Balancing Cognitions and Emotions to Advance Lean Corporate Programs

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Danilo Pesce and Paolo Neirotti

***Abstract*—This study investigates how cognitive and emotional mechanisms drive advancement in lean corporate programs, addressing a key yet underexplored factor in continuous improvement. While existing research documents lean program successes, it often overlooks the role of cognitive and emotional factors in program progression. Using a phenomenological approach, we integrate individual and plant-level data through both qualitative and quantitative methods. Focusing on a lean corporate program implemented across 22 Italian plants of a leading global carmaker, we employ a structural equation model to assess the relationships among lean organizing principles, cognitive involvement, emotional perceptions, and lean program advancement. Three key insights emerge: 1) A comprehensive application of lean organizing principles enhances employees' cognitive involvement in lean practices; 2) Cognitive involvement is essential for advancing lean corporate programs; 3) Positive emotional states—such as pride, self-efficacy, and perceived fairness—significantly mediate the relationship between cognitive involvement and lean advancement. This study contributes to lean management literature by demonstrating that positive emotions are critical for sustaining lean progress. By bridging the knowledge-based view with behavioral theories, we provide researchers and practitioners with a nuanced understanding of the interplay between cognitive and emotional factors in advancing lean programs.**

***Index Terms*—Cognitive involvement, continuous improvement, emotional perceptions, lean corporate programs.**

I. Introduction

LEAN corporate programs, designed to identify and eliminate unproductive activities, enhance value creation and streamline production processes [1, p. 83], are pivotal for implementing lean principles across global plant networks. While extensive research has investigated the success and outcomes of lean practices, limited attention has been given to understanding what prevents these programs from achieving ongoing advancement and operational improvements [2], [3], [4]. Recent studies have delved into the complexities of lean methodologies [5], revealing that high-performing teams often regress [6] or plateau after initial success [7]. This phenomenon partially results from the intricate processes of knowledge creation and management required for the implementation and progression of lean practices [8], [9], [10]. Although some research has examined employee behaviors within a knowledge management cycle during lean implementation [11], [12], the dynamic interplay between workers' cognitive and emotional perceptions and the momentum of lean programs remains underexplored [13]. Cognition encompasses mental processes such as perception, reasoning, and judgment [14], while emotional factors significantly influence human behavior, often introducing elements that can impact lean adoption in unexpected ways [15], [16], [17].

The knowledge-based viewpoint [11], [12] frames lean rollouts as initiatives of knowledge creation, transfer, and dissemination [8]. However, this perspective does not fully account for the ways employee perceptions and emotions influence knowledge management processes—especially regarding the initiation, continuity, and advancement of lean programs. While lean production can potentially ignite intrinsic motivation in workers under certain job design configurations [18], it may also lead to increased stress levels [19] and complex mixes of positive and negative emotions [20] that emerge from a delicate balance between empowering and coercive elements of lean practices or mismatches between job demands and employees' skills [18]. Such emotional states can decelerate lean program advancement, limiting the sustained implementation of continuous improvement practices. Neirotti [20] observed that mature stages of lean program implementation are associated with heightened positive emotions, such as efficacy and job satisfaction, resulting from increased employee involvement in continuous improvement initiatives. However, the role of positive emotions in catalyzing lean practices accumulation and sustaining lean outcomes remains largely unexplored in lean management literature.

The operational complexities inherent in advanced lean production stages require not only new mindsets, attitudes, and skills but also increasing adaptability to data-driven decision-making and probabilistic thinking, as highlighted by Hopp and Spearman [4]. These complexities may lead to "emotional confusion," contributing to reversals in lean implementation and limiting program advancement. Our study addresses this gap by investigating the balance between cognitive involvement and emotional engagement as essential drivers of lean corporate program advancements, especially in more mature program stages.

Behavioral theories offer a promising framework for understanding this underexplored domain, providing a complementary perspective to the knowledge-based viewpoint. Such theories underscore how specific leadership styles among higher level and middle managers influence the assimilation of new routines, particularly through cultivating the emotional

Received 28 August 2024; revised 5 November 2024 and 19 December 2024; accepted 22 December 2024. Date of publication 31 December 2024; date of current version 17 January 2025. Review of this article was arranged by Department Editor T.-M. Choi. *(Corresponding Author: Danilo Pesce.)*

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Digital Object Identifier 10.1109/TEM.2024.3522570

states that emerge from internalizing new operational knowledge of lean methods and practices [21]. Leadership is critical in creating an enabling environment for lean implementation, as demonstrated by research that highlights the role of leadership styles in overcoming barriers to operational transformation and in aligning teams with lean's long-term goals [9], [10]. However, existing research has not fully captured the nuanced challenges managers and technical teams face in later program stages, as they integrate new lean practices. These challenges often do not sufficiently address the need for employees to develop complex cognitive frameworks and emotional perceptions to mastering analytical decision-making and understanding the operational interdependencies within organizational units, such as departments, plants, and stages of the supply chain. Hopp and Spearman [4] argued that lean systems may falter in their continuous evolution when the focus is overly on waste elimination rather than on creating a cohesive production flow and transforming operational mindsets among frontline employees. Consequently, the successful adoption of new lean practices, particularly in advanced stages of lean corporate systems, hinges on employees' ability to adopt more sophisticated cognitive frameworks, link these frameworks to emotional perceptions, and embrace a new behavioral gestalt [22]. This gestalt includes embracing uncertainty, deepening analytical decision-making engagement [21], and understanding and managing interdependencies between production flows across departments or units within the supply chain [23].

In the ongoing debate on the factors that drive lean advancement in corporate program rollouts, Cusumano et al. [3] have advocated for a phenomenological approach, which captures the complex, context-dependent dynamics of lean programs. Responding to this call, our study leverages a phenomenological approach to delve into the subjective experiences and perceptions of participants, providing a nuanced understanding of how these factors influence lean implementation. By integrating individual-level and plant-level data through qualitative and quantitative methods, we offer a comprehensive analysis of lean program dynamics. Specifically, this approach allows us to examine how workers' cognitive and emotional perceptions interact with lean organizing principles (LoPs), offering insights grounded in their lived experiences. Our field investigation focused on the implementation of the lean corporate program used by Fiat Chrysler Automobiles (FCA) across 22 group plants in Italy during the second decade of the 2000s. The qualitative phase included interviews, focus groups, and workshops with managers and employees, which allowed us to identify specific challenges and contextual influences in lean implementation. Following this, a large-scale survey of 4700 employees across these plants quantified cognitive and emotional responses to lean practices. Using a structural equation model, we analyzed the relationships between LoPs, cognitive involvement, emotional perceptions, and program advancement. This integrative approach enabled us to identify the distinctive role of positive emotions—such as pride and self-efficacy—in reinforcing cognitive involvement and facilitating lean program progress, providing insights deeply rooted in workers' direct experiences.

This study advances lean management literature by integrating the knowledge-based view with behavioral theories, offering a comprehensive understanding of the forces driving lean program progression. Specifically, we demonstrate that positive emotions are not merely by-products of successful lean implementation but essential catalysts for its advancement. Our findings align with emerging research that highlights the role of emotional climates—such as trust, respect, and psychological safety—in fostering lean behaviors, promoting innovation, and preventing stagnation. By illuminating the dynamic interplay between cognitive involvement and emotional engagement, this study provides critical theoretical and practical insights into the foundational elements necessary for sustaining advanced lean practices and ensuring long-term program success.

