

Web Application to Improve Advertising Order Management Based on Cloud Computing: Case Study of a Television Company

Ariadna Gisselle Ledesma-Sánchez, Ricardo Alejandro Gamarra-Valle, Ernesto Adolfo Carrera-Salas
School of Engineering, Universidad Peruana de Ciencias Aplicadas (UPC), Lima, Peru

Abstract—Television companies face significant problems in managing advertising orders due to manual processes that cause transcription errors, delays, and a lack of traceability. This study proposes a web application based on cloud computing to automate this process. The solution implements a hybrid architecture that allows advertising agencies to enter orders directly, eliminating manual transcription and providing complete traceability. The results of the pilot test demonstrated substantial improvements: processing time was reduced by 88.33%, decreasing from 17 minutes 16 seconds to 2 minutes 1 second per order. Transcription errors fell from 60% to 0%, and operating costs were reduced by 54.5%. Automation in reporting eliminated manual management, allowing agencies direct access to campaign information. The implementation successfully transformed manual management into an automated, efficient, and scalable system, improving operational efficiency and customer satisfaction.

Keywords—Advertising order management; cloud computing; process automation; television companies; web applications

I. INTRODUCTION

Currently, television companies face a constant transformation driven by technological changes and new demands of the digital market [1]. This context of change forces them to rethink their traditional operating models, in which manual processes, such as managing contracts, advertising orders, and client reports, hinder efficiency.

The entertainment and media sector reached \$2.32 trillion in revenue in 2022 [2], although growth showed a marked slowdown, dropping from 10.6% in 2021 to 5.4% in 2022. This slowdown is leading companies to seek more efficient strategies, rethinking their management models, and looking for the optimization of their administrative processes through technology.

Investment in digital advertising has surpassed television as the main advertising medium. According to the Dataxis report, in 2021, digital formats obtained 44% of total revenues in Latin America [3], while television accounted for 39.4%. This trend marks a shift in brand strategies toward more interactive platforms with precise metrics. In Peru, investment in digital advertising represented 51% of the total advertising spending in the country [4], surpassing television, which occupied 35%. This change demonstrates the rapid adoption of digital technologies in advertising strategies, further highlighting the need for television companies to update their management models to adapt to the increasingly changing market.

Various studies have demonstrated how process automation through technological solutions significantly improves operational efficiency in different organizations. For example, a web platform has been developed for inventory management in small and medium-sized enterprises (SMEs), enabling them to overcome the limitations of manual methods and improve internal record control [5]. In the advertising field, a model based on advanced techniques has been proposed to measure the impact of television advertising on users' digital behavior, integrating metrics from traditional and digital media into a unified analytical platform [9]. Likewise, the benefits of adopting cloud services by small businesses have been widely documented, highlighting their role in commercial expansion and digital transformation in emerging markets [6]. Similarly, a company in the events sector optimized customer service through a web-based system that automates orders, payments, and reporting processes, successfully adapting to digital environment conditions [8]. Simulation tools and modular approaches have also been applied to improve resource planning and operational efficiency, identifying bottlenecks and proposing adjustments without affecting real operations [7], [10]. In the financial sector, the automation of information processing using data flows and continuous integration tools has proven effective in improving report generation and reducing manual errors.

In this context, the present research developed a technological solution aimed at optimizing the management of advertising orders and customer reports in the television sector in order to strengthen operational efficiency, improve order traceability, and facilitate adaptation to the digital environment. Although cases of automation in different industries have been addressed, there is scarce literature focused specifically on digital solutions for advertising order management in media, which supports the relevance of the present proposal. The research implemented an automated web platform using Spring Boot as the main framework, Thymeleaf for the user interface, and Azure Database for PostgreSQL as the cloud storage infrastructure, with differentiated authentication through Spring Security for television channels and advertising agencies. The results obtained in the pilot test demonstrated an 88.33% reduction in order entry time, decreasing from 17 minutes 16 seconds to 2 minutes 1 second per order, and eliminating transcription errors that previously affected 60% of operations. Additionally, a 54.5% reduction in operating costs was achieved, and access to transmission reports was automated. In conclusion, the system effectively transforms advertising order

management from a manual process prone to errors to an automated, efficient, and scalable operation.

II. RELATED WORKS

In [5], inventory management systems intended for small and medium-sized enterprises are reviewed, focusing on overcoming the limitations of manual methods that often generate errors and operational inefficiency. The research highlights the importance of implementing web platforms that facilitate automation and real-time inventory control, allowing SMEs to improve their registration accuracy, traceability, and operational efficiency. The scalability and adaptability of these technological solutions for different business environments and business sizes are highlighted. The adoption of modular systems and robust databases is identified as common practice to provide sustainable and easily maintainable solutions aimed at digitizing processes and reducing errors associated with manual management.

In [6], a systematic review is presented on the adoption of cloud computing by small and medium-sized enterprises, analyzing how this technology allows improving operational efficiency, scalability, and cost reduction without requiring significant investments in physical infrastructure. The study identifies that cloud-based platforms facilitate access to advanced computing resources, allowing SMEs to implement scalable and flexible web systems that adapt to business growth. The research examines key adoption factors, technological and organizational barriers, and the impact on business competitiveness. The study concludes that cloud computing constitutes a strategic tool for digital transformation, allowing SMEs to access modular architectures and services that were previously only available to large corporations.

