	1	2
5	As a user, I want to register the information of the products in the system through a form and the subsequent visualization of this data.	1	2
6	As a user, I want to be able to enter the data of purchase, sale, and quantity of the product in the inventory through a form that allows me to visualize their data respectively.	2	2
7	As a user, I want to be able to enter the data of the new suppliers into the system through a form that allows me to visualize their data respectively.	2	2
8	As a user, I want to be able to generate invoices for customers and allow me to view their data respectively and print the invoices.	2	2
9	As a user, I want to be able to pay a customer's invoice.	2	2
10	As a user, I want to enter a role into the system through a form that allows me to visualize its data respectively and grant permissions.	3	3
11	As a user, I want to be able to add more users to the system through a form.	3	3
12	As a user, I want to be able to generate reports and allow me to view your data and print them.	2	2
13	As a user, I want to update the company's information.	3	3
14	As a user, I want to update my user password provided by the company.	3	3

Table 3. First sprint details

User History (UH)	Description
UH 1 User – Time Acceptance criteria	As a user, I want to access the system via a login screen. User - 2 days The system will only allow logins to users in the company's database.
UH 2 User – Time Acceptance criteria	As a user, I want to register new customer data in the system using a form. User - 2 days It is necessary to validate that the fields are not empty.
UH 3 User – Time Acceptance criteria	As a user, I want to view customer information with the amounts paid, purchased, and due. User - 2 days The specific customer information must already exist in the database.
UH 4 User – Time Acceptance criteria	As a user, I want to register the information on the general categories of the products in the system using a form and the subsequent visualization of this data. User - 2 days The messages to be notified to the user after a successful transaction should be similar to Category Added, Category Updated, and Category Removed.
UH 5 User – Time Acceptance criteria	As a user, I want to register product information in the system through a form and the subsequent visualization of that data. User - 2 days The product category must be selected to register correctly.



(a) **(b)**

Fig. 3 Sprint backlog 1: (a) Interface designed for log-in (b) Display of customers registered in the system

Table 4. Second sprint details

User History (UH)	Description
UH 6 User – Time Acceptance criteria	As a user, I want to be able to enter the data of purchase, sale, and quantity of the product in the inventory through a form that allows me to visualize their data respectively. User - 2 days You must validate that a category is selected. You must validate that a product is selected. It must be validated that a supplier is selected.
UH 7 User – Time Acceptance criteria	As a user, I want to be able to enter the data of new suppliers into the system through a form that allows me to visualize their data. User - 2 days You must validate that the fields are not empty.
UH 8 User – Time Acceptance criteria	As a user, I want to be able to generate invoices for customers and allow me to view their data respectively and print the invoices. User - 2 days When creating an invoice, the user must have the option to select whether the customer exists in the database or is new.
UH 9 User – Time Acceptance criteria	As a user, I want to be able to pay a customer's invoice. User - 2 days The date field must be selected to be able to credit the invoice.
UH 12 User – Time Acceptance criteria	As a user, I want to be able to generate reports and allow me to view your data and print it. User - 2 days You must validate that the fields are selected to generate a report with all the necessary information.