II. Theoretical Background

The success of lean corporate programs has long been associated with management commitment [24], [25] and organizational incentive mechanisms [26]. These insights initially emerged from phenomenological studies that captured first and organizational challenges, but over time, they have evolved into a more theoretically grounded conversation. This progression underscores the importance of understanding both cognitive and emotional factors as driving forces behind lean adoption and provides a foundation for our study's exploration of how these elements contribute to lean program advancement.

Building on these foundational insights, Secchi and Camuffo [8], [27] explored a knowledge-based perspective, detailing how lean knowledge dissemination occurs through the replication and adaptation of new operational practices and methods. Their findings suggest that lean implementation is not merely a process of replicating methods but is instead a dynamic endeavor involving the creation and adaptation of knowledge frameworks across corporate and plant levels. This perspective highlights the oscillation in organizational design decisions between centralization and decentralization, emphasizing that the effective integration of lean principles relies on organizational structures that facilitate knowledge transfer, adaptation, and mutual learning among teams and management. Complementing this knowledge-centric narrative, behavioral research suggests that the speed and efficacy of lean transformation are significantly influenced by management behaviors and leadership styles [10]. Middle managers play a critical role in driving the organizational learning necessary for integrating new lean practices. Since early studies on the organizational characteristics of lean production [28], team leaders have been identified as pivotal change agents [21], mediating between top-down directives and grassroots-level improvements [29], [30].

In alignment with this, Arellano et al. [31] illustrated how the belief systems of plant-level operational managers can either accelerate or inhibit workforce engagement with lean initiatives. The interplay between management beliefs and the emotional landscape of the workplace reveals how emotional states influence behavior and organizational adaptability to change [15], [16], [17]. Emotions are broadly understood as reactions to

events [32], manifesting as affective states directed toward entities or individuals [33], and serving as responses to attributed meanings [34], [35]. In the context of lean practices, the emotional dynamics fostered by senior management and middle management become instrumental in shaping both collective motivation and individual commitment. Lanzolla and Annosi [36] demonstrated how line managers, especially in the early phases of agile development practices, become "missionaries" of transformation, promoting the strategic relevance of change to facilitate value adoption. Such emotional management fosters a positive climate for change and reinforces organizational learning and knowledge adaptation processes. This view is echoed by Huy [15], who underscores the essential role of middle managers in "emotional balancing." By addressing the emotional responses of employees, middle managers create an environment conducive to change commitment. This emotional balance supports a positive climate for change, facilitating organizational learning loops and providing a foundation for adaptive behavior and effective lean practice implementation [16], [17].

The influence of emotions on team dynamics, particularly shaped by managerial strategies and emotional intelligence, is central to fostering a collaborative and productive organizational culture that enhances lean system effectiveness [37], [38]. Forza [28] noted that teams engage actively because they have autonomy in daily operations and problem-solving, fostering ownership over the production process and a collaborative ethos. Team leaders and supervisors are essential in transferring the motivation and skills needed for embracing these behaviors. This underscores the relevance of social learning theory [39], which posits that individuals are more profoundly influenced by their immediate social surroundings than by distant entities. Thus, lean practices succeed not only as procedural adjustments but also through a cultivated climate where social dynamics, team cohesion, and emotional climates collectively foster lean advancement [40].

Recent research in information systems research has further informed our understanding of the roles of emotions and cognition in adopting of new routines, particularly technology-driven processes [41], [42]. Emotions are shown to mediate the relationship between cognitive understanding and the internalization of these routines. Similarly, in lean systems, successful implementation requires a supportive culture that empowers employees to actively engage in problem-solving through both cognitive clarity and emotional support [38]. This resonates with Rother's [40] emphasis on the "andon cord" principle, which promotes worker autonomy in proactively addressing issues. In such a culture, where cognitive understanding and emotional engagement coexist, organizations can achieve a balanced response to both challenges and improvements in lean implementation [18], [38]. Moreover, integrating the concept of "gestalt cognition" [43]—a holistic understanding of lean processes—provides valuable insight into the complex perception and processing of lean principles. This approach reinforces employees' ability to engage meaningfully with lean objectives, enriching the organization's capacity for sustained lean advancement.

III. Hypotheses Development

Cognitive perceptions in lean production encapsulate the mindset, beliefs, and cognitive frameworks that individuals internalize over time through exposure to lean practices [14]. This cognitive evolution profoundly shapes employees' decision-making, behavioral patterns, and analytical capabilities, forming the foundation for lean methodologies [14]. A critical aspect of this cognitive adaptation occurs through collaborative team dynamics, with team leaders playing a pivotal role. Studies by Januszek et al. [44] and Van Dun and Wilderom [21] suggested that fostering employee engagement, encouraging learning from mistakes, and actively seeking employee input are pivotal practices facilitated by team leaders. Van Dun and Wilderom [21] further detail how team leaders foster employee engagement and learning through relational behaviors, establishing a plan-do-check-act feedback loop that involves regular review and discussion of results. In addition, team leaders facilitate performance monitoring, information sharing, and problem resolution within their teams. This collaborative environment encourages employees to move beyond the traditional division between manual and intellectual tasks, embracing an integrated work paradigm that promotes cognitive involvement and enables proactive participation in continuous improvement [4], [10].

Recent studies underscore the importance of managerial commitment to conveying organizational values and building structures conducive to continuous improvement [21], [25], in line with LoPs conceptualized by Womack et al. [45]. Building on insights from our examination of LoPs and related studies, we propose that extensive implementation of these principles—particularly those enhancing teamwork and managerial communication of a new work paradigm—significantly boosts employees' cognitive engagement with lean processes and their involvement in continuous improvement.

H1. A high extent of LoPs *positively affects an employee's perceived cognitive involvement in lean.*

Through a knowledge-based lens, we posit that an evolved psychological contract [46] that integrates manual and cognitive tasks fosters more rapid cycles of knowledge absorption and adaptation, enhancing lean program integration [8]. This accelerated integration aligns with a broader decentralization of knowledge management at the plant level. Enhanced cognitive involvement, coupled with increased job autonomy, allows employees to deftly balance the demands of conforming to established lean standards with the flexibility needed to incorporate emerging lean technologies and methodologies. Likewise, greater cognitive involvement by line employees in lean production encourages their active role in creating new operational practices aimed at waste elimination, which can later be standardized at a plant or corporate level [47].

In scenarios involving higher employee cognitive involvement, greater job autonomy, and broader task variety, employees exercise judgment in balancing alignment with existing lean standards and adaptability to new lean-related technologies and practices. Thus, we hypothesize that more advanced cognitive

involvement developed by workers at the plant level leads to more rapid and effective absorption of new lean practices defined at the corporate level.

H2. Higher employee cognitive involvement in lean practices leads to faster advancement in lean corporate programs at the plant level.

Grounded in behavioral theories and Lazarus' appraisal theory of emotion [48], [49], there is a strong consensus that emotions stem from cognitive processes and play a crucial role in organizational learning within teams. A fundamental principle of these theories is that emotions serve as relevance detectors, alerting individuals to necessary behavioral changes and motivating adaptive responses. Positive emotions, such as pride and job satisfaction, encourage self-transcendence and adaptation, while emotions such as fear may inhibit change [50]. In lean environment, positive emotions foster commitment to new practices, especially when managers cultivate psychological safety and uphold high performance standards [51]. Lean practices that encourage open communication—such as stand-up meetings and Gemba walks—reduce hierarchical barriers and build a culture of continuous improvement, reinforcing psychological safety [21]. This sense of safety mitigates the tension between control and empowerment, paving the way for a culture of innovation and fostering a sense of collective responsibility [18], [20], [52].

