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Research Article

Optimizing New Product Development: The role of cross-functional collaboration and leadership practices

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ABSTRACT

Introduction: In the fast-evolving landscape of production and operations management, organizations face significant challenges in coordinating cross-functional teams to enhance the efficiency and effectiveness of new product development (NPD). Misalignment among functional areas, lack of cohesive leadership, and inefficient collaboration practices often lead to delays and hinder innovation. Addressing these challenges requires a structured approach to leadership and collaboration strategies to optimize NPD performance.

Objectives: This study aims to identify key leadership and collaboration strategies that enhance cross-functional teamwork in NPD. It seeks to analyze the impact of leadership models, communication protocols, and coordination mechanisms on improving innovation outcomes, reducing delays, and fostering constructive collaboration.

Methods: A quantitative research approach was employed, utilizing industry surveys to collect data from professionals involved in NPD. The study examines the relationship between leadership practices, communication effectiveness, and structured coordination on cross-functional team performance. Statistical analysis was conducted to derive insights into the most impactful strategies.

Results: The findings reveal that strong leadership practices, well-defined communication protocols, and structured coordination significantly enhance team collaboration, reduce project delays, and improve innovation outcomes. Leadership models emphasizing inclusivity and agility were found to have the highest impact on fostering cross-functional collaboration in NPD.

Conclusions: This study underscores the critical role of leadership and collaboration in driving productivity and innovation in NPD. The findings provide actionable insights for managers to streamline cross-functional teamwork and improve product development efficiency. Decision-makers can leverage these insights to refine leadership models and ensure alignment with organizational goals. Additionally, the study lays a foundation for further academic research on interdisciplinary coordination and leadership in NPD, contributing to theoretical advancements in operations management.

Keywords: Cross-Functional Collaboration, New Product Development (NPD), Leadership Practices, Innovation Management, Team Coordination

INTRODUCTION

In today's highly competitive and rapidly evolving business environment, the ability to innovate and bring new products to market efficiently is essential for organizational success. New Product Development (NPD) is a cornerstone for sustaining competitive advantage, especially in industries characterized by technological advancements and shifting consumer demands (Aghina et al., 2021). Despite its importance, NPD processes are inherently complex, requiring seamless coordination across various functional areas such as marketing, operations, engineering, and procurement. The challenge lies in aligning diverse perspectives, expertise, and objectives to ensure the timely and cost-effective delivery of innovative products (Gomes et al., 2022). This study explores how cross-functional collaboration and leadership practices can optimize the NPD process, addressing the interplay between

team dynamics, communication strategies, and leadership models. The need for cross-functional collaboration in NPD arises from the multifaceted nature of product innovation. Unlike routine tasks, NPD requires input from multiple disciplines, each contributing unique insights to the development process. For instance, marketing teams bring market intelligence and customer preferences, while engineering teams focus on technical feasibility and design. However, these functional areas often operate in silos, leading to miscommunication, duplication of efforts, and delays. According to Wang et al. (2021), effective cross-functional integration can mitigate these challenges by fostering a shared understanding of project goals and priorities. This integration not only enhances the efficiency of the NPD process but also ensures that the final product aligns with market needs and organizational capabilities. Leadership plays a critical role in facilitating cross-functional collaboration. Leaders act as catalysts for synergy by fostering an environment of trust, inclusivity, and open communication. Transformational leadership, characterized by vision, inspiration, and a focus on team development, has been shown to enhance team performance and innovation outcomes (Dinh et al., 2020). In the context of NPD, transformational leaders can bridge the gap between disparate functional areas, ensuring that all stakeholders work towards a common objective. Conversely, a lack of effective leadership can exacerbate conflicts and hinder project progress, highlighting the need for organizations to invest in leadership development tailored to the unique demands of NPD. The significance of optimizing NPD processes is underscored by its impact on organizational performance. Efficient NPD practices contribute to reduced time-to-market, improved product quality, and cost savings, which are critical for maintaining competitiveness in dynamic markets. For example, research by Tran et al. (2022) highlights the correlation between cross-functional collaboration and product success rates. Their study demonstrates that organizations with high levels of collaboration are more likely to deliver products that meet customer expectations and achieve commercial success. Furthermore, effective NPD processes can enhance an organization's adaptability, enabling it to respond swiftly to changing market conditions and emerging opportunities. Despite these benefits, the implementation of cross-functional collaboration in NPD is fraught with challenges. One of the primary obstacles is the presence of functional silos, which impede the flow of information and create barriers to collaboration. According to Zhao et al. (2021), these silos often result from differences in goals, priorities, and communication styles among functional areas. For instance, marketing teams may prioritize customer satisfaction and revenue generation, while engineering teams focus on technical feasibility and cost efficiency. Such misalignments can lead to conflicts, delays, and suboptimal outcomes, underscoring the need for effective leadership and coordination mechanisms. Another challenge is the inherent uncertainty and risk associated with NPD. Unlike established processes, NPD involves a high degree of unpredictability, as teams navigate uncharted territories in terms of technology, market trends, and customer preferences. This uncertainty necessitates a flexible and adaptive approach to collaboration and decision-making. Research by Rossetti and Osei-Bryson (2022) suggests that organizations that adopt agile methodologies and iterative development practices are better equipped to manage NPD complexities. These approaches enable teams to experiment, learn, and adapt in real time, reducing the likelihood of costly errors and enhancing innovation outcomes. The role of digital tools and technologies in facilitating cross-functional collaboration cannot be overlooked. In recent years, organizations have increasingly leveraged digital platforms to streamline communication, coordinate tasks, and monitor progress in NPD projects. Tools such as project management software, virtual collaboration platforms, and data analytics systems have revolutionized the way teams interact and share information. For example, tools like Asana and Microsoft Teams enable real-time communication and task tracking, ensuring that all team members are aligned and informed. Moreover, data analytics tools provide valuable insights into project performance, enabling leaders to make informed decisions and address potential issues proactively (McKinsey & Company, 2023). While digital tools offer significant advantages, their effectiveness depends on the organizational culture and leadership practices in place. An organization's culture shapes how teams perceive and adopt digital tools, while leadership practices determine the extent to which these tools are integrated into NPD processes. For instance, leaders who prioritize transparency and collaboration are more likely to foster an environment where digital tools are embraced and utilized effectively. Conversely, a lack of leadership support can hinder the adoption of these tools, limiting their potential to enhance collaboration and efficiency. This study aims to contribute to the existing body of knowledge by examining the interplay between cross-functional collaboration and leadership practices in NPD. Drawing on insights from industry surveys, the research seeks to identify best practices and provide actionable recommendations for optimizing NPD processes. The findings are expected to benefit both academics and practitioners, offering a comprehensive framework for addressing the challenges and opportunities associated with cross-functional collaboration in NPD. The optimization of NPD processes is critical for organizations seeking to maintain their competitive edge in today's fast-paced markets. By fostering cross-functional collaboration and leveraging effective leadership practices.

