

DEVELOPMENT OF A LEAN LEADERSHIP FRAMEWORK FOR THE TECHNOLOGY SECTOR

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ABSTRACT

Lean leadership is crucial for the technology sector, as it facilitates continuous improvement, rapid innovation, and adaptability in a fast-paced and ever-changing environment. The purpose of this study was to identify the key leadership skills necessary for effective lean management in the technology sector. This was achieved using a mixed-methods approach, where data were gathered through surveys with frontline staff and semi-structured interviews with managers at three different companies. The findings underscore the importance of leaders in establishing a collective vision to provide the team with a clear direction, embracing decentralised problem-solving for agility, and the need for coaching and development to enhance operational excellence. A lean leadership framework has been proposed, with three key elements at its core, to help leaders facilitate lean implementation within the technology sector. The framework is human-centered, ensuring an inclusive leadership approach that emphasises employee empowerment and fosters a culture of transformation to drive sustainable success and innovation.

Keywords: lean leadership skills, lean leadership framework, technology sector, operational excellence

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1 INTRODUCTION

The technology sector has experienced rapid growth due to innovation and the increasing adoption of digital solutions across various industries. While lean principles have proven effective globally, the unique structure of the technology sector poses challenges to their successful implementation. A key obstacle is the lack of detailed studies focusing on lean leadership in this sector, limiting insights into the specific challenges faced by leaders. Innovation, characterised by the introduction of new ideas, methods, or products, is central to the tech industry, prompting companies to prioritise creativity, research, and development to remain competitive and meet evolving consumer demands. Innovation requires a distinct leadership approach, one not fully addressed by traditional leadership models [1]. Leadership approaches significantly influence organisational behaviour in technological environments, where managerial decisions shape strategic outcomes and impact organisational performance. Patrick [2] reinforces this, stating that ‘managerial behaviour in information technology organizations is affected by leadership behaviour,’ underscoring the critical role of leadership in these settings.

In innovative sectors like technology, leadership is crucial for fostering creativity, supporting professional growth, and driving organisational success. As the demands of the modern workplace become increasingly unpredictable, there is a growing need to provide ongoing professional development and learning opportunities for employees. In the technology sector, where knowledge-intensive tasks and the ability to adapt quickly are crucial, creativity is essential for staying competitive. It is also emphasised as a critical response to the ever-changing challenges of the modern workplace, especially in the field of information technology [3].

Leadership practices are essential to both professional agency and creativity within organisations [3]. This approach shifts the focus from individual traits or behaviours to collective organisational efforts aimed at problem-solving, routine development, and reaching organisational goals [4]. In a sector like technology, which is driven by constant change and innovation, this approach becomes even more critical. Lean leadership, in particular, provides a unique approach that aligns well with the needs

of the technology sector. Unlike traditional leadership styles, which often focus on maintaining existing processes, lean leadership emphasises continuous improvement and empowers employees [5]. This approach decentralises decision-making authority, fostering greater collaboration and harnessing collective intelligence throughout the organisation. By empowering employees, especially those on the front lines, lean leadership fosters a culture of innovation, enabling organisations to stay adaptable and responsive to market changes [6].

The study analysed three technology companies as case studies to identify leadership practices in the technology sector. The first company, Company A, is a high-tech firm that supplies automated mining machinery to various mines. While the company's services enhance productivity in the mining industry, automating mining equipment also improves social sustainability by reducing risks to workers who would otherwise perform hazardous tasks, thereby increasing safety. Additionally, automating repetitive processes helps workers avoid monotonous tasks, which enhances job satisfaction. The second company, Company B, is an information technology firm offering IT solutions and consulting services across various sectors, including mining and manufacturing, as well as government agencies and municipalities. The third company, Company C, is a global engineering firm that provides solutions to enhance productivity and sustainability in the manufacturing, mining, and infrastructure sectors.

To gain a comprehensive understanding of the challenges related to leadership in the rapidly evolving technology sector, the research question was defined as follows: What are the key leadership skills required for effective lean management in the technology sector? A lean leadership framework has been proposed to help integrate effective leadership within the technology sector.