In [7], the research analyzes the impact of process modularity on manufacturing times and throughput rates in the context of mass customization. The study implemented a simulation-based methodology to evaluate different modular assembly process structures, using three independent modularity indicators to provide a reliable assessment of this system property. Experiments were carried out using deterministic models of alternative process structures, applying both theoretical and practical case studies. The results demonstrated moderate correlations between process modularity and manufacturing time, as well as between process modularity and throughput rate. The study concluded that assembly processes with greater structural modularity provide significant advantages in terms of operational efficiency, reducing

manufacturing times by up to 51% and improving throughput rates in mass customization environments.

In [8], the development of a web system for an event organizing company is studied, in order to facilitate order management and interaction with clients during health restrictions due to the pandemic. The Rapid Application Development (RAD) methodology was used, and functionalities were designed for three types of users: administrator, manager, and client. The evaluation of the system included alpha and beta tests, as well as compliance with the Eight Golden Rules of Interface Design. The system was rated as very viable, obtaining a usability score of 89%. In addition, it automates processes such as orders, payments, reports, and package management. The study concludes that digitalization can significantly improve the operational efficiency of personalized services.

In [9], the study addresses the challenge of measuring the impact of television advertising on the digital behavior of users through advanced technologies. To solve this problem, machine learning and causal inference techniques were used, developing the TV-Impact model that combines television consumption data with digital metrics. The evaluation of the system was carried out through indicators such as incremental reach and campaign effectiveness, applying quantitative analysis based on large volumes of advertising data. The results showed that video advertising represents approximately 30% of global advertising spending, with significant growth in digital markets, such as Turkey, where it reaches 49%. The study concludes that the integration of these technologies allows optimizing advertising strategies and demonstrates the importance of modernizing television systems to respond to digital transformation and improve operational efficiency.

In [10], the research developed SustAI-SCM, a modular system for process automation in supply chains based on artificial intelligence. The modular architecture integrates specialized components for procurement management, logistics planning, and resource monitoring, where each module operates autonomously but is coordinated within the global system. The results demonstrated substantial improvements: a 26.0% reduction in fuel consumption, a 31.4% increase in procurement efficiency, and a 28.4% decrease in operating costs. The study concluded that modular design constitutes a fundamental strategy for developing scalable and adaptable systems in contemporary business operations.

Table I presents a comparative analysis of existing approaches and the proposed model.

TABLE I. COMPARISON BETWEEN PROPOSED MODEL VS RELATED WORKS

Year	Paper	Description / Technology	Applied Sector	Metrics
2022	Paper 1 [5]	A modular architecture and MySQL database were implemented that allow scalability and adaptation to different environments.	Small and medium-sized enterprises	Significant improvement in inventory accuracy and data processing speed.
2022	Paper 2 [6]	Use of cloud services to improve operational efficiency, scalability, and cost reduction in e-commerce SMEs.	Small and medium e-commerce enterprises	E-commerce growth, increase in broadband penetration, and impact on high-speed connections.
2023	Paper 3 [7]	Analysis of the impact of process modularity on manufacturing times and throughput using modular architectures and deterministic simulation.	Manufacturing sector	Reduction of manufacturing time, moderate correlation between modularity and efficiency, improvement in throughput rate, and optimization of modular process structures.

2024	Paper 4 [8]	Web application with integrated database and three roles (administrator, manager, client), developed with RAD methodology.	Clients and providers of wedding organization services	Improvement in communication between client and company, automation of package and report management, increase in operational efficiency, and reduction of manual errors.
2024	Paper 5 [9]	Use of web traffic data and TV ads with the CausalImpact model, classifying ads according to their temporal overlap.	3 companies from different sectors that implement television advertising strategies	Reduction of prediction error and classification, estimated increase in web traffic.
2025	Paper 6 [10]	Modular system for process automation in supply chains based on agent-type artificial intelligence.	Sustainable supply chain management	Decrease in emissions, improvement in warehouse efficiency, reduction of operating costs in logistics, and optimization of procurement processes.
2025	Proposed Model	Web application for advertising order management in a television company, deployed on Azure.	Television sector	Reduction of average time per order, increase in the number of orders processed per hour, decrease in errors in order registration, and reduction of operational resources.

Source: Own Elaboration.

III. CONTRIBUTION

A. Commercial Break

A commercial break is a block of time assigned within television programming for the consecutive broadcast of several advertisements, usually located at strategic moments such as the beginning, middle, or end of a program [11]. In the proposed system, this concept is integrated as a fundamental entity within advertising order management, allowing the automatic organization, scheduling, and allocation of advertising slots based on time availability and advertiser requirements. This study contributes by formalizing the commercial break as a structured and optimizable entity within a digital management system, improving scheduling efficiency compared to traditional manual approaches.

B. Advertising Order

An advertising order is the formal contract or agreement between a television company and an advertiser, through which the broadcast of one or more advertisements is established within a defined period [12]. In the developed web application, the advertising order constitutes the core of the commercial management process, centralizing advertiser information, contracted slots, and broadcast schedules. The contribution of this work lies in the digital integration and automation of advertising orders, enabling traceability, consistency, and real-time management, which are typically limited in traditional systems.

C. Cloud Services

Cloud services are technological solutions delivered over the internet that enable remote access to resources such as storage, processing, databases, and applications, providing flexibility, scalability, and cost efficiency [13]. In this project, cloud services form the backbone of the system infrastructure, hosting the web application, database, and synchronization mechanisms. This research contributes by implementing a hybrid cloud architecture that combines scalability and local operational continuity, enhancing system availability and reducing infrastructure costs in the television sector.

D. Web Application

A web application is a software system accessible through a web browser that enables user interaction and data processing

over the internet [14]. In this research, the web application serves as the main interface for the advertising order management system, allowing users to register information, monitor campaigns, and access reports from any connected device. The contribution of this study is the development of an integrated web-based platform that improves accessibility, usability, and real-time interaction in advertising management processes.