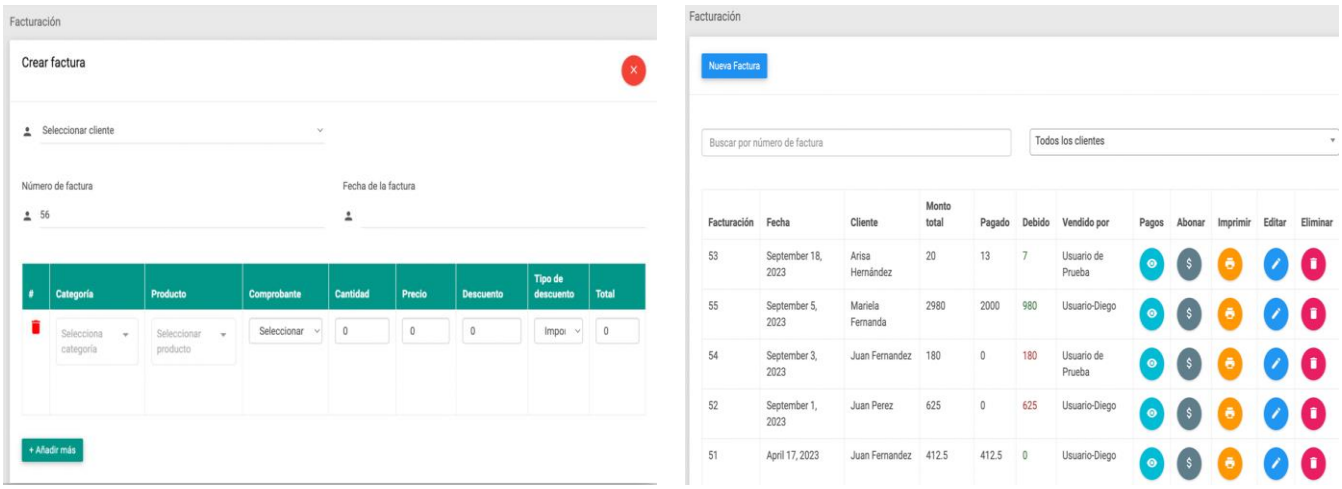
Second Sprint

For the second sprint, we focused on working with user stories 6, 7, 8, 9, and 12 of the product backlogs. Table 4 provides additional details on these stories, such as the estimated duration and corresponding acceptance criteria.

Figure 4 below shows some of the main prototypes, such as the entry of purchase, sales, and product quantity data, the recording of supplier information, as well as the generation of invoices and their crediting to customers.

Third Sprint

Third sprint: User stories 10, 11, 13, and 14 of the product backlogs are developed. Table 5 provides additional details on these stories, including their estimated duration and corresponding acceptance criteria. Then, in Figure 5, some main prototypes are presented, such as the creation of users, the roles assigned to each user, and their functionalities.

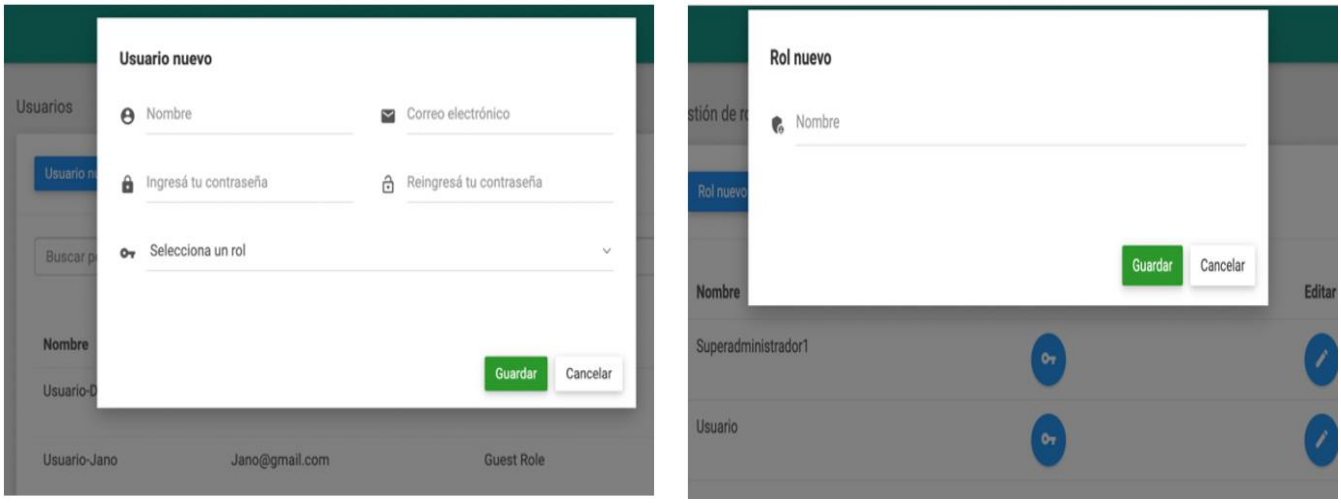


(a) **(b)**

Fig. 4 Sprint backlog 2: (a) Interface for invoice generation (b) Interface for the visualization of invoices in the system

Table 5. Third sprint details

User History (UH)	Description
UH 10 User – Time Acceptance criteria	As a user, I want to enter a role into the system through a form allowing me to view their data and grant permissions. User - 3 days You must validate that the fields are not empty.
UH 11 User – Time Acceptance criteria	As a user, I want to allow me to add more users to the system through a form. User - 3 days You must validate that the fields are not empty. A role must be selected to add the user.
UH 13 User – Time Acceptance criteria	As a user, I want to update the company information. User - 3 days You must validate that the fields are not empty. The pattern of the messages that will be notified to the user after a successful The pattern of messages that will be notified to the user after a successful operation should be similar to the Company information updated.
UH 14 User – Time Acceptance criteria	As a user, I want to update my user password provided by the company. User - 3 days The pattern of the messages that will be notified to the user after a successful operation should be similar to the Password-updated configuration.