The organisation of this paper is as follows: the literature review discusses previous work on lean leadership and its contributions to social sustainability within technology organizations. The methodology section outlines the methodology used to execute the study, and the results section highlights the results obtained from the study, which include both quantitative and qualitative data collected from managers and frontline workers at the companies involved in the study. A lean leadership framework

has been proposed for the technology sector based on the results obtained. Lastly, the discussion section presents the results and details the lean leadership framework, along with each of its components.

2 LITERATURE REVIEW

2.1 Development and structure of lean leadership

Liker's 4P Model provides a foundational approach to lean leadership, comprising four levels: philosophy, process, people and partners, and problem-solving. Most organisations tend to focus on the process level, emphasising waste elimination, while neglecting the other three levels, and this imbalance often leads to stagnation in lean leadership practices over time. Lean leadership is defined as 'a methodical system for sustainable implementation and continuous improvement of lean production systems' [5]. It also describes the cooperation between employees and leaders in striving for perfection while integrating customer focus, employee development, and long-term leadership growth to achieve organisational goals [7].

Lean leadership development is described as an everyday activity within managerial hierarchies, requiring a paradigm shift from individual learning to team-based and organisational learning [8]. While some researchers argue that organisations not structured like Toyota may struggle to replicate its success, others suggest that tailored programs addressing organisational needs can yield significant benefits. Effective programs should balance technical and interpersonal leadership skills, utilise multiple delivery methods, and occur on-site to maximise individual and organisational outcomes [9]. Moreover, lean leadership must align management structures and corporate strategies across all levels to ensure a cohesive approach [10].

Despite its growing prominence, lean leadership research remains fragmented and underdeveloped, with insufficient connections to general leadership theories. Existing definitions often lack a theoretical foundation, resulting in inconsistencies across studies. Lean leaders play a crucial role in eliminating waste, training team members, developing problem-solving capabilities, and aligning teams with organisational objectives. Their

responsibilities extend to setting challenges and goals that drive team performance and organisational success [11].

2.2 Frameworks and principles of lean leadership

Several frameworks highlight the principles of lean leadership. The Diamond Model, one of the more popular lean leadership frameworks, emphasises four core principles centred around true north values, which include self-development, coaching others, supporting daily kaizen, and creating vision-aligned goals [7]. Liker's 4P Model similarly underscores the importance of continuous improvement, positioning problem-solving as central to sustainable lean implementation. Organisations must foster a culture where problem-solving is a daily activity, and learning from mistakes is encouraged [12]. The Toyota Kata introduces two methodologies, the Improvement Kata and the Coaching Kata. The Improvement Kata enables employees to experiment and refine processes through incremental improvements, while the Coaching Kata focuses on embedding these practices organisation-wide [5]. Leaders guide employees using structured questions to promote effective problem-solving and process improvements [13]. Across various lean leadership models, key principles emphasised by all include the leader's self-development and the coaching of employees, all grounded in the concept of continuous improvement. This approach focuses on the ongoing enhancement of both the company's systems and processes, as well as the development of its individuals.

Coaching is a crucial aspect of lean leadership, making a significant contribution to both individual and organisational development. In lean environments, the emphasis is on building the improvement capacity of individuals rather than solely focusing on immediate results. A lean leader's primary duty is to enhance the team's ability to improve through systematic coaching, often referred to as a "coaching routine" or "coach the coach" approach. Ideally, each management level should possess the skills to coach its subordinates effectively. However, this is often hindered by top management appointments based on external credentials or connections rather than internal development, posing a significant challenge for lean leadership [14]. Effective lean leadership requires consistent support,

clear communication, visibility, and coaching to build trust and promote a culture of continuous improvement [8].

