

## FROM SQUADS TO ENTERPRISES: A TIERED MODEL ANALYSIS OF TEAMS SCALING MODELS IN MULTILAYERED ORGANIZATIONS

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**Purpose:** The paper investigates how team size, structure, and coordination practices influence delivery performance, satisfaction, and predictability in multilayered technology organizations operating under concurrent, multi-workstream environments. It explores how Human Resources (HR) / People & Culture (P&C) frameworks, delivery lifecycles, and strategic governance interact to create scalable value streams. The aim is to codify a model (empirically derived from practice) that links tactical delivery (using Scrum/Kanban) with operational lifecycles and strategic portfolio management under unified vision and SLA/KPIs control.

**Design/methodology/approach:** The study applies a mixed-methods empirical design using structured surveys conducted among development and platform engineering teams within a large, globally distributed technology enterprise. Quantitative measures capture relationships between autonomy, backlog ownership, collaboration density, and delivery predictability; qualitative inputs contextualize observed tensions between standardization and flexibility. Statistical and thematic analyses are used to identify patterns, and results are interpreted through a comparative organizational lens linking Project Development Lifecycle (PDLC) maturity with matrix and team network-based scaling.

**Findings:** Results indicate that balanced autonomy, standardized work-lifecycle tools, and transparent backlog governance yield higher delivery predictability and employee satisfaction. PDLC/SDLC integration reduces context switching and clarifies accountability, while strategic program steering enables measurable gains in cost control, quality, and innovation velocity. AI-assisted tools amplify, but do not replace, human domain expertise.

**Research limitations/implications:** Results reflect one enterprise context and rely partly on self-reported data. Future work should test cross-industry adaptability and quantify correlations between culture maturity, lifecycle discipline, and value-delivery metrics.

**Practical implications:** The proposed model provides a governance reference for large organizations adopting agile-at-scale, clarifying how development, quality assurance analysts/engineers, HR/P&C, DevOps, and PMO functions can coevolve under unified lifecycle management. It supports measurable efficiency gains through visibility, predictability, and empowered teams.

**Social implications:** By reinforcing people-centric scaling, responsible tooling and AI augmentation, the model promotes effective and healthier digital workplaces and knowledge retention in large engineering ecosystems.

**Originality/value:** The paper unifies implementation/tactical agile practice, project/operational lifecycles, and financial/strategic governance into a single comparative architecture of scaling. It offers a reproducible blueprint for enterprises pursuing agility at scale while maintaining cultural cohesion and measurable business value.

**Keywords:** scaled agile, team scaling models, SDLC, PDLC, organizational agility, autonomy and alignment, AI-augmented delivery.

**Category of the paper:** Research Paper (primary); Technical Paper (secondary).

## 1. Introduction

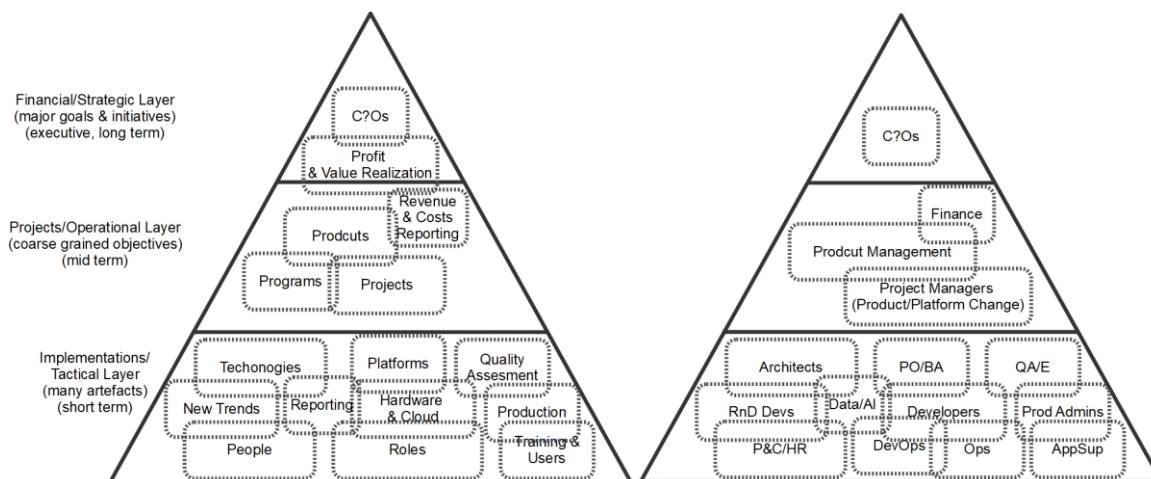
Modern technology enterprises operate as multi-layered sociotechnical systems where numerous autonomous teams, shared platforms, and business programs interact in parallel. As organizations scale, the challenge shifts from building individual agile teams to sustaining coherence, predictability, and human motivation across tens to hundreds of concurrent workstreams. The rapid evolution of digital ecosystems, coupled with hybrid work and generative-AI augmentation, further amplifies the need for models that integrate people, process, and governance into a unified delivery architecture.

The problem examined in this study arises from the tension between team-level agility that is embodied in frameworks such as Scrum and Kanban and enterprise-level coordination, which requires to be structured life-cycle governance and strategic oversight. This study focuses on balancing (a) top-down direction, from strategy through program operations to implementation, and (b) bottom-up feedback, from technology implementation back to financial and strategic target monitoring, while reconciling the discipline of hierarchical governance with the integration, quality, and creativity enabled by flat, autonomous teams. While many scaling frameworks, such as: Spotify Matrix Model (Kniberg, Ivarsson, 2012), Large Scale Scrum (LeSS) (Larman, Vodde, 2016), Scaled Agile Framework (SAFe) (Leffingwell, 2018), Disciplined Agile (DAD) (Ambler, Lines, 2012) propose partial solutions, few have been empirically validated in real, multi-platform environments that must balance innovation speed with regulatory, financial, and cultural stability. Although, the frameworks are established on foundations of Scrum (Cohn, 2004) they differ in the larger organizations culture and introduce differences in roles and teams formation. The research therefore investigates how structural/team-formation mechanisms, human-resources (HR) and People & Culture (P&C) policies, and Project Delivery Lifecycles (PDLCs) (Goodpasture, 2015) interact to produce measurable business value introduced iteratively.

Anchored in the classic people-process-technology (PPT) lens (Pee, Kankanhalli, 2009; Williams, Leask, 2011), the organization's operating model across three complementary dimensions: project, product, and platform; where (a) *project* denotes time-boxed change delivery governed by schedule, scope, and budget; (b) *product* denotes an enduring stream of

customer value, steered by a roadmap and evaluated by outcomes and revenue/impact; (c) *platform* denotes shared capabilities that accelerate many products and projects by increasing leverage and reliability while managing technical maintenance needs, operating cost and performance. These dimensions are mutually reinforcing: projects catalyse change within products; products set direction for projects; and platforms institutionalise reusable capabilities that reduce the marginal cost and risk of future work.

