World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(REVIEW ARTICLE)

Enhancing Efficiency in PLM Systems: Innovations in workflow automation and user notifications

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World Journal of Advanced Research and Reviews, 2025, 26(02), 4074–4079

Publication history: Received on 15 April 2025; revised on 24 May 2025; accepted on 26 May 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.26.2.2021

Abstract

Workflow automation and notification systems are essential for boosting efficiency and user engagement in Product Lifecycle Management (PLM) environments. This article explores innovative solutions, such as license management chatbots and automated approval workflows, which tackle persistent challenges in PLM implementations. By streamlining operations, reducing administrative overhead, and enhancing user experiences, these technologies help organizations address common issues like underutilized licenses, lengthy approval cycles, and limited user adoption. The article also delves into best practices for implementation, emphasizing stakeholder engagement, system integration, and user-centric design principles to ensure successful technology adoption.

Keywords: Workflow automation; License management chatbot; User notification systems; PLM optimization; Artificial intelligence integration

1. Introduction

Product Lifecycle Management (PLM) systems have become foundational infrastructure for modern manufacturing enterprises, with the global PLM market valued at USD 24.05 billion in 2022 and projected to grow at a compound annual growth rate (CAGR) of 7.5% from 2023 to 2030 [1]. This growth is primarily driven by increasing demands for collaborative product design and development, improved operational efficiency, and the accelerating digital transformation across industries. PLM systems are integral to managing complex product development processes, spanning initial conception through design, manufacturing, service, and eventual disposal, creating an essential digital thread throughout the entire product lifecycle [1].

While PLM systems are crucial for modern manufacturing enterprises, they frequently encounter implementation challenges that hinder their effectiveness. Studies indicate that 67% of PLM implementations exceed their planned budgets and timelines, with an average cost overrun of 32% and time delays of approximately 4.5 months [2]. The primary factors contributing to these inefficiencies include manual workflows, siloed data management practices, and inadequate user adoption strategies. Moreover, approximately 70% of organizations report significant difficulties with user engagement, leading to diminished returns on their technology investments [2].

The emergence of advanced workflow automation technologies presents transformative opportunities to address these persistent challenges. Integration of artificial intelligence and machine learning techniques into PLM frameworks has demonstrated remarkable efficiency improvements with evidence suggesting that automated workflows reduce process cycle times by 35-45% and decrease human error rates by up to 83% [1]. Furthermore, modern PLM systems now incorporate real-time collaborative capabilities that have been shown to reduce design iteration cycles by 29% and improve cross-functional team productivity by 24% [1].

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Notification systems and intelligent workflow management play a particularly crucial role in enhancing user engagement within PLM environments. Research indicates that organizations implementing proactive notification frameworks experience a 41% increase in user interaction frequency and a 37% improvement in workflow completion rates compared to those relying on manual tracking and communication methods [2]. Moreover, effective implementation strategies that incorporate change management principles have demonstrated 62% higher user adoption rates within the first six months of deployment compared to implementations lacking such methodologies [2].

This article explores concrete applications and implementation strategies for these transformative technologies, with particular emphasis on extensible frameworks and customization capabilities. By examining practical case studies and methodological approaches, the author provides actionable insights for administrators, strategists, and business process owners seeking to optimize their PLM environments through automation and enhanced notification systems. The focus will remain on how organizations can leverage these emerging technologies to overcome common challenges and maximize the value derived from their PLM investments.

2. Case Study: License Deactivation Chatbot in Teamcenter

2.1. Context and Problem Statement

PLM systems operate primarily on named user licensing models, creating significant financial implications for enterprises. According to industry research, organizations typically experience license utilization rates of only 65-75%, with the remaining 25-35% of purchased licenses sitting idle at any given time [3]. This underutilization represents substantial financial waste, with the average enterprise overspending on software licenses by approximately 25% annually. This translates into hundreds of thousands of dollars for mid-sized implementations. License management also creates administrative burdens beyond direct costs. A 2022 survey revealed that 78% of organizations rely on manual processes for tracking software usage with IT personnel spending an average of 8-10 hours weekly on license-related administrative tasks [3]. Traditional email-based communications achieve only a 43% response rate which results in prolonged reclamation cycles that average 47 days from identification to resolution.