A positive emotional climate driven by lean programs also facilitates decentralized decision-making, essential for adopting continuous improvement initiatives [53]. In this environment, employees feel empowered to engage with new technologies and practices, reinforcing their roles within the workflow. For example, the integration of collaborative robotics and data analytics into traditional operational tasks balances manual and cognitive demands, amplifying line workers' roles [54]. Supported by psychological safety, such positive emotional states empower line employees and their leaders to tackle the complexities of lean improvements with confidence and creativity, addressing the operational task interdependencies that are crucial in advanced stages of lean implementation [51]. Managing these factors becomes increasingly intricate as complex task interdependencies—stemming from the application of work practices and the adoption of new process technologies—resist codification [55]. The interplay between cognitive involvement and positive emotions may therefore accelerate lean program progression at the plant level. Accordingly, we hypothesize:

H3. Employee cognitive involvement leads to high levels of positive emotions, which in turn lead to faster advancements in lean corporate programs at the plant level.

IV. Methodology

A. Research Setting

Our study draws data from a comprehensive field investigation into the implementation of a corporate lean program, the World Class Manufacturing (WCM) model, across 22 Fiat Chrysler Automobiles (FCA) group plants in Italy (formerly Fiat Group Automobiles, now part of Stellantis). This focus minimizes variances associated with different institutional and cultural contexts by concentrating on a single country, thus enhancing the study's internal validity. Initiated in 2005 under the leadership of CEO Sergio Marchionne, the WCM program marked a significant evolution from Fiat's earlier, more fragmented lean practices of the 1990s, with a renewed emphasis on ergonomics, behavioral norms, and skill development. The program's progress was assessed through semiannual audits conducted by external specialists from the WCM association, who evaluated adherence to 20 distinct categories or "pillars." By the end of 2019, the WCM methodology had been adopted in 96 plants worldwide, covering 99% of all FCA facilities. Among these, only six had achieved the top "gold" stage, indicating the substantial challenges of embedding lean principles across varied operational and cultural landscapes.

B. Study Architecture

Our study was executed in several stages, beginning with qualitative inquiries that preceded a survey. First, an exploratory investigation was conducted through interviews with corporate and plant managers. This phase also included a five-hour workshop with 40 union delegates from FCA plants to refine the research focus and identify specific areas for investigation. We then followed a sequential approach, initiating with qualitative focus groups to identify core WCM-related challenges for workers and to understand the contextual factors shaping their perceptions. These focus groups further helped capture the linguistic nuances and contextual perspectives of workers concerning the WCM lean corporate program, directly informing the constructs under examination.

Qualitative Research: To systematically analyze the qualitative data, we employed a structured methodology involving ten focus groups, each comprising 15 workers from diverse plants, representing various production areas and demographic profiles. Workers were invited to participate by union delegates, ensuring a range of perspectives from plants at different stages of WCM advancement. Open-ended questions guided discussions, enabling rich, experiential data collection on workers' perceptions of WCM [56]. The discussions were recorded, transcribed, and subjected to thematic analysis, where responses were inductively coded to identify recurring themes related to cognitive and emotional responses, as well as firm-specific contextual factors linked to lean practices.

The insights from these focus groups guided the refinement of our research focus and the development of theoretical constructs. For example, expressions of "ownership" and "responsibility" during discussions were aligned with cognitive involvement, while feelings of pride and perceived fairness informed the emotional perception constructs. This iterative process anchored our constructs and hypotheses in the study's specific context, enhancing both the relevance and rigor of the analysis. Moreover, to enhance the methodological robustness of the qualitative phase, we triangulated data from focus groups with observations of plant-level practices and detailed archival analysis of WCM documentation, ensuring alignment between employee-reported experiences and recorded operational changes. The focus groups also identified context-specific

TABLE I
SURVEYED PLANTS BY PRODUCTION TYPE AND WCM SCORE, NUMBER OF COLLECTED QUESTIONNAIRES, AND COVERAGE RATE COMPARED TO WORKFORCE

Plant #	Product Type	WCM Score	Number of Questionnaires	Coverage Rate
1	Finished cars	High	526	10%
2	Finished cars	High	460	11%
3	Finished cars	Medium	443	7%
4	Finished cars	High	356	9%
5	Industrial engines	Low	311	14%
6	Engines and automotive mechanics	Medium	243	17%
7	Engines and automotive mechanics	Medium	216	9%
8	Finished industrial vehicles	Medium	208	13%
9	Industrial engines	Medium	207	13%
10	Finished cars	Very Low	206	10%
11	Finished cars	Medium	164	4%
12	Engines and automotive mechanics	High	163	26%
13	Components, spare parts, robotics	Very Low	141	18%
14	Components, spare parts, robotics	Medium	138	14%
15	Finished industrial vehicles	Medium	125	5%
16	Finished industrial vehicles	Low	114	19%
17	Finished industrial vehicles	Very Low	113	14%
18	Finished industrial vehicles	Low	112	13%
19	Engines and automotive mechanics	Medium	109	6%
20	Finished industrial vehicles	Very Low	107	19%
21	Components, spare parts, robotics	Very Low	74	6%
22	Components, spare parts, robotics	Very Low	54	7%
TOTAL			**4590**	**10%**

language that authentically captured workers' perspectives on WCM, enabling us to tailor survey items accordingly—a methodological contribution that ensures our theoretical constructs resonate with the unique setting of our study.

Quantitative Research: A stratified survey was then distributed across 31 FCA plants in Italy, supported by FIM-CISL, the leading trade union in these facilities. A total of 5034 questionnaires were completed, although quality checks led to the exclusion of some responses due to limited representativeness. The final analysis included 4590 questionnaires from the 22 plants listed in Table I. The survey utilized a 4-point Likert scale and included control variables such as employee age, gender, role, organizational unit, and recent lay-off days. Random stratified sampling was employed to ensure a representative cross-section of the workforce, aligning with FCA's demographic profile in Italy. Each plant represented a stratum, and sample sizes were calculated to achieve a minimum statistical power of 80%.

The sample of respondents was consistent and comparable with the main sociodemographic characteristics (age, gender, role, company seniority) of the reference population (see Table II). The survey, distributed directly in plant common areas by trained union delegates, reached approximately 10% of the workforce that, at the time of the survey, amounted to approximately 47 000 people in the 22 selected plants. To ensure research rigor, several steps were taken following Podsakoff et al.'s [51] recommendations to minimize potential common method bias: first, questionnaire revisions minimized ambiguity through iterative feedback from union delegates and focus groups; second, survey distribution aimed to mitigate bias related to union channels, ensuring inclusivity across all affiliations; third, respondents were selected randomly without management or union influence; finally, a Harman's single-factor test indicated no significant common method bias. Following the idea of principal component analysis, we loaded all items in this study into an exploratory factor analysis as a post hoc analysis of marker variables [57]. A potential bias exists if a single factor can explain most of the variance. Our test shows that the first factor explains only 31.5% of the variance, indicating little concern for common method bias in the sample.