The context of analysis is a globally distributed technology organization maintaining systems of integrated platforms exceeding seven million lines of code. Within this environment, squads and chapters constitute the basic tactical units, coordinated through a PDLC and integrated with platform Software Delivery Lifecycles (SDLCs) (Gupta, Rawal, 2021). This tiered architecture of implementation/tactical (SDLC), projects/operational (PDLC), financial/strategic, forms the theoretical *triangle model* used throughout the paper (Figure 1).



**Figure 1.** A three-tier triangle model shows how short-term implementation layer activities (people, technologies, platforms, QA, production, training, reporting) roll up into mid-term operational layer objectives (programs, projects, products, revenue & cost reporting) and ultimately into long-term strategic layer outcomes led by team of executives (CxOs) for profit and value realization). The left part focuses on activities and functions, whilst the right, on roles and organization departments.

The research builds on mixed-methods empirical research design: (I) a qualitative synthesis of organizational process documentation describing formation of squads, chapters, and platform teams, but also lifecycle, governance, and program coordination; and (II) three quantitative surveys ( $N \approx 114$ ) exploring (1) AI impact on work, (2) career paths and aspirations, and (3) team size and structure. Together they capture relationships between autonomy, backlog refinement discipline, collaboration density, satisfaction, and delivery predictability. The surveys provide a data-driven complement to qualitative organizational observation, allowing cross-validation between perceived and measured outcomes.

The principal research question is: **How do structure, size, and coordination practices influence performance, satisfaction, and predictability in large-scale development organizations?**

Supporting questions include:

1. How can HR and P&C functions enable scalable autonomy through competency development frameworks in supports of the best fir of career-paths to corporate needs and hybrid-work policy?
2. How can PDLCs (treated as the program/project operational middle layer) integrate effectively with platform SDLCs to reduce waste and clarify accountability?
3. Which strategic governance mechanisms (programs, portfolio KPI control, AI-assisted knowledge management, coding and analytics) ensure alignment between local delivery and corporate value creation?

The paper contributes a comparative model of scaling that connects tactical delivery practices (SDLC; Scrum, Kanban) with projects operational lifecycle governance (PDLC) and strategic program steering. The model emphasises balanced autonomy, with a degree of freedom at squad level, aligned with lean software delivery monitoring and forecasting (Little, 2011; Little, Graves, 2008; Al-Baik, Miller 2015), combined with standardised lifecycle interfaces and transparent backlog governance (Alaidaros, Omar, Romli, 2018; Damij, Damij, 2021), as a predictor of both performance and employee satisfaction. It further identifies AI-augmented lifecycle tooling as an amplifier, not a replacement, of human expertise.

By bridging agile theory, organizational design, and empirical data, this work aims to codify a reproducible reference for enterprises pursuing agility at scale. It defines how tactical, operational, and strategic layers can co-evolve under unified vision, culture, and measurement systems, establishing foundations for the subsequent analysis of PDLC/SDLC integration and program-level value realization. The novelty of this research lies not in introducing new agile methods, but in **empirically demonstrating an integrated, tiered scaling architecture** that links people systems, delivery lifecycles, and strategic governance within a single operational model. By synthesizing insights from established scaling literature with quantitative and qualitative evidence, the paper contributes a reproducible reference model suitable for scientific discussion and further validation.

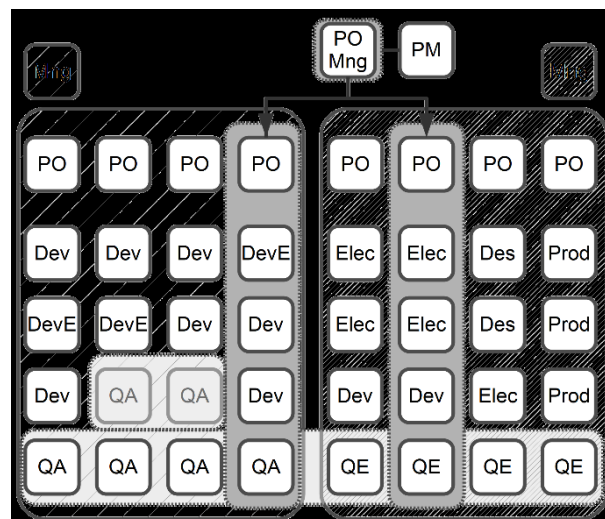
## 2. Literature Review

The study is grounded in the interdisciplinary field of organizational scaling, where agile software delivery, systems theory, and human-centric management converge. Over the past two decades, research has increasingly emphasised that sustainable agility depends on sociotechnical coherence; how team autonomy, process discipline, and structural alignment interact to sustain learning and predictability across layers of the enterprise (Larman, Vodde, 2016; Denning, 2018).

## 2.1. Scaling Frameworks and Matrix Organization Models

Prominent scaling frameworks, following *Agile Manifesto* (Fowler, 2001), *Lean software development principles* (Poppendieck, Poppendieck 2003) and *Iterative Development Delivery* (Larman, Basil 2003) including: Spotify, Large-Scale Scrum (LeSS), Scaled Agile Framework (SAFe), and Disciplined Agile Delivery (DA), offer complementary but partial approaches. The Spotify model (Kniberg, Ivarsson 2012) emphasises cultural autonomy through *squads*, *chapters*, *tribes*, and *guilds*, demonstrating that micro-units can deliver at speed when bound by shared values and transparent alignment. LeSS extends the Scrum model to multiple teams by promoting whole-product focus and systems thinking. SAFe adds a hierarchical structure of *Agile Release Trains* and *Program Increments*, providing financial and portfolio alignment. DAD seeks to unify these approaches through process-goal frameworks and contextual tailoring.

In practice, enterprises often implement hybrid constructs combining Spotify-style autonomy with SAFe-like governance. This hybridization creates what the applied model terms the matrix organization (Figure 2), where vertical delivery lines (of *squads* allocated to workstreams changing platforms) intersect with horizontal competency structures (*chapters*). Squads are organised technology teams against the business needs for fast flow and low cognitive load (Skelton et al. 2019). Since architecture follows communication (Conway, 1968; Herbsleb et al., 1999), Product Owner (PO) hierarchy (product office reaching strategic tier), platform interfaces, delivery teams ceremonies, and stage gates are used to deliberately shape communication paths, in result producing cleaner system boundaries and more predictable delivery. Such arrangements reconcile specialization and cross-functional collaboration, but they also introduce coordination complexity that must be mitigated through clear lifecycle and governance interfaces.



**Figure 2.** An example of a flat, matrix-oriented structure, under SDLCs, integrated with a hierarchical overlay used to steer larger platforms and introduce strategic initiatives at the operational level via PDLC. The product-ownership spine links team-level Product Owners (POs) to a PO Manager and Product Manager (PM) for unified backlog direction and product portfolio alignment. QA/QE chapters operate as shared enablement pools across teams. Visual encoding: dark grey denotes squad value streams delivering projects; hatched program frames indicate platform/enterprise scope; grey vertical bands show the PO spine hierarchy; light-grey blocks mark chapter pools. This clarifies how governance and enablement scale beyond single squads.

