

Assessing the Relationship Between DevOps Practices and Customer Satisfaction: A Preliminary Analysis

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Abstract. The advent of digitalization in the 21st century has significantly transformed how businesses develop and implement strategies. In this evolving context, DevOps practices have emerged as essential methodologies to improve the efficiency and effectiveness of software delivery and operations. Despite recognizing the benefits of DevOps, a significant research deficiency exists regarding the relationship between DevOps maturity and customer satisfaction. To address this gap, this study analyzes the relationship between DevOps maturity and business customer satisfaction. The methodology involved surveying IT professionals from several Brazilian companies to assess the implementation and maturity of their DevOps practices. Concurrently, customer satisfaction data were extracted from the Brazilian consumer feedback platform Reclame Aqui to establish an external metric for analysis. The preliminary analysis results revealed a moderate negative correlation between the change failure rate (CFR) and customer satisfaction, indicating that organizations that experience fewer deployment failures tend to achieve higher customer satisfaction levels. In contrast, no statistically significant relationships were observed between customer satisfaction and other performance indicators typically associated with DevOps, including deployment frequency, mean recovery time (MTTR), and change lead time. In conclusion, effective DevOps practices may improve customer satisfaction by reducing deployment failures. However, it emphasizes the need for more research involving larger datasets and a more comprehensive analysis to validate and extend these initial findings. Organizations are encouraged to improve deployment reliability and foster an organizational culture supportive of DevOps practices to realize more significant customer satisfaction benefits.

Keywords: Software Engineering · DevOps Practices · Customer Satisfaction · Continuous Improvement

1 Introduction

Ensuring robust and resilient software delivery requires safety nets that protect the customer experience from degradation as changes are introduced. As declared

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by Forsgren et al. [6], DevOps is not merely a set of tools or isolated practices; it is an integrated approach that demands attention to both technological processes and the underlying culture that supports them. Moreover, it emphasizes that while the rapid deployment of new features is crucial, these changes must not compromise the external quality experienced by customers, but rather refine internal operations.

When implementing DevOps practices, organizations often rely on continuous integration and automated testing as safety nets to preserve service quality. However, if these underlying processes are not robust, the benefits of rapid delivery can be negated by increased service disruptions or degraded performance [3]. Some researchers have suggested employing detailed performance monitoring and incident analysis to safeguard against such degradation [6]. Specifically, evaluating key performance indicators, such as deployment frequency, change failure rates, and recovery times, provides insight into how well the organization maintains service stability despite frequent changes. Forsgren et al. [6] demonstrate that comparing these metrics before and after the adoption of DevOps practices can reveal both improvements and potential shortcomings.

In this paper, we propose a study to assess the relationship between the maturity of DevOps practices and customer satisfaction. Unlike previous work that has focused solely on technical metrics, this study integrates quantitative customer satisfaction data with internal performance indicators to provide a comprehensive view of the impact of DevOps on business outcomes. Our research makes three main contributions: 1) extends established models by incorporating customer satisfaction as a key performance indicator; 2) proposes an integrated methodology to map DevOps maturity to customer experience; and 3) presents a preliminary analysis that explores the potential relationship between these dimensions.

The remainder of this paper is organized as follows: Sect. 2 provides the theoretical background necessary to understand the research question and the proposed approach. Section 3 reviews the related literature on DevOps and customer satisfaction. In Sect. 5, we detail our methodology for data collection and analysis. Section 4 presents the results of our study and discusses the findings. Finally, Sect. 6 concludes the paper and offers perspectives for future work and some recommendations.

2 Background

2.1 DevOps Principles and Performance Metrics

DevOps is a comprehensive approach that integrates software development with IT operations to accelerate delivery and improve product quality [7,12]. Central to this paradigm are practices such as continuous integration, continuous delivery, and continuous deployment, which enable teams to release updates frequently and reliably [1,8]. Fundamental principles include automation, measurement, and sharing, all supported by a culture of continuous improvement [7,15]. Key performance indicators – often referred to as the DORA metrics –

quantify DevOps maturity through measures such as deployment frequency, lead time for changes, mean time to recovery (MTTR), and change failure rate (CFR) [7,13,15]. Research has shown that companies with advanced DevOps practices experience fewer failures and faster recovery times, which streamline internal operations and contribute to superior business outcomes [1,8].

