

Productivity and Quality Challenges of Novice Developers in Agile Engineering Environments - A Comparative Study

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Abstract: The Agile methodology has significantly transformed the landscape of software development, offering a dynamic approach that prioritizes adaptability and customer feedback. This paper harnesses insights from the authoritative State of Agile report, an annual publication produced by CollabNet and Digital.ai. Findings of six financial years (2015-2021) reveal the current positioning of the software development community in terms of agile adoption and the prevalent trends. This finding was elaborated with a micro survey, conducted targeting various agile roles within software development companies focusing on novice developers. An in-depth exploration offers a granular view, underscoring the reasons behind the significance pinpointed in the State of Agile reports. Overall, this research provides a comprehensive understanding of Agile's impact, its evolving trends, and its implications for diverse software development teams.

Keywords: Agile methodologies, State of Agile Report, Heterogeneous Experience Team Dynamics, productivity challenges, requirement changes

1. Introduction

The agile software engineering environment emerged in response to the rigid and often slow-moving traditional software development methodologies, such as the waterfall model. With the proclamation of the agile manifesto in 2001, a new approach prioritizing collaboration, customer feedback, and adaptability was introduced. Agile methodologies, like Scrum and Kanban, emphasize iterative development cycles, called sprints, and promote continuous communication among cross-functional teams. This dynamic environment allows for rapid responses to changes, fostering innovation, and ensuring the delivery of value to end-users with greater frequency and adaptability. With its ability to swiftly address market dynamics and user needs, agile methodologies gained global adoption, revolutionizing software development across various industries.

The State of Agile survey [1] has consistently highlighted various dynamics influencing the agile landscape, prompting deeper investigations into the factors at play. Drawing insights from the state-of-the-art agile survey, a micro survey was done to provide a granular understanding of these dynamics in the context of newcomers in agile teams. While the novice developers bring fresh insights and approaches, it introduces elements of unpredictability, especially in productivity and quality metrics. This paper studies the intricacies of these challenges posed by the newcomers, and potential solutions to harmonize adaptability with structure.

1.1 Challenges of Novice Developers

In the dynamic software development ecosystem, especially within the agile framework, clear communication, precise requirements, and feedback loops are the cornerstones. Yet, a glaring disconnect between developer output and customer feedback frequently surfaces. This gap particularly affects the productivity and quality deliverables of newer developers. Such issues manifest in several ways. Developers often find themselves

revisiting the same requirements due to misinterpretations or shifting expectations, leading to repetitive iterations. Testers too grapple with these inconsistencies, continuously assessing the same user stories, a process that compounds inefficiencies over time. This relentless cycle of rework and testing extends development timelines, leading to an inevitable surge in costs. Such delays and the financial burden harm the relationship and trust between the developers and stakeholders, especially the customer. The ultimate is that the dissatisfied customers, who are pivotal to a business's success, exit from future collaborations.

Moreover, the agile approach, celebrated for its flexibility and emphasis on feedback, can become a conundrum. Instead of facilitating adaptability, it can sometimes loop into an endless cycle of misaligned tasks and objectives. New developers trying to navigate this maze often feel swamped, which compromises both quality and productivity. Given these intricacies, it's imperative to address the issues new developers face. The aspiration is to evolve from the prevailing chaos into a seamlessly functioning, productive software development realm.

While the adoption of agile practices is globally increasing, its positive impact on productivity and quality needs greater attention. This paper extends the annual State of Agile report in the context of heterogeneous experience teams by conducting a micro field survey to study the impact of freshers on the productivity of the team and quality of the deliverables. The results are highlighted with potential transformations to be incorporated.

2. Productivity and Quality in Agile

The State of Agile report, has over the years delineated the evolving landscape of agile practices, consistently emphasizing productivity and quality. This literature review, informed by the report's findings, delves into the fluctuating trends of productivity and quality within agile environments over the years.

2.1 Fluctuating Trends in Productivity

The promise of increased productivity has been a major driver behind agile's adoption. Highlighted benefits, such as improved project visibility and accelerated product delivery, have consistently emerged as manifestations of agile's potential to enhance productivity. Foundational practices, from daily stand-ups to short feedback loops, have played pivotal roles in aligning team efforts and driving productivity [2],[3].

