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Adapting Agile Scrum for Middleman Pricing: A Web-to-Print E-Commerce Case Study

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Abstract

Agile Scrum methodologies assume stable backlog effort, but middleman-driven e-commerce platforms face volatile pricing derived from competitors rather than internal cost logic. This paper analyzes a 2025 web-to-print case study where two Scrum teams stalled when 30% of sprints required real-time, reverse-engineered pricing adjustments. As both developer and project manager during this case study, I document how surface-area pricing and non-linear formulas forced sprint overrides and SaaS workarounds in tools designed for manufacturers. Key interventions included process redesign, the development of practical tooling workarounds, and enhanced client communication, leading to the conceptualization of "Pricing-Aware Sprints"—a hybrid Agile model. Findings from this study reveal that 80% of standup disruptions traced to pricing volatility (half from tooling limitations, half from delayed competitor analysis), which were significantly reduced by these interventions, ultimately improving product delivery timelines. This bifurcation suggests Agile's 'defined work' principle collapses when backlogs depend on external market forces. The study proposes the "Pricing-Aware Sprints" model to stabilize workflows in such intermediary sectors, offering critical insights for practical application and engineering education. Generalizability is limited by confidentiality constraints (anonymized client, partial artifact access).

Keywords: Web-to-print e-commerce, Scrum, Tooling limitations, Pricing-Aware Sprints, Hybrid Agile Model, Process Improvement, SaaS Workarounds.

1. Introduction

Agile Scrum methodologies are foundational in software development and engineering education, lauded for their efficacy in environments with predictable inputs, such as traditional manufacturing or software projects with defined feature sets and internal cost structures. However, their direct applicability to intermediary-driven sectors like e-commerce, particularly those reliant on opaque, competitor-based pricing, remains under-explored. These sectors present a fundamental tension: Agile's insistence on 'defined work' and stable backlogs often collapses when sprint priorities are dictated by real-time, reverse-engineered competitor pricing and when standard SaaS tools (e.g., Magento, CloudLab) are ill-suited for middleman operational logic. For engineering students training to lead cross-functional teams, understanding this mismatch is not merely theoretical but a career-critical insight.

This paper analyzes a 2025 web-to-print e-commerce case study where such challenges led to significant project stalls, with 30% of sprints requiring urgent, reactive pricing adjustments. It examines the root causes, including tool limitations and the complexities of surface-area and non-linear pricing formulas that overwhelmed development teams. More significantly, building on insights gained from direct intervention and process redesign during the period of this case study, this paper details the practical adaptations implemented and proposes a hybrid Agile framework, "Pricing-Aware Sprints." This model is designed to mitigate pricing volatility by decoupling development from high-volatility pricing research and establishing specialized handling for these complex tasks.

The study documents how these interventions led to substantial improvements in project timelines and team efficiency. By dissecting the initial failures and subsequent successful adaptations, this paper aims to: 1) illuminate the specific ways standard Agile practices falter in middleman e-commerce contexts; 2) present the "Pricing-Aware Sprints" model as a viable approach to stabilize workflows; and 3) draw critical lessons for both industry practitioners and engineering curricula. The findings underscore the need for more context-aware Agile training and the development of hybrid project management methodologies for businesses operating with high external dependencies.

2. Literature Review

Agile methodologies, particularly Scrum, have become widely adopted in software development and are increasingly integrated into engineering education [1]. For instance, Pócsová et al. (2020) [2] detail the implementation of Scrum into a Mathematics 1 engineering course, demonstrating its utility in increasing educational process efficiency and fostering soft skills, even in non-software domains where problem parameters can be well-defined within the course structure. These frameworks are valued for their iterative nature, fostering collaboration and adaptability. Advanced pedagogical models, such as the Challenge-Based Learning (CBL) 4.0 framework proposed by Coelho et al. [3] for Industry 4.0 curricula, leverage Agile Scrum principles to structure complex student projects. A key tenet in such applications is that the problem parameters or "challenges," while complex, are often predefined or discoverable through structured, internally-driven processes. This allows for relatively stable backlogs where sprint goals can be committed to with a degree of confidence, as the core variables remain largely within the project's control. The effectiveness of agile practices, such as Scrum and Kanban, is well-documented for enabling organizations to enhance product innovation and customer satisfaction by fostering continuous improvement and rapid response to market feedback [4].