## 2.2. Lifecycle Governance and Delivery Coherence

The PDLC concept links tactical team execution with strategic oversight tiers. PDLCs formalize planning, design, build, and release phases while preserving iterative feedback from SDLC cycles. The implementation illustrates how PDLCs operate as the middle layer connecting product, technology, and business governance. It aligns with Lean-Agile principles (Beck et al., 2001; Poppendieck, 2003; Ries, 2011) by emphasizing flow efficiency, incremental value delivery, and risk transparency through use of *Kanban* (Ahmad et al., 2013, 2018) and *Kanban-of-Kanbans* project coordination (Brechner, 2015).

At the tactical level, Software Development Lifecycles (SDLCs) provide discipline in execution. Integration between PDLC and SDLC phases ensures that multi-team programs share common definitions of scope of work, readiness, quality, and completion (DoR/DoD).

The tiered model operationalises organisational ambidexterity (O'Reilly, 2013): strategic tiers fund exploration, PDLC gates convert validated options into exploit streams, and platform services sustain efficiency at scale. This reduces context switching, improves accountability, and reinforces alignment between various roles engaged: Product Owners (PO), Business Analysts (BA), Technology Platform Managers (TPM), and Chapter Leads. Empirical studies in large organizations (Rigby et al., 2018) highlight that such hybrid lifecycle governance is a prerequisite for predictable delivery.

## 2.3. The Socio-Technical and People-Centric View

Following Trist & Emery's (1960) sociotechnical system theory, the paper adopts the premise that human motivation and structural clarity are interdependent. Agile scaling succeeds only when People & Culture (P&C) functions institutionalize continuous learning, psychological safety, and flexible career paths. Chapters serve as communities of practice maintaining shared standards, while squads act as self-organizing micro-enterprises. Survey evidence from this study confirms that perceived autonomy, mentorship, and visibility correlate positively with satisfaction and quality outcomes.

## 2.4. Integrating AI-Augmented Delivery and Strategic Control

Recent literature introduces the impact of AI-assisted lifecycle tools (Taulli, 2024; Noor, 2025) on delivery performance and governance transparency. Generative AI (especially with use of LLM, RAG) supports knowledge retrieval, impact analysis, and test automation, but requires mature processes and ethical oversight. Within the triangle model adopted here: tactical (teams and platforms engineering), operational (lifecycles and coordination), strategic (program and major initiatives), AI acts as an amplifier of human capability, not a substitute. The theoretical synthesis therefore extends classical scaling models by embedding responsible automation and data-driven feedback loops into human-centric governance.

## 2.5. Conceptual Gap

Existing frameworks rarely integrate *people systems, lifecycle rigour, and strategic alignment* into a single comparative schema. This paper addresses that gap by analysing how HR/P&C-driven competency management, PDLC/SDLC integration, and program-level steering co-evolve in large enterprise. The result is a holistic architecture of scaling that unifies agile delivery practice with organizational design and empirical governance evidence.

## 2.6. From Literature to Research Constructs

Prior research on agile scaling consistently highlights the tension between team autonomy and coordination mechanisms as a determinant of delivery performance and predictability (Kniberg, Ivarsson, 2012; Larman, Vodde, 2016; Rigby et al., 2018). Studies grounded in sociotechnical systems theory further emphasize that autonomy yields positive outcomes only when supported by clear interfaces, shared standards, and governance structures (Trist, Emery, 1960; Pee, Kankanhalli, 2009).

Building on these findings, this study operationalizes “balanced autonomy” through survey measures capturing perceived autonomy, adherence to shared standards, and collaboration effectiveness. These constructs directly inform **H1**, which tests the relationship between autonomy-with-alignment and delivery predictability.

Similarly, literature on human-centric agile organizations identifies mentoring, career-path clarity, and P&C enablement as predictors of satisfaction and retention in scaled environments (Denning, 2018; O’Reilly, Tushman, 2013). These insights motivate **H2**, operationalized through survey items measuring perceived career clarity, organizational support, and mentoring behavior.

Research on lifecycle governance and flow-based coordination (Little, 2011; Brechner, 2015; Ahmad et al., 2018) underpins **H3**, which examines backlog orchestration across PDLC and SDLC layers as a predictor of predictability and reduced coordination waste.

Finally, emerging studies on AI-assisted software development emphasize productivity gains contingent on process maturity and governance safeguards (Forsgren et al., 2018; Taulli, 2024). These findings inform **H4**, which evaluates AI-assisted tooling as a moderated amplifier of delivery efficiency rather than a standalone driver.

### 3. Methodology

#### 3.1. Research Design

This study employs a mixed-methods empirical design to explore the relationships between organizational structure, team coordination, delivery predictability, and employee satisfaction in large-scale technology organizations. The research combines quantitative survey analysis with qualitative process synthesis derived from internal organizational documentation, operational data, and lifecycle frameworks. The approach was selected to balance contextual depth with statistical reliability, ensuring that results can be interpreted both through the lived experience of practitioners and through measurable correlations among key variables.

The qualitative component captures the codified delivery governance architecture of the enterprise, encompassing team formation (squads and chapters), lifecycle integration (PDLC and SDLC), and strategic governance through program and portfolio management. These materials, documented in *Scaling Teams: Dev Teams Formation*, provide the theoretical and procedural backbone of the model.

The quantitative component consists of three structured surveys conducted across multiple platform engineering and product teams between September and October 2025, yielding a total of 114 valid responses. The surveys measure perceptions of AI impact on work and satisfaction, career progression and motivation, and team size, structure, and performance. Together, they operationalize the constructs of autonomy, lifecycle maturity, collaboration density, and satisfaction.

#### 3.2. Conceptual Model and Hypotheses

The research is guided by a conceptual model derived from the “triangle” organizational theory developed internally within the organization tech department and supported by sociotechnical systems and scaling-agile literature. The model distinguishes three mutually dependent layers: (1) Tactical/Implementation Layer: Team formation, HR/P&C enablement, delivery ceremonies, and lifecycle discipline (Scrum, Kanban), (2) Operational/Project Layer: PDLC integration with SDLCs across platforms, risk control, and synchronization of backlogs (“Kanban of Kanbans”), (3) Strategic/Financial Layer: Program governance, KPI-based steering (in technology domain: DORA metrics, cost control, MTTP by CI/CD) (Humble, Farley, 2010; Forsgren et al., 2018; Beyer et al., 2018; Wilkes et al., 2023), and value realization mechanisms (Bowman, Ambrosini, 2000).

The following hypotheses guided the research:

**H1:** Balanced autonomy and standardized lifecycle interfaces are positively correlated with delivery predictability.

**H2:** Career path clarity and perceived support rise with mentoring activity.

**H3:** Backlog orchestration (integration between PDLC and SDLC across planned allocation of steams and squads) is positively associated with predictability; reduction of context switching and waste.