C. Data Analysis

To test the hypotheses, we employed a structural equation model (SEM) using Stata with maximum likelihood estimation, allowing for the examination of both direct and indirect effects among the constructs. This approach facilitated the identification of latent variables—such as organizational infrastructure awareness, cognitive involvement, and emotional perceptions—while simultaneously analyzing their influence on the implementation of the lean corporate program [58]. Through SEM, we conducted

TABLE II
COMPARISON BETWEEN SAMPLE AND REFERENCE POPULATION FOR DEMOGRAPHIC AND OCCUPATIONAL VARIABLES

Indicator	Value in the sample	Value in the reference universe
Male component share	81.4%	81.9%
Average age in years	43	41
Rate of higher education and graduates	36.8%	38%
Share of assembly workers	62%	60%
Share of voters at Unitary Trade Union elections	87.7%	80-90%
Professional share	3.9%	8%

a nuanced analysis that revealed the intricate relationships between LoPs, cognitive involvement, and emotional perceptions. The SEM model demonstrated excellent fit indices (e.g., RMSEA = 0.045; TLI = 0.983; CFI = 0.962), all exceeding established thresholds for reliability and validity, further validating the methodological robustness of our approach. These results ensure that the identified relationships and mediations accurately capture the underlying dynamics within the lean implementation framework. To confirm the robustness of the findings, we conducted a recalibration of the model using program implementation scores from 2015 to 2017, which yielded consistent results. In addition, mediation analyses employing bootstrapping (with a 95% confidence interval) validated the indirect effects of emotional perceptions on lean program advancement, thereby enhancing the credibility and rigor of the study's conclusions.

In our analyses, we controlled for respondents' age, gender, role in the company (distinguishing between direct line worker, indirect line worker, and technical specialist), organizational unit they belong to (distinguishing within each plant between assembly, sheet metal, and painting departments), contractual classification, educational qualification, company seniority (measured in years in the company), days of lay-offs relative to the two months prior to the survey, and unionization (a dummy variable that distinguishes who voted in the last union representative elections). In addition to these variables, we also controlled for the effects due to the production sector of the factories that can be attributed to five groups: "car terminals," "industrial terminals," "car gearboxes and engines," "industrial vehicle gearboxes and engines," and "components." Random stratified sampling was used. The 22 plants were the strata, and the sample size was defined in each of them to achieve sufficient statistical power (i.e., 80%). By focusing on a single company, we implicitly controlled for industry, organizational culture, and process complexity, further enhancing the study's internal validity. In addition, to validate the SEM's robustness, a bootstrapped estimation was employed to confirm the stability of parameter estimates across multiple samples.

D. Measures

Measurement Model: The measurement model describes the design of latent variables based on observable items. In our model, we have three latent variables using 16 items. We test the measurement model for individual item reliability, internal consistency, and convergent validity (see Table III). Starting with confirmatory factor analysis, all measurement items loaded on their respective factors at statistically significant levels ($p < 0.001$), demonstrating good item reliability. Cronbach's alpha coefficients, composite reliability (CR), and average variance extracted (AVE) were calculated for each construct, confirming reliability and validity according to recommended thresholds [59], [60].

Clarification on Item Development: Our items were developed directly from the qualitative insights, rather than through adaptation of existing scales. Constructs, such as lean organizing principles were based on themes from focus groups and interviews, ensuring contextual alignment with the WCM implementation at FCA plants. For example, "LoP1 - Sustainable Workplace" captures workers' firsthand descriptions of improvements in workplace conditions, and "LoP2 - Teamwork" reflects their observations about the responsiveness of team leaders, both directly voiced in qualitative sessions. Similarly, items for the Cognitive Involvement construct were directly informed by workers' descriptions of their tasks and involvement in lean practices. For instance, "C1 - Cognitive Workload" captures the perceived increase in intellectual demands workers reported as a result of lean initiatives. Likewise, emotional perception items were grounded in qualitative data. For example, "E1 - Pride" reflects workers' expressions of loyalty and endorsement of FCA as a reputable manufacturer. This alignment was validated through multiple pretests and item refinements, ensuring that the constructs accurately captured the nuanced interplay between cognitive and emotional factors in lean adoption, thereby enhancing the methodological rigor of our model.

Lean Organizational Principles: The lean organizational principles were operationalized through six core dimensions, each closely aligned with established lean literature themes. Emerging as foundational elements in FCA's lean program, these dimensions reflect both qualitative and quantitative insights into how lean principles were adopted across plants.

[LoP1] Sustainable Workplace: Reflects improvements in workplace conditions such as cleanliness, noise levels, and lighting. These enhancements contribute to waste reduction and operational efficiency while supporting

TABLE III
CONFIRMATORY FACTOR ANALYSIS, COMPOSITE RELIABILITY, CRONBACH α, AND AVE

			Standardized loadings	t value (all $p < 0.001$)	CR	α	AVE
[LoP] LoPs in the company's lean program					0.847	0.848	0.642
LoP1	Sustainable workplace	My working environment has improved in terms of cleanliness, noise and lighting.	0.83	30.23			
LoP2	Teamwork	Team leaders are there promptly to solve problems.	0.82	26.46			
LoP3	Shop-floor training	The training I received on WCM has been adequate.	0.81	25.63			
LoP4	Visual management	I know the production, quality, absence/presence of targets and the results of my team.	0.78	23.74			
LoP5	Sense-giving	I know the reasons for the change brought about by the WCM (international competition, crisis in the car industry, low productivity).	0.79	24.34			
LoP6	Management commitment	The company demonstrates commitment and consistency in the application of WCM.	0.75	24.62			
[C] Cognitive involvement					0.819	0.827	0.713
C1	Cognitive workload	The amount of intelligence required of me at work has increased.	0.88	38.16			
C2	Ease and relief	My job is less tiring than in the past.	0.87	36.19			
C3	Workplace conditions	The health and safety of my workplace has improved.	0.82	26.83			
C4	Involvement	I provide/have provided ideas and suggestions to improve work (e.g., safety, productivity, quality).	0.84	31.78			
C5	Team Supportiveness	The pace of work allows me to help my teammates when problems arise.	0.77	22.81			
[E] Emotional perceptions					0.863	0.846	0.762
E1	Belongingness	At my workplace, I feel I am part of a team.	0.88	37.2			
E2	Collective efficacy	The collaboration with my work colleagues has increased: we help each other more.	0.84	31.13			
E3	Fairness in recognition	The rewards for the accepted suggestions are appropriate.	0.83	29.43			
E4	Pride	I would recommend FCA as a good car manufacturer.	0.87	36.93			
E5	Self-efficacy	I now feel I count more.	0.89	38.16			

the sense-making process driven by managers, ensuring employees understand and embrace the strategic importance of lean as a systemic shift.

[LoP2] Teamwork: Captures the essential role of teamwork as the backbone of organizational learning in lean. Shop-floor teamwork, organized by specific areas, fosters accountability for waste reduction and continuous improvement, embedding innovation and problem-solving as part of the daily workflow [28].

[LoP3] Shoop-floor Training: Represents employees' active involvement in training on lean practices. Shop-floor training transfers essential operational knowledge, aligning employees with key performance indicators and enabling them to integrate lean methods effectively into their daily roles.

[LoP4] Visual Management: Measures the use of visual tools and dashboards that enhance transparency and allow teams to monitor performance and share information on critical operational metrics. Visual management reinforces team cohesion and supports proactive engagement with lean processes [21].

[LoP5] Sense-Giving: Encompasses the efforts of higher level managers to communicate the strategic relevance of lean, fostering a "psychological contract" between the company and employees. Improved workplace conditions are presented as prerequisites for deeper cognitive

involvement and behavioral shifts, building shared understanding around lean's systemic goals.

[LoP6] Management Commitment: Demonstrates the commitment of both plant and corporate managers to drive lean practices forward with a long-term vision. Leaders actively endorse lean principles, emphasizing core values like "waste elimination" and "continuous improvement," crucial for sustaining lean's transformative impact [25], [61], [62].