2.2. Solution

A chatbot solution was implemented to address these challenges through intelligent automation and proactive user engagement. The system monitored authentication logs, identifying inactive accounts according to configurable thresholds. Upon detecting extended inactivity, the system initiated a graduated notification protocol through Microsoft Teams by providing inactivity alerts at 45, 52, and 58 days before automatic deactivation at 60 days. The implementation leveraged natural language processing capabilities which allowed users to respond conversationally to notifications. This approach facilitated immediate action without requiring navigation of complex administrative systems. Studies indicate that AI-powered chatbots reduce response times by up to 80% compared to traditional communication channels and this significantly accelerated the license reclamation process [4]. The contextual understanding capabilities enabled processing various user responses, from simple acknowledgments to complex extension requests, with minimal human intervention. The solution is integrated with the PLM environment's workflow system, ensuring licenses are not deactivated for users with pending work items. This safeguard prevented disruptions to critical business processes while maintaining optimization targets.

2.3. Benefits

The chatbot implementation delivered measurable improvements across multiple dimensions. From an efficiency perspective, the automated system reduced license management effort by approximately 75%, freeing IT resources for higher-value activities [4]. The solution automated 93% of routine license management tasks, requiring human intervention only for exceptional circumstances. Financial benefits materialized rapidly following implementation. By improving inactive license identification and accelerating reclamation, the organization realized first-year savings of approximately $85,000 through recovered licenses. Research indicates that AI-powered license management systems typically achieve ROI within 4-6 months, with average three-year returns of 250-300% on initial investment [3]. User engagement metrics demonstrated substantial improvement with the chatbot approach. Response rates increased from 43% to 89% within a 72-hour window, while average response times decreased from 5.2 days to 9.7 hours [4]. The conversational interface received positive user feedback with satisfaction scores averaging 4.2/5 compared to 2.7/5 for previous communications. This enhanced engagement directly contributed to faster reclamation cycles and improved system acceptance. The implementation established a foundation for expanding automation capabilities throughout the PLM environment with several additional workflow processes identified as candidates for similar chatbot-driven automation approaches.

Table 1 Impact of Chatbot Implementation on License Management Efficiency [3,4]

Metric	Before Implementation	After Implementation
License Utilization Rate (%)	65-75	90-95
Response Rate to Notifications (%)	43	89
Average Response Time	5.2 days	9.7 hours
License Reclamation Cycle Time	47 days	~14 days
IT Personnel Time Spent Weekly (hours)	8-10	2-3

3. Extending Innovations: Workflow Approvals and Beyond

3.1. Workflow Approval Automation

Manual workflow approvals are a significant bottleneck in product development cycles, with research indicating that approval processes consume up to 30% of total product development time [5]. The automotive industry provides a compelling example where traditional engineering change order approvals take an average of 14 days to complete but only 4 hours of actual review time resulting in approximately 98% idle time during the process. This inefficiency translates directly into delayed market entry and missed revenue opportunities with studies showing that companies launching products six months behind schedule realize 33% less profit over five years compared to on-time launches [5].

Automation technologies offer powerful solutions to these challenges through intelligent workflow management. Product development automation systems have demonstrated remarkable efficiency improvements, with implementation studies revealing an average reduction of 75% in cycle time for standardized approval processes. Organizations employing AI-driven approval routing report 30-40% faster time-to-market metrics compared to industry peers relying on manual workflow management [5]. Modern simulation-driven development approaches integrated with automated approval workflows enable parallel evaluation processes, reducing overall development cycles by up to 90% in specific applications such as aerodynamic component design and structural optimization.

The automatic triggering of approvals based on predefined criteria represents a key advancement in workflow efficiency. By establishing objective thresholds for design validation and verification, systems can initiate approval processes without human intervention, eliminating an average waiting period of 2.3 days between completion of prerequisite activities and manual workflow initiation. These triggers apply particularly effectively to simulation results evaluation, where parameters falling within predetermined tolerance ranges can automatically progress through approval gates [5].

3.2. User Notifications for Workflow Approvals

The effectiveness of workflow automation depends heavily on timely user engagement, making notification systems a critical component of PLM optimization. Industry research indicates that 74% of employees would prefer receiving important information through multiple communication channels rather than a single method [6]. Modern notification systems delivering messages across email, messaging platforms, and mobile applications achieve 91% confirmation rates compared to 65% for single-channel approaches, significantly accelerating approval processes and reducing bottlenecks.

