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Agile Methodologies in the Implementation of Software for the Development of Pallet Racking in a Metalworking Industry

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Abstact
This study analyzes the implementation of software designed to automate pallet-rack project development within a metalworking company, integrating agile methodologies with structured project management practices. The initiative is organized into four sequential phases—automated floor plan generation, technical views, bill of materials, and 3D modeling—supported by iterative deliveries and continuous validation. The research outlines the project scope, stakeholder mapping, resources, risks, quality plan, and financial structure, emphasizing how agile practices enhance transparency, adaptability, and operational efficiency. Expected outcomes include a significant reduction in project lead time, elimination of manual quantitative errors, improvement in design standardization, and increased productivity across engineering and production workflows. The project contributes to the company's broader digital transformation strategy by strengthening technical reliability and enabling scalable process automation.
Keywords: *Agile methodologies; Project automation; Pallet racking.*

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I. INTRODUCTION

In a scenario of constant technological advancements, project management has become a fundamental principle for companies seeking efficiency, quality, and competitive advantage. The use of agile methodologies and specific software has been applied in different areas to optimize processes, minimize costs, and guarantee effective results.Recent studies show that automation initiatives in engineering design significantly reduce operational costs and increase process accuracy, aligning with global Industry 4.0 practices. The use of agile methodologies and specific software has been applied in different areas to optimize processes, minimize costs, and guarantee effective results.[1-3].

According to the Project Management Body of Knowledge (PMBOK)[4], project management involves the application of knowledge, skills, tools, and techniques to project activities in order to meet its needs. This definition is fundamental in structuring management practices in areas such as scope, time, costs, quality, risks, communications, procurement, and stakeholders. Furthermore, it considers processes that occur throughout the entire project lifecycle, which includes initiation, planning, execution, monitoring, and closure. Thus, project management, according to PMBOK [4], functions as an integrated system of best practices aimed at transforming ideas into concrete and valuable results, minimizing uncertainties, improving resources, and increasing the chances of success for ventures.

In this context, this work addresses the implementation of software for the development of pallet racking projects in a metalworking company. The central objective is to analyze how the application of project management, associated with agile methodologies, contributes to structuring and monitoring the development stages of the tool, generating productivity gains, error reduction, and greater standardization in technical projects. The software will be applied at *BR7 Sistemas de Armazenagem,* a company founded in 2011 in the city of Ponta Grossa, Paraná, in Brazil, characterized as a micro-enterprise specializing in the manufacture of metal structures, with emphasis on pallet racking and storage systems.

The software development allows pallet rack models to be pre-registered and, based on the application of measurements and quantities, automatically generates four deliverables that were divided into four phases:

• Phase 01: Floor plan design;
• Phase 02: Project views design;
• Phase 03: List of materials needed for production and assembly;
• Phase 04: 3D model design.

The phased structure of the project reflects principles of DFMA (Design for Manufacture and Assembly), which emphasize integration between design and manufacturing to reduce errors and increase standardization [5].

The project began on April 8, 2025, with the first phase scheduled to end on September 30 of the same year. The initial investment for Phase 01 was R$ 4,500.00, including labor, software, and training. Subsequent phases are expected to maintain similar values.

The relevance of this project is justified by the need to overcome an existing gap: the manual preparation of projects has demanded a lot of execution time, generating inconsistencies and difficulty in standardization. The automation of processes in the design phase can provide greater speed, accuracy, and reliability. Knowing this, we can highlight the main objectives:
• Reduce project development time by 40% to 50%;
• Eliminate errors resulting from manual quantity take-offs;
• Increase the standardization of drawings and bills of materials;
• Integrate agile methodologies into project monitoring.