Cognitive Involvement: Cognitive involvement was measured across five individual-level factors related to the job characteristics of lean, each impacting workers' well-being and operational performance.

[C1] Cognitive Workload: Represents the level of intellectual demand employees experience due to their engagement in continuous improvement activities, such as detecting production anomalies and proposing solutions.

[C2] Ease and relief: Assesses the extent to which lean's organizational structure reduces physical fatigue, especially for tasks that involve prolonged standing or repetitive motions [63].

[*C3] Workplace Conditions:* Reflects employees' perceptions of improvements in cleanliness, order, health, and safety within their workstations.

[C4] Employee Involvement: Measures the degree to which employees actively contribute ideas and suggestions for continuous improvement efforts.

[C5] Team Supportiveness: Captures the level of social support within teams, an essential factor for balancing efficiency, adaptability, creativity, and problem-solving [20].

Emotional Perceptions: The constructs rooted in emotional perceptions were operationalized according to appraisal theory, examining how emotional responses to work-related experiences shape behavior [15]. Our qualitative research identified five relevant constructs, spanning individual, team, and plant-level factors.

[E1] Pride: Reflects the degree to which employees identify with FCA as a reputable manufacturer, enhancing a sense of organizational identity. This aligns with findings on how employee involvement in operational performance strengthens pride [64].

[E2] Self-Efficacy: Denotes a heightened sense of personal agency, aligned with Bandura's concept of self-efficacy, which emphasizes individuals' confidence in their capabilities [39].

At the team level, our inquiry highlighted the unique roles of belongingness and collective efficacy across different contexts.

[E3] Belongingness: Measures employees' emotional awareness of being part of a cohesive team.

[E4] Collective Efficacy: Defined by Bandura's [39] the shared belief in a group's conjoint capabilities to organize and execute required actions, fostering trust, cohesion, and coordinated effort.

At a broader level, the construct of *fairness in recognition* captures the relationship between employees' perceptions and managerial appraisal. In behavioral theories, *fairness in recognition* underscores justice perceptions, impacting emotional and motivational responses.

[E5] Fairness in Recognition: Refers to employees' perceptions of equity in reward and recognition distribution for continuous improvement, reinforcing principles of fair treatment and justice.

Advancement in Lean Corporate Program: Our dependent variable measures the advancement of each plant within FCA's lean corporate program from 2014 to 2018, capturing progress through external audit scores. Building on Netland and Ferdows [1] and Netland and Aspelund [65], the measure includes 1) the extent of lean program implementation across different plant areas and 2) the fidelity of these areas in adhering to lean principles. The WCM program, comprising 20 pillars (split between technical and management categories), evolves in stages, beginning with selected modules in pilot areas and expanding to include additional areas and practices. Lean program progress reflects the "maturity" of a plant's implementation, gauged by the breadth and depth of applied methods, tools, and behaviors across the production process. Higher scores indicate proactive waste-prevention strategies, while lower scores suggest a reactive approach. Mid-range scores represent preventive actions designed to avoid the recurrence of critical inefficiencies. The managerial pillars emphasize behaviors and practices that promote employee commitment, motivation, and responsibility for continuous improvement. This comprehensive score reflects organizational behavior, change management practices, and strategies to foster new mindsets aligned with lean change management principles. For example, following a major refurbishment at the Pomigliano plant and the launch of a new car model, FCA invited employees' families to visit the factory, fostering emotional engagement and pride in the transformative process. The WCM Association's Methodology Implementation Index (0–100 scale) awarded Bronze (50), Silver (60), Gold (70), and World Class (85) designations to facilities. Higher index scores signify advanced lean understanding and implementation, encapsulating a holistic application of lean principles and continuous enhancement of workplace conditions and environmental sustainability. This dependent variable thus captures lean program implementation as an "integrated socio-technical system" [66, p. 791].

V. Findings

A. Cognitive and Emotional Characterizations of a Lean Corporate Program

Consisting of firm-specific applications of general organizing and managerial principles oriented toward waste elimination, as advocated by Netland [3], we have studied how the lean corporate program at FCA evolved uniquely at each plant, influenced by both corporate-level managers and plant-specific contexts. This approach aligns with Cusumano et al.'s [3] call for phenomenological studies capable of capturing firm-specific effects related to behavioral aspects such as leadership behaviors and the cognitive foundations of their application and evolution over time. The following sections report on the variance at the plant level in employees' cognitive involvement and emotional perceptions about lean, and the differences in how new LoPs were absorbed, influenced by corporate-level managers, including the CEO and their direct reports.

Application of LoPs. Sustainable Workplace [LoP1]: At FCA, quality, safety, and ergonomics were prioritized to establish a renewed psychological contract between the company and its workers, as indicated by Marchionne. Workers across plants widely observed improvements in these areas, evidenced by statements such as, *"WCM has focused on workers' health and safety," "Now, we see a cleanliness that was unimaginable before,"* and *"WCM has addressed physical work-related issues."* However, some plants reported a lack of worker involvement in workstation redesigns, as one worker noted: *"Redesigns were handled by managers without our input."* In contrast, in plants where workspace conditions were restructured to meet WCM standards, workers attributed increased attentiveness and vigilance to these changes, saying, *"Cleanliness and order have changed our mindset; now we notice and respond to issues proactively."*

Teamwork [LoP2]: The reconfiguration of production teams into smaller units aimed to enhance worker accountability and support for continuous improvement. Previously, larger units like the Unità Tecnologica Elementare (UTE) hindered cohesion, as stated by a Chief Operational Officer: *"Managing 50 people as a span of control meant not really managing anyone."* Despite the structural reorganization, the experience of teamwork varied among plants. In Mirafiori, a worker shared, *"Team spirit depends heavily on the team leader's character; collaboration is key, but not all leaders understand this."* Meanwhile, workers in Cassino perceived a disconnect between managerial skill in technical areas and human relations, stating, *"Team leaders are good with techniques but struggle to connect with us on a human level."* These accounts highlight a disparity between theoretical teamwork benefits and workers' practical experiences.

WCM Training [LoP3]: Training intensity and quality were also heterogeneous across plants. For instance, in Pomigliano, workers participated in comprehensive training sessions that were directly applied to their daily tasks. One worker described the experience: *"Returning to the plant, we saw firsthand that the principles taught in training were not just theory—they were part of our work."*

Visual Management [LoP4]: Visual tools and dashboards were intended to facilitate team performance monitoring and information sharing. However, their effectiveness depended on both the frequency of updates and the accessibility of data. A worker noted, *"We can see defect rates displayed, but other indicators are not always clear or accessible due to time constraints."*

Sense-Giving [LoP5]: Higher level managers played a critical role in ensuring that employees understood the strategic objectives of WCM, framing the principles as vital to FCA's competitive survival in high-cost markets like Italy. This "sense-giving" process fostered a shared language across diverse cultural contexts and inspired workers to adopt a new identity centered on WCM. Many workers found this inspiring, expressing sentiments like, *"WCM is our opportunity to regain competitiveness and help shape a new production system"* (Pomigliano). The effectiveness of this sense-giving was reinforced by accessible communication styles, as noted by the Head of Manufacturing for mass-market brands, *"Our communication aimed to simplify WCM, making it understandable across all cultural barriers in our plants."*

Management Commitment [LoP6]: The dedication of FCA's management to WCM was fundamental in shaping employee behavior and developing the skills and work environment necessary for continuous improvement. CEO Sergio Marchionne underscored the need to reduce waste and elevate worker dignity, saying, *"Waste was not just visible in clutter but in how people worked."* This emphasis on systemic change permeated WCM, with managers observing that, *"Previous lean programs failed because they didn't focus on changing people's behavior."* The commitment at both plant and corporate levels reinforced lean principles as a permanent change in operational culture.