**H4:** AI-assisted tools improve perceived efficiency, but are moderated by process maturity and team autonomy.

### 3.3. Data Collection

Data were collected from employees working in software development, QA/QE, and DevOps roles across six platforms maintained by teams across Europe, Asia, and North America (participation was voluntary). Each survey employed 4 or 5 point Likert scale questions complemented by open-ended responses (Figures 3 and 4). Key indicators included:

1. Survey #2: AI Impact (N = 34):

(S02-Q01) survey indicates 76% (n=26/34) began using AI in 2023..2025 (26% since 2022, 29% after 2024, 20% in 2025). Earlier adopters are fewer: 12% (n=4/34) started in 2020..2022 and 9% (n=3/34) before 2020. Only 3% have not used AI yet (N=34).

(S02-Q02) Influence on daily work (Somewhat/A lot): 91.2% (31/34).

(S02-Q03) Usage frequency: Regularly (multiple/day) 44.1% (n=15/34); Occasionally (weekly) 38.2% (n=13/34).

(S02-Q04) Performance improved (Somewhat/Strongly): 79.4% (n=27/34).

(S02-Q05) Job satisfaction increased (Slightly/More): 64.7% (n=22/34).

(S02-Q06) Quality & flow improved (Somewhat/Greatly): 70.6% (n=24/34).

2. Survey #3: Career Path & Support (N=55)

(S03-Q01) Career path clarity (Very/Somewhat): 56.4% (n=31/55), Very clear: 14.5% (n=8/55); Not very/Not at all: 43.6% (n=24/55).

(S03-Q02) Feel supported (Very/Somewhat): 49.1% (n=27/55); Neutral 27.3% (n=15/55).

(S03-Q03) Support you give others (Very high/High): 85.5% (n=47/55).

(S03-Q04) Growth interests: multi-select (qualitative themes).

(S03-Q05) Strongest support timing: multi-select (qualitative themes).

3. Survey #4: Team Size & Structure (N=32)

(S04-Q01) Team size distribution: 3..5 28.1% (n=9/32); 6..9 21.9% (n=7/32); 10..15 37.5% (n=12/32); >15 12.5% (n=4/32).

(S04-Q02) Cross-team collaboration (Mostly/Very): 71.9% (n=23/32).

(S04-Q03) Autonomy vs standards (Mostly/Excellent): 78.1% (n=25/32).

(S04-Q04) Backlog orchestration by POs (Mostly/Highly): 46.9% (n=15/32).

(S04-Q05) Chapter/enabement influence (Moderate/Strong): 28.1% (n=9/32).

(S04-Q06) Overall delivery rating (Good/High): 87.5% (n=28/32).

(S04-Q07) Predictability & effectiveness (Mostly stable/Very predictable): 78.1% (n=25/32).

(S04-Q08) Matrix status: Yes 28.1% (n=9/32); No 43.8% (n=14/32); Partial 25.0% (n=8/32).

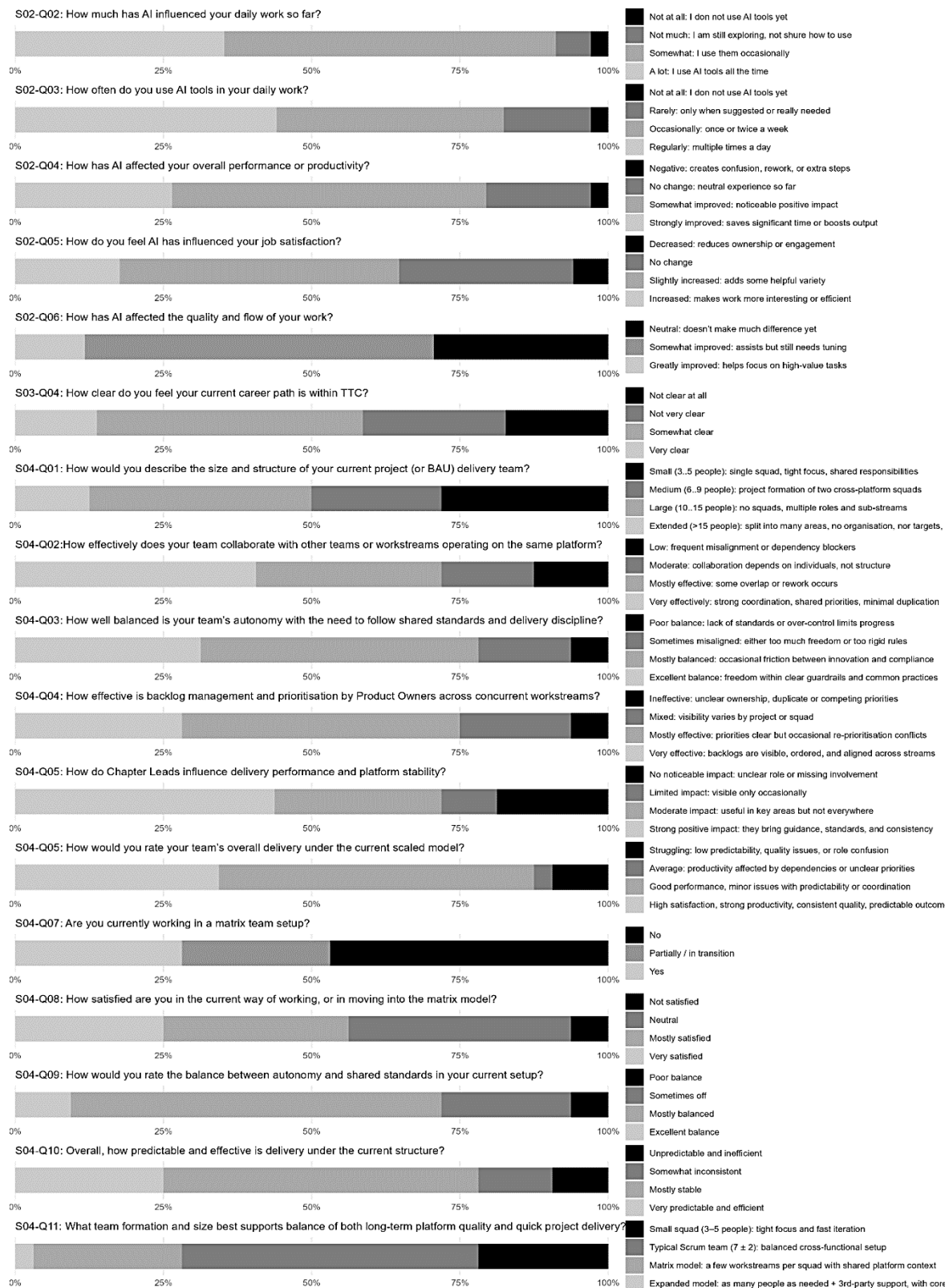
Perceived collaboration effectiveness (S04-Q02) lowers as team grows (S04-Q01): small teams of 3..5 show 78% good-or-better collaboration (n=7/9), medium 6..9 peak at 100% (n=7/7), while large 10..15 drop to 58% (n=7/12), and larger than 15 fall to 50% (n=2/4). (Note: overall association is weak, Spearman  $\rho=-0.19$  (N=32)).