In addition to technical metrics, cultural factors play a crucial role. A robust DevOps culture – characterized by collaborative communication, shared responsibility, and a generative work environment, as defined by Westrum [16] – encourages teams to view failures as learning opportunities, thereby enhancing overall resilience [7,12]. Furthermore, lean methodologies that promote working in small batches enable early and iterative feedback, ensuring continuous refinement of both code and process [7,13]. In essence, standardized metrics provide a framework for organizations to benchmark their performance and drive targeted improvements, aligning operational excellence with strategic objectives [8,15].

2.2 Customer Satisfaction

Customer satisfaction is a critical indicator of an organization's success, reflecting the extent to which its products and services meet or exceed customer expectations [11,14]. It encompasses every touchpoint of the customer journey, from initial engagement to post-purchase support [2,5]. Widely adopted metrics, such as the Net Promoter Score (NPS) introduced by Reichheld et al. [14], classify customers as promoters, passives, or detractors based on their likelihood of recommending a brand [2,14]. In the Brazilian context, platforms like Reclame Aqui[1] (RA) aggregate consumer feedback and complaint resolution data to generate comprehensive reputation scores, serving as proxies for customer satisfaction [5,11]. High customer satisfaction is closely linked to customer retention, positive word-of-mouth, and improved financial performance [2,14]. Moreover, understanding customer satisfaction enables organizations to identify areas for product and service enhancement [5,13]. Researchers such as Becker [2] and Kucukosmanoglu [10] emphasize that the customer experience is multidimensional, encompassing cognitive, emotional, and behavioral responses throughout the entire journey. When companies integrate these external satisfaction metrics with internal performance data, like those obtained from DevOps practices, they achieve clarity on the efficacy of the internal processes concerning customer outcomes [7,14]. This integration is critical when developing strategies that enhance operational efficiency and competitiveness in the market [8,13].

3 Related Work

The past decade has witnessed both academic and rigorous industry approaches toward the advancement of software delivery processes and operations management. Within the scope of these works, it is hard to miss the book published

[1] http://www.reclameaqui.com.br.

by Forsgren et al. [7]. In their work, *Accelerate*, the authors claimed that after conducting a qualitative study for more than four years collecting evidence and technical practices along with cultural components of software organizations, their driving business value is the result of organizational engineering toward measurable results. Extracted from their work, there is much emphasis on critical value drivers —now popularized as DORA metrics: deployment frequency, lead time for changes, mean time to recovery, and change failure rate —also referred to as the maturity index of DevOps practices. This framework highlights the importance of technical automation and process integration and values a high-performance, supportive organizational culture.

Oriented by the principles of *Accelerate*, later studies aim to broaden and deepen the understanding of DevOps. For example, Bertolino et al. [3] proposed integrating reliability testing within the DevOps cycle, presenting the DevOpRET methodology. DevOpRET leverages operational profile-based testing, which uses real-world data to simulate user interactions and continuously refine reliability estimates. Their work demonstrates that by embedding reliability assessments into the acceptance testing phase, organizations can achieve more consistent and robust software performance, even as the frequency of deployments increases. This study, which emphasizes the integration of testing with deployment practices, complements the DORA metrics by providing an in-depth look at how software reliability can be systematically improved.

In their paper, Leite et al. [12] provide a detailed survey of DevOps concepts, tools, and challenges. It is especially commendable for attempting to organize the myriad practices and terms developed in DevOps. Leite et al. [12] divides DevOps into several dimensions such as automation, continuous integration, delivery, collaboration, and monitoring, giving organizations a self-contained framework to use to assess their practices. This survey also confirms many of the findings of *Accelerate* but additionally pointed out some other issues like cultural resistance, toolchain complexity, and lack of meaningful metrics. Their analysis illustrates that some level of technical capability is required, but more often than not, the difficulty lies in the people and structure of the organization.

Offerman et al. [13] conducted a worldwide survey to analyze the scope and effect of DevOps practices in the organization. Their research outlines 14 automated subsystem monitoring configuration management practices and subpractices. A significant takeaway from Offerman et al. [13] is the excellent degree of relations between the level of automation and the operational failure rate of a system. This adds to the argument that some level of automation, complemented by a good culture, significantly improves the reliability of services and business outcomes. In addition, the study underscores that companies with a developed DevOps culture dominated peers not only on internal performance measures but also on externally visible ones [13].

Agile practices, which have long been associated with rapid and flexible software development, are also central to the literature on DevOps. Ghimire and Charters [8] investigate the impact of Agile methodologies on project outcomes, focusing on the synergy between agile and DevOps practices. Their work reveals

that the adoption of agile practices, such as stand-ups, user stories, and retrospectives, improves communication and alignment within teams, leading to clearer project requirements and better customer interactions. This is particularly important because agile methodologies emphasize iterative development and continuous feedback, principles that are fundamental to both DevOps and customer satisfaction. The integration of agile with DevOps creates a virtuous cycle: agile methods drive rapid iteration, while DevOps ensures that these iterations are delivered reliably, resulting in a smoother customer experience.