However, this foundational assumption of predictable inputs faces significant challenges in volatile operating conditions, a recognized feature of many contemporary business environments [5]. Blair et al. [6] emphasize that such volatility makes skills acquisition and development inherently more difficult, necessitating adaptive responses and a systems view of learning and operational processes. This is particularly acute in specific industry sectors. Middleman-driven businesses, such as e-commerce resellers, operate under fundamentally different economic constraints. Unlike manufacturers who can base pricing on known Cost of Goods Sold (COGS), middlemen often lack this direct cost visibility. Hultén, Viström, and Mejtoft [7], in their study of Swedish printing houses, highlighted that even producers with access to cost data found pricing new services challenging, relying on cost-based pricing with mark-ups – a strategy inherently dependent on knowing internal costs.

For middleman entities, the "cost" input is frequently the competitor's price, which is volatile and externally dictated. This necessitates a reactive pricing strategy based on reverse-engineering competitor data, operating within an "information vacuum" regarding true production costs, as observed in the context of this study. The logistics and retail sectors, which often function as intermediaries, increasingly recognize the vitality of dynamic pricing models that leverage real-time data and algorithms to balance cost efficiency with fluctuating market demands [8]. Muthukalyani [9] specifically highlights the need for agile retail supply chains to implement real-time pricing adaptation using algorithms and automated tools to navigate market dynamics.

The effective management of projects within such volatile IT environments also calls for specific leadership approaches. Ahmad et al. [5] found that empowering leadership positively influences project success, particularly through fostering employee self-leadership and when coupled with goal clarity. This dynamic starkly contrasts with the stable foundations assumed in many Agile applications and educational models.

The recognition that purely traditional or purely agile approaches may not always be optimal for complex projects subject to change has led to the exploration of hybrid project management models. Lalmi et al., for instance, propose a hybrid model for construction projects that draws on traditional, agile, and lean practices to promote change and increase project value [10]. Similarly, Reiff and Schlegel's [11] systematic review on hybrid project management aims to synthesize knowledge on combining traditional and agile techniques to benefit from the strengths of each. Leong et al. [12] also examine hybrid approaches, looking at combining agile methodology with traditional software development lifecycles for future sustainability. Further exploring hybridity, Azonuche et al. [13] investigate the integration of Scrum and DevOps for continuous delivery in regulated software environments. Their work underscores how combining Scrum's iterative planning with DevOps' automation and deployment capabilities can help organizations meet strict compliance and auditability requirements—external pressures that, much like volatile pricing, demand significant adaptation beyond standard agile practices.

The existing literature often overlooks the combined impact of inherent business model volatility (like that of middlemen) and the project management adaptations required to navigate it. While Agile principles are robust, their standard application falters when external market volatility, rather than internal project control, dictates a significant portion of the workload. Even within e-commerce, where Scrum is applied, its effectiveness hinges on necessary adaptations, as its theoretical foundations are often rooted in software development, requiring deviations for data-intensive market research projects [14].

The challenges of integrating Scrum into the fast-paced, cross-functional nature of e-commerce, particularly in non-software areas, highlight the need for tailored strategies [7]. This paper addresses this gap through a case study analysis of such a scenario, detailing the interventions undertaken and proposing a modified Agile framework designed for enhanced resilience in these contexts.

3. Methodology

This study employed a qualitative case study methodology combined with principles of action research, conducted through direct, ongoing involvement between January and April 2025. The research focused on a web-to-print e-commerce platform development project for a client of Canspirit Artificial Intelligence, Pune, who operated as a middleman reseller. The platform involved configuring 147 unique products requiring dynamic, competitor-driven pricing, presenting a context where standard Agile Scrum assumptions were severely tested.

3.1 Research Context and Case Selection

The selected case was deemed particularly illustrative due to several factors:

- Middleman Pricing Volatility: Unlike manufacturers with direct Cost of Goods Sold (COGS) data, the client relied entirely on reverse-engineering competitor pricing, introducing significant unpredictability.
- Tooling Mismatch: Industry-standard e-commerce platforms (Magento and CloudLab) were primarily designed for manufacturer-centric operations, leading to critical data field gaps and necessitating extensive workarounds for the reseller model.
- Hybrid Team Structure: Two Scrum teams (four members each), one with a mix of Computer Science and Electronics engineering students (Team 1, including the author) and the other primarily Electronics students (Team 2), faced identical backlogs but adopted different adaptation strategies over time.