Coaching is inherently personalised, recognising and respecting individual differences while enhancing performance across teams and departments. It aligns with lean principles by addressing problem-solving, reducing waste, and creating value [15]. Jones notes that coaching improves work outcomes such as goal achievement, professional development, managerial flexibility, productivity, resilience, and overall workplace well-being [16]. These attributes are particularly valuable in innovative industries, such as the technology sector, where expanding coaching initiatives could yield significant benefits. Despite its importance, many managers resist adopting a coaching role, preferring traditional decision-making and supervisory approaches [14]. Furthermore, a lack of formal training in coaching skills impedes the success of such initiatives [17].

While certain leadership qualities are inherent, others require intentional cultivation through self-development [5]. Continuous self-improvement is crucial for leaders to effectively lead their teams in embracing and maintaining lean practices. To maximise self-development, hiring a specialised lean coach or mentor can greatly enhance self-development efforts. External support from lean consultants can aid in the effective development of lean leadership within an organisation [18]. However, relying entirely on lean consultants has its limitations. Although consultants offer valuable expertise, they may lack a deep understanding of the organisation's unique culture and work environment, which can reduce the impact of their recommendations. Halling and Renstrom [19] highlight this issue by describing how a shared company vision was lost once a consulting firm's involvement ended, emphasising the need to develop internal lean leadership capabilities. One of the most effective ways for leaders to build their lean leadership skills is through hands-on experience [20].

Overall, lean leadership is frequently misinterpreted as merely implementing a few visible techniques, whereas these are surface-level indicators of a much deeper organisational culture [21]. For organisations to succeed in their lean transformation, it is crucial to strengthen leadership roles. This requires managers to use their actions and interactions

with employees to motivate and involve them in ongoing, systematic improvement efforts [22].

2.3 Lean leadership competences

Key competencies for lean leaders include encouraging self-development, visiting the work floor, coaching employees, communicating effectively, promoting motivational skills, and fostering a culture of continuous improvement. Among these, self-development is considered the most critical for upcoming leaders. These competencies are echoed across models such as the Diamond Model and Liker's 4P Model. Leadership is a practical task requiring ongoing practice and on-the-job learning [23]. It is a complex role that involves making critical decisions affecting organisational performance. With sustainable leadership relying on a deep understanding of both positive and negative leadership traits, most studies emphasise the behaviours and traits that lead to success, with fewer studies examining the traits that contribute to leadership failure within organisations. Some factors contributing to leadership failure, such as arrogance, lack of proactivity, and destructive behaviours, must also be addressed to build resilient leaders [24] [22] [25].

The difference between a leader and a manager has been widely discussed and analysed in organisational studies. While both roles are crucial to an organisation's success, they vary significantly in their methods, responsibilities, and influence on their teams. The manager's role involves overseeing and controlling an organisation's operations to ensure smooth functioning in accordance with established procedures. At the most basic level, the difference between a leader and a manager lies in the way they motivate their employees. Managers are the primary decision-makers, influencing their teams both directly and indirectly [26]. Their primary responsibility is to manage the organisation so that the production process proceeds as planned without disruptions [27]. This requires effective planning, organising, directing, and controlling resources, including human, financial, physical, and informational resources, to achieve organisational goals [28]. Managers are typically viewed as authoritative figures who adopt a transactional leadership style. They prioritise work

and results, focusing on task completion over addressing employee needs and aspirations. Their approach often emphasises maintaining comfort, stability, order, and control within the organisation [26].

In contrast, leaders are defined by their ability to inspire and motivate others. They possess unique qualities such as strategic and multidimensional thinking, professional intuition, and excellent communication skills [27]. Leaders are often seen as charismatic individuals who influence and guide their teams through their vision and strong personal connections. Leadership centres on creating a vision and inspiring others to work toward it. Unlike managers, leaders focus on building morale and motivation within their teams, ensuring alignment with the organisation's collective goals [26]. They act as a bridge, facilitating communication between organisational objectives and the aspirations of their team members [29].

Lean leadership is not limited to managing processes; it is a holistic and social process that demands continuous learning and adaptation. While theoretical frameworks like the Diamond Model, Toyota Kata, and Liker's 4P Model offer valuable guidance, effective lean leadership requires practical application, a focus on personal growth, and fostering a culture of improvement. Organisations can achieve sustainable lean leadership practices by addressing leadership failures through a balance of technical and interpersonal skills.