One of the many things discussed as part of DevOps in existing literature is the concept of organizational culture. The Westrum typology [16] defines three types of organizational culture: pathological, bureaucratic, and generative. Software delivery has been shown repeatedly to be better when there is a generative culture in place, which is marked by high cooperation, free flow of information, and collective accountability. Many of these studies, such as those conducted by Forsgren et al. [7] and Leite et al. [12], emphasize that culture is just as important as technical practices. Research evidence also supports that trying to understand why highly cross-functionally collaborative teams with a no-blame culture tend to make changes with greater speed, a lower failure rate, and faster recovery [8,13]. It is evident that technology and people need to be systematically integrated to attain excellent efficiency in DevOps.

Another important line of research examines the interplay between technical practices and customer satisfaction. Customer satisfaction is increasingly recognized as a critical metric for business success. Reichheld et al. [14] introduced the Net Promoter Score (NPS), which categorizes customers based on their likelihood of recommending a product or service. This metric has been widely adopted in various industries to assess customer loyalty and predict business growth. In Brazil, platforms such as Reclame Aqui offer an alternative perspective by aggregating consumer feedback and complaint resolution data to generate comprehensive reputation scores. Studies by Kucukosmanoglu [11] and Chrysochou [5] have explored the nuances of customer satisfaction and brand loyalty, illustrating how these metrics not only reflect product quality, but also capture the overall customer experience. The relationship between internal operational metrics, such as those provided by DevOps practices, and external customer satisfaction has become an area of intense study. By linking internal performance data (such as deployment frequency, lead time, and failure rates) with customer-centric metrics (such as NPS and Reclame Aqui scores), researchers are beginning to uncover how improvements in software delivery can translate into enhanced customer experiences.

The literature presents a comprehensive perspective on DevOps by emphasizing its technical and cultural dimensions. These dimensions, thoroughly articulated by Forsgren et al. [7], constitute the foundation of high-performing software organizations. This foundation is expanded by studies that integrate reliability testing [3], systematize the various DevOps practices [12], and quantify the impact of these practices on both internal performance and customer results [8,13]. Furthermore, the discussion of organizational culture [16] and customer

satisfaction [5,11,14] highlights the interdependencies between how companies operate internally and how they are perceived externally.

In summary, the collective body of research indicates that while technical prowess in software deployment is necessary, the synergy between robust technical practices, a supportive organizational culture, and the continuous pursuit of improvement ultimately drives business success. This integrated approach lays the foundation for future studies and serves as the impetus for our research. By investigating the correlation between DevOps maturity and customer satisfaction, our work aims to extend these insights and provide actionable recommendations to organizations seeking to optimize both their internal processes and their external service quality.

4 Research Design and Data Collection

To examine the connection between customer satisfaction and DevOps practices, a mixed-method approach was used, combining qualitative insights with quantitative data collection and statistical analysis. The primary data collection method was a survey, and secondary data was collected from public customer feedback websites.

The survey was designed following established guidelines in the literature [9] and based on the foundational framework presented by Forsgren et al. [7]. It comprised closed-ended questions, including multiple-choice items and Likert scale questions, aimed at capturing a wide array of DevOps dimensions. The survey questions were systematically categorized into respondent profile questions (Table 1), technical metrics aligned with the DevOps Research and Assessment (DORA) framework (Table 2), and cultural dimensions encompassing organizational culture (Table 3), team burnout (Table 4), testing and deployment practices (Table 5), lean product development practices (Table 6), organizational identity and culture (Table 7), and leadership perception (Table 8).

The key metrics quantitatively assessed through the survey included deployment frequency, lead time for changes, mean time to recovery (MTTR), and change failure rate (CFR). Furthermore, cultural elements such as shared accountability, cross-team collaboration, and team maturity were qualitatively assessed to provide additional context on how these factors affect organizational performance in DevOps. Such a thorough categorization required advanced statistical analysis to identify the relationship between customer satisfaction and the factors considered.

The study population comprised Brazilian citizens working in large enterprises as Software Developers, DevOps Engineers, System Administrators, and IT Managers. The survey was sent out through emails and LinkedIn, which helped achieve representation in various roles. The responses were collected and presented at the corporate level to maintain anonymity and reduce bias toward individual respondents, as all identifying details were removed.