E. Process Automation

Process automation is defined as the use of technology to execute repetitive and manual tasks in order to improve efficiency and reduce human intervention [15]. In the proposed system, automation is applied to the scheduling and control of advertising orders, eliminating manual tasks such as schedule validation and ad registration. This work contributes by demonstrating a practical automation model that significantly reduces operational errors and processing time, improving overall efficiency in advertising workflow management.

IV. METHOD

The implementation of the web application to improve advertising order management based on cloud computing was developed following these steps:

A. Technology Selection

After a detailed analysis of the main cloud platforms, Microsoft Azure is positioned as the most balanced solution for enterprise environments, with a guaranteed uptime of 99.95% and native integration with Microsoft corporate tools that facilitate management and reduce operating costs, according to its official SLA [16]. Although AWS offers slightly higher availability of 99.99% [17], its more complex pricing model can make budget control difficult in projects with strict limits. For its part, Google Cloud Platform stands out in performance for specific data analysis workloads, thanks to its global infrastructure and recommended practices for region selection that allow optimizing latency [18]. More economical alternatives, such as Render, present limitations in scalability and lack of formal availability guarantees, which restrict their suitability for critical systems. Collectively, these factors position Azure as the platform that best combines technical performance, enterprise integration, and predictable costs, optimizing the management of demanding advertising systems.

The selection of databases for advertising management systems requires evaluating criteria for performance, robustness, and scalability under different workloads. A recent comparative study that used JMeter to evaluate MySQL, Oracle, and PostgreSQL showed significant differences in average response times and transfer rates: MySQL presented the best time with 675 ms and 0.119 requests per second, followed by Oracle with 5553 ms and PostgreSQL with 10483 ms [19]. However, these metrics reflect a scenario of low concurrency and limited workload, so they should not be interpreted as absolute performance indicators for productive environments with high concurrency. Even so, PostgreSQL is distinguished by its capacity to handle complex data and its scalability, essential features for maintaining integrity and adaptability in high-volume transactional advertising environments. MySQL offers an interesting balance in response times, while Oracle provides stability and robust enterprise support. These differences justify the choice of databases that respond to specific project requirements and facilitate future scalability.

The selection of the programming language for advertising management systems requires evaluating the performance and enterprise scalability among the main alternatives. Recent comparative studies demonstrate significant differences in performance, where C# and Java take twice as long as system languages like C in computational tests, but are still many times faster than Python, positioning both Java and C# as superior options for high-performance enterprise applications. Benchmarks also reveal that Python remains one of the two most used scripting languages despite its poor performance [20], which represents a critical limitation for advertising management systems that require high-volume transactional processing. Java emerges as the most balanced option due to its combination of robust performance, enterprise maturity, and multiplatform versatility, especially when implemented with frameworks like Spring Boot that facilitate concurrent transaction handling. C# offers performance comparable to Java but presents greater dependence on the Microsoft ecosystem, while Python, although facilitating rapid development, lacks the necessary performance for enterprise implementations that demand high concurrency and intensive data processing.

B. System Architecture

The architecture of the proposed system, illustrated in Fig. 1, explicitly enforces modular boundaries across three layers: 1) the Presentation Layer, responsible for UI rendering through Thymeleaf templates and user interaction; 2) the Business Logic Layer, encapsulating transaction processing, role-based access control, and workflow orchestration through Spring Boot services; and 3) the Persistence Layer, managing data storage and integrity via Azure Database for PostgreSQL and local on-premise synchronization through Debezium CDC.

This architecture presents a distributed system of a hybrid nature that integrates cloud services with local infrastructure, designed to provide high availability, robust security, and horizontal scalability. The cloud environment is structured on the Microsoft Azure platform, where a modular monolithic backend developed in Spring Boot and Thymeleaf has been deployed. This configuration allows maintaining centralized business logic, but organized into independent modules that

facilitate system maintainability, scalability, and evolution. This approach was chosen due to its lower operational complexity compared to microservices, which simplifies the deployment and administration of the environment without sacrificing flexibility. Deployment on Azure App Service guarantees elasticity in resource allocation, while KeyVault acts as a centralized repository for managing secrets and credentials. In addition, the Content Delivery Network (CDN) optimizes the delivery of static resources, reducing latency and improving the end-user experience. To guarantee the security of critical data, an isolated subnet with network security groups hosts the PostgreSQL database, implementing multiple layers of perimeter security and role-based access control according to the principle of least privilege. On the other hand, the local infrastructure maintains operational autonomy through a dedicated database that synchronizes with the cloud environment through Apache Debezium as a change data capture (CDC) engine. This real-time synchronization preserves transactional integrity, while the Domain Name System (DNS) facilitates unified access by directing traffic to the appropriate services according to load-balancing policies. From an architectural point of view, the implementation follows the Hybrid Cloud Computing pattern, allowing the strategic distribution of workloads according to latency and data regulation criteria. Likewise, the Change Data Capture pattern is materialized through Debezium, providing automatic synchronization of changes between distributed environments and guaranteeing transactional integrity between both environments.