Organizations can overcome the challenges associated with NPD and unlock new opportunities for innovation and growth. This study underscores the importance of a comprehensive approach to NPD, integrating diverse perspectives and leveraging advanced tools to drive efficiency, quality, and innovation. Through this research, the study aims to provide valuable insights and practical guidance for organizations navigating the complexities of NPD in an increasingly interconnected and dynamic world.

LITERATURE REVIEW

Effective New Product Development (NPD) is vital to maintaining a competitive advantage in today's fast-paced market. However, challenges persist in coordinating cross-functional teams to optimize NPD performance, particularly due to misalignment between departments, inefficient communication, and suboptimal leadership practices (Tatikonda & Rosenthal, 2020). As organizations strive to improve their NPD processes' efficiency and innovation, leadership and cross-functional collaboration have become central to addressing these challenges (Cooper & Edgett, 2012).

Leadership in NPD: Leadership is crucial in driving the direction of NPD projects, particularly in aligning teams from diverse functions such as engineering, marketing, and operations. Previous research highlights that leadership behaviors such as clear vision, decision-making flexibility, and empowerment are essential for fostering collaboration (Atem & Olanrewaju, 2018). Effective leaders who encourage inclusivity and transparency are more likely to build cohesive teams that can tackle the complexities of NPD (Liu et al., 2017). Furthermore, leadership models that incorporate agility are linked to improved responsiveness to market changes and increased innovation (Kuo, 2018).

Cross-Functional Collaboration and Communication: Cross-functional collaboration is a key determinant of NPD success, as it involves aligning various expertise and perspectives to drive innovation. A lack of effective coordination among functional areas can lead to delays, increased costs, and missed market opportunities (Browning et al., 2021). For instance, Jassawalla and Sashittal (2017) argue that the integration of marketing, design, and production teams early in the development process significantly improves product quality and market success. Clear communication protocols are another critical factor. Without standardized communication, teams often experience misunderstandings that can derail the NPD timeline (Kahn et al., 2019).

Impact of Organizational Structures and Processes: Organizational structures and coordination mechanisms are essential for optimizing NPD outcomes. Research by Song et al. (2019) underscores that companies that adopt more flexible and cross-functional team structures outperform those with siloed functional teams. These flexible structures allow for rapid decision-making and quick adaptation to changes, which are particularly important in today’s fast-moving industries. Structured coordination mechanisms, such as regular cross-departmental meetings and the use of collaborative digital tools, have been shown to enhance team constructive collaboration and reduce delays (Kumar & Gupta, 2021).

Inclusion of Agility in Leadership and NPD Practices: The introduction of agile methodologies into NPD has revolutionized how teams approach product development. Agile leadership, which emphasizes continuous feedback, iterative development, and customer-focused delivery, fosters a dynamic work environment where cross-functional teams can thrive (Highsmith, 2017). Studies have found that agility in leadership positively correlates with improved collaboration and faster product delivery (DeLone & McLean, 2018). This approach is particularly beneficial in environments where market conditions are volatile and customer expectations are constantly evolving. The literature consistently highlights that leadership, communication, and organizational structures are critical to optimizing cross-functional collaboration in NPD. Best practices in leadership, such as inclusivity, agility, and clear communication, can significantly improve the effectiveness of NPD processes. Furthermore, adopting flexible and integrated team structures supports timely product delivery and innovation. This body of work provides a solid foundation for understanding the factors that drive successful NPD and offers valuable insights for managers and decision-makers aiming to enhance their organization’s NPD capabilities.

