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Development of a Corporate Extranet as an Integral Management tool in an Agroindustrial SME: the Case of Agronasaja S.R.L.

Sanguinetti, J. [2]; Pena de Ladaga, S. [1]; Marra, R. [1]; Kurincic [1]
[1],*Professors Cátedra de Administración Rural – Facultad de Agronomía – UBA*
[2],*CEO Agronasaja SRL.*

Abstract: *Agricultural input supply chains process a massive volume of two-way information daily, which is often duplicated or triplicated. Added to the flow of quotes, delivery notes, receipts, invoices, and debit or credit notes are the requirements of tax authorities (ARCA) and regulatory bodies (SENASA, RENSPA). The need for ongoing communication with external suppliers and the demands of clients complicate business management to a high degree. Efficient information management is a critical business factor. Organizations often turn to rigid software systems that lack adaptability to different operational scenarios. This forces the integration of multiple platforms, where each additional software package represents an added cost. Aware of this challenge, and in his role as co-owner of Agronasaja S.R.L., the lead author of this paper implemented the use of Artificial Intelligence (AI) to transform these data into a strategic resource for decision-making. The methodological approach used ensures regulatory compliance and efficiently connects the company with suppliers of commercialized inputs not produced in-house. This case study does not claim to offer a one-size-fits-all solution for all small and medium-sized enterprises (SMEs), but it demonstrates the feasibility of building a corporate intranet using a structured methodology, achieving a solid final product with low maintenance costs.*

Keywords: Corporate management, agricultural inputs, Artificial Intelligence, corporate extranet, SMEs.

I. INTRODUCTION

The Argentine agroindustrial sector has been undergoing a process of sustained productive transformation for almost three decades, associated with the adoption of management technologies, genetics, biotechnology, and machinery. Bragachini et al. (2014) outline three stages in this process:

The Early Years (1995–2000): The collection of georeferenced data begins with the first yield monitors on combine harvesters and the use of satellite guidance systems (GPS) on tractors, led by INTA Manfredi.

Agro 4.0 and Connectivity (2005–2015): The use of satellite imagery and management software for cost and inventory control becomes widespread, alongside the consolidation of site-specific crop management (Ministerio de Agricultura, 2011).

The AgTech Boom (2016–Present): A period of technological explosion characterized by the integration of artificial intelligence, agricultural drones (growing from a few dozen to thousands of operational units), soil sensors, and the Internet of Things (IoT) to achieve traceability and efficiency (Sensacultivos, 2024).

Argentina's AgTech ecosystem appears to be one of the most dynamic in Latin America, integrating dozens of companies and startups that digitize everything from crop yields to access to agricultural credit. However, the digitization of business management and administrative processes is advancing at a slower, more uneven pace, particularly within the SME segment (Quinteros, 2026; Infocampo, 2026)—a trend that seems to extend across Latin America (CEPAL-FAO, 2021). It appears that digital transformation reaches productive processes first and administrative and managerial processes later, where information accumulates without proper classification for effective management (Quinteros, 2026; Gonzalez, 2025). Rural connectivity, which used to be an infrastructure constraint in the region conditioning the digitization of businesses in the agricultural interior (IICA-BID-Microsoft, 2020), seems to be changing following the arrival of Starlink in the country in 2022 (Gatti, 2025; Loustalot, 2026; Stok, 2026; D'Annunzio, 2026). This disparity creates an opportunity for improvement with a direct impact on business productivity and economic sustainability: organizing, integrating, and digitizing the daily flow of information in an agroindustrial organization through the use of Artificial Intelligence (AI).

In their systematic review of management system adoption in agricultural firms, Giua et al. (2021) identify recurring barriers: scale, financial availability, digital competencies, and trust in data management.

This paper describes the diagnosis, design, development, and implementation of a proprietary corporate extranet[1] for an-SME dedicated to seed production and commercialization, agricultural input distribution, and field production through joint farming ventures. The intervention is conceived as an organizational redesign process based on the alignment of people, processes, and technology (Laudon & Laudon, 2020).

[1] *For reader's convenience, a "glossary" of the terms used has been included.*of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

II. MATERIALS AND METHODS

The Case Study: A case study was conducted at a real company (Agronasaja S.R.L.), leading to the implementation of a corporate extranet designed to centralize commercial, operational, administrative, and human resources management processes. The outcomes were evaluated in terms of adoption rates, quality of available information for managerial decision-making, and user/client satisfaction.

In early 2022, improvement initiatives were launched. Initially, centralized dataentry procedures were introduced using shared spreadsheets for line managers, access credentials to external extranets were organized in protected SharePoint files, and uniform guidelines were established for using corporate WhatsApp for document transmission. This partially reduced information dispersion and addressed structural fragmentation; however, each business line continued operating under its own logic, requiring manual consolidation of managerial information at every financial close. Since Agronasaja S.R.L. (like many SMEs) requires centralized, real-time, and traceable operational, commercial, and administrative information, these measures were insufficient to sustain growth and streamline management across its three business lines—a situation that significantly increased administrative overhead and maintained dependency on external software providers.