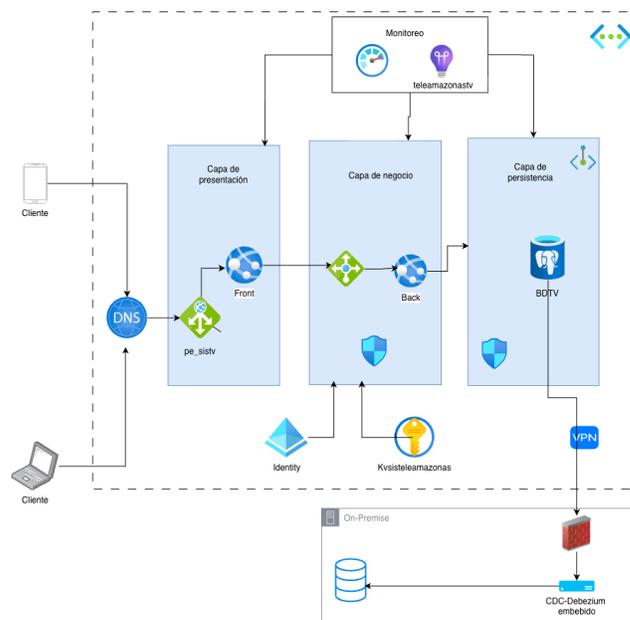


Fig. 1. Hybrid cloud architecture adopted for the system deployment.
(Source: own elaboration)

It is worth noting that the implemented solution involved the migration of a legacy module previously based on Power Builder scripts and an Oracle database to a modern stack using Java (Spring Boot), PostgreSQL, and Azure cloud deployment. This transition presented typical integration challenges, including data schema mapping between Oracle and PostgreSQL, the

replacement of procedural scripting logic with service-oriented components, and ensuring data continuity during the cutover period. The use of Apache Debezium as a CDC engine facilitated this transition by enabling real-time synchronization between the on-premise legacy database and the new cloud environment, minimizing operational disruption.

A critical aspect of the proposed architecture is its resilience to partial failures and operational continuity. Through the use of the Change Data Capture (CDC) component and an asynchronous replication strategy, the system ensures that the web application remains functional even in the event of interruptions in the local server. In such a scenario, registered orders are maintained in a persistent cloud buffer and automatically synchronized once connectivity is restored, eliminating the risk of transaction loss. Similarly, processing in the local infrastructure is not interrupted if the web application experiences latency, ensuring hybrid availability that strengthens data integrity throughout the entire order management flow.

A. DB Configuration

The database was configured using Azure Database for PostgreSQL, focusing on the definition of schemas and relationships that allow for efficient information management. Strategic indexes and integrity constraints were implemented to optimize query performance and ensure data consistency. Likewise, security practices were adopted to protect sensitive information, and the configuration was planned to facilitate scalability, considering the possible future expansion of the system and the need to maintain high availability.

B. System Development

The system has been designed and implemented under a modular and multilayer approach, with a service-oriented architecture that guarantees scalability, security, and ease of maintenance. For server-side logic, the Spring Boot framework was used, widely adopted in enterprise environments for its robustness and integration capacity. In the presentation layer, the use of Thymeleaf was chosen, allowing the dynamic generation of views integrated directly into the backend, which optimizes performance by avoiding unnecessary communication between client and server. Regarding data storage, the system connects to an Azure Database for PostgreSQL, which allows a fully managed database infrastructure in the cloud, eliminating the costs and complexities associated with physical server administration. This database not only hosts the information registered by system users but also acts as an integration point with the television company's internal database. To achieve efficient and real-time synchronization between both data sources, a replication service called CDC Replicator was developed, implemented in Spring Boot and integrated with the embedded Debezium connector. This application detects changes made in the local environment tables and automatically applies them to the cloud database, ensuring the coherence and availability of the information without the need for manual replication processes. The use of embedded Debezium allows processing change events directly within the application, dispensing with intermediate infrastructure based on Kafka. This approach offers a lightweight and efficient alternative for real-time synchronization of databases, maintaining data

coherence and consistency between the local and cloud environments. The entire ecosystem was developed with a view to its deployment on the Microsoft Azure infrastructure, which not only facilitates remote availability and continuous operational continuity of the system but also provides automatic scalability according to user demand. The system includes security mechanisms for access, session control, and backup policies, aligning with current software engineering standards in cloud-based solutions.

1) *Access module*: The authentication module was implemented using Spring Security, allowing secure and differentiated session login management according to the user's role. Through this mechanism, the credentials entered in the interface are validated, and the authenticated user is directed to the corresponding section of the system. The television channel, as the platform administrator, accesses functionalities related to order management and control, while advertising agencies exclusively access the sections that allow them to register requests, review their order history, and consult reports. This segmented access control mechanism not only guarantees the protection of sensitive data but also ensures a coherent and role-oriented user experience.

Role Differentiation and Access Control

The system only contemplates two clearly differentiated types of users:

- External users (advertising agencies), who can only access the modules related to order registration, visualization of the status of their campaigns, and report generation.
- Internal users (television channel administrators), with exclusive access to critical functions such as order review and approval, agency registration and management, and global system supervision.

The access control logic is managed by Spring Security, using a Role-Based Access Control (RBAC) approach, which ensures that each user can only interact with the functionalities relevant to their profile, thereby maintaining system security and traceability.

2) *Advertising request registration module*: This module constitutes the central piece of interaction for advertising agencies. From this section, agencies can register new requests for the broadcast of their advertising spots, indicating essential information such as the associated contract, the start and end date of the campaign, and the television block in which the broadcast is desired. This data is stored directly in the cloud database and, thanks to the integration with Debezium, can be automatically synchronized with the television company's internal programming system, without the need for manual intervention. This solution guarantees that the advertising blocks registered by the agencies are available in real-time for review and approval by the channel, ensuring efficiency and traceability.