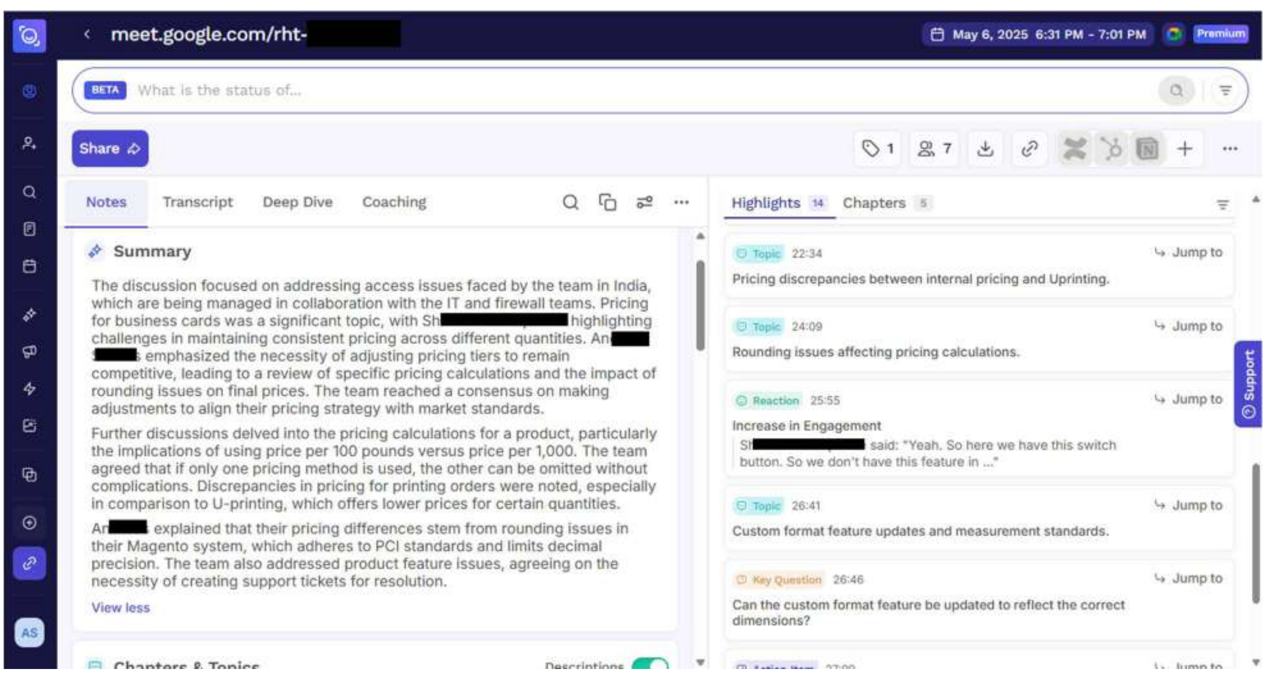

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Figure 1. Meeting summary discussing Software actively reporting wrong prices and missing features that are necessary.