There are 66 unique respondents across all surveys S02, S03, S04. 43.9% participated once only (n=29/66), whilst 56.1% appeared in 2 or more surveys (n=37/66).

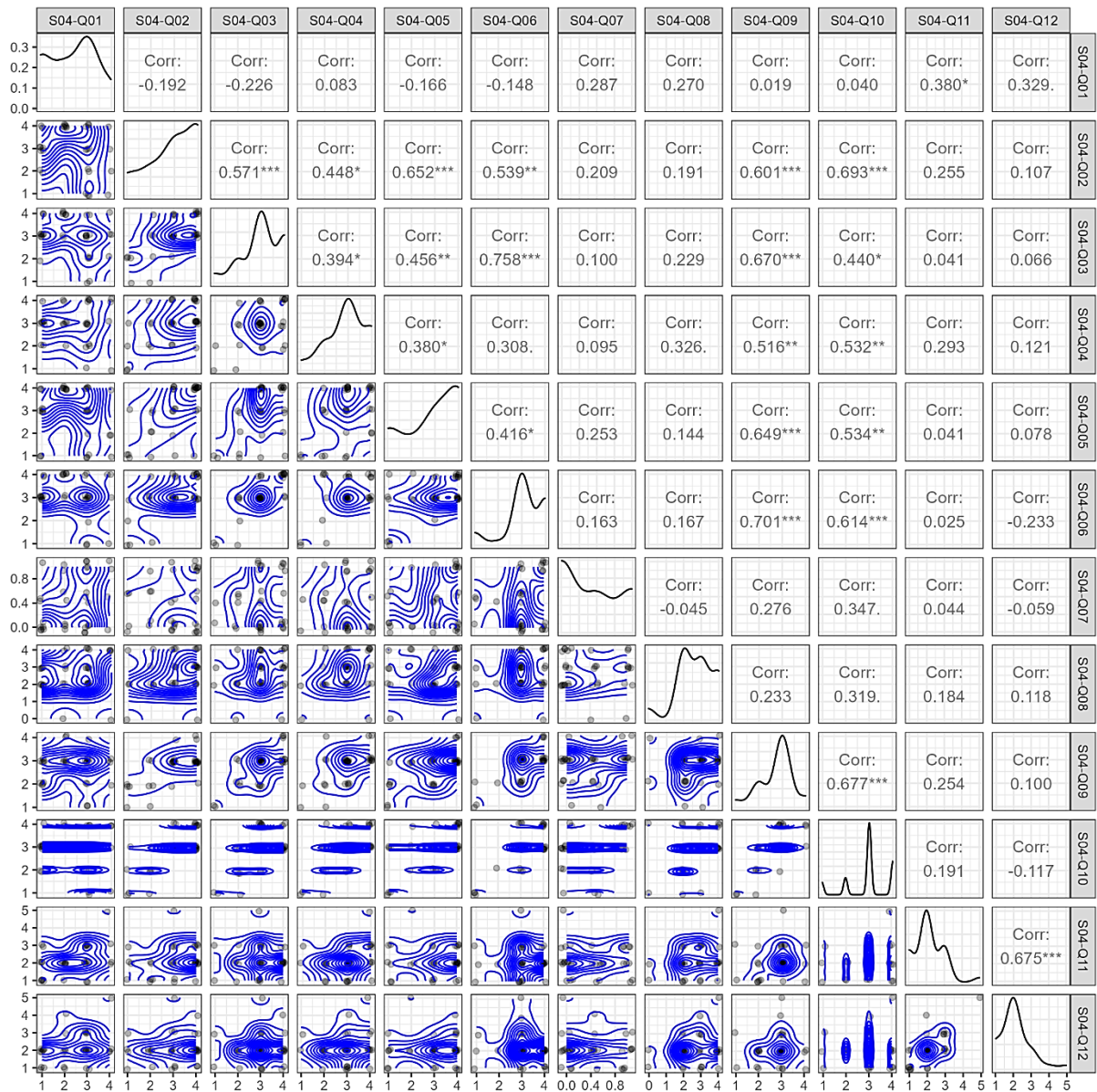
### 3.4. Analytical Procedures

The analysis proceeded in three stages:

1. Descriptive and Correlational Analysis: Using aggregated survey results, correlations were computed between team size, delivery performance, satisfaction, and lifecycle maturity. Smaller, autonomous squads with high ceremony adherence (refinement, review, retrospective) showed stronger predictability and quality outcomes.
2. Thematic Coding: Open-ended responses and document excerpts were analysed using grounded-theory coding (Glaser, Straus, 1967; Martin, 1986). Recurring themes included: (a) *Autonomy with Accountability*: teams value freedom when expectations and governance are clear (b) *Lifecycle Integration Reduces Waste*: teams in well-defined PDLC/SDLC environments report fewer delays and less rework; (c) *I as Amplifier, Not Substitute*: developers emphasize that AI tools enhance speed and accuracy but must be constrained by governance and code-review processes.
3. Comparative Mapping: The model was compared with reference frameworks (Spotify, SAFe, LeSS, and DAD) to determine overlap and divergence. The comparative lens shows that while Spotify emphasizes cultural autonomy and SAFe emphasizes program governance, the approach integrates both dimensions through PDLC/SDLC unification, achieving structural coherence without suppressing flexibility.



**Figure 3.** Survey #2, #3 and #4; AI influence, team size, structure, and ways of working: distribution of responses by question. Horizontal 100% stacked bars show the response distribution for each question with exact response options. Survey #2 (S02-01...S02-06: AI influence, frequency of use, productivity, satisfaction, and workflow quality), Survey #3 (S03-04: clarity of career path) and Survey #4 (S04-01...S04-11: team size/structure, collaboration, autonomy vs standards, backlog management, chapter influence, delivery, matrix status, satisfaction, predictability, and preferred formation). Each bar sums to 100%; segments represent ordered response categories (legend at right).



**Figure 4.** Pairwise association map for Survey #4 (S04-Q01..S04-Q12); Upper panels report Spearman’s rank correlation coefficient  $\rho$  (ggplot2:GGally.ggpairs/wrap("cor", method = "spearman")); the diagonal shows univariate distributions; the lower panels show bivariate kernel-density contours (indicating distribution of responses). Items are Likert-coded treated as ordinal and plotted to screen relationships prior to multivariate analysis.

### 3.5. Validity and Reliability Considerations

To mitigate bias and subjectivity, multiple data sources were cross-referenced. Survey reliability was assessed through internal consistency of response distributions and replication across teams of varying maturity levels. Process observations were validated by senior TPMs and HR/P&C partners to ensure contextual accuracy. The study recognizes limitations inherent in single-enterprise case analysis; particularly the influence of corporate culture, existing process maturity, and respondent self-selection. However, triangulation of methods and transparency in data interpretation provide robustness supporting base of applied organizational research (Yin, 2018).