(a) **(b)**

Fig. 5 Sprint backlog 3: (a) Interface designed for user creation (b) Interface designed for the creation of user roles

4. Results

A group of 10 experts evaluated the level of design quality. For this evaluation, various criteria, such as usability, design, functionality, and efficiency, were applied, which served as the basis for developing questions using the Likert scale. The purpose of this validation is to determine the degree of acceptance of the prototype according to the experts' opinions. Table 6 specifies the criteria considered in this evaluation and the questions about each.

This process obtained the quality level by calculating the mean and standard deviation (S.D.). It should be noted that the overall mean is 4.51, which is interpreted as a level of quality classified as "Very good". To determine the quality level of our prototyping, we have obtained the average corresponding to each of the previously mentioned evaluated criteria.

According to Figure 6, we can notice the criteria used: usability, design, functionality, and efficiency, with an average score of 4.45, 4.58, 4.57, and 4.43, respectively. Thanks to the results obtained, we can prove that our web system's quality is within acceptable standards. Since the overall average of all these indicators is 4.51, which is higher than the minimum acceptable, we, as researchers, have granted that value of 4.51. Thanks to the participation of the 10 experts, Figure 7 shows that 35.71% of them expressed that the application's usability is considered “Very good”, while 64.29% evaluated it as “Good”. In addition, it is important to note that none of the respondents rated the system as “Very bad”, “Bad” or “Fair”.

This allows us to classify our system as highly competent and suitable for implementation in the company in question. Finally, this closing graph summarises all the results obtained with the criterion with the best qualification, the design with a score of 57.50% of “Strongly agree”. Next is functionality, with 56.67% “Strongly agree”, efficiency with 56.67% “Agree” and 43.33% “Strongly agree”, and finally, usability, with 55% “Agree” and 45% “Strongly agree”. The graphical presentation of these results allows a quick understanding of the virtues and aspects to be improved in our prototyping according to the criteria presented to the surveyed experts.

Table 6. Validation by expert judgment

Criteria	Questions	Median	SD	Quality
Usability	Does the platform provide a satisfactory user experience from login to completion of key tasks?	4.1	0.32	Very Good
	Is the interaction with elements such as buttons, drop-down lists, and input fields accurate and error-free?	4.5	0.53	Good
	Does the system provide a consistent user experience across all screens and modules?	4.5	0.53	Good
	Is learning and adapting to the system quick and easy for new users?	4.7	0.48	Very Good
Design	Is the interface design intuitive, and does it make the available functions and actions easy to understand?	4.7	0.48	Very Good
	Does the platform use visual effects to highlight important elements or key actions?	4.6	0.52	Good
	Does the design allow for efficient navigation, minimizing the need for constant scrolling?	4.6	0.52	Good
	Does the web system use icons and symbols effectively to represent actions and functions?	4.4	0.52	Good
Functionality	Does the web system meet the objectives and functional requirements established for operational management?	4.5	0.53	Good
	Are supplier management and purchasing functions effectively integrated into the system?	4.5	0.53	Good
	Are the reporting features flexible, and do they allow users to customize their reports?	4.7	0.48	Very Good
Efficiency	Does the system present information in a clear and organized manner, facilitating the company's decision-making?	4.2	0.42	Very Good
	Is the system response agile and not experiencing noticeable delays during common operations?	4.5	0.53	Good
	Do reporting and analysis functions scale effectively for large data sets?	4.6	0.52	Good
	Total average and final quality level	**4.51**		**Very Good**