The interface features a sidebar with navigation options: 'Dashboard', 'Crear orden publicitaria', 'Resumen de orden', 'Mis órdenes', and 'Salir'. The main form is divided into sections: 'Cliente' (Nombre cliente), 'Contrato' (Selecciona un contrato), 'Producto' (Selecciona un producto), and 'Spot' (Selecciona un spot). Below these are 'Fecha registro' (29/06/2025), 'Mes' (Selecciona mes), and 'Programa' (Selecciona un programa). A 'Hora / Día' field is also present. A 'Guardar' button is at the bottom.

Fig. 2. Advertising request registration interface: The screen shows a form that allows you to create the advertising order registration request. (Source: Own elaboration)

Fig. 2 shows the structured form through which agencies enter their campaigns, including contract, date, and television block fields.

3) *Advertising agency dashboard*: This initial interface is designed to facilitate navigation and provide relevant information in real-time, such as the number of orders in process and the consolidated status of previous requests. From this panel, the user can access a section for reviewing pending, accepted, or rejected orders, where the requests that have been created are listed. Fig. 3 shows the main panel that summarizes the status of the requests and the quantity of each status.

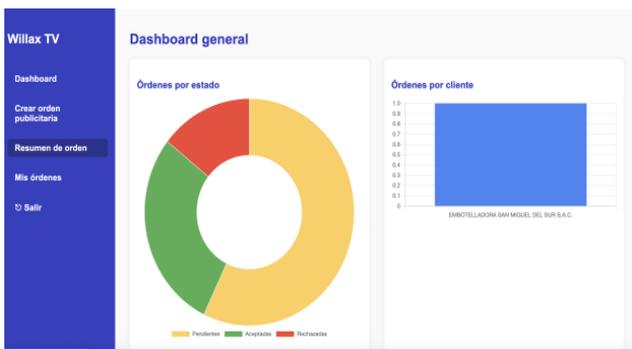


Fig. 3. General view of the advertising agency dashboard showing the distribution of advertising orders by status and client. (Source: Own elaboration)

4) *Agency management module*: Intending to maintain flexible management of the actors interacting with the system, an exclusive module was implemented for the channel administrator, from which it is possible to register new advertising agencies, edit their data, and assign access credentials. This section was developed with server-side validation controls, ensuring the integrity of the records before being stored. The creation of agencies automatically implies the creation of an associated user with delimited permissions, which simplifies account administration and avoids duplication errors.

5) *Order approval and tracking module*: The system administrator has a centralized view that allows them to monitor all orders registered by the agencies. Requests can be filtered by status (pending, approved, or rejected) and viewed

in detail. From this section, the administrator has the capacity to approve or reject orders based on the real availability of the channel's programming, which can be consulted thanks to the synchronization with the operational database. The logic that regulates status changes was developed under a transactional approach, so that any modification is fully registered and automatically replicated to the company's database through the integration service with Debezium. Fig. 4 illustrates the order approval and tracking interface available to the channel administrator.

The table 'Órdenes Pendientes' contains the following data:

ID	Cliente	Fecha	Acciones
000007	EMBOTELLADORA SAN MIGUEL DEL SUR S.A.C.	2025-06-27	Ver detalle
000008	EMBOTELLADORA SAN MIGUEL DEL SUR S.A.C.	2025-06-27	Ver detalle
000010	EMBOTELLADORA SAN MIGUEL DEL SUR S.A.C.	2025-06-27	Ver detalle
000012	EMBOTELLADORA SAN MIGUEL DEL SUR S.A.C.	2025-06-28	Ver detalle
000013	0000456	2025-06-27	Ver detalle
000014	EMBOTELLADORA SAN MIGUEL DEL SUR S.A.C.	2025-06-28	Ver detalle
000015	EMBOTELLADORA SAN MIGUEL DEL SUR S.A.C.	2025-06-28	Ver detalle
000019	EMBOTELLADORA SAN MIGUEL DEL SUR S.A.C.	2025-06-29	Ver detalle

Fig. 4. Control panel for request approval: The screen allows reviewing orders entered by the agencies, with approval or rejection options. (Source: Own elaboration)

6) *Advertising spot reports screen*: In this section, advertising agencies can visualize a detailed summary of their broadcast spots, showing key information such as the name of the spot, the program in which it was transmitted, the date and time of broadcast, as well as the number of times it has been played. Furthermore, to facilitate control and management, a button is included that allows downloading a report in PDF format with all this data, thus ensuring transparency and documentary support for the campaign. This functionality is designed to offer agencies quick and easy access to accurate information, promoting agile decision-making based on reliable data.

7) *System interface and relevant screens*: One of the most representative screens of the system is the one corresponding to the advertising request registration, which allows agencies to complete all the required fields to request the broadcast of their campaigns. This interface was designed under principles of simplicity and visual clarity, facilitating navigation and reducing the margin of error in data entry. Likewise, the administrative control panel screen is highlighted, where the channel can effectively manage the order flow, apply dynamic filters, and perform approval or rejection actions centrally.

8) *Final considerations*: The development of the system has followed guidelines of good practices in software architecture, use of modern technologies, and orientation towards the cloud. Integration with Microsoft Azure, along with the use of tools like Debezium for data synchronization, has allowed building a solid, reliable solution prepared to be used in real production environments. The use of Spring Boot, Thymeleaf, and Azure Database for PostgreSQL, as well as the

clear differentiation between user and administration modules, reinforce the fulfillment of the functional and non-functional objectives established at the beginning of the project. The system not only addresses the current needs of advertising management but also provides a robust basis for its continuous and sustainable operation.