METHODOLOGY

This research employs a quantitative approach to comprehensively explore the role of cross-functional collaboration and leadership practices in optimizing new product development (NPD). The approach is particularly suited to this study as it allows for a holistic understanding of the complex interplay between team dynamics and leadership behaviors, combining statistical rigor with in-depth contextual insights (Creswell & Plano Clark, 2017).

Data Collection: Data collection involved primary methods: An industry survey in India from July to Dec 2024. The questionnaire was created in a completely anonymous format, pretested, and standardized. The questionnaire's target group consisted of Automobile industries 2-wheelers, 3-wheelers, 4-wheelers, heavy-duty vehicles, and special vehicle manufacturers from various functions. The survey was distributed across multiple sectors through various modes like E-mail, WhatsApp, and Linked In., etc., there are 3 sections in the questionnaire, section I has 12 Demographic variables, and Section II contains 30 Dependent and Independent variables which contain four key drivers. [1. Alignment and Communication (Q1–Q5), 2. Organizational Silos (Q6–Q10), 3. Leadership Effectiveness (Q11–Q20), 4. Coordination Mechanisms (Q21–Q30)] and section 3 contains NPD success (Q31 - Q35). The software tools used for Data Collection, Analysis, and Statistics are detailed in Table 1.

Table 1: Software tools used for Data Collection, Analysis Software, and Statistics used.

(Source: own research)

Data Collection	Data Analysis Software used	Statistics
MS Forms	JAMOVI version 2.6.19	Descriptive statistics, Normality tests, Frequency Distribution, Coefficient analysis, Correlation analysis, Structural Equation Modeling (SEM)

The study focuses on organizations that have demonstrated successful NPD practices, offering qualitative insights into effective leadership behaviors, team coordination mechanisms, and challenges faced during the product development cycle. Concurrently, surveys targeting industry professionals provided quantitative data, including Likert-scale responses, to evaluate the impact of specific leadership styles and collaboration strategies on NPD outcomes (Kahn & Barczak, 2019).

Analysis: Descriptive statistics and regression analysis were used for the quantitative survey data to establish correlations between variables such as leadership practices, cross-functional alignment, and NPD performance metrics (Song & Montoya, 2019). These methods are appropriate for the study as they ensure both depth and breadth in understanding the research problem. Figure 3 maps the framework of the NPD optimization, including key drivers, factors, and major parameters.

Figure 1: Framework of the NPD optimization concerning key drivers, factors, and its major parameters
(Source: Own research)

This methodology framework, supported by robust data collection and analysis techniques, is designed to yield actionable insights into how organizations can enhance NPD processes through effective leadership and cross-functional collaboration (Browning & Ramasesh, 2021).

Descriptive Study of the Respondents: The analysis is based on responses from 281 participants from different regions of India from different automobile sectors in New Product Development, a total of 35 questions framed under 4 Independent Variable (factors) and 1 Dependent Variable (NPD Success), under 2 key drivers (Leadership Practices

and Cross-functional collaboration). The 4 factors are 1. Alignment and Communication (Q1–Q5), 2. Organizational Silos (Q6–Q10), 3. Leadership Effectiveness (Q11–Q20), and 4. Coordination Mechanisms (Q21–Q30).

Table 2: Descriptive Statistics of Q1 to Q30

	N	Mean	Median	Mode	SD	Variance
Total (Q1 to Q30)	281	3.71	3.80	3.80	0.556	0.310

Based on the summary of statistics for the dataset (Q1 to Q30)

General Positive Response**:** The mean score of 3.71 and median of 3.80 indicate that, on average, respondents tend to rate the items positively. The median is slightly higher than the mean suggesting a tendency toward more favorable responses, with most participants selecting ratings close to 4 on the scale.

Consistency in Responses: The mode of 3.80 confirms that this rating was the most frequently chosen by respondents, indicating a consensus around this value. Additionally, the low standard deviation (0.556) and variance (0.310) suggest that there is little variability in the responses, with most respondents providing similar ratings.

Slight Positive Skew: The mean being slightly lower than the median indicates a mild positive skew in the data. This implies that while most responses are clustered at the higher end of the scale, a small number of responses towards the lower ratings exist.

Overall Consensus: The low variability, coupled with the high frequency of responses at the 3.80 rating, points to a strong overall agreement among participants, with a general tendency to rate the items positively and consistently.

Table 3: Descriptive Statistics for Major Factors

Key Drivers	N	Mean	Median	Mode	SD	Variance
Alignment and Communication (Q1 to Q5)	281	3.79	3.80	4.00	0.621	0.385
Organizational Silos and Resource Challenges (Q6 to Q10)	281	3.74	3.80	3.80	0.602	0.363
Leadership Effectiveness (Q11 to Q20)	281	3.76	3.80	3.80	0.601	0.361
Coordination Mechanisms and Tools (Q21 to Q30)	281	3.61	3.80	3.90	0.625	0.390