Cognitive Involvement: Workers widely acknowledged tangible improvements in physical fatigue reduction [C2] and workplace health and safety [C3]. They expressed that *"WCM solves physical problems"* (Cassino) and *"The worker has everything at his disposal"* (Pomigliano). While these changes were largely positive, they accompanied an increase in cognitive workload [C1] due to intensified work pace and focus on waste elimination. Some employees found this cognitively demanding, with comments such as, *"The work pace is faster, and my mind is always on"* (Mirafiori), and *"The rhythms are now tighter; it's mentally taxing even though physical strain has reduced"* (Melfi).

In plants where WCM was in earlier stages, unmet expectations occasionally led to worker dissatisfaction. Workers felt that efficiency benefits seemed to primarily favor the company, particularly when they were excluded from the design of new workflows [C4]. However, in more advanced WCM plants, employees often expressed pride in their contributions to workplace improvements and operational outcomes. For instance, workers shared, *"I make dozens of proposals to improve things here"* (Melfi), *"Our ideas reduce waste and improve conditions"* (Cassino), and *"Our contributions keep us at the forefront of quality"* (Pomigliano).

In plants like Pomigliano and Melfi, where WCM implementation was more mature, teamwork [C5] fostered a supportive environment essential for adapting to lean demands. Workers highlighted the value of mutual assistance, explaining, *"We give each other a hand when there's a problem"* (Pomigliano), *"I help a colleague who's more saturated than me"* (Melfi), and *"During breaks or even outside work—like when we go for pizza—we discuss quality issues"* (Pomigliano). These insights underline how trust and reciprocity strengthened teamwork, making it effective. As one worker elaborated, *"Trusting teammates requires getting to know them. Some teams even get together outside work for a barbecue"* (Cassino).

The team leader's role was pivotal in facilitating open communication and instilling a sense of value among team members. However, in less advanced WCM settings, workers felt disconnected from these participatory ideals. Some expressed, *"They told us the worker is central, but in practice, that's not the case"* (Melfi), and *"We feel sidelined; there's no real value placed on us"* (Mirafiori).

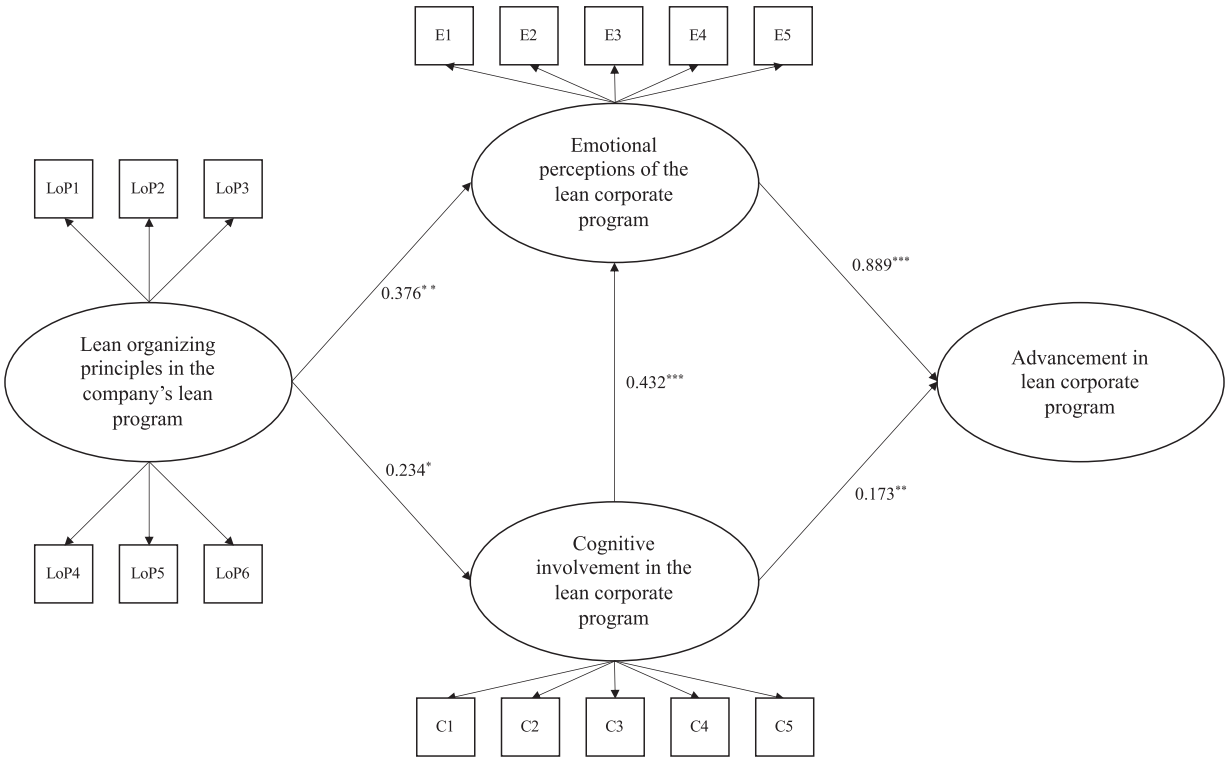

Fig. 1. SEM with parameter estimates and factor loadings. *Notes: control variables included* * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Emotional Perceptions: Daily Improvement Meetings (DIM) were instrumental in fostering a sense of accountability and professional community among workers. Led by the plant director, these meetings gathered team leaders, area supervisors, and sometimes external suppliers to address issues and share solutions. A Head of Manufacturing remarked, *"Initially, some directors doubted DIM's value, but they soon realized it fosters problem-solving and accountability at the team level."*

At the individual level, improvements in job characteristics and workplace conditions contributed to increased pride [E1] and self-efficacy [E2]. For instance, in Pomigliano, operational success, new productions, and enhanced safety metrics instilled a sense of significance in workers. Comments included, *"With the WCM, we've shown that we are good… others are starting to see our value"* and *"WCM is something to be proud of; we've shown our commitment to change"* (Pomigliano). The visible impact of worker ideas on waste elimination reinforced their sense of professionalism, with one worker stating, *"We should have something like a patent for our contributions"* (Pomigliano).

Recognition of workers' contributions [E5] was essential for sustaining engagement, with both symbolic and economic acknowledgment perceived as vital. In advanced WCM plants, feedback systems were implemented to assess and recognize employee input, which further reinforced self-efficacy. Workers expressed, *"I feel more heard, and I'm happier because I'm valued"* (Mirafiori) and *"Now, I can have a say and make an impact"* (Maserati Grugliasco).

At the team level, emotional engagement was most strongly fostered through mutual support within small, close-knit teams. Informal gatherings, such as meeting for pizza or barbecues, allowed workers time for reflection and idea-sharing outside formal structures. A line worker in Pomigliano explained, *"Teamwork happens even when we lack time for formal meetings. We use breaks, and sometimes we get together outside work. Our team has become like a second family—a group united by respect, trust, and a shared project for the future."*

B. Structural Model

The SEM shows a strong fit. The chi-square test, a traditional metric for assessing overall model fit through the discrepancy between sample and fitted covariance matrices [67], indicates a favorable model fit, providing a nonsignificant result at a 0.05 threshold and a χ^2/df of 1.34, which is below the threshold of 3 [68]. Despite the chi-square test's popularity, its limitations [69] prompted us to include three alternative indices for model fit assessment. According to Steiger and Lind [70], the root mean square error of approximation (RMSEA) stands at 0.045, beneath the 0.08 cutoff [71]. In addition, the Tucker–Lewis index (TLI) and comparative fit index (CFI) are 0.983 and 0.962, respectively, surpassing the 0.90 threshold [72], [73], [74]. These indices collectively indicate a satisfactory model fit. Fig. 1 displays the hypothesized relationships and standardized regression coefficients.