Concurrently, external data on customer satisfaction were obtained from the Reclame Aqui platform, a widely recognized platform in Brazil that aggregates

consumer complaints and feedback to generate a comprehensive reputation score: the RA metric. This metric is calculated based on four weighted components: (i) the **response rate (RR)** – the percentage of complaints answered by the company (weight: 2); (ii) the **average evaluation (AE)** – the average customer rating on a scale from 0 to 10 (weight: 3); (iii) the **solution rate (SR)** – the percentage of complaints successfully resolved (weight: 3); and (iv) the **return business rate (RBR)** – the percentage of customers who would do business with the company again (weight: 2). The final RA score is computed using the following formula:

$$RA = \frac{(RR \times 2) + (AE \times 10 \times 3) + (SR \times 3) + (RBR \times 2)}{100}$$

Based on this score, companies are classified into five performance tiers: *Excellent* (8.0–10), *Good* (7.0–7.9), *Regular* (6.0–6.9), *Poor* (5.0–5.9), and *Not Recommended* (below 5.0). For the RA score to be considered valid, companies must have a response rate above 50% and at least 10 customer evaluations in the past six months. Moreover, companies that meet higher thresholds—such as RR and SR above 90%, AE above 7, RBR above 70%, and a minimum of 50 evaluations— may be awarded the prestigious *RA1000 Seal*, a distinction that signals consistent excellence in customer service.

Table 1. Respondent roles and DevOps involvement.

Question	Type
What is your position?	Open
In which company do you work?	Open
At what stage in your career are you?	Selection
Do you know what DevOps is?	Yes/No
Are you responsible for applying DevOps in your organization or do you participate in the application?	Yes/No
On a scale of 0 to 10, would you recommend the company you work for to a friend or family member?	Numerical
Employees agree to participate in the survey.	Likert

Table 2. Questions on DORA performance metrics.

Question	Type
In how many days does your company usually solve a critical problem like a bug? (MTTR)	Open
How long does it usually take from the moment a new idea or need for change is suggested until it is officially accepted for development? (Lead time for changes)	Open
When new updates or changes are made, what percentage of the time do you encounter problems or errors that require additional corrections or reversions to a previous version? (Change failure rate)	Open
How many times does your company deploy per month?	Open

Table 3. Items on organizational culture traits.

Question	Type
Information is actively sought	Likert
Messengers are not punished when delivering news of failures or other bad news	Likert
Responsibilities are shared	Likert
Collaboration between areas is encouraged and rewarded	Likert
Failures cause investigation	Likert
New ideas are welcome	Likert
Failures are primarily treated as opportunities to improve the system	Likert

Table 4. Questions measuring team burnout.

Question	Type
If they felt burnt out or exhausted	Likert
If they felt indifferent or cynical about work or felt ineffective	Likert
If their work was having a negative effect on their lives	Likert

Table 5. Testing and deployment practices questions.

Question	Type
We can do most of our tests without requiring an integrated environment	Likert
We can and do deploy or launch our application independently of other applications/services it depends on	Likert

Table 6. Questions on lean development behaviors.

Question	Type
My product team breaks products and features into small batches that can be completed in less than a week and released frequently, including the use of MVPs	Likert
Teams have a good understanding of the business workflow to customers and have visibility of this flow, including the status of products and features	Likert
Organizations actively and regularly seek customer feedback and incorporate this feedback into the design of their products	Likert
If development teams have authority to create and change specifications as part of the development process without needing approval	Likert

Table 7. Items on identity and organizational alignment.

Question	Type
I am satisfied to have chosen to work in this organization instead of another company	Likert
I talk about this organization to my friends as a great company to work for	Likert
I am willing to put in a lot of effort beyond what is normally expected to help my organization succeed	Likert
I think my values and the values of my organization are very similar	Likert
In general, people employed by my organization are working towards the same goal	Likert
I feel that my organization cares about me	Likert

Table 8. Leadership perception questions.

Question	Type
About my leadership [I am satisfied to have chosen to work in this organization instead of another company]	Likert
About my leadership [I talk about this organization to my friends as a great company to work for]	Likert
About my leadership [I am willing to put in a lot of effort beyond what is normally expected to help my organization succeed]	Likert
About my leadership [I think my values and the values of my organization are very similar]	Likert
About my leadership [In general, people employed by my organization are working towards the same goal]	Likert
About my leadership [I feel that my organization cares about me]	Likert

Data analysis incorporated both descriptive and inferential statistical techniques. The descriptive statistics summarized the central tendencies and dispersion of the survey responses, providing an initial overview of the current state of DevOps practices across the sample. For exploratory analysis, Pearson and Spearman correlation coefficients [17] were calculated to assess the relationships between the individual DevOps metrics and the RA metric. Pearson's correlation was employed to examine linear relationships, while Spearman's correlation was used to capture potential monotonic relationships, particularly given that some variables were measured on ordinal Likert scales.