3 METHODOLOGY

A mixed-methods approach was employed, utilising both qualitative and quantitative data. The qualitative data were collected through semi-structured interviews conducted with individuals in managerial roles within the company. Quantitative data were collected through survey questionnaires administered to frontline workers from the three companies. The integration of multiple data collection methods, triangulation, and standardised procedures strengthened the study's validity and reliability. This comprehensive approach ensured that the research findings were credible and consistent, offering valuable insights into the implementation of lean leadership within the technology sector.

3.1 Semi-structured interviews

Semi-structured interviews were conducted with industry experts holding managerial positions across the three companies. This method was chosen for its flexibility and focus, enabling researchers to explore predetermined topics while accommodating spontaneous discussions and follow-up questions based on participants' responses [30]. The interview protocol is available in Appendix A. The interview questions were designed to align with existing lean leadership frameworks, allowing for a systematic exploration of industry challenges. This ensures validity, aligns findings with established practices, supports comparisons, and highlights gaps or barriers within the current state. Tailored solutions can be developed by linking results to specific framework components, addressing broader trends and unique sector needs.

A total sample of 15 managers participated in the study, with five from each company. Given the study's focus on lean leadership in the technology sector, purposive sampling was employed. This method was deemed appropriate as it allowed the researchers to target a specific subset of individuals with the necessary expertise and experience relevant to the research topic [31]. Across the three companies, participants hold positions ranging from top to middle management, each with varying responsibilities within their managerial roles. This diversity provides a broad and valuable range of perspectives and insights into the challenges and practices of leadership within the respective companies. Figure 1 illustrates the participants' positions and years of experience within the company. In the figure, the participants' positions and rankings within the company are displayed in hierarchical order, from the highest to the lowest position. In Companies A and B, the human resources managers fall under level two. Company C, on the other hand, has the general manager at level two and the human resources manager at level three. This is because Company C is bigger in size compared to the other two, and the general manager oversees all managerial roles within the Southern African Development Community (SADC).

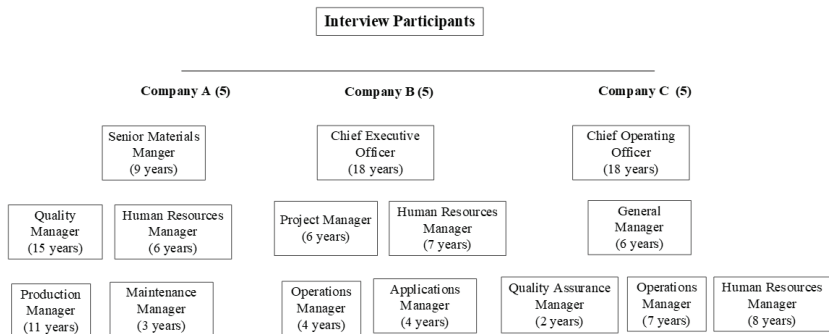


Figure 1: Participant information

3.2 Survey questionnaires

Survey questionnaires were distributed to a sample of 60 frontline workers across the three companies, with 20 participants selected from each organisation. Convenience sampling was used based on the availability of the frontline workers on the day of the study. The survey questionnaire (Appendix B) consisted of 24 structured questions. It was designed to be completed within 10 minutes, considering both the participants' time constraints and the fact that the study was conducted during work hours. To simplify responses and ensure consistency, the questions were closed-ended, offering a fixed set of multiple-choice options for respondents to select from [31]. The surveys were conducted using the "face-to-face interview" method, which facilitates higher response rates, allows for clarification of questions when necessary, and provides an opportunity to motivate respondents to participate fully [31]. This method enhanced the quality and completeness of the data collected by facilitating direct interaction with the participants.

4 RESULTS

4.1 Survey results

Table 1 presents a summary of the results obtained from the survey questionnaires distributed to frontline workers across the three companies.

A total of 60 participants were included in the survey. The table highlights the questions, the number of respondents, their responses, and the corresponding chi-square and p-values.