LoPs significantly and positively affect employees' cognitive involvement ($\beta = 0.376$, $p < 0.01$) and emotional perceptions

TABLE IV
MEDIATION EFFECTS

	Baron and Kenny's stepwise approach			Result
	Effect of X on M	Effect of X on Y	Effect of M on Y	
Emotional perceptions of the lean corporate program	β 0.648 T 29.98 p 0.000	β 1.09 T 7.88 p 0.000	β 0.551 T 13.25 p 0.000	Mediation supported
	Sobel test z 3.28 p 0.001			Mediation supported
	Bootstrapped estimate Confidence Interval 0.052	0.278		Mediation supported

($\beta = 0.234$, $p < 0.05$). Furthermore, both cognitive involvement ($\beta = 0.173$, $p < 0.01$) and emotional perceptions ($\beta = 0.889$, $p < 0.001$) significantly enhance the advancement of the lean corporate program. Specifically, a one standard deviation increase in employees' emotional perceptions correlates with a 0.889 standard deviation increase in the advancement of the lean corporate program. In addition, employees' emotional perceptions positively influence their cognitive involvement ($\beta = 0.432$, $p < 0.001$). Control variables had no significant effects on model variables.

We also explored the potential mediation effect where employees' emotional perceptions mediate the influence of cognitive involvement on the advancement of the lean corporate program. Following the stepwise approach by Baron and Kenny [75], a mediation effect is present if the independent variable significantly predicts the mediator; the independent variable significantly predicts the dependent variable; the mediator significantly predicts the dependent variable, controlling the independent variable.

The stepwise analysis in Table IV confirms the mediating role of emotional perceptions in the advancement of the lean corporate program. For robustness, a nonparametric test using the bootstrap approach [76], with a 95% confidence interval, corroborates the stepwise findings. Furthermore, Sobel's [77] parametric test, affirming the mediation effect, enhances our confidence in these results.

VI. DISCUSSION

Recent research on lean adoption has primarily focused on knowledge creation and transfer processes across plants to explain lean practice outcomes [8], [27], [78]. Extensive literature underscores the critical role of middle managers, particularly through their leadership behaviors and competencies, in shaping learning processes on the shop floor. However, while prior studies have documented emotional responses—such as pride, job satisfaction, and ambivalence—stemming from factors like job design, reward systems, and managerial feedback, the specific role of emotions in facilitating or hindering plant-level lean advancement remains underexplored. Our study addresses this gap by examining how emotional states, triggered by new organizing principles in lean production, influence the absorption and internalization of cognitive frameworks essential for advanced lean stages. These stages require a mindset shift among line workers and frontline managers, who must embrace a new gestalt [20] and a more systemic logic [4] foundational for sustained lean advancements.

Compared to previous research, our study bridges the knowledge-based perspective with behavioral theories, highlighting the role of emotions in organizational transformation. Using a phenomenological approach that combines qualitative and quantitative data, we capture the nuanced interplay between employee-level experiences in lean implementation and plant-level advancements in lean programs. This approach not only reveals the distinct effects of emotions—such as pride and both individual and collective self-efficacy—but also enriches lean literature by offering a theoretical framework adaptable to diverse organizational contexts. Moreover, our study's integrated qualitative-quantitative design allows us to capture the phenomenological dimension (via qualitative data) while also achieving statistical generalizability (via quantitative data). This dual approach provides a robust understanding of lean program dynamics across varied settings. In line with recommendations by Cusumano et al. [3], our approach highlights how workers' subjective experiences influence lean program advancement at the plant level. Thus, this research contributes both methodologically and theoretically, enhancing our understanding of the behavioral dynamics that underpin successful lean implementation.

A key contribution of our study thus lies in its methodological approach, specifically in tailoring constructs from established frameworks to fit the phenomenological context of our research. Drawing on qualitative insights, we tailored survey items for LoPs, cognitive involvement, and emotional perceptions to closely reflect employees' experiences and vocabulary. More specifically, our focus groups enabled us to capture the salient role of FCA employees' perceptions of physical workplace improvements, such as cleanliness and ergonomics—factors often underemphasized in organizational studies focused on identifying the foundational mechanisms of successful lean

programs. Similarly, cognitive and emotional items were designed based on themes identified in focus groups and interviews, incorporating employees' perspectives on job autonomy and pride associated with lean practices.

This tailored approach strengthens the validity of our quantitative model by ensuring that it resonates with participants' operational realities and psychological responses, thus enhancing the precision and relevance of our findings. Overall, the tailoring of constructs and survey items provides a contextually grounded analysis of lean advancement.

Below, we detail the theoretical and practical contributions of our study.

Role of Emotions in Lean Implementation Success

Our empirical investigation further demonstrates the substantial impact of employees' emotional perceptions of lean job characteristics. Two mediation effects emerged, revealing how positive emotions influence lean corporate program advancement. First, positive emotional states fully mediate the relationship between lean principles' deployment and lean corporate program advancement. Second, positive emotions partially mediate the relationship between employees' cognitive involvement in lean practices and the program's plant-level progression. By providing empirical evidence on the importance of employees' cognitive involvement in lean implementation success, our primary contribution lies in demonstrating that cognitive involvement alone contributes only partially to lean program progress. Instead, it is employees' emotional responses to their cognitive involvement with new organizing principles—encompassing pride, individual and collective self-efficacy, and perceived equity in reward systems [64]—that amplify the positive impact of lean principles on program advancement at the plant level. This perspective aligns with Katz-Navon et al. [79], who address the paradox between lean standardization and innovation. Their work identifies problem-solving as a bridging mechanism, whereas our study underscores the importance of fostering positive emotional climates to mitigate tensions between efficiency and creativity, thereby sustaining lean program progression.

This finding builds on previous studies, highlighting how managerial behaviors—such as relational roles [50], [80] that support organizational learning—positively influence employees' engagement in new lean methods and practices [21], [81]. Our study thus establishes that emotional states are essential to understand plant-level advancements in lean programs, providing a more articulated view of lean transformation dynamics.

Cognitive and Emotional Underpinnings of Lean Advancement

A second contribution of our study lies in identifying the core elements that catalyze the emotional mechanisms driving lean implementation progress. Emotions, as responses to perceived meanings [34], play a foundational role in shaping employees' motivation and engagement with lean practices. Our phenomenological approach enabled us to uncover how progress in lean corporate programs relies on context-specific elements that evoke emotional responses, which in turn support program advancement. Specific lean principles within FCA, for example, triggered emotional responses that helped facilitate lean advancement in certain plants. This finding underscores the importance of a new psychological contract [46] between employer and employees to foster long-term success in lean initiatives. Specifically, the relational aspect of this contract aims to ease the job demands of lean production by enhancing workplace conditions—focusing on factors like health, safety, cleanliness, and order [63]. These factors become particularly important in a context of increasing production volumes, where there is a push for more efficient capacity utilization and, at the microlevel of tasks and roles, greater job intensification [47]. Our qualitative analysis revealed that employees perceived these enhancements as a "first moment of truth" in addressing previous workplace deficiencies, eliciting a positive initial emotional response.