However, this rise in productivity has not been linear. Certain reports have highlighted instances where agile adoption initially spiked productivity, only for it to plateau or even decline in subsequent stages. Such variations are often attributed to challenges like resistance to change, inconsistent agile practices across teams, and the complexities tied to scaling agile in expansive corporate setups [4].

2.2 Quality Impediments in Agile

In terms of quality, the State of Agile report has consistently portrayed agile as a catalyst for enhanced software robustness. With an emphasis on practices such as Test-Driven Development (TDD) and continuous integration, organizations have reported fewer defects and improved software reliability [5]. Yet, just like productivity, the journey towards impeccable quality has seen its ebb and flow. Some editions of the report indicated spikes in software quality, while others pointed towards phases where quality enhancements remained stagnant or dipped, potentially due to challenges in implementing and adhering to agile principles consistently [6].

2.3 Challenges in Agile Environments

Agile methodologies have rapidly expanded in adoption, celebrated for their promise of flexibility, adaptability, and heightened customer satisfaction. Nevertheless, for budding software developers, Agile terrains come with their set of unique challenges.

Software developers have often chosen tasks based on personal preferences like interest or expertise, rather than project needs, which contrasts with agile principles prioritizing essential functionalities. This personal approach sometimes deviated from planned tasks, especially when direct communication between developers and customers took place, leading to inefficiencies [7]. Despite agile's emphasis on open dialogue, there were notable communication gaps within teams. Decisions were occasionally made without the full team's input, missing out on collective insights. Such human-centric challenges, including task choices driven by individual preferences and communication disconnects, hindered agile's collaborative spirit [8],[9].

The importance of team management, motivation, and customer satisfaction as crucial factors for productivity was underscored. However, there was a significant concern: a lack of management support frequently led to the derailment of agile projects. When looking at estimation challenges, particularly within Scrum teams, a myriad of issues arose. Estimating tasks within tight sprint durations proved difficult, and delays in one sprint could adversely affect the following sprints, potentially threatening the overall project timelines. In a study focusing on agile implementation in government settings, a wide range of challenges were identified, including the absence of key roles, reluctance to adopt new methods, training gaps, and infrastructural issues. At a macro level, challenges in scaling agile were explored. This research outlined various challenges, pinpointing obstacles related to organizational culture, stakeholder engagement, and product quality[10], [11].

2.4 Documentation in Agile

Over the years, as agile methodologies have evolved, one of the key areas of discussion has been the role of documentation. The agile manifesto itself prioritizes "working software over comprehensive documentation," hinting at a shift from traditional software development paradigms where exhaustive documentation was the norm. However, this principle has sparked debate within the agile community. On the one hand, there's an appreciation for agile emphasis on delivering tangible results and avoiding documentation for documentation's sake, which can lead to inefficiencies and delays.

On the other hand, concerns arise regarding the potential risks of insufficient documentation, such as knowledge loss when team members leave, or challenges in scaling and integrating solutions in larger systems. This tension has led to a more nuanced understanding: while agile does not dismiss documentation, it encourages discernment about what, when, and how much to document, always keeping in mind the end goal of delivering value to the customer. The evolution of agile has thus brought to the fore a balanced perspective on documentation, recognizing its importance while advocating for efficiency and relevance.

3. Methodology

The State of Agile report provides valuable insights into the adoption, practices, and challenges associated with agile methodologies in the software development world. This annual survey was initiated in 2006 by VersionOne, a software company that provides agile project management solutions and later as CollabNet and then as part of Digital.ai in 2020. The report serves as an authoritative benchmark for companies looking to embrace agile or improve their current agile practices. Using data and findings from the State of Agile report, 10th to the 15th Annual Reports, between the years 2015 and 2021, the current context where the software development community stands in terms of agile adoption can be stated. From the State of Agile reports, five prominent parameters are selected. These parameters are analyzed to identify trends spanning six financial years, specifically focusing on the topics "Reason for Adopting Agile" and "Benefits of Agile." Their importance is subsequently identified and examined.

A micro survey is conducted among agile software development companies with multiple roles of agile to know the efficacy of agile environments, particularly when the teams are heterogeneous, having members with different years of experience and backgrounds. The detailed nature of the micro survey further elaborates on the reasons for the significance identified in the State of Agile reports.

3 Findings from State of Agile Survey

Collating the annual reports of the state of agile and comparing two dominant factors namely the rationale for agile adoption and its benefits, deeper issues are highlighted which need to provide bespoke strategies to address and enhance the efficacy of agile process.