Table 1: Survey Responses

N = 60		N (%)	Chi Square	P value*
Gender	Female	0 (0%)	30.0	<0.0001
	Male	60 (100%)	30.0	<0.0001
Number of years at company	< 1 year	14 (23.33%)	0.0667	0.116
	1 – 3 years	6 (10%)	5.40	0.00219
	3 – 5	29 (48.33%)	13.1	<0.0001
	> 5 years	11 (18.33%)	1.07	0.0617
Work Scope	Wide range of responsibilities	25 (41.67%)	6.67	0.00195
	Routine tasks with occasional projects	17 (28.33%)	0.267	0.0956
	Specialized tasks	16 (26.67%)	0.0667	0.111
	Other	2 (3.33%)	11.3	<0.0001
Work-life balance	Poor	16 (26.67%)	0.80	0.0534
	Neutral	13 (21.67%)	2.45	0.118
	Good	31 (51.67%)	6.05	<0.0001
Employee Motivation	Low	9 (15%)	6.05	0.0864
	Average	8 (13.33%)	7.20	0.0598
	High	43 (71.67%)	26.5	<0.0001
Contribution to solutions	Very involved	6 (10%)	5.40	0.00219
	Somewhat involved	5 (8.33%)	6.67	0.000717
	Rarely involved	18 (30%)	0.60	0.0761

N = 60		N (%)	Chi Square	P value*
Working preference	Not involved	31 (51.67%)	17.1	<0.0001
	Individually	11 (18.33%)	12.0	<0.0001
	Teamwork	49 (81.67%)	12.0	<0.0001
Relationships with managers	Poor	17 (28.33%)	0.267	0.0956
	Average	24 (40%)	5.40	0.00407
	Good	13 (21.67%)	0.267	0.103
	Excellent	6 (10%)	5.40	0.00219
Training provided by the company	Regularly scheduled programs	4 (6.67%)	12.8	0.00292
	Occasional training	8 (13.33%)	7.20	0.0598
	No training	48 (80%)	39.2	<0.0001

The survey results offer detailed insights into the workplace dynamics of the organisation, with the data highlighting trends, strengths, and potential areas for improvement. All 60 survey participants were male (100%), highlighting a notable lack of gender diversity among the respondents. Women remain significantly underrepresented in the technology sector due to societal and cultural factors. The Matilda effect shows that women's contributions in STEM are often overlooked. Furthermore, the absence of visible female role models in the technology sector can lead to underrepresentation, creating an environment that can feel isolating for women. Addressing this is vital when recruiting talent in the technology sector, as diversity tends to promote innovation and foster a more inclusive workplace.

The most significant proportion of respondents (48.33%) have worked at their respective companies for three to five years, with this group showing strong statistical significance ($p < 0.0001$). This suggests a relatively stable core of experienced employees. Employees with less than one year of service account for 23.33%, followed by those with more than five years (18.33%) and those with one to three years (10%).

Most respondents view work-life balance positively, with 51.67% rating it

as “Good.” This is likely due to the prevalence of flexible work arrangements, including remote options, which are common in the technology sector. This category showed strong statistical significance ($p < 0.0001$), highlighting the sector’s effectiveness in promoting employee well-being. However, 26.67% rated it as “Poor,” and 21.67% as “Neutral,” suggesting there is still room for improvement.

Most respondents (71.67%) reported high levels of motivation, supported by a highly significant p-value (<0.0001), which is linked to a positive work-life balance. A good work-life balance enhances productivity and overall motivation. This underscores the importance of effective engagement practices, as the 15% reporting low motivation indicates areas where leadership can address individual concerns.

Regarding the work scope, 41.67% of employees reported managing a wide variety of responsibilities, which showed significant relevance ($p = 0.00195$). The core business operations that employees are responsible for include infrastructure management, software development and maintenance, technical support, and vendor and asset management. Routine tasks with occasional projects (28.33%) and specialised tasks (26.67%) were less common, with only a small percentage (3.33%) categorised as “Other.” This distribution suggests a somewhat dynamic workplace where a significant portion of employees are expected to handle diverse roles.