### **3.6. Ethical and Procedural Integrity**

All surveys were complied with internal data protection policies and the Acceptable Use and AI Use Policies of the organization. Data were anonymized and aggregated for visualisation. Respondents were informed of the research purpose and potential use in academic publication. The author, serving as both practitioner and researcher, followed a reflexive stance to distinguish empirical observation from managerial influence.

### **3.7. Synthesis and Analytical Framework**

The methodology thus integrates practice-based evidence with empirical inquiry. The triangle mode (linking tactical, operational, and strategic tiers) acts as both analytical and explanatory framework. At the tactical level, data illuminate the influence of HR/P&C alignment and agile ceremonies; at the operational level, PDLC/SDLC integration is analysed as a coordination mechanism; and at the strategic level, program governance. Cross-cutting concerns through the tiers, such as architecture working group or tool set use, including AI augmentation, are assessed as enablers of organizational learning.

This approach situates the research within the emerging field of scalable agile enterprise studies, contributing a reproducible methodology for evaluating large-scale delivery systems through both cultural and quantitative lenses. The mixed-methods strategy ensures that the findings are not only statistically supported but also grounded in the realities of day-to-day engineering, management, and human collaboration.

## **4. Results**

The empirical surveys, complemented by organizational documentation, confirm that the studied enterprise functions as a multilayered sociotechnical system where delivery capability and satisfaction are determined by the interaction of three governance tiers: tactical, operational, and strategic/executive. Each tier contributes distinct mechanisms of alignment, autonomy, and feedback.

### **4.1. Tactical Layer: HR and People, Team Formation, and Delivery Discipline**

Survey #4 (Team Structure and Collaboration) shows that 73 % of respondents work in small squads of up to nine people, with 46 % in 3..5-person teams. These smaller teams report the highest perceived predictability (62 % “high” or “very high”) and satisfaction levels.

## 4.2. Results and Tiered Model of Organization

Over the pre-research observation period (2023-Q2 to 2025-Q3), the product-engineering group grew from two cross-functional teams into a multi-team, platform-oriented structure. Growth was non-linear: a steady baseline in 2023-Q2..2023-Q4 was followed by two planned step-ups: first in 2024-Q1, aligned with scope increases and the rollout of a standardised PDLC and shared platform services; and second in 2024-Q3, as cross-platform initiatives scaled. The added capacity (2024-Q1..Q3) prioritised complementary roles (QA/QE, SRE/DevOps, data engineers) alongside core developers while maintaining a balanced senior-junior mix. From 2024-Q4 through 2025-Q3, hiring flattened as the focus shifted to consolidation; deepening domain and technical skills, tightening ceremonies, reducing coordination costs, and stabilising throughput. Exact counts remain confidential; the trajectory reflects deliberate scaling tied to demand and value-creation milestones rather than opportunistic headcount growth.

## 4.3. Operational Layer: Lifecycle Integration and Program Coordination

The operational tier, represented by PDLC and its integration with platform-level SDLCs, converts strategic intent into structured delivery flow.

Empirical data indicate that teams with clearly defined PDLC gates and synchronization practices experience fewer coordination losses. Over 60% of respondents report that consistent backlog governance and cross-squad visibility improved delivery predictability. Conversely, teams without such mechanisms cite duplicated testing and unclear ownership boundaries.

Survey #2 (AI Impact on Work) highlights the emergence of AI-augmented delivery intelligence as a new coordination layer: (1) 70% of respondents confirmed that AI tools improved productivity or quality; (2) 25% expressed concern over skill dilution or inconsistent outputs without proper review; (3) frequent use of AI (daily by 40%) correlated with higher perceived efficiency but only in teams with mature PDLC compliance.

## 4.4. Strategic and Executive Layers: Programs, Governance and, Value Creation

At the apex of the organization, strategic governance aligns programs and investments with measurable business value. Survey #3 results show that employees identify learning and growth opportunities (67%) and project impact (35%) as their primary career motivators; indicating that value creation is understood not only financially but intellectually.

Programs under the Strategic Planning (over 6 quarters) process provide top-down direction and financial oversight. They translate strategic KPIs (cost, revenue, quality, DORA metrics) into operational objectives. The executive layer integrates performance dashboards, risk analytics, and AI-assisted forecasting tools. These mechanisms enable continuous steering while maintaining human accountability in decision-making.

Across all layers, surveys confirm that respondents perceive stronger alignment and motivation when strategy is transparent between perceived alignment quality and satisfaction. This reinforces the proposition that strategic clarity and participatory governance directly enhance morale and predictability.

## 5. Discussion

Empirical analysis confirms that balanced autonomy, lifecycle integration, and transparent governance are decisive enablers of delivery predictability and satisfaction in large-scale enterprises. Survey data reveal that small, cross-functional squads (3..7 members) working under consistent PDLC/SDLC frameworks achieved the highest reported performance and morale. Teams with clear Definitions of Done, stable mentorship, and chapter support showed higher perceived delivery quality and lower rework rates.

Autonomy is valued but effective only when combined with shared standards: 68 % rated their autonomy/discipline balance as “good” or “excellent,” while excessive independence correlated with coordination issues.

P&C and HR functions serve as enablers of competence formation and role clarity. Survey #3 (Career Path and Aspirations) reveals that 68% of employees feel motivated by structured mentoring and clear progression paths, while 61% perceive alignment between personal growth and company goals. Chapters (acting as communities of practice) amplify this effect through mentoring and skill standardization.

Agile ceremonies and lifecycle discipline remain the core operationalizes of culture. Teams adhering consistently to Scrum/Kanban routines (refinement, review, retrospective) report 20 ..30% higher satisfaction and predictability. Thus, at the tactical tier, autonomy within alignment (supported by HR policy, mentoring, and standard definitions of readiness and completion) constitutes the human foundation of scaling.

### 5.1. Cross-Layer Dynamics and Feedback Loops

The organization operates through three interdependent feedback loops:

1. Bottom-up learning: performance metrics, AI insights, and retrospective feedback from squads aggregate into PDLC dashboards and inform strategic planning.
2. Top-down alignment: program KPIs cascade into backlog priorities, ensuring that day-to-day delivery reflects corporate objectives.
3. Lateral standardization: chapters and communities of practice connect peers across platforms, enabling horizontal knowledge diffusion.

These loops institutionalize the balance between agility and control. Survey evidence supports this: respondents who rated cross-team collaboration as “effective” or “very effective” ( $\approx 70\%$ ) also reported higher predictability and lower rework, confirming that structured information flow strengthens both speed and quality.