3.1 Rationale for Agile Adoption Over the Years

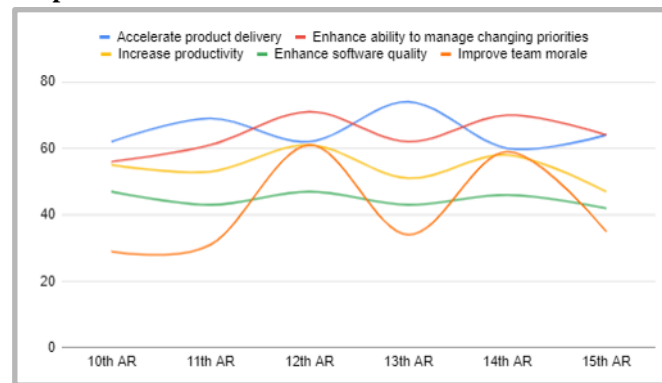


Fig 1: Reasons for Adopting Agile

Figure 1 shows that the reasons for adopting agile suggests variability across all categories from the 10th to the 15th Annual Report.

"Accelerate product delivery" remains relatively stable, fluctuating within a close range. "Increase productivity" shows a noticeable decline, while "Enhance software quality" oscillates within a narrow band. "Improve team morale" demonstrates the most significant variation, with a sharp spike in the 12th report followed by a decline. Similarly, "Enhance ability to manage changing priorities" rises initially but reverts by the 15th report. Overall, none of the reasons present a consistent upward trend, indicating shifting perceptions or priorities regarding agile benefits over the surveyed years.

3.2 Benefits of Agile

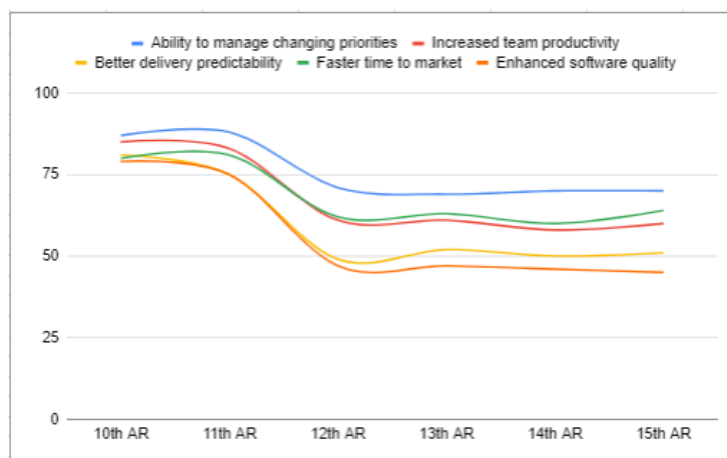


Fig 2: Benefits of Agile

Figure 2 brings to the fore some compelling insights regarding the tangible benefits reaped from agile methodologies. 'Ability to Manage Changing Priorities' consistently ranking high reiterates agile's inherent forte in adaptive prioritization, catering to volatile market demands and client needs. But, this positive is juxtaposed with the variability observed in metrics like 'Increased Team Productivity' and 'Enhanced Software Quality'. Such variations insinuate that the multifaceted benefits promised by agile may require more bespoke strategies or supplementary measures to ensure consistent improvements in team productivity and software quality.

A closer inspection of data trends also reveals that while aspects like 'Faster Time to Market' and 'Better Delivery Predictability' feature prominently, their fluctuating patterns intimate the mutable nature of business objectives over the years. It becomes discernible that despite business value and customer satisfaction occasionally overshadowing other metrics, the quest for unwavering productivity and impeccable software quality remains an indispensable ambition for IT enterprises.

Although some factors dominate the State of Agile survey, most of the factors are fluctuating. However the need to focus on productivity and quality is strongly evident.

4. Micro Survey with Heterogeneous Teams

To comprehend the agile practices within software development organizations, a structured questionnaire was designed to conduct a survey with heterogeneous experience teams. The primary intent behind the survey was to discern the nuances and varied approaches to agile methodologies. The questionnaire was disseminated among 44 software development organizations known to employ agile practices. The questionnaire focused on the concerns related to productivity and quality in involving freshers with objective and open-ended questions.