Although this integrated methodology provides a robust framework for analysis, limitations such as sample size, reliance on self-reported data, and potential selection bias are acknowledged. These issues are carefully addressed through statistical confidence testing and are discussed in detail in subsequent sections. Overall, the methodological approach was intended to ensure that the study findings are valid and reliable, offering meaningful insights into how efficient DevOps practices can enhance customer satisfaction.

4.1 Survey Implementation and Sampling

According to Kasunic [9], identifying the target audience is essential when designing a survey. In this study, the target audience comprised managers, site reliability engineers, system administrators, software developers, agilists, and other IT professionals familiar with DevOps practices.

After gathering data, 62 responses were collected, allowing a comparative analysis of 23 different companies. The results were consolidated into Table 9 and Fig. 1. Table 9 provides a summary of the survey findings, presenting the minimum, maximum, and average values obtained for each question, effectively demonstrating the range and central tendency of the responses.

Table 9. Summary statistics of key survey responses.

Questions	Min	Max	Mean	Median
MTTR	0.05	7.00	2.15	1.00
Lead time for change in months	0.10	15.00	2.62	1.00
Change failure rate	0.01	1.00	0.21	0.10
Number of deployments per month	1.00	70.00	20.74	8.0
Information is actively sought	1.00	5.00	4.27	4.20
Messengers are not punished for reporting failures.	1.00	5.00	3.60	3.60
Responsibilities are shared	3.00	5.00	4.38	4.30
Collaboration across areas is encouraged	2.00	5.00	4.10	4.00
Failures lead to investigations	2.00	5.00	4.12	4.10
New ideas are welcome	1.00	5.00	4.45	4.40
Failures are treated as improvement opportunities	1.00	5.00	3.98	3.90
Employees feeling burned out	1.00	5.00	3.02	3.00
Employees feeling indifferent or ineffective	1.00	4.00	2.70	2.60
Employees feeling work negatively affects life	1.00	4.00	2.32	2.30
Most testing can be done without an integrated environment	1.00	5.00	3.06	3.00
Deployment can be independent of other services	1.00	5.00	3.40	3.40
Teams break features into small batches and use MVPs	1.00	5.00	4.09	4.00
Teams understand and have visibility of business flow	1.00	5.00	3.79	3.70
Organizations actively seek and incorporate customer feedback	1.00	5.00	4.11	4.10
Teams can change specifications without approval	2.00	5.00	3.63	3.60
Employees are happy they chose this company	1.00	5.00	4.29	4.20
Employees recommend the company to friends	1.00	5.00	4.15	4.10
Employees are willing to put in extra effort	1.00	5.00	4.33	4.30
Employees' values align with company values	1.00	5.00	3.90	3.90
Employees feel the company works towards the same goal	1.00	5.00	3.92	3.90
Employees feel the company cares about them	1.00	5.00	3.84	3.80
Employees agree to participate in the survey	4.00	4.00	4.00	4.00

To facilitate better visualization and understanding of the correlations among variables, Fig. 1 presents a detailed correlation analysis using both Pearson and Spearman correlation coefficients. This figure clearly illustrates the strength and direction of the correlations, helping to identify meaningful relationships and trends among the different variables measured in the survey. The visual representation improves readability and quickly conveys insights regarding the relationships between DevOps practices and customer satisfaction.

All data used in this research can be obtained through the replication package available at the Zenodo.org[2] repository.

5 Results and Analysis

The data collected from 62 questionnaires in 23 companies also indicate substantial variability in the implementation of DevOps practices, reflecting different levels of organizational maturity. As presented in Table 9, the mean time to recovery (MTTR) ranged from 0.05 to 7.00 d, with an average of 2.15 and a median of 1.00. Meanwhile, the lead time for changes fluctuated between 0.10 and 15.00 months, with an average of 2.62 and a median of 1.00. The change failure rate ranged from 0.01 to 1.00, with an average of 0.21 and a median of 0.10, while the frequency of monthly deployments varied from 1 to 70 (with an average of 20.74 and a median of 8). These indicators underscore both the agility of some continuous delivery processes and the challenges related to release quality, reflecting the heterogeneity of practices adopted by organizations.