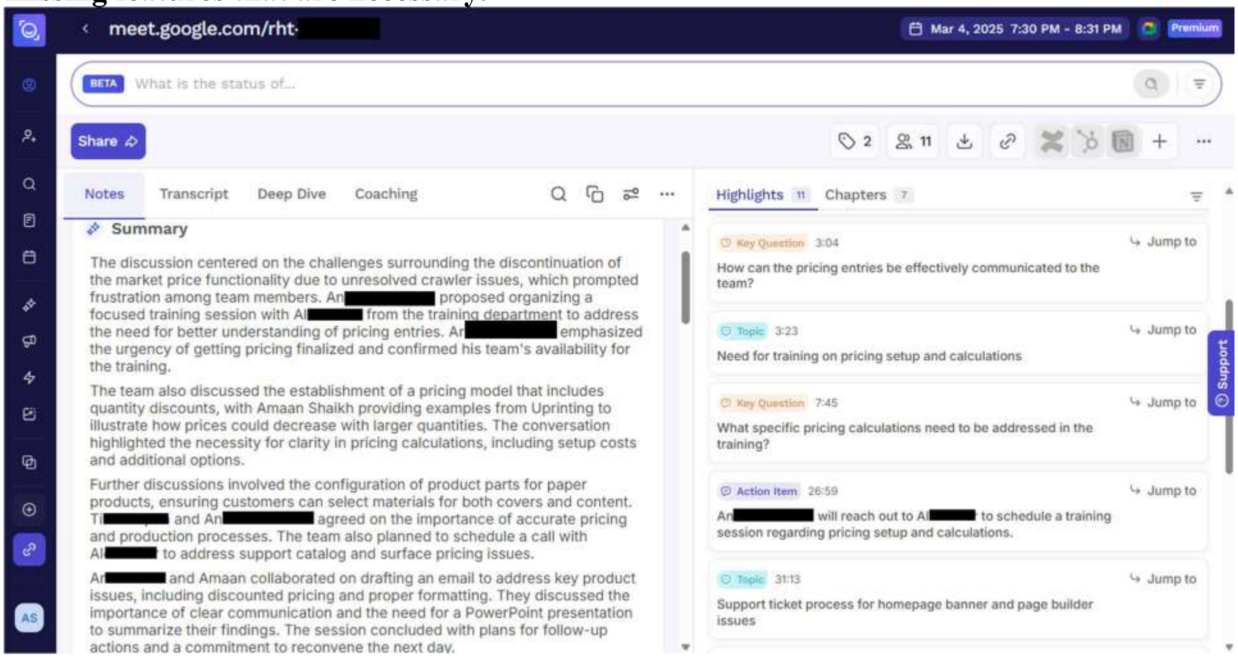

Figure 2. Meeting summary discussing extremely delayed communication regarding pricing and possible training sessions to better equip the team to handle software troubleshooting.

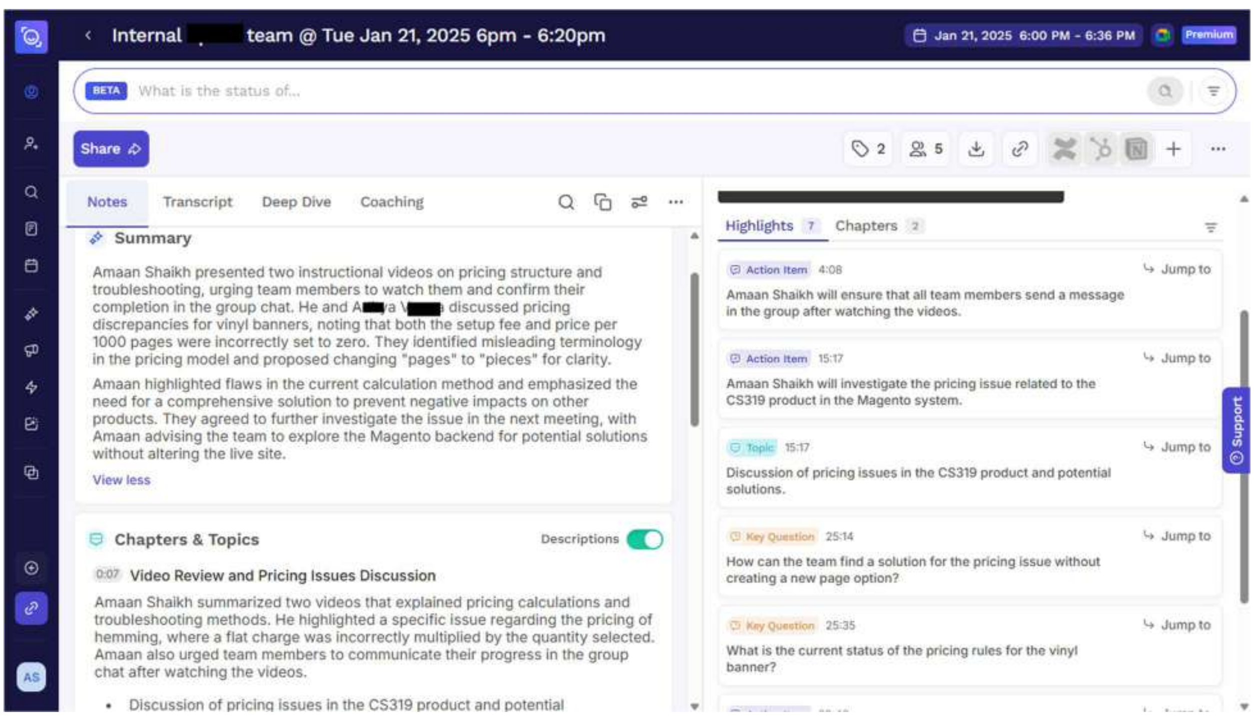

Figure 3. Meeting summary of author training Team 1 troubleshooting, proper procedures for handling errors and innovating on price calculations using familiar tools such as Excel.