## 5.2. The Role of Technology and AI Across Layers

Technology operates as both an enabler and a regulator within the layered model. At the tactical level, AI-assisted coding and test-generation tools accelerate individual productivity. At the operational level, automated analytics aggregate delivery data, supporting lifecycle compliance. AI-powered feedback synthesise knowledge streams. The guiding principle is augmentation, not substitution; AI amplifies human capability while governance safeguards responsibility

## 5.3. Comparative Perspective and Summary

When contrasted with established scaling frameworks, the proposed tiered model demonstrates several distinctive advantages: (1) Compared with Spotify, it introduces formal lifecycle governance and cost visibility. (2) Relative to SAFe, it retains grassroots autonomy and cultural flexibility. (3) Beyond LeSS, it embeds HR/P&C and AI-augmented governance as first-class organizational systems.

Thus, the tiered architecture defines the enterprise as a system of systems (human, procedural, and strategic) where predictability, innovation, and wellbeing co-evolve. It explains how empirical findings from surveys on autonomy, lifecycle maturity, and AI adoption converge into a unified organizational pattern capable of sustaining large-scale delivery with measurable value.

## 5.4. AI, Experience and Collaboration

Recent AI diffusion and experience matters. Adoption is recent, 76.5% began in 2023..2025; only 2.9% have not used AI (N=34). Earlier adopters use AI more and feel stronger impact (timing/frequency  $\rho=0.52$ ,  $p=0.002$ ; timing/influence  $\rho=0.37$ ,  $p=0.032$ ), suggesting experience compounds everyday usage and perceived value.

AI usage intensity drives benefits. Frequency tightly tracks perceived influence (frequency/influence  $\rho=0.84$ ,  $p<1e-9$ ). With 44.1% using AI multiple times daily, higher frequency associates with better performance ( $\rho=0.62$ ,  $p<0.001$ ), improved quality/flow ( $\rho=0.74$ ,  $p<0.001$ ), and higher job satisfaction ( $\rho=0.77$ ,  $p<1e-7$ ).

Seen AI usage productivity gain, flow, and morale rise together, as perceived performance improvement co-occurs with smoother flow and higher morale: performance/quality/flow  $\rho=0.79$ ,  $p<1e-7$ ; performance/satisfaction  $\rho=0.76$ ,  $p<1e-6$ . Overall, 79.4% (n=27/34) report better performance and 70.6% (24/34) better quality/flow; benefits appear systemic rather than

isolated.

Tenure alone is not enough; further AI enablement matters, as we observe adoption timing shows weak/insignificant links to performance ( $\rho=0.23$ ,  $p=0.2$ ) and quality/flow ( $\rho=0.3$ ,  $p=0.09$ ); converting usage into durable gains likely depends on governance, guardrails, and training; aligning with the tiered model's PDLC gates and enablement pools to operationalise AI effectively.

The adoption of AI-assisted tools increased perceived productivity (over 70% of respondents) but required mature processes and ethical safeguards. Teams emphasized that generative models enhanced velocity only when embedded within disciplined agile and review practices, validating the hypothesis that AI amplifies rather than replaces human expertise.

Career-path clarity (S03-Q01) strongly correlates with feeling supported (S03-Q02) ( $\rho=0.671$ ,  $p<0.001$ ). Support is 74.2% ( $n=23/31$ ) among those Very/Somewhat clear 16.7% ( $n=4/24$ ) when clarity is low. Implication would be to continue guidance, publish transparent role ladders and run regular career check-ins, carry on sponsorship, and coaching to lift perceived clarity at scale. Clearer paths associate with stronger prosocial behaviour ( $\rho=0.300$ ,  $p=0.026$ ): 96.8% ( $n=30/31$ ) of clearer respondents report High/Very-high support to colleagues 70.8% ( $n=17/24$ ) with low clarity. Further, Managers and P&C support clarifying growth routes to amplify mentoring and likely more informal enablement is needed.

Shown in (S04-Q04) backlog orchestration is positive for only 46.9% ( $n=15/32$ ), yet it strongly explains outcomes: it highly correlates with S04-Q06 delivery ( $\rho=0.758^{***}$ ) and S04-Q10 predictability ( $\rho=0.614^{**}$ ). Raising orchestration should lift delivery, already 87.5% ( $n=28/32$ ) across the sample ( $N=32$ ).

Collaboration (S04-Q02) Mostly/Very 71.9% ( $n=23/32$ ) and autonomy-with-standards S04-Q03 Mostly/Excellent 78.1% ( $n=25/32$ ) reinforce each other ( $\rho=0.571^{**}$ ) and link to outcomes (see Q02/Q06  $\rho=0.652^{**}$ , Q02/Q10  $\rho=0.649^{**}$ ) supporting platform-level standards with autonomous squads to reduce dependencies, improve interfaces, and sustain predictable cadence.

Predictability anchors delivery as seen in (S04-Q10) Mostly/Very 78.1% ( $n=25/32$ ) aligns strongly with S04-Q06 Good/High 87.5% ( $n=28/32$ ) ( $\rho=0.701^{***}$ ). Perceived best team formation for predictability S04-Q12 also aligns with delivery ( $\rho=0.675^{**}$ ), reinforcing a shared cadence and clear interfaces across the platform and programs.

Team size does not outcome driver; despite sizes: 3..5 28.1% ( $n=9/32$ ), 6..9 21.9% ( $n=7/32$ ), 10..15 37.5% ( $n=12/32$ ), over 15 12.5% ( $n=4/32$ ), responses to (S04-Q01) show negligible association with predictability (S04-Q10,  $\rho\approx 0.04$ ) and modest with delivery (S04-Q06,  $\rho\approx 0.15$ ). Thus, practices drive outcomes more than headcount scale.

In Survey #4 ( $N=32$ ), the “operating” cluster of (S04-Q02) collaboration, (S04-Q03) autonomy-with-standards, and (S04-Q04) PO backlog orchestration, co-varies and is strongly associated with (S04-Q10) predictability and (S04-Q06) overall delivery ( $\rho\approx 0.65..0.76$ ). Chapter influence (S04-Q05) is weaker. Structural levers of pairs (S04-Q01) team size and

(S04-Q08) matrix status, show notably weaker links.

Survey #4 with N=32 shows smaller teams show higher satisfaction: 3..5 and 6..9 post 100% good/high delivery (n=9/9; 7/7) versus 75% in 10..15 and over 15 (n=9/12; 3/4). Team size to delivery is weak ( $\rho=-0.15$ ,  $p=0.42$ ) and team size to predictability ( $\rho=0.04$ ,  $p=0.83$ ). Backlog orchestration and collaboration matter more. Integration between PDLC and platform SDLCs demonstrably improve targets clarity and backlog definitions, this in result, reduces context switching and coordination loss. Participants cited improved accountability and clearer ownership boundaries when lifecycle artefacts (briefs, reviews, and retrospectives) were standardized across projects. Conversely, loosely coupled or ad-hoc lifecycles correlated with duplicated testing and fragmented knowledge transfer.