Most employees (81.67%) preferred teamwork, with a significant chi-square value (<0.0001), indicating a strong collaborative culture. This is likely due to the diverse projects (manufacturing, mining, and infrastructure) managed by tech teams, which require working in cross-functional or hybrid setups. Conversely, only 18.33% of employees preferred working alone.

Regarding contributions to solutions, a significant 51.67% of employees are not involved, with this category showing strong statistical significance ($p < 0.0001$). This underscores a gap in participatory decision-making, which could hinder innovation and employee engagement. The other participants were rarely involved (30%), somewhat involved (8.33%), or very involved (10%).

Manager-employee relationships were mainly rated as average (40%), followed by poor (28.33%). Strengthening these relationships can be achieved by involving employees in the development of solutions, which

promotes mutual trust and helps ensure the long-term success of those solutions. Good and excellent ratings were less common, with only 10% of respondents describing their relationships as excellent.

Regarding the training provided by companies to their frontline workers, a concerning finding was that 80% of respondents reported receiving no training, with this category showing a highly significant p-value (<0.0001). Managers in the technology sector must prioritise skills development and professional growth to improve their employees' skills, which in turn enhances their company's overall expertise. This helps foster innovation and drive successful outcomes, resulting in improved financial performance. Only 6.67% participated in regularly scheduled programs, and 13.33% received occasional training, highlighting a key opportunity to boost workforce skills and professional development.

4.2 Interview results

The survey findings revealed a lack of collective vision, as employees were not involved in the development of solutions. Additionally, a gap was identified in skills development, which negatively impacted the relationship between managers and employees. The interviews help expand on the different criteria to provide a broader understanding of the gaps existing within the current state of the technology sector. Most managers were focused on production output and process optimisation rather than the philosophy, people, and problem-solving principles required when implementing lean leadership as a whole. The primary focus for managers was to achieve annual targets and meet established deadlines.

Therefore, in an attempt to meet operational requirements, managers often end up micro-managing and limiting frontline workers' involvement in contributing to solutions, decision-making, and creativity within the workplace. Furthermore, there are limited opportunities for development for both managers and frontline workers. Thus, the interview results further validate those of the survey questionnaires.

4.2.1 Vision alignment

Under the first theme, vision alignment, managers were asked questions about the company's vision and goals, employee responsibilities, and leadership styles across departments. A common trend emerged across the three companies: while most managers acknowledged the importance of the company vision, many admitted that they either rarely communicated it to employees or did not emphasise it as much as they should have.

Company C has a structured approach by which the company's vision is embedded into the operational framework, ensuring that employees' efforts align directly with organisational goals. In contrast, Company B, being smaller than the other two companies, demonstrates more frequent, though informal, discussions about the company vision among internal employees. These regular interactions foster better alignment within the internal team. However, as noted by the project manager, Company B's contracted frontline workers are less engaged in these discussions and have limited interaction with internal employees, highlighting a gap in vision alignment for external staff.

A clear trend observed across the three companies is the strong alignment between individual roles and the organisation's strategic objectives. Employees across various departments consistently demonstrated an understanding of how their tasks contribute to the company's vision, reflecting effective communication and alignment within these organisations. One of the managers mentioned that quality and safety are priorities, and stated that, in completing his tasks, he works with the company to reduce operating costs. This perspective underscores the integration of personal responsibilities with broader organisational goals. Similarly, HR managers at Companies B and C emphasised the critical role of their positions in advancing the company's mission by maintaining a safe and supportive work environment for all employees. This shared focus across roles demonstrates a cohesive effort toward achieving each company's vision and priorities.

All the managers agreed that frontline workers contribute to the company's vision through their daily tasks, whether by following direct instructions, as is more common in Companies A and C, or by having some freedom to develop solutions, as observed with the programmers at

Company B. However, notable differences in role execution were evident, shaped by each company's structure and operational requirements. At Company B, some managers give their employees the freedom to devise solutions. At the same time, the project manager has significant autonomy in selecting team members and managing projects, reflecting a more decentralised approach to project management. Conversely, Company C's HR manager described a structured environment where tasks are clearly defined for employees, indicating a more hierarchical management style. Despite these variations, a consistent principle emerges; roles are well-defined, and their execution is closely aligned with the company's overall success.