Productivity Concerns: Agile is fundamentally about iterative development and delivering value. Therefore, understanding respondents' sentiments about sprint commitments is pivotal. If teams consistently feel their sprints are overambitious, it's an indicator for organizations to revisit their planning dynamics. Equally important is gauging the perceived impact of team members with lesser experience. The original observation that sparked this survey centered on this very aspect, making it essential to corroborate or challenge that observation systematically. Additionally, by cataloging frequent productivity hurdles, the survey can offer organizations a priority list of areas to address.

Quality Metrics: Quality is the linchpin of any software delivery. Balancing speed and quality is a quintessential challenge in agile settings. Thus, discerning how often teams feel they compromise quality for speed can provide organizations with critical feedback. Do they need to recalibrate expectations? Or perhaps invest in better testing tools or training? The factors affecting quality, when identified, can be the roadmap to enhancements.

Open Feedback: The open-ended section acts as a catch-all, granting respondents the liberty to voice unique concerns, share anecdotes, or propose solutions. Such qualitative feedback, when juxtaposed with the quantitative data, paints a richer, more holistic picture of the agile landscape in the surveyed organizations.

Questionnaire: Survey on Productivity and Quality Challenges in Agile Process

Profile of the participant with Location, Role and Years of experience in Agile environments is considered.

1. *How often does the team feel that sprint commitments are unrealistic?*
2. *Does the presence of fresh or less-experienced team members affect the team's productivity?*
3. *Challenging factors for productivity...*
 - a. Frequent changes in requirements
 - b. Inadequate tools or infrastructure
 - c. Lack of clarity in user stories or requirements
 - d. Too many meetings
4. *How often do you feel quality is compromised to meet sprint deadlines?*
5. *The factors that most commonly affect software quality (Select all that apply)*
 - a. Insufficient testing time
 - b. Incomplete requirements
 - c. Lack of expertise or training
 - d. Pressure to meet deadlines
6. *What is the biggest challenge regarding productivity in the agile environment?*
7. *List three methods to improve software quality in agile projects.*

The responses laid the foundation for a multi-faceted analysis. Developers in agile environments predominantly fall within the novice (24%) and early-stage practitioner (30%) categories. Business analysts are primarily early-stage practitioners (50%) or novices (37.5%), indicating a relatively recent immersion in agile engineering. QA/Testers have a balanced distribution, with the most significant portion being mid-level practitioners at 37.5%. Product owners display a diverse experience spectrum, with both mid-level and veteran stages each accounting for 27.27%. Scrum masters are primarily mid-level practitioners, representing 50% of their group. Furthermore, specialized roles, such as senior cloud developer & architect and senior manager, emphasize the depth of agile integration in high-ranking positions, with a significant portion being veterans.

6. Results and Analysis

Given our emphasis on the influence of novice developers on productivity and quality, our comparative study is tailored specifically to assess the impact on these two metrics based on data from the survey.

6.1 Productivity Challenges

From the "Heterogeneous Experience Team Dynamics in Agile Environments Survey," there is a variety of perceptions regarding sprint commitments.

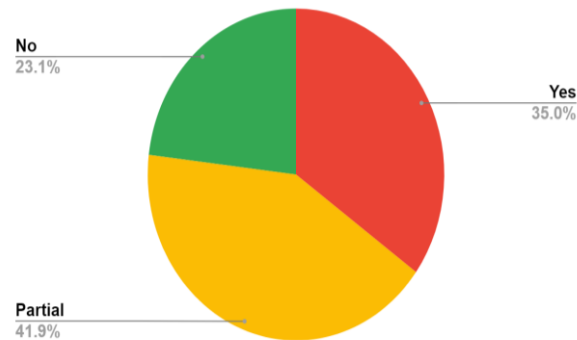


Fig 3: Unrealistic Sprint Commitments

From Figure 3, Sprint commitments are often perceived as unrealistic by 35% of respondents. Meanwhile, 41.9% remain uncertain about their commitments' feasibility. And so, it is evident that nearly 75% of the respondents are uncertain about the realism of sprint commitments.