Table 4: Key Drivers and its Statistical Outcome

Key Drivers	Observations	Inference
Alignment and Communication (Q1 to Q5)	**Highest mean** (3.79) and mode (4.00).	The strongest area; reflects effective communication and alignment practices with positive perceptions.
	Moderate variability (SD: 0.621, Variance: 0.385).	
Organizational Silos and Resource Challenges (Q6 to Q10)	Mean (3.74) slightly lower than Alignment and Communication.	Managed well, but some challenges persist; room for improvement.
	Consistent responses (Median & Mode: 3.80).	
	Moderate variability (SD: 0.602).	
Leadership Effectiveness (Q11 to Q20)	Mean (3.76), consistent with Organizational Silos.	Leadership is perceived as satisfactory, with potential areas to enhance effectiveness.
	Median and Mode (3.80) indicate consensus.	
	Low variability (SD: 0.601, Variance: 0.361).	
Coordination Mechanisms and Tools (Q21 to Q30)	**Lowest mean** (3.61) among all categories.	Perceived as less effective, with greater variability in responses. Requires targeted improvements.
	Mode (3.90) is slightly higher than the mean.	
	Highest variability (SD: 0.625, Variance: 0.390).	

Data Normality Confirmation

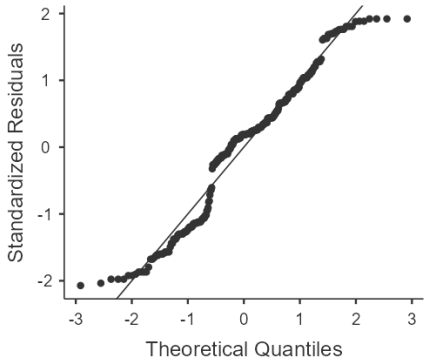

Figure 2: Total (Q1 to Q30) Data Normality confirming.

Source: Own research

The Q-Q plot for the standardized residuals of the total score (Q1 to Q30) indicates that the data approximates a normal distribution. Most points align closely with the diagonal reference line, confirming that the residuals exhibit a linear relationship with the theoretical quantiles of a normal distribution.

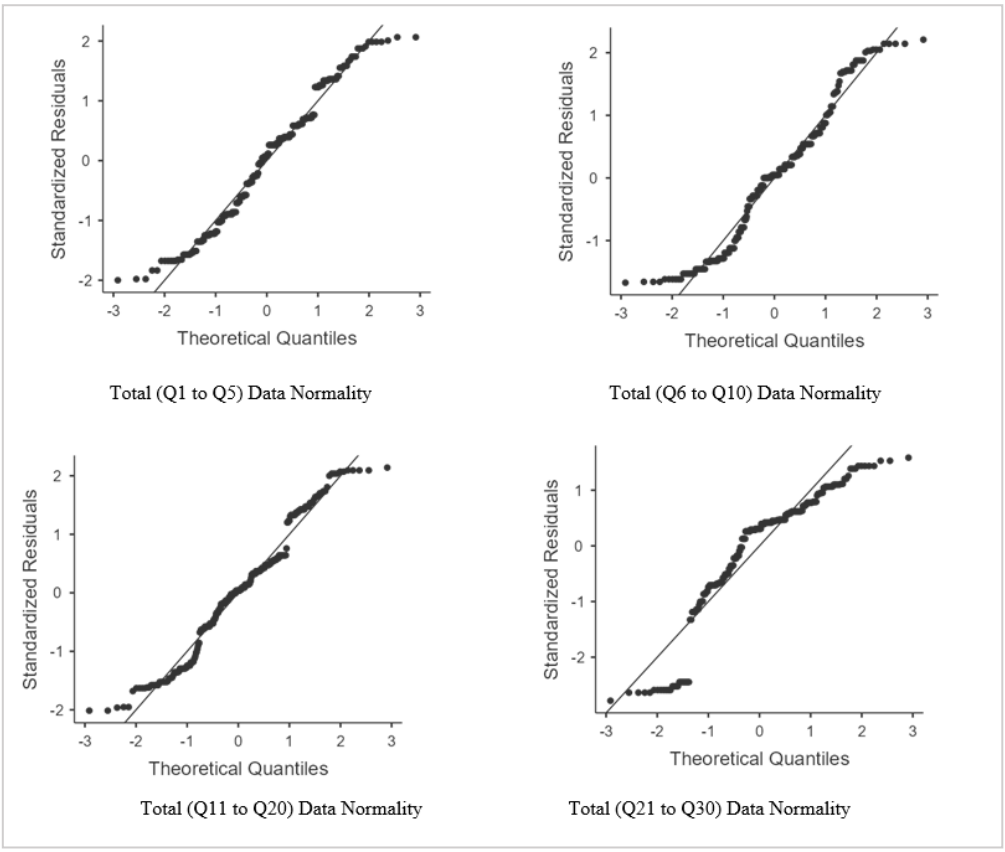

Figure 3: Total (Q1 to Q5, Q6 to Q10, Q11 to Q20, Q21 to Q30) Data Normality confirming.

Source: Own research

Data Normality confirmed for the 30 questions with the split of Q1 to Q5, Q6 to Q10, Q11 to Q20, and Q21 to Q30: The Q-Q plot for the standardized residuals of Q1 to Q5 reveals that the data closely aligns with the diagonal reference line, indicating an approximately normal distribution. Minor deviations are observed at the extremes, suggesting

potential outliers or slight skewness, but these deviations are minimal and do not significantly affect the overall normality.