II. METHODOLOGY

The methodology adopted in this study was structured as an applied project management approach designed to plan, monitor, and validate the implementation of the software for automating pallet-rack design. The process began with the development of the **Project Charter** (Item 2), which outlined the project's objectives, preliminary scope, schedule, deliverables, team structure, budget, and initial risks. Subsequently, a **Stakeholder Mapping** exercise was conducted (Item 3), identifying key actors and assessing their respective levels of influence and interest. Based on these definitions, the **Scope Statement** (Item 4) was established, detailing the project boundaries, assumptions, and constraints. The next stage involved defining the **Project Resources** (Item 5), encompassing material, human, and financial resources required for system development. This was followed by the formulation of a **Supplier Management Plan** (Item 6), specifying responsibilities, development stages, and validation criteria for the software provider. The study then outlined the **Investment Structure** (Item 7), organized into phased expenditures aligned with the project's progression. In addition, a comprehensive **Risk Management** process (Item 8) was implemented to identify, analyze, and mitigate potential project threats. To ensure continuous alignment among stakeholders, a **Communication Plan** (Item 9) was defined, covering communication channels, frequency, and responsible parties. Lastly, a **Quality Plan** (Item 10) was developed to establish technical standards, performance criteria, and testing procedures to be applied throughout all development phases. Collectively, this methodological sequence provided systematic guidance, ensured adequate control mechanisms, and enhanced the traceability of decisions throughout the software implementation process.

2.1 PROJECT CHARTER

2.1.1 GENERAL OBJECTIVE

The purpose of this project is to automate the creation of pallet rack designs, providing greater productivity, reducing errors, and standardizing certain processes. This initiative seeks not only to expedite project development but also to establish a reliable technical basis to support the production and marketing areas of the structure.

2.1.2. SPECIFIC OBJECTIVES

The defined objectives are measurable and geared towards concrete results, such as a significant reduction in project development time, project standardization, and the automatic and reliable generation of bills of materials. However, some risks have been identified that may cause interference and should be monitored during project execution. These include resistance to change from employees, possible technical failures in software development, and difficulties in integrating with existing systems in the metalworking company.

2.1.3. SCHEDULE

The overall project schedule began on April 8, 2025, with the completion of the first phase on September 30, 2025. Phase 2 is scheduled for November 2025, phase 3 for January 2026, and phase 4 for March 2026.

Table 1 - Delivery Schedule

PHASE	apr/25	may/25	jun/25	jul/25	aug/25	sep/25	oct/25	nov/25	dcz/25	jan/26	feb/26	mar/26
01												
02												
03												
04												

2.1.4. DELIVERABLES

Among the main deliverables of the project, we can highlight:

• the creation of an automated floor plan,
• the availability of front and side views,
• the automatic generation of material lists, and
• the creation of three-dimensional (3D) models of the pallet racking designs.

2.1.5. PROJECT TEAM

The project will be conducted through bi-weekly follow-up meetings, with partial deliveries of the software, i.e., every two weeks, a new version of the application will be available and automatically deployed for testing.

2.1.6. BUDGET

The initial investment for the execution of the first phase was R$ 4,500.00, with similar values projected for subsequent phases, comprising an incremental budget.

2.1.7. PRELIMINARY RISKS

Some risks have been identified that may affect the progress of the project. Among them, the following stand out: user resistance to adopting the new tool, possible technical flaws in the application's development, and delays in delivery from the supplier. These risks will be monitored throughout the project so that corrective actions can be taken when necessary.

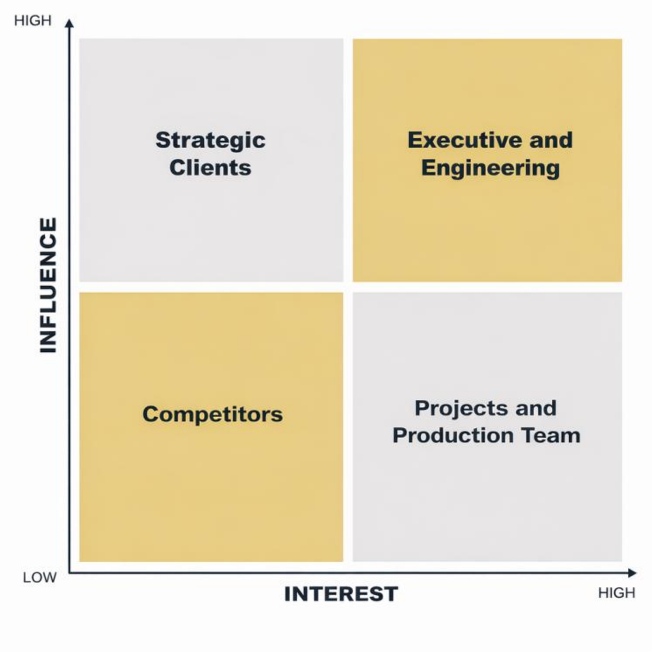
2.3. STAKEHOLDER MAPPING

In this project, the following were identified as the main stakeholders:

• BR7 Board of Directors acting as sponsor.
• Engineering is responsible for strategic direction and technical validation of the system.
• The project team plays an essential role as users.
• Third-party company responsible for the development and implementation of the software.
• The production sector, which will use the developed solution for the manufacture of parts.
• The clients, who will indirectly benefit from greater agility in project delivery.

The influence and interest analysis allowed the stakeholders to be structured in a classification matrix, as shown in Figure 1. In the high influence and high interest quadrant are the board of directors and the engineering team, considered critical actors for the success of the project. Strategic clients are situated in high influence and low interest; although they do not actively participate in the development, they have a significant impact on the acceptance of the results. End users, such as project and production teams, fall into the low influence and high interest category, as their work routine will be directly impacted by the new system. Finally, competitors can be considered to have low influence and low interest, given that they do not participate in the process but monitor the market movements resulting from the innovation.Effective stakeholder alignment is widely recognized as a determinant of project success, particularly in Agile-driven initiatives where communication cycles are short and iterative[6].

Figure 1 - Influence x Interest Matrix



2.4. SCOPE STATEMENT

The project scope was defined to encompass the essential deliverables for automating the creation of pallet racking designs. The project includes software development activities in four distinct phases: floor plan, views (front and side), bill of materials, and 3D model, as well as training for designers and the execution of internal tests and validations, ensuring the quality and adherence of the solution to the technical requirements.

On the other hand, the integration of the system with external platforms, such as ERP or CRM, and continuous maintenance after the implementation phase are not part of the scope, these activities being the responsibility of future projects.

Among the established assumptions, the availability of an average budget of R$ 4,500.00 per development phase stands out, as well as the active participation of the engineering team, especially in the technical validation stages.

The identified restrictions refer to the mandatory fulfillment of bi-weekly delivery deadlines and the limitation of financial resources, factors that require detailed planning and rigorous management for the project to achieve its objectives within the defined parameters.

All activities related to the integration of the software with external platforms, such as ERP or CRM systems, are outside the scope of the project. Additional developments that go beyond the four planned phases (floor plan, views, bill of materials, and 3D model) will also not be considered, with these items reserved for future initiatives should the company choose to expand the system's functionalities.

2.5. PROJECT RESOURCES

The resources needed to execute the pallet rack design software implementation project were structured into three main categories: materials, human resources, and financial resources, each playing an essential role in the success of project automation.

Regarding material resources, notebooks, servers, and software licenses that will be used for programming, modeling, and testing activities stand out.

Regarding human resources, the project has a multidisciplinary team composed of professionals from the BR7 team, responsible for the technical validation of the results and the definition of the structural parameters of the storage systems. In addition, there is support from a third-party team specialized in systems development, whose technical experience and strategic vision contribute directly to the quality of the deliverables.

The selection and development of employee skills follow the Knowledge, Skills, and Attitudes model, which seeks to balance technical training, operational capacity, and professional behavior. Thus, the professionals involved must have technical knowledge in projects and mastery of CAD tools, as well as the ability to work under agile methodologies, promoting iterative deliveries and continuous improvements [6,7].

In terms of financial resources, the project is organized into pre-planned investment phases, enabling more effective control over cash flow and budget allocation. Each development stage has a pre-defined budget, which allows management to monitor the cost-benefit ratio of deliverables and assess the expected return in productivity and efficiency. Furthermore, the financial forecast includes direct costs, such as licenses and development services, and indirect costs, such as training and technical support. This approach allows for greater transparency and predictability of expenses, reducing the risk of deviations and ensuring economic sustainability throughout the project.