The correlation analysis between these technical indicators and the RA index, which represents the customer satisfaction factor, in Fig. 2, reinforced the moderate negative relationship already mentioned between CFR and customer satisfaction. This finding suggests that lower change failure rates are associated with improved customer satisfaction, reinforcing the assertion by Forsgren et al. [7] that deployment reliability is a key driver of positive business outcomes.

In contrast, as noted by MTTR in Fig. 3, the lead time for changes in Fig. 4 and the deployment frequency in Fig. 5 did not exhibit statistically significant correlations with customer satisfaction, indicating that, on their own, these operational aspects may not directly reflect external perceptions of service quality. However, these findings go beyond the study by Forsgren et al. [6], which highlights deployment frequency and lead time for changes as a critical metric for elite performers, linking frequent deployments to faster feedback cycles and improved customer satisfaction. The absence of a similar correlation in this study may be attributed to differences in sample characteristics or methodological limitations, pointing to the need for more experiments in this research area.

In parallel, data on organizational culture, including shared responsibilities, collaboration between departments, failure investigation, and encouragement of innovation, showed weak to moderate positive correlations with customer satisfaction, as shown in 1. These findings support the idea that the consolidation of

[2] https://zenodo.org/records/15098963.



Fig. 1. Pearson and Spearman correlations between survey variables and customer satisfaction.

a collaborative and learning-oriented culture is key to positive client outcomes. Another key point from Fig. 1 reveals that organizational culture and employee well-being appear to have more consistently positive relationships with customer satisfaction than some of the classic DevOps indicators. Fostering an environment in which employees feel safe to report failures, actively seek information, and share responsibilities is positively correlated with external satisfaction metrics. It is worth noting that differences between Pearson and Spearman coefficients in several variables indicate that some relationships may be monotonic rather than strictly linear, suggesting potential threshold effects (for example, a "tipping point" in collaboration, after which satisfaction improves more sharply).

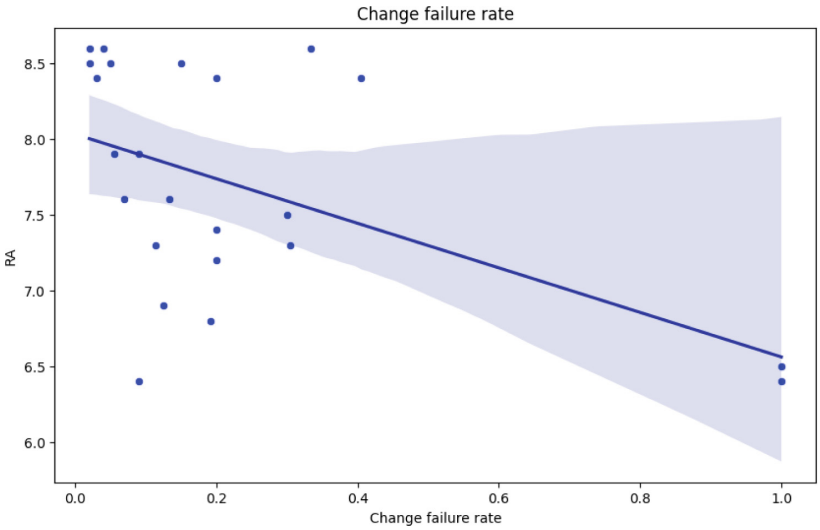


Fig. 2. Pearson and Spearman correlations between RA Metric and mapped companies change failure rates.

Continuing the examination of Fig. 1, although small-batch (MVP) development and independent deployments demonstrated mild to moderate correlations, they underscore the proposition that incremental, decoupled releases have the potential to enhance the user experience, particularly when integrated with com-

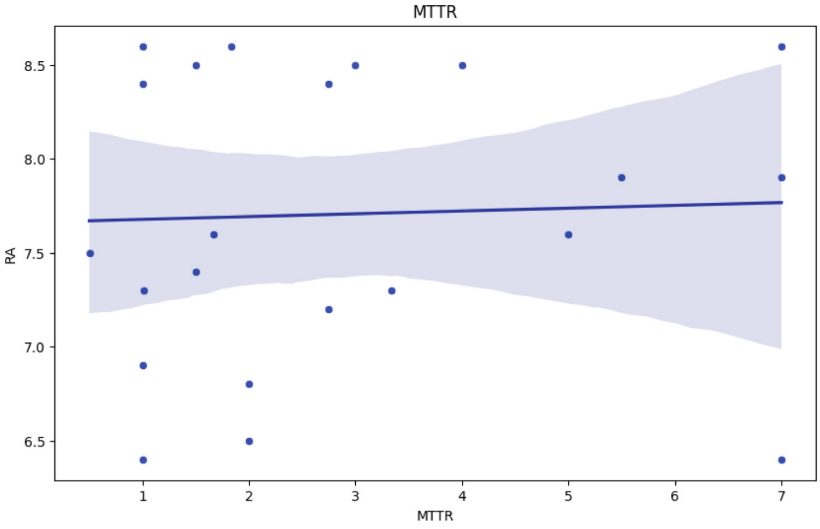


Fig. 3. Pearson and Spearman correlations between RA Metric and mapped companie's MTTR rates.