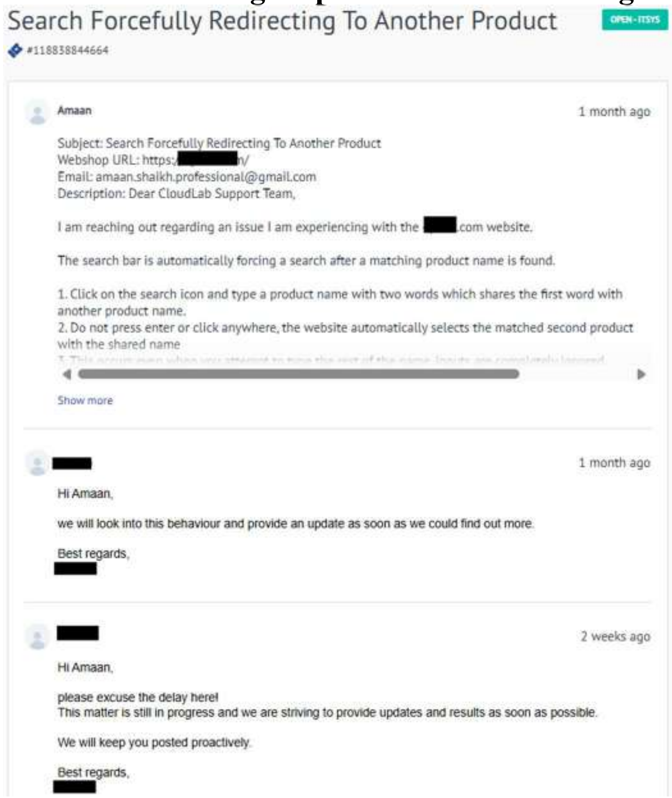

Figure 4. A support ticket raised about a software bug in Sprint 10 being worked on even now till sprint 15, causing product specific delayed deadlines.

3.2 Data Collection and Role of the Researcher

Data was collected through participant observation where the researcher (author) initially served as a developer on Team 1 (Month 1) and subsequently transitioned to a Project Management role (Months 2-4), overseeing both teams. This dual role provided a unique vantage point for:

- Diagnosing Systemic Issues: Initial observations as a developer detailed the extent of pricing-induced disruptions, inefficient resource allocation due to product complexity variance, and the dominance of non-development work. For example, initial analysis revealed that Team 1 had done more price analysis and troubleshooting than development work by the end of the first month. Daily meeting summaries generated by an AI agent (Read.AI) were used to quantify disruptions, revealing that 80% of standup issues were pricing-related (40% tooling, 40% delayed competitor data).
- Implementing and Observing Interventions: As a Project Management intern, the researcher actively intervened by:

- Intercepting and resolving support tickets from both teams, reducing resolution times from days to often within 24 hours. For instance, problems with obvious solutions that previously took days to resolve with limited vendor availability were addressed much faster.
- Developing practical tooling workarounds, including Excel-based automation for complex pricing calculations (e.g., for surface area, price per 100 pounds, non-linear add-ons which represented a significant hurdle) and an emulator for backend changes to expedite trial-and-error cycles (reducing a 90-second feedback loop to 1-3 seconds).
- Spearheading documentation creation and knowledge sharing, including training Team 2 based on Team 1's learnings, which resulted in Team 2 leapfrogging Team 1 in progress.
- Facilitating direct client communication (through two separate multi-hour meetings) to clarify pricing methodologies and obtain critical business data, which revealed the client had assumed the development team possessed specialized printing business knowledge.
- Effectively forming a de facto "Pricing SWAT team" to shield development teams from pricing volatility; this involved the researcher intercepting support tickets, proactively troubleshooting, and developing pricing tools.

3.3 Phased Approach and Development of the "Pricing-Aware Sprints" Model

The research and interventions evolved through distinct phases:

- Phase 1: Problem Diagnosis (Developer Role - Month 1): Focused on initial product setup, experiencing firsthand the pricing challenges and quantifying their impact on sprint progress (e.g., Team 1 completed only 32 of an initial 147 products by sprint 4, a target supposed to be achieved by mid-sprint 2, representing a delay of approximately 400%).
- Phase 2: Intervention and Process Redesign (PM Role - Months 2-4): Characterized by active process improvements, tool development, and the implementation of a parallel workflow to handle pricing complexities. This phase saw a significant reduction in average product completion time from an estimated three weeks to four days (an 80.9% reduction) and the near-elimination of pricing-related standup disruptions (decimated by 100%).
- Phase 3: Conceptualization of "Pricing-Aware Sprints": Drawing from the successes and learnings of the ad-hoc interventions, this research conceptualized a more formalized hybrid Agile model. This model, termed "Pricing-Aware Sprints," proposes a dual-stream workflow to decouple volatile pricing tasks from core development, ensuring a more stable and predictable environment for development teams (detailed further in Section 4).