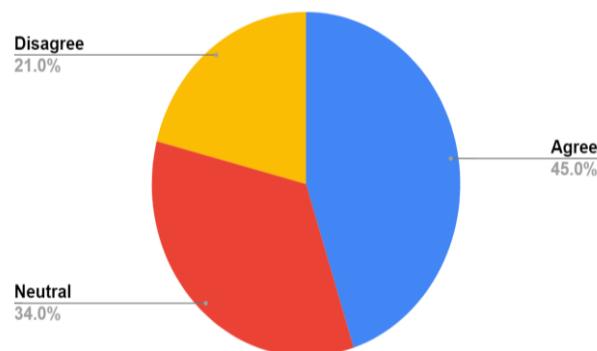


Fig 4: Impact of Novice Team Members on Overall Productivity.

Figure 4, explained that 45% of the team believes that less-experienced members impact productivity, while 34% remain neutral, indicating potential concerns.

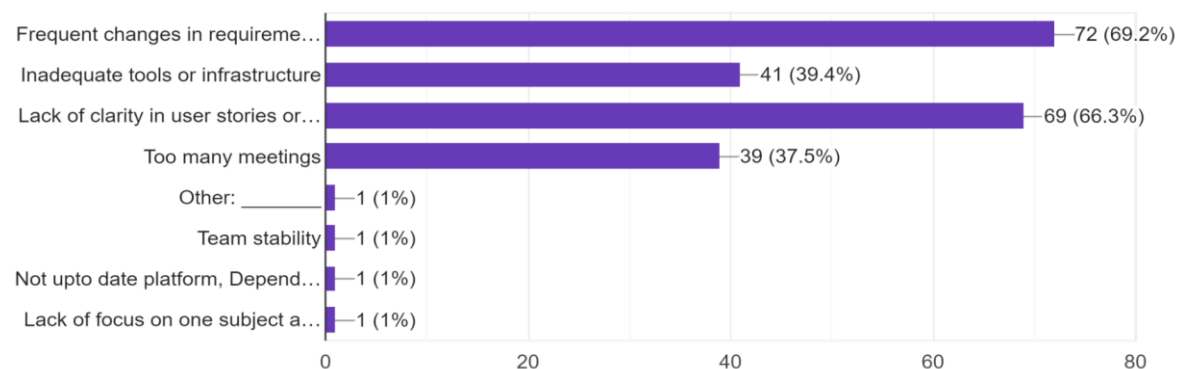


Fig 5: Factors Identified as Challenging for Productivity in Agile Teams

Furthermore the Figure 5 shows some challenges impacting productivity recurrently mentioned include frequent changes in requirements, lack of clarity in user stories or requirements, too many meetings, and inadequate tools or infrastructure.

6.2 Challenges in Quality

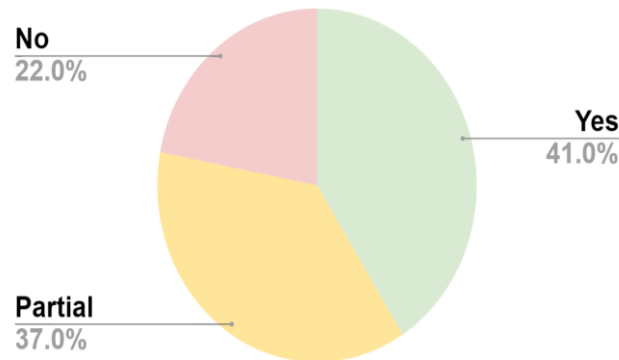


Figure 6: Frequency of Quality Compromise to Meet Sprint Deadlines

41% of the team feels that quality is often or always compromised to meet sprint deadlines, while 22% rarely or never feel this way. A significant 37% have a partial agreement on the compromise.