Methodology: The development process combined elements from three complementary approaches: organizational case study methodology (Yin, 2018), user-centered design (Norman, 2013), and agile software development practices (Sutherland, 2014). This selection was purposeful: it represents a professional intervention within an operating organization where the system built must be used by real people with specific workloads and where software development must match the pace of the business.

The intervention was organized into five partially overlapping phases.

Phase 1: Diagnosis and Data Collection: Conducted during the first two months, combining three complementary techniques. First, semi-structured interviews were held with key stakeholders: General Manager, heads of the three business lines, operations coordinator, and administrative leaders. The interview script (Sanguinetti, 2026) followed Yin's (2018) case study framework, complemented by information flow questions derived from process analysis literature (Hammer & Champy, 2003). Interviews were recorded with consent (managed using Fireflies). Second, participant observation of workflows was carried out, leveraging the author's dual role as system developer and member of the operational team. Third, an exhaustive documentary review was performed, analyzing spreadsheets, shared SharePoint files, email archives, WhatsApp threads, and third-party extranet configurations to unambiguously map what information flows, through which channels, and who inputs or consumes it. Findings were systematized into three deliverables: (a) process maps in BPMN (Business Process Model and Notation) for six critical workflows identified, (b) an inventory of existing software and spreadsheets, and (c) a gap matrix classified by severity and business line.

Phase 2: Functional and Technical Design: Modules were prioritized using a simple impact (potential impact on operations) versus effort (technical complexity) matrix, applying the Minimum Viable Product (MVP) framework extended to enterprise management (Ries, 2011). User experience design utilized low-fidelity prototypes (paper wireframes and Figma), validated in brief sessions with each line manager. This early validation allowed discarding two initial designs that, while logical, did not align with how managers mentally organized daily operations—a recurring risk in top-down software projects imposed on operational teams (Norman, 2013). Concurrently, the technical architecture was defined. Options evaluated included: (i) a mid-tier commercial ERP, (ii) a low-code solution, or (iii) a custom web development built on modern technologies. The third option was chosen for three reasons: first, recurring ERP licensing costs exceeded the financial structure of the project; second, low-code solutions inspected lacked native integration capabilities with Argentine agricultural supplier extranets; third, a custom build grants the firm ownership of the asset, allowing it to evolve with the business. In return, the firm assumed responsibility for maintaining the production system, a risk mitigated by selecting widely adopted technologies and modular code. The technical stack selected comprises: web

application on Next.js 14 with React 18 and TypeScript; PostgreSQL database managed via Prisma ORM; authentication via NextAuth and bcrypt; user interface with Tailwind CSS and lucide-react icons; transactional email via Resend; browser push notifications via web-push; spreadsheet generation via exceljs and PDF generation via pdfkit; data validation via Zod; and cloud deployment on Azure with scheduled cron jobs. Integrated use of Anthropic's official SDK (@anthropic-ai/sdk) enables targeted conversational assistants within the platform—a decision implemented cautiously with human audit of assisted operations, aligning with emerging recommendations on responsible generative AI use in enterprise environments (Birhane et al., 2024).

Phase 3: Iterative Development: Development was organized in two-week sprints with end-of-sprint demos for General Management and line managers (based on scope). This rhythm was sustained over six months. Each sprint followed standard practices: planning with defined goals and prioritized backlog, lightweight daily check-ins (via morning messages rather than meetings), sprint reviews, and brief retrospectives. Sprint deliverables were versioned in a private Git repository (Sanguine86/Agronasaja S.R.L. (extranet on GitHub) with continuous integration enforcing type checks, linting, and automated testing prior to production deployments. Integration with third-party systems was implemented as authenticated scripts running on scheduled cron jobs: the product catalog synchronizes every two hours to maintain an updated WhatsApp Business catalog; customer data synchronizes daily at start-of-day to reflect legacy system updates; and balance/account operations with grain merchants and suppliers are queried on-demand via specific endpoints.

Phase 4: Deployment and Training: Production rollout occurred in stages. The Human Resources module—restricted internally to General Management and the author—was stabilized first to validate roles and permission architecture before opening the platform to broader audiences. The extranet pilot was subsequently deployed on this foundation. Concise user manuals (2 to 4 pages per module) were authored, and one-hour role-specific training workshops were conducted with line managers. Selecting brief, role-specific sessions over lengthy general training aligns with change management literature, which highlights that users adopt new technologies faster when immediate task utility is demonstrated (Kotter, 2012). During transition, the legacy system coexisted with the new platform under an explicit schedule for progressive feature retirement. Known as the "strangler pattern" in software literature (Fowler, 2004, 2018), this strategy mitigates operational disruption risks.