Frequency Distribution: The frequency distributions from the various categories provide a comprehensive view of the respondents' preferences and characteristics. where effective collaboration and adaptive organizational structures are key to successful product development (Smith, 2022; Johnson et al., 2023).

Table 5: Frequencies of Industry Type

Industry Type	Counts	% of Total	Cumulative %
3-Wheeler	36	12.8%	12.8%
2-Wheeler	80	28.5%	41.3%
4-Wheeler	67	23.8%	65.1%
Heavy-Duty Vehicles	66	23.5%	88.6%
Special Vehicle	32	11.4%	100.0%

The frequency distribution indicates that the majority of respondents are from the 2-wheeler industry, comprising 28.5% of the total sample, followed by the 4-wheeler (23.8%) and Heavy-Duty Vehicles (23.5%) segments, which together account for a substantial 76% of the respondents. The 3-wheeler segment contributes 12.8%, while Special Vehicles represent the smallest share at 11.4%. The cumulative percentages highlight the dominance of mainstream vehicle categories, with 88.6% of respondents coming from the 2-wheeler, 4-wheeler, and Heavy-Duty Vehicle segments. This distribution reflects a diverse yet focused representation across key automotive industry sectors.

Table 6: Frequencies of Organization Structure

Organization Structure	Counts	% of Total	Cumulative %
Others	35	12.5%	12.5%
Mixed	75	26.7%	39.1%
Project-based	69	24.6%	63.7%
Matrix	63	22.4%	86.1%
Functional	39	13.9%	100.0%

The frequency distribution of organizational structures shows that the largest group of respondents work in Mixed structures, accounting for 26.7% of the total sample, followed closely by those in Project-based structures at 24.6%. Matrix structures comprise 22.4% of the respondents, while Functional structures account for 13.9%, and Others make up the smallest group at 12.5%. The cumulative percentages indicate that 63.7% of respondents belong to Mixed and Project-based organizations, emphasizing their prominence in the dataset. This distribution highlights a diverse representation of organizational structures, with a strong focus on flexible and integrated models like Mixed, Project-based, and Matrix structures.

Table 7: Frequencies of Experience in NPD

Experience in NPD	Counts	% of Total	Cumulative %
above 15	46	16.4%	16.4%
11 to 15	73	26.0%	42.3%
6 to 10	57	20.3%	62.6%
1 to 5	68	24.2%	86.8%
Below 1 yr.	37	13.2%	100.0%

The frequency distribution for experience in New Product Development (NPD) indicates that the majority of respondents have 11 to 15 years of experience, accounting for 26.0% of the total sample. This is followed by those with

1 to 5 years of experience at 24.2%, and those with 6 to 10 years of experience at 20.3%. Respondents with above 15 years of experience make up 16.4%, while those with less than 1 year of experience comprise 13.2%, the smallest group. The cumulative percentages show that 62.6% of respondents have between 6 and 15 years of experience, indicating a strong representation of mid-level professionals. The remaining 37.4% represent early-career professionals and highly experienced individuals. This distribution reflects a balanced mix of expertise, with a notable concentration in the mid-level experience range, ensuring a comprehensive perspective on NPD practices.

Table 8: Frequencies of Organization Size

Organization Size	Counts	% of Total	Cumulative %
High (above 500)	77	27.4%	27.4%
Medium (101 to 500)	124	44.1%	71.5%
Small (0 to 100)	80	28.5%	100.0%

The frequency distribution for organization size reveals that many respondents work in medium-sized organizations (101 to 500 employees), which accounts for 44.1% of the total sample. This is followed by respondents from small organizations (0 to 100 employees), making up 28.5%, and those from large organizations (above 500 employees), contributing 27.4%. The cumulative percentages show that 71.5% of respondents belong to medium and large organizations, indicating a strong representation from larger entities. This distribution highlights a balanced perspective, with significant input from organizations of varying sizes, ensuring diverse insights into the practices and challenges across small, medium, and large organizations.

Table 9: Frequencies of Primary Collaboration Tools Used

Primary Collaboration Tools Used	Counts	% of Total	Cumulative %
JIRA	41	14.6%	14.6%
Microsoft Teams	97	34.5%	49.1%
Slack	97	34.5%	83.6%
Others	46	16.4%	100.0%

The frequency distribution for primary collaboration tools used indicates that Microsoft Teams and Slack are the most commonly utilized tools, each accounting for 34.5% of the total sample. JIRA follows with 14.6%, while other tools make up 16.4% of the responses. The cumulative percentages reveal that 83.6% of respondents rely on mainstream tools like Microsoft Teams, Slack, and JIRA, indicating their widespread adoption in collaborative environments. The presence of 16.4% in the "Others" category suggests a variety of additional tools being used, reflecting the diversity in tool preferences. This distribution underscores the dominance of Microsoft Teams and Slack as preferred platforms for collaboration while highlighting the importance of alternative tools for specific needs.