2.6. SUPPLIER MANAGEMENT

The main supplier for the project is *Softgraf,* the company responsible for developing the pallet rack design software, whose performance is considered a critical factor for the success of the initiative. The choice of this strategic partner was the result of a market analysis, taking into account technical and operational aspects. The partnership was established based on a service agreement divided into delivery stages (sprints), allowing for greater control over the product's evolution and reducing the risk of delays or scope deviations.

The monitoring of activities is carried out through bi-weekly deliveries, which serve as control points for evaluating the supplier's progress. Each delivery is submitted to technical validation by the BR7 engineering team, which verifies the conformity of the developed functionalities, the software's performance, and adherence to technical storage standards. This iterative approach, inspired by agile methodologies, ensures transparency, flexibility, and agility in the development process, allowing for quick adjustments and more assertive decisions.

Furthermore, alignment and progress monitoring meetings are held between the project manager and the *Softgraf* representative. These meetings aim to assess the status of activities, discuss any difficulties, and propose continuous improvements. Through them, it is possible to identify risks, technical bottlenecks, and optimization opportunities, ensuring that the schedule and budget are met as planned.

To guarantee the quality of deliverables, a joint monitoring model was established, in which each phase of the project must be formally approved by the BR7 team before the start of the next stage. This practice avoids the accumulation of errors and ensures that development progresses in a controlled manner.

The signed contract also includes the provision of post-implementation technical support, ensuring operational continuity and improvement of the tool. This support includes corrections of any failures, security updates, and interface improvements. In this way, it is ensured that the software maintains its efficiency and alignment with the company's constantly evolving needs.

The relationship with the supplier is guided by strategic relationship management, in which BR7 seeks not only contractual compliance but also a long-term partnership based on trust, innovation, and continuous improvement. This approach strengthens the project's value chain and ensures that the developed technology generates a sustainable competitive advantage for the organization, consolidating *Softgraf* as a key partner in *BR7 Sistemas de Armazenagem's* digital transformation journey.

2.7. INVESTMENTS

The investment planned for the implementation of the pallet racking design software was designed considering the financial sustainability and technical feasibility of the project within the reality of *BR7 Sistemas de Armazenagem*. The budget structure was divided into four main phases to ensure progressive cost control and compatibility with the progress of deliveries. Phase 1 represented the initial development of the system, with an investment already made of R$ 4,500.00, allocated to the creation of the basic interface and the automation of the floor plan. Phases 2, 3, and 4, with a projected cost of R$ 4,500.00 each, respectively cover the development of the views (front, side, and top), the automatic generation of the bill of materials, and finally, the three-dimensional (3D) modeling. Thus, the total estimated value for the complete conclusion of the project ranges between R$ 18,000.00 and R$ 20,000.00, and may undergo minor adjustments according to the technical needs identified throughout the development.

The project's cash flow was structured to track the physical progress of deliverables, with disbursements made at the end of each phase. This phase-based payment model reduces financial risks and allows for more effective resource management, as investments are directly contingent on the validation of partial results. In addition, this format contributes to better budget predictability, facilitating expense control and decision-making by management.

Although the project does not foresee an immediate financial return, the indirect benefits are significant. Among them are: reduced project development time, elimination of rework, standardization of technical processes, and increased productivity of engineering and sales teams. These gains directly reflect on the company's competitiveness, allowing for a faster response to market demands and greater assertiveness in commercial proposals.

In addition, the project has strategic value, as it places BR7 in a context of digital transformation and technological innovation, strengthening its image in the storage systems sector and paving the way for future integrations with budgeting and ERP(Enterprise Resource Planning platforms) platforms. From this initiative, the company begins to adopt intelligent automation practices, which tends to reduce operating costs in the medium term and increase the overall profitability of the business.

Finally, the investment should be seen not only as a one-off expense, but as a lever for organizational growth. The adoption of proprietary and customized software gives the company greater technological autonomy, favors data-driven decision-making, and contributes to the sustainability and scalability of internal processes. Thus, the return on investment translates into operational efficiency, technical quality, and a lasting competitive advantage for *BR7 Sistemas de Armazenagem.*

2.8. PROJECT RISKS

After analyzing the implementation of the software for developing pallet racking projects, it was possible to identify and detail three main risks that can directly impact the progress and results of the project. Risk management, according to PMBOK [4], is an essential step in project management and aims to identify, assess, and plan responses to events that may compromise performance, schedule, cost, or quality of deliverables. Therefore, understanding and addressing these risks in a structured way is fundamental to the successful implementation of the system.