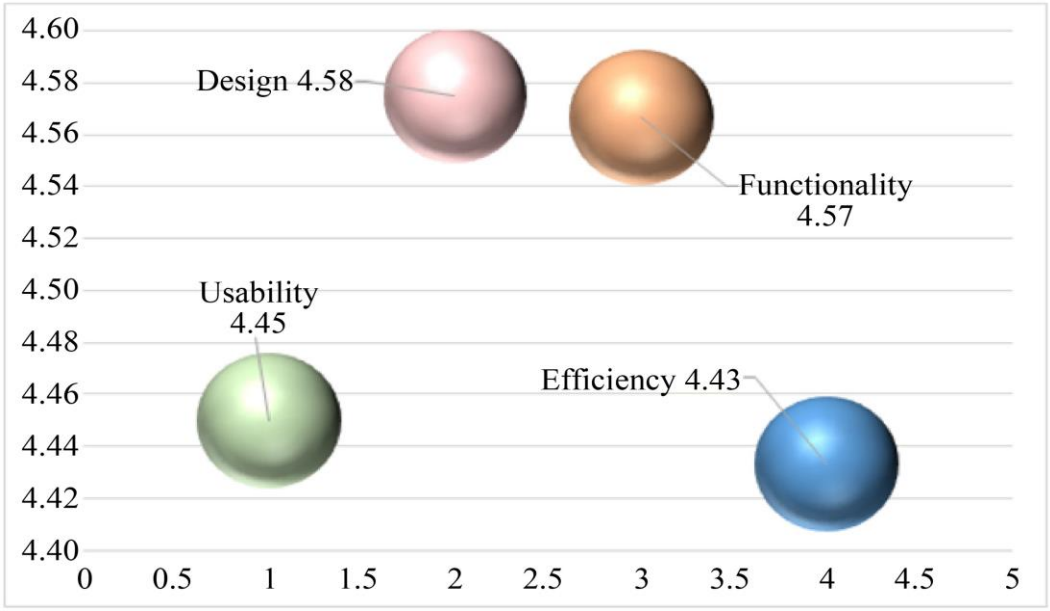


Fig. 6 Criteria evaluation

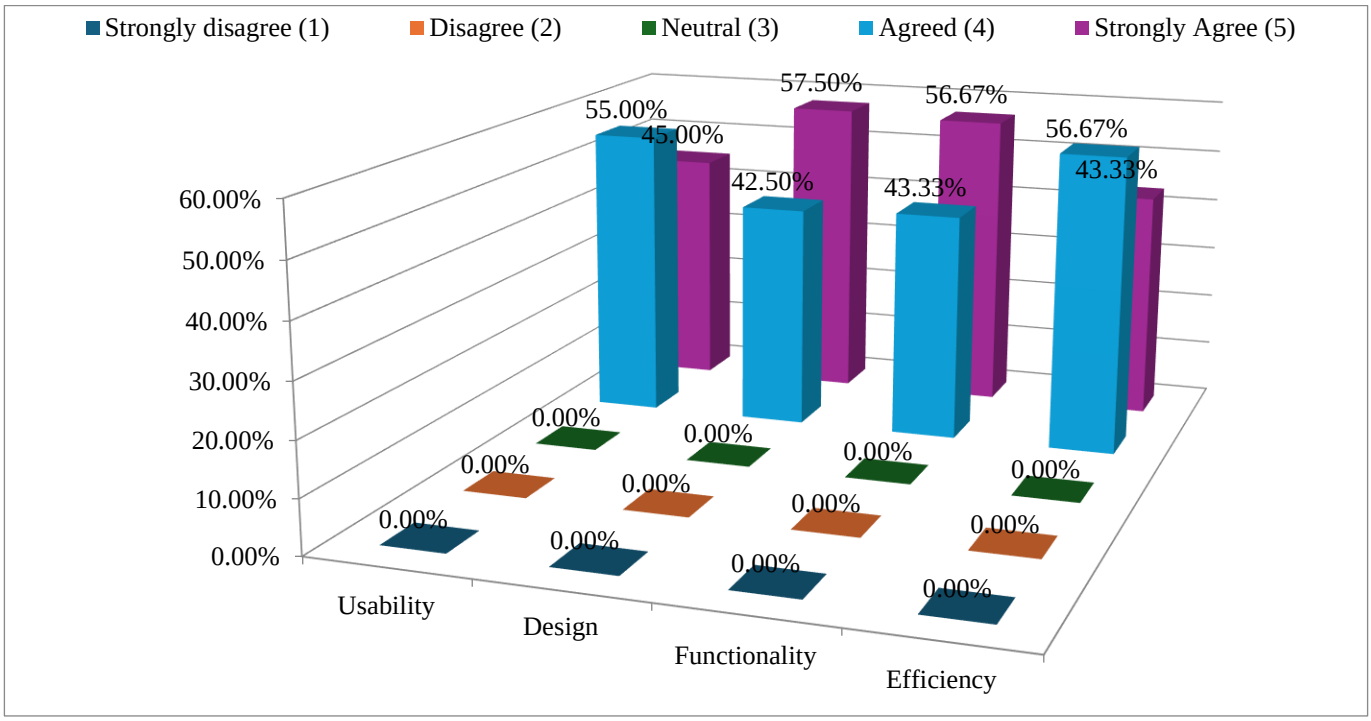


Fig. 7 Criteria summary

5. Discussion

For a deeper interpretation of the results, comparing them with previous research cited in the literature is relevant. Doing so reveals a consistent trend in the importance of technology in improving companies' operational efficiency and financial performance. Previous studies have highlighted that process automation, data collection and analysis, and attention to customer satisfaction are critical factors for business success. The successful implementation of a web-based system aimed at improving operational management in a company is a significant achievement that can boost efficiency and productivity. In this project, the choice of Scrum methodology proved to be a critical success factor. Scrum's inherent flexibility allowed agile adaptation to change and continuous value delivery throughout the project. One of the main benefits of Scrum in this context was the ability to break the project into sprints with early deliverables, which allowed the company to get key functionality early and generate

immediate operational improvements. In addition, the Scrum methodology fostered team collaboration and accountability, with well-defined roles such as Product Owner, Scrum Master, and Development Team. Constant communication and regular follow-up meetings kept all team members aligned with the objectives and needs of the project. When comparing the results of our web-based system implementation in this company with previous studies addressing similar projects, we found similarities in the importance of operational efficiency and process improvement. According to [10], Approximately 81% of software development companies have chosen Scrum because of its advantages in generating progressive business value and adaptability to constantly changing business environments. Our project supports these claims by achieving an average rating of 4.51, indicating a quality level of "Very Good."

The results of this study are consistent with previous research findings that have demonstrated the positive impact of technology on companies' operational efficiency and financial performance. For example, a study conducted by the consulting firm Gartner [21] found that companies that implement a web-based system can achieve a 15% increase in productivity, a 10% reduction in operating costs, and a 5% increase in sales. A similar study conducted by research firm Forrester [22] found that companies implementing a web system can achieve a 20% increase in customer satisfaction, a 15% reduction in customer churn, and a 10% increase in customer loyalty. These findings suggest that the web application developed in this study has the potential to generate significant benefits for the company. However, it is important to note that the results of this study are based on a relatively small sample of experts. Further studies with larger samples are required to confirm these findings.