Table 10: Frequencies of Preferred Mode of Communication in NPD Projects

Preferred Mode of Communication in NPD Projects	Counts	% of Total	Cumulative %
Email	50	17.8%	17.8%
Virtual meetings	88	31.3%	49.1%
In-person meetings	88	31.3%	80.4%
Others	55	19.6%	100.0%

The frequency distribution for the preferred mode of communication in New Product Development (NPD) projects shows that Virtual meetings and In-person meetings are equally popular, each accounting for 31.3% of the total responses. Email is the next most preferred mode, representing 17.8%, while Others make up 19.6% of the total. The cumulative percentages indicate that 80.4% of respondents favor mainstream communication methods like virtual meetings, in-person meetings, and emails, reflecting their importance in NPD projects. The 19.6% in the "Others"

category suggests the use of additional, less conventional communication modes tailored to specific project needs. This distribution highlights the balance between virtual and in-person collaboration in NPD projects, with a notable reliance on digital and traditional communication methods to facilitate effective coordination.

RESULTS

This section presents the study's key findings and discusses their implications within the context of existing research.

Correlation: This correlation matrix presents statistical relationships between four categories derived (factors) from survey questions:

1. Alignment and Communication (Q1 to Q5)
2. Organizational Silos and Resource Challenges (Q6 to Q10)
3. Leadership Effectiveness (Q11 to Q20)
4. Coordination Mechanisms and Tools (Q21 to Q30)

Key findings:

- High Positive Correlations: Alignment and Communication & Organizational Silos and Resource Challenges (r = 0.825): Indicates a strong positive relationship, suggesting better alignment and communication are associated with fewer resource challenges. Leadership Effectiveness with both Alignment and Communication (r = 0.919) and Organizational Silos (r = 0.904): Suggests leadership effectiveness strongly correlates with improvements in communication and resource allocation.
- Moderate Positive Correlations: Coordination Mechanisms and Tools: It shows moderate correlations with the other categories (r ranging from 0.664 to 0.704), indicating their importance but weaker associations than leadership and communication factors.

Table 11: Correlation Matrix – the relationship between four key factors

		Alignment and Communication (Q1 to Q5)	**Organizational Silos and Resource Challenges (Q6 to Q10)**	**Leadership Effectiveness (Q11 to Q20)**	**Coordination Mechanisms and Tools (Q21 to Q30)**
Alignment and Communication (Q1 to Q5)	Pearson's r	—			
	df	—			
	p-value	—			
Organizational Silos and Resource Challenges (Q6 to Q10)	Pearson's r	0.825	—		
	df	279	—		
	p-value	<.001	—		
Leadership Effectiveness (Q11 to Q20)	Pearson's r	0.919	0.904	—	
	df	279	279	—	
	p-value	<.001	<.001	—	

Coordination Mechanisms and Tools (Q21 to Q30)	Pearson's r	0.664	0.704	0.667	—
	df	279	279	279	—
	p-value	<.001	<.001	<.001	—

Statistical Significance: p-values (< .001): All correlations are statistically significant, with degrees of freedom (df) = 279. This matrix highlights critical interdependencies among organizational factors, emphasizing the influence of leadership and communication on overall efficiency and effectiveness in processes.

Highlights the relationships between a central factor (Fctrs) of NPD Success and four critical dimensions of NPD success key factors:

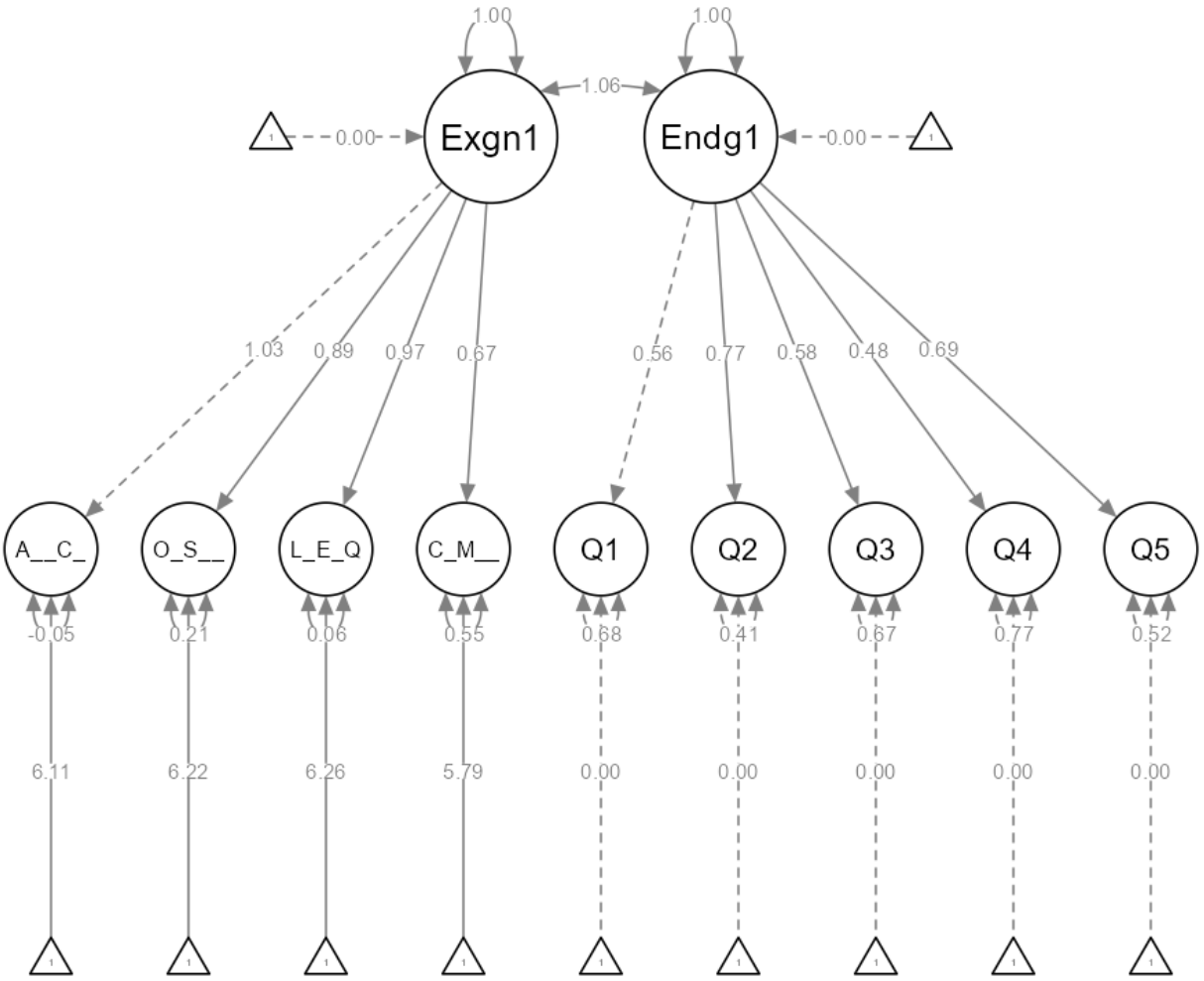

Figure 4: Relationships Between Process Factors and Outcomes in NPD.

Source: Own research

Latent Constructs: Two latent variables, Exgn1 and Endg1, are modeled. They have a strong correlation (1.00), suggesting shared variance or strong interdependence.

Factor Loadings (Exgn1): Observed variables: A__C_ (1.03), O_S___ (0.89), L_E_Q (0.97), C_M_ (0.67), indicating strong associations with Exgn1.

Factor Loadings (Endg1): Observed variables: Q2 (0.41), Q3 (0.67), Q4 (0.77), Q5 (0.52), Q1 (0.68), confirming relevance to Endg1.

Implications: Exgn1 may represent key formative factors, while Endg1 reflects outcomes. Strong associations among variables highlight the model's explanatory power.

Overall Fit: The model demonstrates robustness in explaining relationships between latent and observed variables, with consistently strong factor loadings.

DISCUSSION

The study's findings emphasize the crucial interdependencies between leadership, communication, organizational structure, and coordination mechanisms in enhancing new product development (NPD) success. The correlation matrix provides clear evidence that leadership effectiveness and communication play dominant roles in addressing organizational silos and resource challenges, ultimately improving overall efficiency.

Impact of Leadership and Communication on NPD Performance: The strong positive correlation between Leadership Effectiveness and Alignment & Communication (r = 0.919), as well as Leadership Effectiveness and Organizational Silos (r = 0.904), highlights the pivotal role of leadership in fostering collaboration and breaking down functional barriers. Effective leadership facilitates seamless communication across teams, ensuring alignment with organizational goals and reducing inefficiencies arising from siloed structures. These findings align with existing literature that underscores the role of transformational and agile leadership in enhancing cross-functional coordination and innovation outcomes.

Addressing Organizational Silos and Resource Constraints: The high correlation between Alignment & Communication and Organizational Silos & Resource Challenges (r = 0.825) suggests that improving communication frameworks can significantly mitigate resource-related obstacles. This finding implies that when communication flows effectively across departments, the likelihood of bottlenecks and inefficiencies decreases, leading to better resource allocation and enhanced project execution. The results reinforce prior research advocating for integrated communication strategies and structured team coordination to minimize operational barriers in NPD.

Moderate Role of Coordination Mechanisms and Tools: Coordination Mechanisms and Tools exhibited moderate correlations with other factors (r ranging from 0.664 to 0.704), indicating their importance in the NPD process but with a comparatively weaker influence than leadership and communication. This suggests that while structured coordination mechanisms are beneficial, they must be effectively complemented by strong leadership and communication practices to maximize their impact. Organizations should not rely solely on tools and frameworks but should integrate them within a culture of open communication and strategic leadership to optimize NPD outcomes.

Modeling Relationships Between Process Factors and Outcomes in NPD: The latent construct analysis further validates the study's key findings. The strong correlation (1.00) between Exgn1 (formative factors) and Endg1 (outcomes) suggests that leadership, communication, organizational structure, and coordination mechanisms collectively contribute to NPD success. The high factor loadings for Alignment & Communication (1.03), Organizational Silos (0.89), Leadership Effectiveness (0.97), and Coordination Mechanisms (0.67) within Exgn1 reinforce the significance of these variables as drivers of performance. Similarly, the observed variables linked to Endg1 indicate a robust association with NPD success factors, further strengthening the model’s explanatory power.

The discussion reaffirms that leadership effectiveness, alignment and communication, and organizational coordination play critical roles in the success of NPD. While coordination mechanisms are important, they must be integrated with strong leadership and communication strategies to drive significant improvements. The study’s statistical analysis and modeling further validate these relationships, offering a robust framework for optimizing NPD performance.