Regarding deployment configuration, the application was hosted on Azure App Service using a Standard S1 tier instance. The build process was managed through Maven, and deployments were executed using Azure-provided CLI commands, enabling a controlled and semi-guided deployment process. The CDC Replicator runs as a standalone embedded Spring Boot application without container orchestration, as the current operational load does not require Kubernetes-level scaling. Secrets and credentials are managed through Azure Key Vault, ensuring that sensitive configuration data is never hardcoded in the application.

C. System Evaluation

To evaluate the system, pretest and posttest evaluations were used, meaning before the system implementation and after its implementation:

Advertising Order Entry Time: This is the average time it takes administrators to enter each order, which involves reviewing the information sent by the agencies and verifying it.

$$\text{Average time} = \frac{\text{Sum of order reports}}{\text{Total number of ordes}} \quad (1)$$

Reduction of Operational Inputs: This is the decrease in costs associated with advertising order management, considering personnel, telephone calls, and printouts.

$$\text{Operational cost} = \text{Personnel} + \text{Calls} + \text{Printouts} \quad (2)$$

1) *Questionnaire to evaluate agency satisfaction:* A survey consisting of five questions was applied to the agencies that used the system to evaluate different criteria of use and satisfaction. The questions are described in Table II.

TABLE II. QUESTIONNAIRE FOR ADVERTISING AGENCIES

No.	Criterion	Statement
P1	Registration	How easy was it for you to register an order in the system?
P2	Interface	How intuitive do you consider the system interface to be?
P3	Control	How do you evaluate the control you have over your entered orders?
P4	Recommendation	How likely are you to recommend the system to other advertising agencies?
P5	General Satisfaction	How satisfied are you with the overall user experience?

^aSource: Own Elaboration

2) *Expert validation questionnaire:* The system validation was carried out by expert judgment, with the participation of three specialists from the television and technology sectors. For this purpose, a structured questionnaire was applied with evaluation criteria such as functionality, reliability, efficiency,

usability, and security, in order to assess the general performance of the system. The results obtained from these evaluations are presented in the Results section. The questionnaire items are described in Table III.

TABLE III. EXPERT VALIDATION QUESTIONNAIRE

No.	Criterion	Statement
P1	Functionality	Does the system adequately fulfill the functions of registering, processing, and managing orders?
P2	Reliability	Does the system maintain operational stability during order execution?
P3	Efficiency	Is the observed response time satisfactory?
P4	Usability	Does the system interface favor a fluid and comprehensible interaction for users?
P5	Security	Do the access controls and role assignment guarantee secure and restricted use of information?

Source: Own Elaboration

D. System Test

For the validation of the system in a real environment, a pilot test was conducted in a television company located in the city of Chachapoyas, Amazonas region, Peru. This company specializes in the transmission of audiovisual content and the management of advertising spaces for regional audiences. The pilot test involved the active participation of 10 advertising agencies that maintain regular commercial contracts with the television company, providing a diversified sample to evaluate the system's adaptability to different users and operational needs. The testing process included the participation of 3 key specialists: The System Administrator, responsible for the supervision and approval of advertising orders; the owner of the television channel, who provided the strategic and commercial perspective of the business; and an external Consultant specializing in Information Technology, who participated in the technical evaluation of the system. The pilot test was executed for a full week, a period during which advertising orders were registered and processed under real operational conditions, allowing the evaluation of both the system's technical performance and its impact on the company's administrative and commercial processes.

V. RESULTS

The results of the system tests are:

A. Advertising Order Entry Time

The analysis of advertising order entry time revealed substantial improvements in operational efficiency after the implementation of the digitized system. In the traditional manual process, order entry required the direct intervention of the sales administration area, which had to manually transcribe the information provided by the advertising agencies. The collected data showed that the average time required for manual entry of an advertising order was 17 minutes 16 seconds, with a total time of 2 hours 52 minutes 38 seconds to process 10 representative orders. As shown in Table IV.

TABLE IV. COMPARISON OF ADVERTISING ORDER ENTRY TIMES

Order	Before (mm:ss)	After (mm:ss)
1	20:15	2:05
2	17:32	2:01
3	15:47	1:59
4	15:21	2:03
5	19:05	1:58
6	17:18	2:00
7	16:44	2:02
8	17:09	2:04
9	17:51	1:57
10	15:36	2:00
Total	2:52:38	20:09
Average	17:16	2:01

Source: Own Elaboration

The implementation of the digitized system fundamentally transformed this process by allowing advertising agencies to directly enter their orders into the system, completely eliminating the manual transcription phase. This structural modification resulted in a dramatic reduction in processing time, establishing a new average of 2 minutes 1 second per order, with a total time of 20 minutes 9 seconds for the same set of orders. The comparative analysis reveals a reduction of 88.33% in the average processing time. To obtain this value, the average times were converted to seconds: before implementation, 17 min 16 s = 1036 s, and after, 2 min 1 s = 121 s. Applying the formula:

$$Reduction(\%) = \frac{1036-121}{1036} \times 100 = 88.33 \quad (3)$$

Demonstrates the significant decrease in advertising order entry time.

The implications of this improvement transcend the purely operational scope, as the reduction in processing time translates into an optimization of human resources and allows the reallocation of personnel to activities with greater added value. Additionally, the elimination of the manual transcription process substantially reduces the probability of human errors, improving the quality and accuracy of the data entered into the system, while direct entry by agencies strengthens their autonomy and improves the service experience.

B. Reduction of Operational Inputs

The evaluation of the reduction of operational inputs analyzes the decrease in costs associated with advertising order management, specifically considering administrative personnel, telephone calls, and printouts for the processing of 10 representative orders. In the traditional system, advertising agencies sent their order information via email, and the sales area printed these documents to facilitate the manual transcription of the data into the company's internal system. Additionally, the process required multiple telephone calls for verification and confirmation with advertising agencies, and maintaining administrative personnel dedicated exclusively to the transcription and control of the 10 orders.