3.4 Data Triangulation and Analysis

To ensure the validity of findings and mitigate researcher bias, data from multiple sources were triangulated:

- Project Artifacts: Support tickets (documenting roadblocks), Read.AI meeting summaries (quantifying discussion topics like pricing and software bugs), sprint retrospectives (team reflections on process gaps), and project management documentation (workload allocation charts, progress reports reflecting an average completion rate of a product reducing from three weeks to four days).

- Operational Data: Magento and CloudLab configuration details (e.g., the "Purchase width/height" issue requiring workarounds due to missing middleman data), instances of failed pricing rule executions, and comparisons of implemented prices (achieving a consistent 1-3% undercut target post-intervention versus initial 5-30% error rates) against competitor data.
- Qualitative Feedback: Client communications (revealing initial misunderstandings of team knowledge) and a post-project client satisfaction survey (achieving 70% satisfaction approximately four months into the renewed team efforts).
- Project Metrics: Product completion rates (116 out of 147 products launched within four months of renewed efforts), bug fix rates, and observed changes in team morale (from "significantly demoralised" to "renewed vigor and active participation") and velocity.

Data analysis was primarily qualitative, focusing on identifying patterns in disruptions, the efficacy of interventions, and the emergent principles that informed the "Pricing-Aware Sprints" model.

4. Lessons for Engineering Education

The experiences and challenges encountered in this web-to-print e-commerce project offer several critical lessons for engineering education, particularly in how students are prepared for the complexities of real-world Agile project management in volatile, client-driven environments. Standard curricula often present Agile Scrum as a relatively context-agnostic framework, which can leave graduates unprepared for sectors where backlog stability and internal cost logic are luxuries rather than norms.

1. Beyond Idealized Agile: Incorporating Volatility and Uncertainty:

- Problem: Engineering curricula frequently teach Agile using idealized scenarios where requirements are relatively stable or evolve through controlled internal processes (as seen in models like CBL 4.0)[3]. This case demonstrates that many industries, especially middleman e-commerce, operate with high external input volatility (e.g., competitor-driven pricing) that standard Agile doesn't inherently accommodate, as evidenced by 30% of sprints being disrupted by such changes.
- Lesson/Recommendation: Curricula should incorporate case studies and project simulations that explicitly model high levels of external uncertainty and reactive work. This could involve:
    - "Crisis Sprints" or "Reactive Backlog Management" Modules: Introduce concepts of "emergency sprints" or specialized workflows (akin to the "Pricing SWAT team" observed or the proposed "Pricing-Aware Sprints") to handle urgent, unplanned tasks that derail standard sprint goals. This addresses the frequent sprint disruptions noted in the case study.
    - Simulating External Market Pressures: Design projects where students must react to sudden "market shifts," changes in "competitor data,"

or unexpected "client demands" that force re-prioritization and rapid adaptation, moving beyond purely technical problem-solving.

2. The Importance of Role Fluidity and Hybrid Skill Sets:

- Problem: Traditional engineering roles are often siloed. The pivotal impact of the researcher transitioning from a developer (Phase 1) to a Project Management role (Phase 2) highlighted the immense value of individuals who can bridge technical depth with project oversight and process innovation, especially in crisis situations. This transition led to an 80% faster issue resolution on average for the teams.
- Lesson/Recommendation: Engineering education should actively promote and simulate role fluidity.
    - Cross-Functional Project Roles: Encourage students in team projects to rotate roles, including developer, tester, business analyst, and project coordinator/manager, to gain empathetic understanding of different pain points and perspectives.
    - "Developer to PM" Simulations: Specific exercises or capstone project phases could simulate a developer needing to step into a leadership or process-improvement role to solve systemic project blockages, mirroring the researcher's impactful transition. This develops critical thinking about process as well as product.