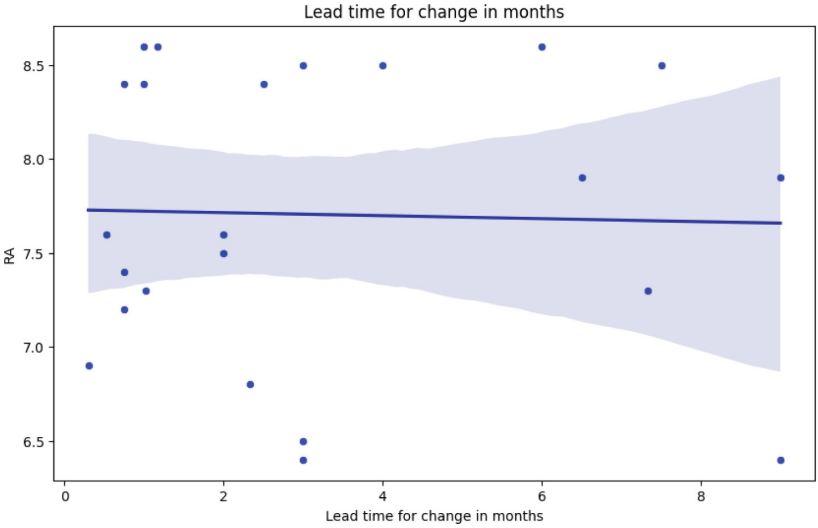


Fig. 4. Pearson and Spearman correlations between RA Metric and mapped companie's lead time for changes rates.

prehensive change management practices. In contrast, near-zero correlations for lead time and deployment frequency suggest that reliability, reflected by a lower CFR, may be more relevant to customers than speed or the sheer volume of releases.

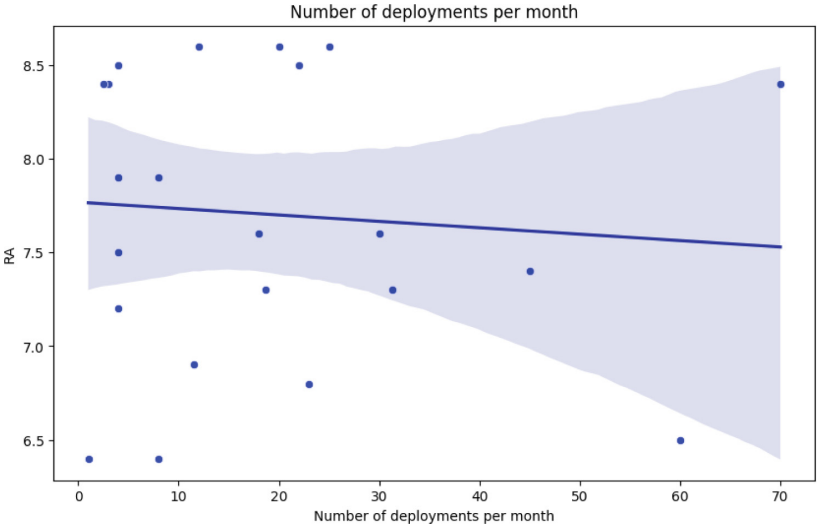


Fig. 5. Pearson and Spearman correlations between RA Metric and mapped companie's number of deployments rates.

In summary, these findings underscore the strategic relevance of reducing the change failure rate to improve customer satisfaction, aligning with continuous integration and continuous delivery practices to minimize implementation failures. However, the fact that other technical indicators do not show significant correlations with external perception suggests that operational efficiency alone is not enough to boost positive evaluations. Thus, the combination of technical excellence and a collaborative, learning-oriented organizational culture emerges as a promising path to achieve positive results. It should be noted that sample size limitations and data variability require caution in generalizing the findings, reinforcing the need for future research with larger samples and more refined methodologies to deepen the understanding of the relationship between DevOps practices and customer satisfaction.

5.1 Threats to Validity

Although this study provides valuable information on the relationship between DevOps practices and customer satisfaction, some limitations must be acknowledged. These limitations pertain to various threats to the validity of the findings, including the validity of internal, external, construct, and statistical conclusions.