Response time statistics clearly demonstrate the impact of effective notification strategies. Organizations implementing comprehensive notification systems report average response times of 27 minutes for urgent approvals, compared to 5.7 hours using traditional communication methods [6]. This dramatic improvement directly influences development timelines, with studies showing that each 10% reduction in approval response time correlates with a 3.2% reduction in overall product development cycles. Emergency notification technologies have proven particularly valuable for critical approval scenarios with 83% of surveyed organizations reporting that emergency alerts receive responses within 3 minutes—essential for time-sensitive manufacturing decisions.

Integration with collaboration platforms creates particularly powerful notification ecosystems. Systems incorporating contextual information directly within notifications enable 70% of approvals to be completed without requiring navigation to separate systems. This streamlined approach reduces average decision time per approval action from 15 minutes to 4 minutes, delivering substantial cumulative efficiency gains across complex product development processes [6]. Furthermore, notification systems implementing escalation protocols automatically redirect approvals to

alternative decision-makers after predetermined periods of inactivity, reducing workflow stalls by up to 45% in manufacturing environments with time-critical approval requirements.

Table 2 Workflow Approval Metrics: Traditional vs. Automated Systems [5,6]

Metric	Traditional Approach	Automated Approach
Approval Process Time (% of Total Development)	30%	7.5%
Engineering Change Approval Cycle Time	14 days	3.5 days
Idle Time in the Approval Process	98%	~25%
Response Time for Urgent Approvals	5.7 hours	27 minutes
Average Decision Time per Approval Action	15 minutes	4 minutes

4. Best Practices for Implementing Innovations

4.1. Stakeholder Engagement

Effective stakeholder engagement forms the cornerstone of successful technology implementations in enterprise environments. Research indicates that implementations with comprehensive stakeholder involvement achieve success rates of 96%, compared to only 47% for projects with limited engagement strategies [7]. The most successful implementations begin with systematic stakeholder analysis, identifying all affected groups and creating dedicated communication channels for each. Projects involving end-users from the planning stage are 80% more likely to be completed on time and within budget than those that engage users only during later implementation phases [7].

Executive sponsorship also plays a crucial role in implementation success, with active executive sponsors making projects 3.5 times more likely to meet objectives than those lacking visible leadership support. Effective communication strategies must address specific concerns of each stakeholder group with customized messaging that emphasizes relevant benefits and addresses potential pain points [7].

4.2. Integration with Existing Systems

The seamless integration of innovative solutions with established enterprise systems presents substantial technical challenges. Research shows that 75% of enterprise implementations experience significant delays due to integration complexities with these issues accounting for approximately 30-40% of total implementation effort [7]. Successful implementations employ phased integration approaches, with each phase thoroughly evaluated before proceeding to the next integration point.

Data migration represents a particularly critical aspect of system integration. Organizations adopting formal data cleansing and validation protocols before migration experience 65% fewer data-related issues post-implementation compared to those employing ad-hoc approaches [7]. The most successful implementations establish clear data governance structures, including detailed documentation of data mapping, transformation rules, and validation criteria.

4.3. Focus on Scalability and User-Centric Design

User-centered design methodologies place end users' needs and requirements at the core of the development process, resulting in solutions that better align with actual usage patterns and preferences. This approach emphasizes understanding users through direct research and continuous feedback rather than relying on assumptions or generalized requirements [8]. The design process typically involves multiple iterations of design, testing, and refinement based on user input at each stage.

Scalability considerations must account for both technical performance and user experience factors. Research demonstrates that even technically robust systems fail to achieve full adoption when usability issues impede user acceptance. User-centered design methodologies incorporate several key principles, including early and continuous focus on users, empirical measurement of usage, and iterative design processes [8]. These practices ensure innovations not only function technically but also integrate effectively into users' daily workflows.

Implementation success ultimately depends on the system's ability to enhance user productivity rather than introduce additional complexity. Solutions developed with deep understanding of users' contexts, goals, and pain points consistently outperform those focused primarily on technical capabilities [8]. By prioritizing user needs throughout the

implementation process and continuously incorporating feedback, organizations can develop innovations that deliver sustainable value and achieve lasting adoption.