The first risk identified is related to the resistance of designers and end users to technological change. This behavior is consistent with findings that human-centric factors, such as trust and adaptation capability, strongly influence Agile adoption success [6].This type of resistance is common in digital transformation processes, especially when it involves replacing traditional methods with automated systems [7,10]. Lack of familiarity with the new tool can generate insecurity, fear of loss of control, and even an initial drop in productivity. To mitigate this risk, training and engagement actions will be applied, including practical training, support materials, and feedback sessions. Furthermore, it is important to adopt clear and transparent communication about the benefits of the software, demonstrating how the tool will facilitate the work of designers, reduce rework, and increase the accuracy of results.

The second risk concerns the overrun of deadlines and schedules, one of the most recurring problems in software development projects. Studies indicate that Agile methods, although flexible, require explicit risk management practices to avoid schedule deviations in complex environments [11].Technical complexity, scope changes, and adjustments during the coding process can lead to significant delays. To control this risk, the project will adopt agile methodologies, with bi-weekly deliveries and iterative monitoring of activities. This management model allows for greater flexibility, constant communication between teams, and early identification of deviations, enabling quick corrections before problems escalate.

The third risk is related to technical failures and software performance problems during development and deployment. Current literature highlights that automated design tools require continuous validation cycles to ensure traceability and reliability [9].These risks may include programming errors, incompatibility with operating systems, server instability, or difficulties in the automatic generation of drawings and bills of materials. To mitigate these occurrences, a continuous process of technical testing and validation will be implemented at each phase of the project. The engineering team will work together with the third-party team to verify the accuracy of the functions, compliance with technical standards, and the overall performance of the system

Table 2 – Risk Analysis

RISKS	PLANO DE AÇÃO
Resistance of designers to change	This risk will be mitigated through practical training, support materials, and clear communication about the benefits of the software, facilitating user adaptation.
Deadlines and schedule	The use of agile methodologies, with biweekly deliveries and continuous monitoring, will allow quick identification and correction of issues, keeping the project on schedule..
Technical failures	A continuous cycle of testing and technical validation will be adopted in each phase, ensuring proper functionality, regulatory compliance, and reliable system performance.

In short, anticipating and controlling these risks strengthens the project's solidity, ensuring not only adherence to deadlines and budgets, but also the successful adoption of the software by the team and the technical reliability of the final tool. Thus, the implementation process can occur safely, efficiently, and in line with the company's strategic goals.

2.9. COMMUNICATION PLAN

Communication is essential in project management, especially when it involves multiple teams and stages that depend on each other, such as in the development of pallet racking project software. Recent research confirms that communication quality is one of the strongest predictors of Agile project performance, especially in multidisciplinary [5].According to PMBOK [3] a good communication plan ensures that the right information reaches the right people, at the right time, and through the best channel, avoiding errors and rework.

In this project, communication is fundamental to keeping everyone involved aligned. To this end, procedures have been defined to ensure the clear and efficient transfer of information.

The bi-weekly meetings with the team have an operational focus: monitoring deliverables, analyzing indicators, identifying problems, and recording lessons learned. The monthly meetings with the board are more strategic, serving to review the overall progress, deadlines, costs, and priorities.

Different communication channels will be used as needed: Email, for formal records, approvals, and official announcements; In-person or online meetings, for technical discussions and status updates; and *WhatsApp* for quick day-to-day messages.

The effectiveness of communication will be evaluated periodically through feedback, internal questionnaires, and analysis of indicators. This will allow for continuous adjustments to the communication plan, ensuring greater alignment, team engagement, and support for project and company objectives.