3. Navigating Tooling Mismatches and Vendor Collaboration:

- Problem: Students are often trained on tools within ideal parameters. This case study showed significant friction with industry-standard SaaS tools (Magento, CloudLab) designed for manufacturer-centric models (e.g., requiring "purchase width/height" data unavailable to middlemen), requiring extensive workarounds and complex vendor support interactions (where support was only available weekly, delaying simple fixes) to fit a middleman reseller's needs.
- Lesson/Recommendation: Educate students on the realities of "tooling mismatch" and the skills needed for effective vendor engagement.
    - Critical Tool Evaluation: Teach students to critically evaluate COTS (Commercial Off-The-Shelf) software not just for its features, but for its underlying architectural assumptions and suitability for diverse business models.
    - Developing Workaround Strategies: Include modules or workshops on creative problem-solving when standard tool functionality is insufficient, including how to document and manage such workarounds, as was necessary for CloudLab.
    - Vendor Communication Skills: Role-play scenarios involving reporting complex bugs, requesting non-standard features, and managing vendor support timelines and limitations (as experienced with CloudLab support, where some unique issues were identified as requiring significant impact to their core software for little return, leading to about 20% of issues needing workarounds).

INDEX

Figure 5. The index of the created documentation outlining best practices and common errors.

Purchase width	26
Purchase height	20
Price per 1000 sheets	471.48
Price per 100 pounds (CWT)	117.87
Basis width	26
Basis weight	100
Basis height	20

Figure 6. Workaround of CloudLab SaaS

The field Purchase width/height are integral to the backend price calculations and cannot be left empty but aren't available to middlemen. Duplication of Basis

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width/height with modified price expressions had to be utilized

.

Paper 100 lb Weight	100		A1 = 100			Paper 100 lb Weight	A1 = 100	
Paper Basic Weight	130		A2 = e.g. 60			Paper Basic Weight	A2 = e.g. 60	
Paper Purchase Width	20		A3 = e.g. 20			Paper Purchase Width	A3 = e.g. 20	
Paper Purchase Height	30		A4 = e.g. 30			Paper Purchase Height	A4 = e.g. 30	
Paper Basic Width	17		A5 = e.g. 17			Paper Basic Width	A5 = e.g. 17	
Paper Basic Height	22		A6 = e.g. 22			Paper Basic Height	A6 = e.g. 22	
Product Width	8.5		A7 = e.g. 8.5			Product Width	A7 = e.g. 8.5	
Product Height	11		A8 = e.g. 11			Product Height	A8 = e.g. 11	
Pages (Color Factor)	1		A9 = e.g. 1			Pages (Color Factor)	A9 = e.g. 1	
Quantity	100		A10 = e.g. 100			Quantity	A10 = e.g. 100	
Final Value			6.5			Final Value	#REF!	
	Width	Height	conver	Surface	Qty	Surface*Qty		final price
	2.5	1	144	0.01736111111	25	0.4340277778		1.302083
	5	7	144	0.2430555556	100	24.30555556		43.75
	5	7	144	0.2430555556	125	30.38194444		42.53472
	5	7	144	0.2430555556	150	36.45833333		14.58333
	5	7	144	0.2430555556	175	42.53472222		11.48437
	5	7	144	0.2430555556	200	48.61111111		11.18055
	5	7	144	0.2430555556	500	121.5277778		170.1388
	5	7	144	0.2430555556	1000	243.0555556		340.2777
	5	7	144	0.2430555556	2000	486.1111111		194.4444
	5	7	144	0.2430555556	5000	1215.277778		328.125
	5	7	144	0.2430555556	10000	2430.555556		559.0277
	Surface*Qty	Price						
Color	1	3						
	10	1.8						
	100	1.4						
	400	0.4						
	1000	0.27						
	2000	0.23						

(((paper_p100pound * ((paper_basic_weight * paper_purchase_width * paper_purchase_height) / (paper_basic_width * paper_basic_height)) / 100) / (500 * paper_purchase_width * paper_purchase_height)) * width * height * getPagesBasedOnColor() * qty)

Figure 7. An excel sheet built to brute force the price values based on CloudLab provided formulas.

4. Valuing and Developing "Process Innovation" Skills:

- Problem: Engineering often emphasizes technical innovation. This case demonstrated that process innovation (e.g., creating the Excel automations to speed up pricing analysis by ~60%, the backend emulator, the structured documentation, and conceptualizing "Pricing-Aware Sprints") was equally, if not more, critical to rescuing the project from initial 400% delays.
- Lesson/Recommendation: Curricula should explicitly teach and value process analysis and improvement.
    - Action Research Principles: Introduce basic principles of action research (diagnose, act, evaluate, reflect) as a method for iterative process improvement within projects.
    - Encouraging "Internal Tooling": Encourage students to develop simple custom tools or scripts (like the Excel sheets) to overcome project inefficiencies, fostering a mindset of proactive problem-solving.