Table 3 Impact of Best Practices on Innovation Implementation Success [7,8]

Metric	Without Best Practices	With Best Practices
Implementation Success Rate	47%	96%
Projects Meeting Objectives (with Executive Sponsorship)	1x	3.5x
Projects Completed on Time/On Budget	1x	1.8x
Data-related Issues Post-implementation	100%	35%

5. Challenges and Opportunities

5.1. Challenges

The implementation of workflow automation and notification systems within PLM environments presents significant challenges that must be systematically addressed. Data security and privacy considerations rank among the foremost concerns when integrating external platforms with PLM systems. Recent studies indicate that approximately 60% of organizations implementing AI in PLM environments identify data security as their primary concern, particularly regarding intellectual property protection and confidential design information [9]. The integration of external collaboration platforms introduces additional risks, as these connections potentially expose sensitive product data to channels outside traditional PLM security boundaries. This is especially critical considering that 46% of product development organizations report having experienced at least one security incident related to external system integrations within the past two years.

Balancing automation with appropriate human oversight presents another significant challenge, particularly for critical design and manufacturing workflows. Research indicates that fully automated decision processes in PLM environments may introduce risks in complex scenarios that require contextual judgment. A comprehensive study of AI implementation in manufacturing found that 57% of organizations maintain human oversight for critical decision points within automated workflows even after establishing high confidence in the automation system's reliability [9]. This hybrid approach acknowledges the complementary strengths of human insight and machine efficiency particularly for non-standard scenarios.

5.2. Opportunities

Incorporating AI-driven analytics into PLM workflows presents transformative opportunities for process optimization and bottleneck prediction. Research indicates that machine learning algorithms analyzing historical workflow data can identify patterns and predict potential delays with increasing accuracy as systems mature. Studies of AI implementation in product lifecycle management demonstrate that predictive analytics can reduce cycle times by 20-30% across various PLM processes by enabling proactive resource allocation and bottleneck prevention [9]. These capabilities prove particularly valuable for complex multi-stakeholder workflows where traditional management approaches struggle to identify non-obvious process inefficiencies.

The integration of AI with PLM data can enhance knowledge management and decision support. By analyzing relationships between product data, design decisions, and performance outcomes, AI systems can generate insights that inform future design choices. Research shows that organizations implementing such systems report a 25-40% improvement in decision quality based on increased information accessibility and pattern recognition capabilities [9].

Expanding chatbot capabilities beyond basic functions offers substantial efficiency opportunities across PLM environments. Enterprise-grade chatbots capable of handling complex inquiries are revolutionizing user support and workflow facilitation. Research indicates that implementation of advanced chatbots reduces response times for common inquiries by up to 80% while maintaining high accuracy rates [10]. The economic impact is equally significant, with enterprise chatbot implementations demonstrating ROI improvements of 25-40% compared to traditional support methods by reducing operational costs and improving service quality.

Integration capabilities represent a crucial advantage of modern enterprise chatbot solutions. The ability to connect with multiple enterprise systems, including PLM platforms, enables comprehensive workflow support and information access. Studies show that 65% of enterprise chatbot implementations involve integration with three or more back-end systems to provide users with seamless access to distributed information [10]. This integration capability allows

chatbots to retrieve relevant product data, initiate workflows, and provide contextual guidance without requiring users to navigate multiple systems independently. By prioritizing user needs throughout the implementation process and continuously incorporating feedback, organizations can develop innovations that deliver sustainable value and achieve lasting adoption.

Table 4 Impact of AI and Chatbot Technologies on PLM Performance [9,10]

Metric	Value
Organizations identifying data security as primary concern	60%
Organizations maintaining human oversight for critical decision points	57%
Cycle time reduction through predictive analytics	20-30%
Decision quality improvement with AI-enhanced knowledge management	25-40%
Response time reduction for common inquiries with chatbots	80%

6. Conclusion

The integration of chatbots and workflow automation technologies represents a significant advancement in maximizing PLM system effectiveness. These innovations transform fundamental business processes by reducing manual intervention, accelerating decision cycles, and improving resource utilization across the product development lifecycle. License management chatbots demonstrate the concrete benefits of combining proactive notifications with automated actions, while workflow approval automation addresses critical bottlenecks in development processes. Organizations implementing these technologies can expect substantial improvements in operational efficiency, user satisfaction, and return on investment from their PLM investments. The implementation strategies, focusing on stakeholder engagement, careful integration, and user-centric design, provide a framework for successful adoption. As artificial intelligence and machine learning capabilities continue to evolve, the potential for further optimizing PLM environments will expand. This offers organizations opportunities to build increasingly responsive, intelligent, and value-generating product development ecosystems.

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