During the implementation of the web system, there was the challenge of ensuring effective communication between the development team and the company's stakeholders. To overcome this obstacle, we conducted regular follow-up meetings and encouraged constant collaboration, which resulted in a better understanding of the end users' needs and expectations. An important lesson we learned is prioritising web system features and functions effectively.

This allowed us to deliver key functionality early and generate immediate operational improvements. After implementing the web-based system, the company recorded a marked improvement in operational efficiency. Key functionalities, such as the customer and supplier registration system, invoice generation, and the ability to generate customized reports, helped streamline operations and improve decision-making. User feedback has been positive, as the web-based system provides a satisfactory user experience, facilitating access to critical functions and minimizing errors in the interaction with the platform.

6. Conclusion

Implementing the web system to optimize the company's operational management has been a successful project that has increased the efficiency and productivity of the organization. The selection of the Scrum methodology was key to the project's success, as it allowed for flexibility, adaptability, and continuous delivery of value. Following validation of the design model by a panel of 10 experts, the results reveal an overall rating of "Very Good" with an overall average score of 4.51. This endorsement reflects the robustness and effectiveness of the designed web system, supporting its suitability for improving productivity in operational management.

The comparison of criteria shows an outstanding performance in design, with 57.50% of experts agreeing "Strongly Agree". Functionality also stands out with a solid 56.67% approval rating. Although usability obtained a balanced distribution of opinions, 45% "Strongly Agree" endorsed its effectiveness. Efficiency, although well evaluated, suggests areas for improvement with 43.33% "Strongly Agree". The division of the project into sprints allowed the company to get key functionalities early, leading to immediate operational improvements. Effective collaboration and communication within the development team and with stakeholders ensured that critical needs were addressed as a priority.

This project is an example of how implementing an agile methodology such as Scrum can generate significant results in projects aimed at improving operational management in a company. The success of this implementation supports the effectiveness of Scrum in business contexts and highlights its usefulness for similar projects in the future. Some recommendations for future research or projects related to this investigation: It is advisable to consider both the hardware and software required in future implementations. Compatibility with specific operating systems and software versions is crucial for optimal performance. It is recommended to plan training considering the availability of staff time. Agreeing on pre-established dates will ensure successful system adoption. Implement strong data backup policies and security measures. Information integrity and security are critical to user confidence and the protection of sensitive business data.

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