- Administrative personnel: 2 people → US\$31.67

- Telephone calls: 15 calls → US\$3.00
- Printouts and ink: US\$ 0.30

With the implementation of the digitized system, advertising agencies directly enter their orders into the system, eliminating the need to print emails for transcription and significantly reducing telephone calls to exceptional cases only. The operating costs for the same number of orders were reduced to:

- Administrative personnel: 1 person → US\$15.83
- Telephone calls: 2 calls → US\$ 0.10
- Printouts and ink: US\$ 0.00

The total costs before and after digitalization were US\$34.97 and US\$15.93, respectively. The percentage reduction is obtained using the formula:

$$Reduction(\%) = \frac{34.97-15.93}{34.97} \times 100 = 54.5\% \quad (4)$$

This transformation reflects a reduction of 54.5% in operating costs (a saving of US\$19.04 for every 10 orders processed), representing a significant optimization in the use of operational inputs and contributing both to economic efficiency and the better use of human and material resources in the advertising order management process.

C. Reduction of Transcription Errors

The evaluation of transcription errors constitutes a critical indicator of the quality and reliability of the advertising order entry process. In the traditional system, advertising agencies submitted their order information via email in various digital formats. Subsequently, the sales area printed these documents and manually transcribed the data into the television company's internal system. This sequential process introduced multiple points of failure, generating 60% of errors out of the total analyzed records, caused by typographical errors during data entry. The implementation of the web system eliminated this workflow by granting advertising companies direct access to the registration of advertising order requests. This transformation allows agencies to enter their requests directly into the corporate system, eliminating the intermediate phases that were the main generators of errors. The system incorporates automatic validation mechanisms, fields with predefined formats, and real-time verifications that ensure data integrity from the moment of initial capture. The results obtained show a 100% reduction in transcription errors, reaching 0% of incidents in the digitized process. This improvement represents not only an optimization in data accuracy but also the complete elimination of operating costs associated with corrections, subsequent verifications, and rework that previously demanded considerable administrative resources. The elimination of transcription errors strengthens the reliability of the corporate information system and allows sales personnel to focus on commercial and management activities of greater strategic value for the organization.

D. Automated Report Generation

The process of report generation and delivery experienced a significant transformation with the implementation of the digitized system. In the traditional model, transmission reports were automatically generated through batch processes

approximately between 12:00 and 1:00 AM, but their distribution to advertising agencies required constant manual intervention by the sales administration area during subsequent business hours. This process involved individual searches, manual compilation of information, and personalized sending for each agency and its respective clients, generating considerable delays. The digitalization of the system introduced an automated access mechanism that eliminates the manual management phase in report delivery. The reports continue to be generated automatically through the established batch process with the previous day's information, integrating directly into the web system, where advertising agencies can access the reports without requiring requests to administrative personnel. This automation not only accelerates the consultation process but also allows access to complementary information relevant to the agencies' commercial management. The results show a substantial improvement in process efficiency, significantly reducing the time elapsed between report generation and their availability for consultation by advertising agencies.

E. Questionnaire Results

The qualitative evaluation using a Likert scale reflected a positive assessment by advertising agencies, although with aspects that show opportunities for improvement. The results showed averages of 3.5 in ease of order registration, which indicates that, as a new system, it still requires a period of adaptation by users. In contrast, the intuitiveness of the interface obtained 4.1, highlighting the good perception of the design and ease of navigation. Control over entered orders reached an average of 3.9, showing confidence in the tracking of requests. Likewise, the recommendation of the system to other agencies registered a score of 4.0, which reflects favorable acceptance. Finally, general satisfaction with the user experience reached 3.5, which suggests an overall positive experience, although with a margin for improvement in the initial learning curve, as shown in Table V.

TABLE V. RESULTS OF THE ADVERTISING AGENCIES QUESTIONNAIRE

Agency	P1	P2	P3	P4	P5
A1	4	5	4	5	4
A2	3	4	4	4	4
A3	5	5	5	5	5
A4	4	4	3	4	4
A5	3	4	4	3	3
A6	3	4	4	4	3
A7	4	3	4	4	3
A8	3	4	4	4	3
A9	3	4	3	4	3
A10	3	4	4	3	3
Average	3.5	4.1	3.9	4.0	3.5

Source: Own Elaboration

The three participating experts—the system administrator, the channel owner, and an external IT consultant—positively evaluated the established criteria for the validation of the developed system, as observed in Table VI. The analysis of the results shows that system efficiency obtained the highest rating with an average of 4.3, highlighting the significant improvement

in processing times and the optimization of operational resources. The reliability and security of the system reached averages of 4.0 each, showing confidence in the stability and data protection of the implemented platform. System functionality registered an average of 3.7, indicating a favorable evaluation, while usability obtained 3.3, identifying opportunities for improvement in the user experience that require attention to optimize system adoption.

TABLE VI. RESULTS OF THE EXPERT JUDGMENT QUESTIONNAIRE

Criteria	E1	E2	E3	Average
Functionality	4	3	4	3.7
Reliability	4	3	5	4
Efficiency	5	4	4	4.3
Usability	3	3	4	3.3
Security	4	3	5	4

Source: Own Elaboration

VI. DISCUSSION

Before the implementation of the digitized system, the manual registration of 10 advertising orders presented a transcription error rate of 60%, attributable to the human data entry process. After enabling direct entry by agencies in the automated system, this rate was reduced to 0%, completely eliminating transcription errors thanks to automatic validation and real-time control mechanisms. This improvement is consistent with the findings of [5], which highlights the importance of implementing web platforms with modular architectures to automate processes, reduce human errors associated with manual methods, and improve accuracy in the registration of business data.