4.2.2 Employee relationships

Employee relationships emerged as a central theme in the study, focusing on the dynamics between managers and frontline workers. Communication was identified as a vital component of these relationships, with managers across the three companies describing varied but consistent efforts to maintain open and effective communication channels. Interview responses highlighted generally positive communication practices, characterised by frequent interactions across all organisational levels. Managers commonly described the communication within their companies' using terms such as "good," "efficient," and "regular." A noticeable trend across the companies was the emphasis on daily communication. Many managers reported engaging with their teams daily through meetings, one-on-one discussions, or informal interactions. This daily communication was deemed crucial for aligning teams with project objectives and addressing any emerging issues promptly.

The analysis of the organisational culture subtheme revealed both notable differences and shared perspectives on how organisational culture impacts the implementation of lean leadership. A recurring observation, particularly from respondents at Company A, highlighted contrasts within its divisions. The quality manager noted that while the chemical plant has an open and collaborative culture, the steel plant operates in a more rigid and reserved environment. When asked about the importance of organisational culture and its role in the success or failure of implementing

lean leadership, all the managers unanimously agreed that it is a critical factor. Leadership styles also reflected the varying organisational cultures across the companies. Company C was described as having an “inclusive and high-performance-focused” leadership style, with a strong emphasis on recognising and rewarding achievements. In contrast, Company A faces challenges in unifying the distinct cultural dynamics within its divisions, illustrating the complexities of aligning organisational culture with leadership strategies.

The companies generally lack formal team-building activities designed to enhance teamwork and collaboration on projects. This highlights a significant gap in cultivating cooperation between frontline workers. Although no formal team-building initiatives exist for shop floor employees, informal activities are occasionally organised. However, employees often see the team-building component of these gatherings as secondary to their social purpose. Therefore, team-building events may not effectively address the need for structured development activities to strengthen team dynamics.

4.2.3 Self-development

The final theme of the study, Self-Development and Coaching, examines how managers coach employees for specific tasks and continuous improvement while also focusing on their own skills development outside of work to stay current with industry trends. When asked about training opportunities for employees, all managers at Company A confirmed that the company has provided training over the past two to three years but acknowledged that the training is tailored specifically for select individuals in management positions. As noted by the senior materials manager, training is provided whenever the company deems it necessary. Of the five managers interviewed, only two reported participating in the company’s training programmes, as they were among the individuals required to attend. The other three indicated that they had not been invited to participate. At Company B, training is reportedly limited to employees working under the applications manager, who oversees the company’s software development. In contrast, Company C has the most organised and structured training programmes for employee development. However, like Company A, the

training is exclusively available to individuals in managerial roles, with no initiatives aimed at frontline workers. This underscores a gap in inclusive training opportunities across all three companies. Currently, most training programmes are directed at individuals in senior positions to ensure they are skilled and capable of managing their teams effectively. Emphasis is placed on the managers' role in fostering the ongoing development of their team members.

The self-improvement subtheme highlights the managers' efforts to pursue personal and professional growth. Overall, participation in self-development practices is very low, with only a few managers being actively involved. Among these, approaches to self-improvement include both formal and informal methods. Managers who engage in self-development reported activities such as reading industry-related books, conducting online research, and attending conferences and seminars with peers. While these proactive efforts demonstrate a commitment to staying updated, they lack the structured guidance and comprehensive learning offered by formal training programs. For the majority of managers who do not engage in self-improvement activities, time constraints and challenges related to maintaining a work-life balance were identified as significant barriers. These findings suggest that companies should create environments that prioritise continuous learning by addressing the obstacles that hinder self-improvement, thereby empowering managers to effectively enhance their leadership capabilities.

The surveys and interviews revealed the attributes most required by leaders in the technology sector, and Figure 2 below was created from these findings, highlighting the key considerations for leaders in the technology sector.