Phase 5: Evaluation: The evaluation was designed to be concise, feasible, and practical rather than a controlled experiment (which is unfeasible in an organizational intervention of this scope). It relied on actionable indicators—system usage logs, availability of management reports, and satisfaction surveys—to assess impact. Indicators were grouped into three dimensions: Information Quality (number of management reports generated without manual intervention and qualitative response time to internal queries); Adoption (active users per module derived from system logs, both internal and external); and Satisfaction (a brief survey using a 5-point Likert scale [1932] to convert qualitative feedback into structured data for technological acceptance analysis). The survey was administered at project close to all active internal users and, in a condensed format, to regular external clients (details in Sanguinetti, 2026). Impact on operational times was assessed qualitatively through interviews and surveys, leaving quantitative measurement for future research. The Phase 1 diagnostic served as a qualitative baseline: process maps, system inventory, and gap matrices documented the starting state. Adoption metrics and satisfaction surveys were administered three months post-deployment to allow for initial adaptation**.**

III. DISCUSSION

The discussion is organized around five core questions structuring the critical analysis of the intervention:

1. **Were the objectives achieved**? Overall, yes. The corporate extranet was designed, developed, implemented, and is currently in production. However, functional coverage is not yet uniform: the extranet was deployed as a pilot and partially replaces the legacy system, meaning both systems coexist for now. This was a deliberate choice to minimize operational continuity risks; full retirement of the legacy system is planned for a subsequent stage.

2. **What were the main success factors?** Three factors were decisive. First, the dual role of the author as General Manager and founding partner (active since 2007) combined with sustained sponsorship from the Commercial Director, who validated functional decisions during sprints and protected project priority against daily operational urgencies. Change management literature widely agrees that executive sponsorship is a necessary—though not sufficient—condition for such interventions (Kotter, 2012). Second, tailoring the solution to real workflows avoided a common pitfall in enterprise software: divergence between prescribed procedures and

actual practices (Argyris, 1990). Third, selecting a mature technological stack with broad community support minimized unexpected technical hurdles.

3. **What difficulties arose and how were they resolved?** The primary challenge was integrating third-party extranets. Each supplier maintains distinct interfaces, authentication rules, and, in some cases, lacks clearly documented APIs. This heterogeneity required building custom adapters for each integration and accepting manual workflows for certain features until robust technical routes were established. A second challenge related to user adoption: even well-designed modules require time for users to incorporate into daily routines. Short role-based training, concise manuals, and temporary coexistence with the legacy system—practices aligned with technology acceptance literature (Davis, 1989; Venkatesh & Davis, 2000)—supported this process. Survey findings were consistent with this dynamic: weaker internal ratings (for troubleshooting support and training) and client preference for direct personal channels indicate that full adoption extends beyond the timeframe of this project.

4. **How transferable are these results?** Transferability must be interpreted cautiously. The specific technology stack, module prioritization, and third-party integrations are tailored to Agronasaja S.R.L. However, the underlying methodological principles are highly transferable: conducting thorough diagnostics before selecting tools, prioritizing modules by operational impact, validating designs with real users, deploying in phases, evaluating with predetermined metrics, and maintaining executive sponsorship. While these principles are established in the literature, their execution in an Argentine agroindustrial SME under real sector constraints provides actionable value beyond generic frameworks.

5. **What are the limitations of this work?** Two main limitations should be noted. First, the evaluation did not include systematic quantitative time-and-motion studies prior to and after implementation; assessment tools (logs and surveys) were developed alongside the intervention, lacked external validation, and carry potential participant-author bias. Second, the 12-month timeframe is insufficient to measure medium-term effects, such as trained staff retention, maintenance effort sustainability, or long-term total cost of ownership (TCO). Future follow-up studies, ideally in collaboration with the Rural Management Department, should quantify impacts on operational times and track organizational evolution over a two-to-three-year period.

IV. GLOSSARY OF TECHNICAL TERMS

A glossary of technical terms used throughout the paper is provided for readers unfamiliar with information systems terminology.

- **AgTech:** Abbreviation for *agriculture technology*; refers to the ecosystem of companies and technological solutions targeting the agricultural sector.
- **API / Endpoint**: Application Programming Interface; an access point through which a system exposes information or services for automated consumption by another system.
- **bcrypt**: Standard encryption algorithm used to securely and irreversibly store user passwords.
- **BPMN:** Business Process Model and Notation; standard graphical notation used to model business processes and information flows.
- **Cron job**: Scheduled automated task that runs at specified intervals without human intervention (e.g., daily customer data sync at 06:00 AM).
- **CRM**: Customer Relationship Management; software features that record, manage, and track commercial relationships with clients.
- **exceljs / pdfkit**: Software libraries used to programmatically generate Excel spreadsheets and PDF documents from the server.
- **Extranet**: Controlled extension of an internal system to authorized external stakeholders (suppliers, buyers, clients) using role-based permissions.