Table 3 – Communication Methods

Communication Channel	Responsável	Frequência	Forma de Registro
E-mail	Engineering	A s needed	Notapplicable
Meetings	Engineering	Biweekly	Meeting minutes
WhatsApp	Stakeholders	A s needed	Notapplicable

2.10 QUALITY PLAN

In the development of the software for creating pallet racking projects for *BR7 Sistemas de Armazenagem*, the quality plan aims to ensure that the final tool functions correctly, generates accurate plans, views, and bills of materials, and complies with all applicable technical standards, such as Brazilian Standard NBR 17150: Storage Systems — Pallet Racks — Requirements for Design, Assembly, Use and Maintenance [12].

The main quality criteria for the project are:

• Software performance – good response time and stability during use;

• Technical accuracy – drawings and bills of materials compatible with specifications and manufacturing standards;

• Compliance with standards – adherence to structural and safety standards;

• Usability – simple, intuitive, and easy-to-use interface;

• User satisfaction – evaluated through practical tests and feedback after implementation.

The PDCA-based validation structure aligns with international frameworks for continuous improvement in automated engineering tools [7]. To meet these criteria, controls and verifications will be carried out at all stages of development. Each phase will include functional and performance tests, recorded in checklists and reports. After delivery, reviews will be conducted to identify improvements based on the results and user feedback. This information may generate updates to the software and the development process, following the PDCA (Plan–Do–Check–Act) cycle.

Thus, the quality plan ensures not only that the software is technically correct, but also contributes to BR7's efficiency, reinforcing standards of excellence and increasing customer satisfaction.

3. RESULTS

Although the project is still under development, the functionalities already implemented allow us to observe concrete and measurable progress. The tool currently developed already performs:

• Automatic configuration of pallet type and dimensions;

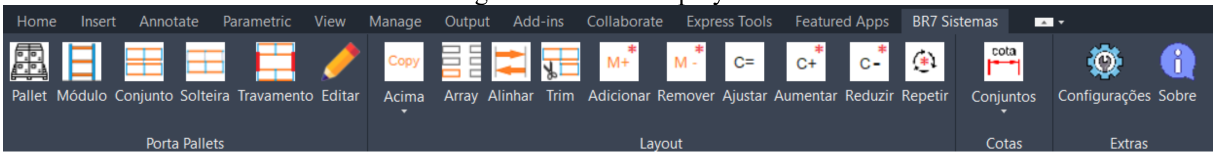
• Generation of the floor plan with the arrangement of the pallet racks;

• Definition of depth, aisle width and other layout parameters;

• Automatic identification of interferences and exclusion of modules that do not meet the dimensional requirements. [13,14]

In order for all these automations to be possible within *AutoCAD®*, the functionalities were organized and made available directly in the toolbar developed for the project, which became the central element of the application. This bar centralizes the configuration commands, allowing the entire process to be executed quickly, intuitively, and in a standardized way.

Figure 2 - Toolbar deployed.



To assess initial performance, several small and medium-sized projects were analyzed. In these applications, a reduction in development time of between 30% and 35% was observed compared to the manual process, demonstrating significant gains in agility, standardization, and reduction of rework.Similar productivity gains have been documented in automation-supported design environments, reinforcing the relevance of the results obtained [1,9,15].

These preliminary results reinforce the system's potential to optimize the layout development process, offering greater reliability and speed in responding to internal and external demands. As the next phases are completed and new functionalities are integrated, it is expected to further consolidate these gains, expanding the positive impact on productivity, the quality of deliverables, and the company's competitiveness.

III. CONCLUSIONS

In summary, this paper provides a solid contribution by demonstrating how project management practices combined with automation can transform and modernize traditional industrial project development processes. The inclusion of agile methodologies, structured communication, and explicit risk management positions the work within a body of literature that explores the convergence between automation, engineering, and project management in an integrated way. Furthermore, the prospect of continued research could include intelligent tools and agent-based automation to enhance efficiency and reduce dependence on manual labor, pointing the way for future academic investigations and industrial applications.

Conflict of Interest

The authors declare that there are no conflicts of interest associated with the development, analysis, or publication of this study. All procedures, interpretations, and conclusions were conducted independently and without any financial, personal, or institutional influences that could compromise the integrity or impartiality of the research.

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