CONCLUSION

This research provides valuable insights into the factors influencing New Product Development (NPD) in the automobile industry, particularly in the Indian context. The findings underscore the critical role of effective leadership, cross-functional collaboration, and process optimization in achieving efficient and competitive NPD outcomes. By analyzing widely practiced NPD models and identifying key drivers such as cost efficiency, time-to-market, product quality, and innovation capability, this study contributes to the existing body of knowledge and offers practical implications for industry professionals. The results reveal that aligning leadership practices with NPD

objectives, fostering collaboration among diverse functional teams, and leveraging technological tools are pivotal to overcoming challenges and enhancing the effectiveness of NPD processes. Additionally, the research highlights the importance of a comprehensive approach that integrates regulatory compliance, market demands, and organizational flexibility to ensure sustainable product development. Despite its limitations, this study serves as a foundation for future research, providing directions for exploring broader geographic and industrial contexts, as well as incorporating longitudinal and qualitative methodologies. By addressing these avenues, future studies can deepen the understanding of NPD practices and help organizations refine their strategies to navigate the complexities of modern product development. In conclusion, this research emphasizes the significance of strategic alignment, innovation, and adaptability in driving successful NPD initiatives, contributing to the long-term competitiveness and growth of the automobile industry.

IMPLICATIONS

The findings hold significant implications for both academia and industry:

For Managers and Practitioners: The study provides actionable insights on how organizations can enhance NPD performance by focusing on leadership development, fostering open communication, and implementing structured coordination strategies. Leadership training programs and cross-functional collaboration initiatives can mitigate organizational silos and streamline product development cycles.

For Decision-Makers: The study highlights the need for decision-makers to assess their organizational structures and leadership models critically. Emphasizing agile and inclusive leadership approaches can significantly impact innovation efficiency and cross-functional teamwork.

For Academics and Researchers: The study contributes to the growing body of knowledge in operations and NPD management by demonstrating empirical relationships between key organizational factors. Future research can expand on these findings by exploring sector-specific variations and integrating qualitative insights to deepen the understanding of NPD dynamics.

LIMITATION AND FUTURE DIRECTIONS

Data collected from 281 participants across various regions and sectors in India, the sample may not fully represent the global automobile industry or niche sectors, limiting the generalizability of the results. Additionally, the cross-sectional design captures data at a single point in time, which restricts the ability to observe changes in New Product Development (NPD) practices over time. The study primarily relies on quantitative survey data, potentially overlooking qualitative aspects such as cultural, behavioral, and emotional factors influencing NPD processes.

Furthermore, the findings are tailored to the automobile sector, which may limit their applicability to industries with different dynamics and challenges. Some predictors, such as the frequency of cross-functional meetings and preferred communication modes, did not yield statistically significant results, indicating the need to explore additional factors. Lastly, while the study highlights commonly used collaboration tools, it does not assess their comparative effectiveness, which could provide more actionable insights.

Future research could address these limitations by expanding the geographical scope to include participants from diverse cultural and economic contexts, enabling comparisons of NPD practices on a global scale. Conducting longitudinal studies could also provide deeper insights into how NPD strategies evolve over time and under varying market conditions. Incorporating qualitative methods, such as interviews and case studies, could capture nuanced insights into leadership practices and cross-functional collaboration.

Researchers might explore additional predictors, including innovation culture, employee training, and the impact of emerging technologies like AI and digital twins on NPD efficiency. Comparative studies across different industries could identify sector-specific best practices and general optimization strategies for NPD. Further, assessing the effectiveness and user satisfaction of collaboration tools like Slack, Microsoft Teams, and JIRA could offer practical recommendations for improving tool utilization in NPD processes. Investigating nonlinear relationships among variables and focusing on behavioral dynamics, such as trust-building and conflict resolution in cross-functional teams, could provide fresh perspectives on enhancing team collaboration.

Finally, future research could explore the integration of agile methodologies and digital transformation in optimizing coordination mechanisms, as well as the role of sustainability and regulatory compliance in shaping NPD practices.

Addressing these directions could significantly advance the understanding and application of effective NPD strategies across industries.

AUTHOR CONTRIBUTIONS

M. Vasudevan is the 1st author who prepared and wrote the article and Dr. B. Senthil Kumar is the supervisor and guide who contributed to the analysis and finalizing the article.

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DECLARATION OF INTEREST STATEMENT

We, the authors, declare that the research presented in this manuscript adheres to the ethical standards as required by the journal requirement. This research did not involve any studies with human participants, animals, or personal data that require specific ethical approval. The data utilized in this study are either publicly available or obtained with proper permissions and have been cited appropriately. We confirm that this manuscript is our original work, has not been published elsewhere, and is not under consideration for publication elsewhere. We have upheld integrity and transparency in the research process, ensuring that all methodologies, findings, and conclusions are reported accurately and without bias

DATA AVAILABILITY

Data is available on request due to privacy/ethical restrictions. The data that support the findings of this study are available on request from the corresponding author, [M. Vasudevan -author 1]. The data are not publicly available because it is primary data, it contains information about the research participants.

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CONFLICT OF INTEREST

All authors disclosed no relevant relationships

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