Among valid responses (N=28), 89.3% (n=25/28) report TPM, PO and Chapter Lead in the same office. Co-location associates with stronger outcomes: (S04-Q03) autonomy-with-standards (point-biserial  $r=0.66$ ,  $p<0.001$ ), (S04-Q05) chapter influence ( $r=0.61$ ,  $p=0.001$ ), (S04-Q06) delivery ( $r=0.55$ ,  $p=0.003$ ), (S04-Q02) collaboration ( $r=0.52$ ), (S04-Q10) predictability ( $r=0.47$ ,  $p=0.011$ ). Effects are weaker for (S04-Q04) PO backlog orchestration ( $r=0.36$ ,  $p\approx 0.06$ ) and (S04-Q08) matrix status ( $r=0.22$ ,  $p=0.27$ ).

From a governance perspective, the triangle model proved effective in linking human-centric delivery with measurable value. HR/P&C policies fostering transparent career paths and hybrid-work structures reinforced cohesion, while strategic programs under KPI control ensured alignment with enterprise vision.

Practically, the study offers a reproducible scaling blueprint: small autonomous squads anchored in standardized lifecycles and connected to strategic dashboards form a stable architecture for complex delivery organizations. Conceptually, it extends agile theory by integrating lifecycle discipline, people systems, and AI-augmented governance within a single comparative framework for sustainable agility at enterprise scale.

## 6. Conclusions and Future work

This study examined how team structure, coordination practices, and lifecycle governance influence delivery predictability, performance, and employee satisfaction in large-scale, multilayered technology organizations. Across three empirical surveys, the most consistent and reproducible findings indicate that operating conditions of delivery (rather than structural headcount choices) are the dominant drivers of outcomes at scale.

Across three surveys, the strongest, most reproducible signals come from the operating conditions of delivery rather than structural headcount choices. In Survey 4, (S04-Q03) autonomy-with-standards, (S04-Q02) cross-team collaboration, and (S04-Q04) PO backlog orchestration co-vary and are consistently associated with (S04-Q10) delivery predictability

and (S04-Q06) overall delivery. By contrast, (S04-Q01) team size and (S04-Q08) matrix status show notably weaker standalone links. This points to a pragmatic organisation-scaling rule (implementation layer): keep squads autonomous, but tighten shared interfaces, prioritisation, and guardrails.

Leadership proximity amplifies these effects. Among valid responses, co-locating the TPM/PO/Chapter triad correlates with stronger (S04-Q03/Q02) operating practices and better (S04-Q10/Q06) outcomes, suggesting that synchronous decision-making and shared context accelerate alignment without adding ceremony.

On the people side, Survey 3 (S03) shows that (S03-Q01) career-path clarity and (S03-Q02) feeling supported move together, and both improve with (S03-Q03) mentoring/helping others. Clear ladders, regular check-ins, and recognition of mentoring behaviours are therefore central to sustaining motivation in scaled settings.

Finally, Survey 2 (S02) indicates AI is an amplifier: usage intensity and routine integration associate with higher performance (S02-Q04), better quality/flow (S02-Q06), and greater job satisfaction (S02-Q05). Tenure alone is weaker than embedded practice; AI improvements show most when woven into the same operating system (interfaces, prioritisation, review). Overall, the evidence favours a coherent blueprint: autonomous squads within clear guardrails, platform-level orchestration, leadership proximity, and AI embedded in disciplined lifecycle practice.

Beyond these specifics, the "three-tier triangle" and "People, Process, Technology" models provides the general backbone for scaling. People (capability building, (S03-Q01/Q02/Q03) clarity/support/mentoring) supply durable motivation and skills. Process (PDLC/SDLC integration, (S04-Q02/Q03/Q04) interfaces/standards/orchestration) shapes communication paths and reduces coordination loss. Technology (platform services, common tooling, and AI assist from S02) lowers cognitive load and enforces quality by default. Scaling, therefore, is not a headcount exercise but a triadic alignment: squads remain stream-aligned and autonomous, while platform teams institutionalise shared services and cadences, and leadership steers strategy through transparent governance and measurable outcomes. Practically: standardise cadence and interfaces first, strengthen chapter enablement, and then let structure follow flow—using the triangle model to keep incentives and mechanisms coherent across tactical squads, operational platforms, and strategic portfolio layers.

The study has several limitations. The results are derived from a single organizational context and rely partly on self-reported survey data, which limits generalisability and causal inference. Sample sizes constrain statistical power and prevent formal mediation or moderation analysis. These limitations suggest caution in extrapolating the findings beyond similar enterprise settings and underscore the need for broader empirical validation.

The inferences are based on modest samples (S02 N=34, S03 N=55, S04 N=32) with matched-by-email N only ~18–27 across surveys, which limits power, precision (wide confidence intervals), and any moderation/mediation tests (e.g., S02 joined S04 effects on (S04-

Q10/Q06)). To strengthen conclusions it is required to (1) run additional survey waves to at least double–triple Ns per cohort, (2) expand cross-firm sampling, (3) pre-register analyses and conduct power analyses, and (4) report bootstrap CIs with multiple-comparison controls. Larger, longitudinal panels will enable credible causal identification and robust generalisation.

In the future work the continuation of the research should, first, apply a causal-inference apparatus rather than relying solely on correlations. Define explicit direct acyclic-graphs (DAGs) that encode our hypotheses about the operating system: (S04-Q02) collaboration, (S04-Q03) autonomy-with-standards, and (S04-Q04) PO backlog orchestration as parents of (S04-Q10) predictability and (S04-Q06) overall delivery. Pre-register the analysis plan; when practices change asynchronously across teams, use staggered roll-outs / difference-in-differences to estimate treatment effects. For observational data, deploy propensity weighting / matching to balance covariates and explore instrumental variables where valid instruments exist (e.g., exogenous scheduling constraints) to bound causal effects.

Second, build larger, multi-firm datasets to improve precision and generalisability. Objectivise from the product delivery dimensions and harmonise the survey instruments across firms and domains, and test measurement invariance so that questions mean the same thing across contexts.

Third, run field interventions on the people system. For career path (S03), A/B test transparent ladders, sponsor-matching, and mentoring circles; track shifts in (S03-Q01) clarity, (S03-Q02) feeling supported, and (S03-Q03) helping others, alongside retention and time-to-promotion. In parallel, run skills growth experiments: short enablement sprints on product ownership, backlog hygiene, and interface design between teams; evaluate uplift on (S04-Q02/Q03/Q04) and downstream (S04-Q10/Q06). Introduce further queries if needed.

Fifth, expand survey on external tools (e.g. AI Copilots, general LLM chats) and internal AI for knowledge engineering.

Sixth, model the system correctly with multi-level statistics. Use hierarchical models with teams nested in platforms and platforms in business units to separate team-level from platform-level effects; test mediation paths (e.g., S02 frequency, S04 operating variables, S04 outcomes).

Finally, commit to open science and community building. Share an anonymised codebook and analysis scripts; invite replication studies; and present findings at Agile, DevOps Enterprise, and related practitioner–research venues. Convene an industry roundtable to refine a shared metric set for scaled delivery, turning today’s correlational insights into reliable, causal guidance for enterprises that require support in their scaling phases.

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