Internal Validity: The study relied on survey data and public metrics, which may introduce biases such as self-reporting and selective sampling. Respondents' interpretations of the survey questions could vary, potentially affecting the consistency of the data. Furthermore, external factors influencing customer satisfaction, such as market dynamics or product quality, were not controlled, which confounds the observed relationships.

External Validity: The generalizability of the findings is constrained by the sample of 62 responses regarding DevOps parameters. Twenty-three companies had their RA metric listed, which focused on specific organizations and industries within the Brazilian region. The applicability of these results to other contexts or global organizations remains uncertain, highlighting the need for a more extensive sampling in future research.

Construct Validity: Certain constructs, such as work-life balance and team autonomy, were measured using indirect proxies or single metrics, which may not fully capture their complexity. This limitation raises questions about the degree to which these constructs are accurately represented in the study and their direct relationship to customer satisfaction.

Statistical Conclusion Validity: The statistical power of the study is limited by the small sample size and the variability of the data, even though it reached the minimum mentioned in Carpita and Manisera [4]. The wide confidence intervals observed in several correlations indicate uncertainty in the findings, emphasizing the importance of larger datasets to improve precision and reliability.

Although there are limitations, this study establishes a foundation for understanding the connections between DevOps practices and customer satisfaction. Addressing these validity threats in future research through improved data collection, broader sampling, and refined measurement techniques will enhance the

robustness of subsequent findings and strengthen their implications for organizations.

6 Conclusion and Future Directions

In this study, the importance of developing solutions that integrate and streamline DevOps practices to improve customer satisfaction was highlighted.

The investigation made initial progress toward its objectives, as reflected in the preliminary results. First, a slight positive correlation was observed between metrics related to employee well-being and customer satisfaction, although with wide confidence intervals, indicating substantial uncertainty in estimates. Second, a moderate negative correlation was identified between the change failure rate (CFR) and the Reclame Aqui (RA) metric, suggesting that lower CFRs are associated with higher customer satisfaction. Third, exploratory analysis revealed that while variables such as mean time to recovery (MTTR), lead time for changes, and deployment frequency did not exhibit significant correlations with the RA score, cultural factors – including shared responsibilities, cross-functional collaboration, failure investigation, and the encouragement of new ideas – demonstrated weak to moderate positive correlations.

The investigation focused on addressing the critical challenges associated with linking internal DevOps practices to external customer satisfaction. The results partially resonate with the findings reported by Forsgren et al. [7], although limitations in sample size and data variability call for further research. In this study, the analysis has advanced the understanding of the interplay between technical performance and organizational culture in influencing customer satisfaction. These findings suggest that improvements in continuous delivery practices and the cultivation of a collaborative, learning-focused environment can drive enhanced customer outcomes.

In the future, providing more comprehensive studies that use larger and more diverse datasets will be crucial to improve generalizability and statistical power. Future research should also explore the indirect effects of DevOps practices by examining mediating variables such as employee productivity, team dynamics, and organizational culture. Longitudinal studies are recommended to capture how changes in DevOps maturity influence customer satisfaction over time, while mixed methods, combining quantitative surveys with qualitative interviews, can yield richer insights into the underlying mechanisms.

6.1 Practical Recommendations for Practitioners

Based on the findings of this study, organizations are encouraged to implement targeted actions that align with the strongest observed relationships between DevOps practices and customer satisfaction. These include the following:

1. **Reducing Change Failure Rates (CFRs):** Prioritize lowering CFRs by adopting robust continuous delivery practices. Investments in automated

testing, comprehensive configuration management, and efficient integration pipelines are essential to minimize deployment failures and improve operational reliability.
2. **Fostering Cross-Functional Collaboration:** Enhance interdepartmental collaboration by establishing clear communication channels, shared objectives, and accountability mechanisms. This kind of collaboration has been shown to contribute positively to customer satisfaction.
3. **Encouraging Shared Responsibilities:** Promote an equitable distribution of responsibilities within teams to strengthen accountability and improve overall performance.
4. **Investigating and Learning from Failures:** Cultivate a culture of continuous improvement by treating failures as opportunities for learning. Implement systems to analyze root causes and apply these insights to refine processes, ultimately leading to better customer experiences.

By acting on these recommendations, organizations may be better positioned to leverage DevOps practices to achieve tangible improvements in customer satisfaction and overall operational performance. Future research will aim to extend the integrated approach, expand the dataset, and refine the methodological instruments to further validate these preliminary findings.

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