6.3 Factors Impacting Software Quality in Development Processes

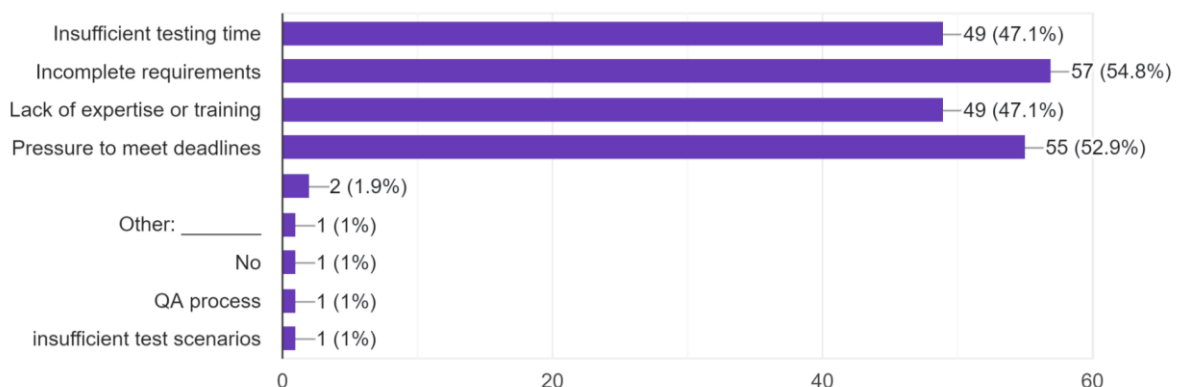


Fig 7: Factors Impacting Software Quality in Development Processes

The above Figure 7, In the bar chart representation highlighting factors impacting software quality, both 'Pressure to meet deadlines' and 'Incomplete requirements' are significant concerns.

7. Findings and Discussion

The State of Agile report consistently demonstrates the fluctuating factors dominating the annual survey. While many elements ebb and flow, the emphasis on productivity and quality remains consistent. This observation led to the execution of a micro survey to delve deeper into the underlying reasons for such fluctuations in the state of agile factors.

Highlight of Micro Survey Results:

1. **Ambiguity in Sprint Commitments:** There's an evident lack of confidence in sprint commitments, with a significant 75% of respondents expressing doubts about their realism. This lack of clarity can lead to missed deadlines and overall dissatisfaction within teams.
2. **Influence of Newcomers:** The survey clearly shows that novice or less-experienced team members have a considerable impact on both productivity and the quality of deliverables. 45% of respondents believe that newcomers affect productivity, suggesting a potential skill or experience gap.

3. Operational Challenges: Factors such as frequent changes in requirements, unclear user stories, excessive meetings, and lack of proper tools contribute to productivity issues. Such operational challenges can disrupt the smooth functioning of agile teams.
4. Quality Sacrifices: The pressure to meet deadlines often results in compromised software quality, as indicated by 41% of the respondents. This trade-off can lead to long-term repercussions, including technical debt and dissatisfied stakeholders.
5. Determinants of Software Quality: The survey pinpoints two predominant concerns affecting software quality: the urgency to meet tight deadlines and incomplete requirements. These challenges can significantly disrupt the software development lifecycle, leading to further challenges downstream.

Thus, the State of Agile survey, bolstered by insights from a micro survey, has brought to light key challenges in the realm of agile team dynamics. Notably, the continuous fluctuations in these dynamics, as underscored by the survey, are a primary concern. A deeper examination through the micro survey elucidated that newcomers to agile teams significantly contribute to these fluctuations.

While these newcomers infuse teams with fresh perspectives, they often grapple with the lack of domain functional points, which translates to an unfamiliarity with specific domain intricacies. This lack, when combined with the challenges of navigating the inherently flexible and adaptive nature of methodologies like scrum, can lead to marked decreases in both productivity and quality. Recognizing these hurdles, the survey findings advocate for the integration of structured, prescriptive processes. Such processes, by offering clear and systematic guidelines, can serve as invaluable roadmaps for newcomers. This structured approach not only facilitates their smoother assimilation into agile teams but also ensures that they contribute meaningfully, maintaining the high standards of productivity and quality in software development. The overarching message from the findings is clear: while agility is paramount in the agile methodology, there's a compelling need for structure, especially when integrating newcomers, to ensure consistent and optimal outputs.

8. Conclusion

The research conducted through the State of Agile report, along with the insights from the detailed micro survey, has shed light on the intricate challenges of assimilating newcomers into agile teams. These newcomers, despite bringing a fresh perspective, often find themselves at a disadvantage due to their lack of domain functional points. This unfamiliarity with specific domain intricacies, when combined with the challenges of navigating the inherently flexible nature of methodologies like scrum, leads to a pronounced decrease in both productivity and quality. The research findings emphasize the importance of structured, prescriptive processes in addressing these challenges. By offering clear and systematic guidelines, these processes can serve as foundational roadmaps for newcomers, ensuring their smooth integration and meaningful contribution to agile teams. Furthermore, this structured approach is pivotal in maintaining the high standards of productivity and quality in software development. In summing up, while adaptability remains a cornerstone of the agile methodology, the research underscores the indispensable need for structure, especially when integrating newcomers. This ensures that teams consistently deliver optimal outputs, leveraging the strengths of all members, irrespective of their tenure.

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