Our study further shows that improved workplace conditions alleviated the physical demands of lean production, enabling greater cognitive involvement. This involvement helps employees navigate ambivalence in job characteristics associated with lean, where coercive elements like job intensification coexist with empowering aspects such as increased autonomy [18], [20], [52]. Our findings support an expanded role for higher level managers in ensuring lean success. Beyond merely believing in lean's efficacy, managers actively reduce employees' physical strain, thereby fostering higher cognitive involvement. As one manager stated, *"We free the line workers' mind from routine tasks to challenge them to adopt an anticipatory logic of the future: how could I change this procedure in the future? How could I innovate it?"* (Head of Manufacturing, premium vehicles business unit).

A second critical role of higher level managers is in sense-giving. Our findings support recent studies [36], [50] on higher level leaders' role in sense-giving during early stages of lean or agile implementations. Our quantitative analysis further illustrates how these leaders cultivate a professional community within plants, promoting cognitive involvement and a collaborative culture [38]. This aligns with the work by van Beers et al. [82] and Van Dun and Wilderom [50], who describe how learning in lean programs transcends hierarchical boundaries through discursive interactions among managers, team leaders, and employees [78]. Building this professional community fosters coactive learning [20] and psychological safety [47], essential for lean team learning [75].

Nuanced View on Centralization and Decentralization in Lean Knowledge Creation

Our study contributes to the knowledge-based view of contextual ambidexterity in lean advancement [8], proposing that a dynamic approach to learning and knowledge creation—rather than mere replication—is crucial for sustaining an effective lean system. Our findings underscore the importance of balancing centralization (corporate-level lean expertise) with decentralization (plant-level employee involvement) in lean knowledge

development. Interviews with managers further contextualize our quantitative findings, revealing the synergistic role of corporate and plant-level knowledge creation in lean progression. As the Head of Manufacturing for the mass market business unit explained, *"In the beginning, WCM was not a structured model as it is now. It was only a set of principles and guidelines. We developed it while we applied the principles."* Similarly, the Head of the WCM corporate program emphasized, *"The factory is where new knowledge is created, evolving from an initial theoretical model to a rich system. While the central office supports with methods and tools, the real momentum comes from the professional communities within the plants."*

These insights highlight the evolving roles of corporate and plant leaders in building a dual-pillar infrastructure: decentralizing the creation of knowledge while centrally standardizing it. This approach, paired with a supportive work culture, cultivates continuous improvement and innovation [38]. Importantly, our study identifies professional communities within plants as essential loci of identity and emotional engagement. These communities not only enable employees to interact with lean practices meaningfully but also serve as centers where shared values and goals reinforce employees' sense of purpose, strengthening their emotional commitment to the lean journey.

Our findings emphasize the role of emotions in supporting effective decentralization for knowledge creation and adaptation, showing how a positive emotional climate enhances engagement with lean practices and promotes knowledge generation. This aligns with the existing research showing that psychological safety aids knowledge absorption, which drives continuous improvement and innovation in lean settings [51]. By extending the understanding of emotions as mediators between cognitive involvement and the adoption of new practices, our study highlights how lean programs, grounded in both emotional and cognitive dimensions, can function as frameworks for broader organizational change [41].

VII. Conclusion

Emotions have long been recognized as critical in shaping individual behaviors within organizations, especially in sustaining the use of technologies that alter operational routines and practices [41]. Building on these foundations, extensive research [17], [50] has highlighted how management styles and leadership behaviors should establish conditions that foster emotional states conducive to innovation and operational flexibility. Over the last decade, lean studies have increasingly adopted this perspective, exploring how the learning processes linked to lean program implementation and progression can lose momentum.

In our study, we leveraged a unique combination of individual-level and plant-level data to expand on the role that positive emotions resulting from lean implementation can play. Our findings indicate that positive emotions—such as pride, individual, and collective self-efficacy, and perceived fairness—mediate the relationship between employee involvement and the extent of plant-level advancements in lean implementation. This insight extends recent studies adopting a knowledge-based view to explore lean implementation success or failure [8], [9], as well as research examining the roles of higher level and middle managers in supporting continuous improvement and operational excellence within lean frameworks. While previous research has focused on these dynamics at the microlevel, within teams or departments [21], our study examines these processes within larger organizational units, such as entire plants.

The practical implications of our findings underscore the importance of fostering positive emotional climates within lean programs. Positive emotional states emerge as critical mechanisms for sustaining operational excellence, particularly in physically demanding and repetitive production environments like discrete manufacturing. Such environments often expose employees to task monotony, limited job control, and physical strain, which can diminish motivation and commitment over time. To address these challenges, we propose that managers reframe lean practices as more than tools for achieving efficiency. Instead, lean programs should be positioned and implemented as pathways to alleviate physical demands (by improving workplace ergonomics and health conditions), foster professional growth (through skill development and opportunities for proactive participation), and unlock space for cognitive and emotional engagement (by emphasizing the value of employees' contributions and creating a meaningful work narrative). This holistic approach aligns with Van Dun and Wilderom [81] observation that "becoming the best lean team is an art, but staying the best is an even higher art." By promoting job characteristics that nurture positive emotional states, our study provides actionable guidance for managers to enable long-term lean success and sustain continuous improvement, particularly in challenging production settings like discrete manufacturing.

Despite these valuable insights, our study has limitations. First, our exclusive focus on FCA plants in Italy may limit the generalizability of our findings to other cultural and organizational contexts. Future research could examine how specific institutional and cultural factors shape emotional and cognitive involvement in lean programs, uncovering essential contextual variations that may enable adaptation of our findings across broader settings. Second, we observed the connection between employees' emotions, involvement, and lean improvements over a four-year period. However, this timeframe may not fully capture the sustained, long-term dynamics of lean implementation and the role of emotions in continuous improvement. Longitudinal studies could extend our insights by examining these effects over a longer period, enhancing our understanding of how emotions and psychological safety underpin knowledge creation and adaptation in lean settings. Third, given the large sample size and quantitative nature of our study, we used simplified coding schemes to measure cognitive and emotional constructs. This may have overlooked more nuanced emotional states and cognitive processes. Future research could apply more detailed coding techniques to capture these complex perceptions, providing a deeper understanding of emotions in lean implementation. Finally, it is possible that the relationship between cognitive involvement and positive emotional states is circular. While our study shows that greater cognitive involvement leads to positive emotions, which, in turn, support lean advancement at the plant level, it is also plausible that positive emotions

themselves enhance employees' cognitive involvement in continuous improvement and learning—critical processes in the evolution of lean corporate programs. Examining this circular relationship would benefit from a longitudinal study design that disentangles the complex interplay between cognitive and emotional factors over time.

In conclusion, our study provides a robust foundation for understanding the role of emotions in lean implementation and opens new avenues for further research. By addressing these limitations and exploring the suggested areas for inquiry, scholars and practitioners can advance the successful, sustainable implementation of lean programs, even within diverse institutional and cultural landscapes.

ACKNOWLEDGMENT

The authors extend their heartfelt gratitude to Luciano Massone and Alberto Cipriani for their invaluable support during their roles at FCA and FIM-CISL at the time of this research. The authors would like to special thanks Professor Quy Huy (INSEAD) for his foundational contributions to the theoretical understanding of emotions, which significantly informed our study. They also deeply appreciate the guidance and encouragement of Professor Tsan-Ming Choi, Editor-in-Chief of IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT. Finally, they acknowledge the four anonymous reviewers for their thoughtful suggestions and constructive feedback, which greatly enhanced the rigor and clarity of our work.

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