5. The Criticality of Proactive Documentation and Knowledge Sharing:

- Problem: The initial lack of clear documentation (relying on old, unresponsive training videos) was a major pain point, leading to wasted effort and slow onboarding. Initial observations showed that by the end of the first month, the team had done more price analysis and troubleshooting than development work. The PM's documentation drive (creating comprehensive guides with images and links) was a key factor in Team 2 "leapfrogging" Team 1 in progress.

- Lesson/Recommendation: Emphasize systematic knowledge capture and dissemination as a core engineering and project management skill, not an afterthought.
  - "Living Documentation" Practices: Teach methods for creating and maintaining useful, accessible documentation throughout the project lifecycle.
  - Peer Training and Mentorship Models: Incorporate activities where students train each other (as Team 2 was trained using recordings of Team 1's work), reinforcing the value of clear articulation and shared understanding.

6. Understanding Business Context and Client Communication:

- Problem: The "startling picture" observed during client meetings, where the client possessed crucial printing pricing knowledge but assumed the development team shared this understanding, highlights a common communication gap.
- Lesson/Recommendation: Engineering programs should integrate more robust training on client communication, requirements elicitation in ambiguous domains, and understanding the client's broader business model and constraints, not just technical specifications.

By integrating these lessons, engineering education can better equip graduates with the adaptive, resilient, and context-aware skills necessary to thrive in complex, volatile project environments like the one detailed in this case study. This moves beyond teaching Agile as a set of ceremonies to fostering a deeper understanding of its principles and the necessary adaptations for diverse real-world applications.

4. Conclusion

This paper investigated the pronounced challenges of applying standard Agile Scrum methodologies within the specific context of a middleman-driven web-to-print e-commerce platform, an environment characterized by high pricing volatility and significant tool-to-task mismatches. The case study presented revealed that such conditions can lead to considerable project disruptions, with externally dictated pricing and the limitations of manufacturer-centric SaaS tools severely undermining sprint stability and team productivity. Key findings from this study highlighted that a substantial portion of sprint work (30%) was consumed by reactive pricing adjustments, and 80% of daily standup disruptions were directly attributable to pricing volatility and associated tooling issues.

Through a participant-observer approach involving direct intervention and process redesign over a four-month period, this research documented a series of successful adaptations. These included the implementation of a parallel "Pricing SWAT team" workflow, the development of custom tooling workarounds (such as Excel-based pricing emulators and automations), proactive documentation, and enhanced client communication strategies. These interventions demonstrably reduced product setup times from an estimated three weeks to four days, virtually eliminated pricing-related standup interruptions, improved team morale, and led to higher client satisfaction.

The practical successes and learnings from these ad-hoc measures culminated in the conceptualization of the "Pricing-Aware Sprints" model. This proposed hybrid Agile framework, with its dual-stream approach to decouple high-volatility pricing research from core development tasks, offers a structured and potentially sustainable solution for managing projects in similar intermediary sectors.

The primary contribution of this paper lies in its detailed empirical analysis of Agile's friction points in a middleman e-commerce context and the subsequent development of a targeted, actionable framework. It moves beyond identifying problems to proposing a replicable model. Furthermore, this study offers significant implications for engineering education, underscoring the need to prepare students for: the realities of volatile project environments beyond idealized Agile scenarios, the value of role fluidity and hybrid skill sets, the challenges of tooling mismatches, the importance of process innovation, and the criticality of robust documentation and client communication. These lessons advocate for a more context-aware and adaptive approach to teaching Agile methodologies.

While this study provides valuable insights from a single in-depth case, future research should focus on empirically testing the "Pricing-Aware Sprints" model across diverse middleman sectors (e.g., travel aggregation, wholesale distribution) to assess its broader applicability and refine its components. Further investigation into developing specific pedagogical tools and simulation models to integrate these complex project management scenarios into engineering curricula would also be beneficial.

Ultimately, this research underscores that while Agile principles are robust, their effective application in increasingly specialized and volatile business landscapes requires continuous adaptation and a willingness to develop hybrid approaches. By preparing engineers to navigate such complexities with both technical acumen and process Cunning, both industry practice and educational frameworks can evolve to meet the dynamic demands of the modern economy.

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