- **Figma**: Online interface design tool used to draft and validate user interface wireframes prior to software development.
- **Fireflies**: Automated meeting recording and transcription service used to document diagnostic interviews.
- **Git / GitHub:** Distributed version control system and cloud platform hosting code repositories, enabling complete tracking of code changes.
- **Continuous Integration (CI):** Development practice where code updates are automatically built and verified (type checks, linting, tests) before deployment.
- **Intranet**: Restricted-access internal network or platform designed for internal organizational management and information sharing.
- **IoT**: Internet of Things; network of physical objects embedded with sensors and connectivity to gather and exchange data (e.g., soil sensors).
- **Finnegans**: Legacy accounting/ERP software system partially used by the firm prior to intervention, mainly for settlements and bank reconciliations.
- **Low-code**: Platforms enabling rapid application development with minimal manual coding, traded off against reduced flexibility for custom integrations.
- **Next.js / React / TypeScript**: Core web technologies used to build the platform: a web application framework (Next.js), a UI component library (React), and a strongly-typed programming language (TypeScript).
- **NextAuth**: User authentication and session management library integrated directly with the application database.
- **ORM Prisma:** Object-Relational Mapping tool translating application code to database queries, simplifying migrations and data handling.
- **PostgreSQL**: Open-source, relational database management system storing the core application data.
- **Minimum Viable Product (MVP):** Early version of a product containing core features necessary to deliver value and gather validated learning for iterative development.
- **Resend**: Transactional email delivery service used for automated system emails (e.g., password reset requests).
- **SDK**: Software Development Kit; set of tools provided by third parties to integrate services (in this work, the Anthropic SDK for AI assistants).
- **Serverless**: Cloud execution model where cloud providers automatically manage server provisioning and infrastructure scaling based on demand.
- **SharePoint**: Microsoft 365 document management platform used by the firm to store shared spreadsheets and files.
- **ERP**: Enterprise Resource Planning system; integrated software suite centralizing business processes (finance, operations, sales) on a shared database.
- **Proprietary System / Custom Development**: Software whose code and intellectual property belong to the organization, as opposed to licensed third-party commercial software.
- **Sprint (Scrum):** Short, iterative development cycle (two weeks in this project) with clear targets set at planning and reviewed at close.

- **Tech Stack**: Set of technologies (frameworks, programming languages, databases, cloud services) powering an application.
- **Strangler Pattern / Strangler Fig Application**: Legacy system migration strategy introduced by Martin Fowler (2004) to incrementally replace a legacy system by building a new system around it piece by piece until complete retirement.
- **Tailwind CSS / lucide-react**: Visual interface design tools: a utility-first CSS framework (Tailwind) and an icon library (lucide-react).
- **Azure**: Microsoft cloud computing platform hosting and running the application with automated continuous deployments.
- **Web-push**: Browser notification standard enabling messages to reach users even when the application tab is closed.
- **WhatsApp Business**: Business-oriented version of WhatsApp used for customer interactions; synchronized with the system product catalog every two hours.
- **Zod**: TypeScript-first schema declaration and validation library enforcing incoming data formats and rules.

diagrams and lettering MUST be either computer-drafted or drawn using India ink.

Figure captions appear below the figure, are flush left, and are in lower case letters. When referring to a figure in the body of the text, the abbreviation "Fig." is used. Figures should be numbered in the order they appear in the text.

Table captions appear centered above the table in upper and lower case letters. When referring to a table in the text, no abbreviation is used and "Table" is capitalized.

V. CONCLUSION

This intervention demonstrates that an-SME in the agricultural sector—with the scale, business lines, and economic constraints of Agronasaja S.R.L.—can successfully build and deploy a proprietary corporate extranet without relying on third-party vendors or recurring high-cost licenses. Key prerequisites include a committed implementation team, clear executive sponsorship, and a structured methodology combining rigorous diagnostics, user-centered design, and iterative development. The resulting platform represents an in-house digital asset aligned with real operations, capable of evolving at the pace of the business.

Three practical recommendations emerge for other sector SMEs:

1. Invest significant time in diagnostics before selecting technology, as most project failures stem from solutions misaligned with actual processes.
2. Prioritize modules by operational impact and deploy iteratively to avoid high-risk, all-at-once replacements.
3. Sustain executive sponsorship and methodological discipline throughout the project, even under daily operational pressures.

Future extensions of this case study include: full retirement of the legacy system to consolidate all commercial operations onto the extranet; medium-term evaluation of the intervention's impact on company profitability and professionalization; and further exploration of generative AI models to assist specific operational tasks—an initiative initiated in this study through the Anthropic SDK that warrants its own dedicated methodological research.

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