Regarding temporal efficiency, the 88.33% reduction in order entry time (from 17:16 to 2:01 minutes per order) demonstrates a substantial operational improvement. This result is comparable to the findings of [8], where process automation through web systems achieved a usability score of 89%, showing that digitalization significantly improves operational efficiency in personalized services. Similarly, automation in report delivery eliminated manual management, allowing agencies direct access to their campaign information. These results are consistent with [7], which demonstrated that processes with greater structural modularity provide significant advantages in terms of operational efficiency, achieving reductions of 51% in manufacturing times.

Furthermore, the results obtained are aligned with [9], which highlights the importance of integrating technological solutions in television advertising to improve the analysis and management of campaigns. While [9] focuses on measuring the impact of television advertising on digital user behavior, the present study complements this approach by optimizing the operational management of advertising orders, contributing to a more efficient and integrated advertising workflow.

On the other hand, the 54.5% reduction in operating costs (a saving of US\$19.04 for every 10 orders) shows comparable improvements with [10], where a 28.4% reduction in operating costs was achieved through modular artificial intelligence

systems. However, the developed proposal achieved resource optimization by eliminating printouts, reducing telephone calls, and optimizing administrative personnel without requiring complex artificial intelligence technologies, which represents an advantage in terms of simplicity of implementation and development costs. Additionally, the implemented workflow transformation is consistent with the findings of [6], which highlight the importance of cloud computing for improving the operational efficiency and scalability of small and medium-sized enterprises. The implemented solution uses Azure cloud infrastructure and eliminates manual intervention in the entry process, establishing an automated flow from registration to report generation. This cloud-based architecture facilitates the operational scalability necessary to support growth in the television advertising sector, allowing adaptation to variable demand volumes without requiring significant investments in physical infrastructure.

Despite the positive results obtained, the study presents important limitations. The pilot test was conducted with 10 advertising orders, consistent with the company's daily operational volume, estimated at approximately 34 orders per day based on pre-implementation processing times. However, this does not allow for definitive conclusions regarding system performance under significantly higher transaction volumes. No fault-injection experiments were conducted to formally evaluate system resilience under simulated failure scenarios such as network disruptions or service unavailability. Additionally, the evaluation period was limited to one week, and seasonal variability in advertising demand was not considered, which could reveal operational characteristics not detected during controlled testing.

From a long-term maintainability perspective, the architecture supports gradual evolution toward CI/CD pipelines and containerized environments as demand grows, balancing current simplicity with future scalability while minimizing unnecessary technical debt. Daily automated backups on Azure Storage and biweekly preventive maintenance cycles further support system continuity.

VII. CONCLUSION

The developed system effectively solves the problem of manual advertising order management that the company faced, characterized by transcription errors, excessive processing times, and dependence on manual management at multiple stages of the operational process. The implementation of the automated web platform eliminated manual, error-prone processes and established a structured workflow that guarantees the integrity and tracking of orders from their creation to their final processing.

The results obtained demonstrate the significant effectiveness of the implemented solution. Transcription errors were eliminated, reducing incidents from 60% to 0% through direct entry by advertising agencies. The automation of the flow allowed for an 88.33% reduction in order entry time, decreasing from 17 minutes 16 seconds to 2 minutes 1 second per order, while the optimization of operational inputs generated a saving of 54.5% in associated costs. Additionally, the automation in report generation eliminated the dependence on manual

management, allowing direct access for agencies to the information about their advertising campaigns.

The web application based on cloud computing provides the necessary scalability and availability to support the future growth of operations, establishing a solid technological base for the expansion of functionalities in the television sector. The implemented modular architecture facilitates the incorporation of new functionalities and the adaptation to different business contexts in the advertising sector.

In summary, the developed model transforms advertising order management from an inefficient and error-prone manual process toward an automated, precise, and scalable operation, fulfilling the objectives set and establishing the bases for future operational improvements in the television advertising sector.

While the solution was validated within the specific context of a regional television company, the modular architecture and cloud-based approach are potentially transferable to other media and advertising sectors, including radio broadcasting, digital media platforms, and event management companies, provided that their operational workflows involve order registration, approval processes, and automated reporting requirements.

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ETHICAL APPROVAL

The study focused on the technical validation and evaluation of the operational efficiency of a web application for advertising order management. The pilot test was conducted with the voluntary participation of external advertising agencies and internal staff of the television company. The process utilized operational and simulated data, and no sensitive, clinical, or confidential personal information from the individual participants was collected; only data strictly related to system performance (processing times, transcription errors). Since the research did not involve the collection of identifiable personal data or expose participants to risks, formal ethical approval was not required. However, the entire investigation adhered to the general ethical principles of transparency, confidentiality of the agencies' commercial information, and the respectful treatment of all participants.

INFORMED CONSENT

Before the pilot test began, the 10 participating advertising agencies and administrative staff were informed about the study's objective: to evaluate improvements in the efficiency of advertising order management. They were provided a clear explanation regarding the system's use, the nature of the data to be recorded (advertising orders and time metrics), and the anonymity of the qualitative responses (satisfaction surveys) was guaranteed. Consent to participate in the usability and performance test was granted voluntarily by each agency and specialist, with the understanding that their participation did not involve risk and that they could withdraw from the study at any time.

DISCLOSURE STATEMENT

The authors report there are no competing interests to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in the Open Science Framework (OSF) at: <https://doi.org/10.17605/OSF.IO/7CXJB>.

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