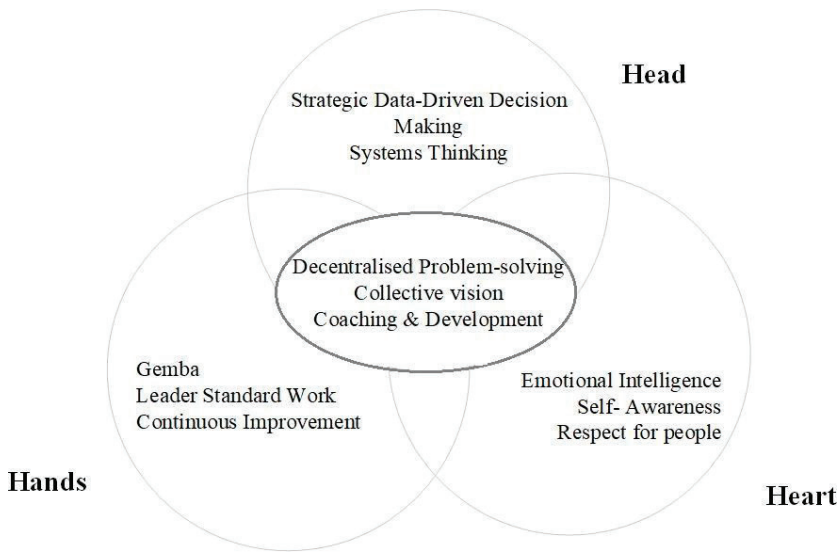


Figure 2: Head, heart, and hands proposed framework for lean leadership, adapted for this study from Sipos et al. [32]

The core of the framework emphasises the importance of decentralised problem-solving, which enables companies to adapt, innovate, and operate efficiently. It also fosters a collective vision as the true north (overarching purpose) and provides coaching and development to enhance skills and decision-making. These were the three dimensions that required the most focus, not only to help improve leadership skills but also to enhance the operational excellence of companies within the technology sector.

5 DISCUSSION

The findings from this study, when compared to the literature, reveal a mix of alignment and gaps in how companies integrate their vision into daily operations and employee responsibilities. The survey results showed that while 81.67% of employees prefer working in teams, 51.67% of the participants reported not being involved in contributing to solutions. The lack of frontline workers' involvement in decision-making within the surveyed companies suggests missed opportunities to leverage employee insights and enhance organisational performance. Additionally, it hinders

collaboration and meaningful engagement in decision-making processes, which are essential for aligning employees' contributions with the company vision. Lean leadership principles emphasise the importance of integrating vision-aligned goals at all organisational levels, with clear communication and decentralised problem-solving being key [10]. By decentralising problem-solving, managers can tap into the collective intelligence of their teams, leading to increased innovation and adaptability, promoting effective leadership. A good leader should not seek to solve every problem single-handedly; instead, a leader should seek to empower employees to find creative solutions by working together. This justifies representing decentralised problem-solving as a core leadership skill for the technology sector in the proposed framework (Figure 2).

While managers across the three companies acknowledge the importance of aligning roles with the organisational vision, their approaches vary significantly. Company C employs a structured approach to embed vision into operations, ensuring precise role alignment with organisational goals. However, its hierarchical structure limits frontline worker autonomy, which stifles innovation and contradicts lean principles of empowering employees to engage in problem-solving and continuous improvement. Company B demonstrates a more flexible approach, with frequent informal discussions within internal teams. However, this practice does not extend to contracted frontline workers, resulting in uneven alignment across the organisation. This discrepancy highlights a gap in inclusivity, which the leadership-as-practice approach identifies as essential for creating cohesive, vision-driven workplaces [4]. Company A presents the most significant challenges in terms of aligning its vision. Managers admitted that operational priorities, such as safety and immediate targets, often overshadow strategic discussions about the company's vision.

This reflects a common issue in organisations that focus predominantly on process-level goals while neglecting other critical aspects of lean leadership, such as philosophy and people development. Without consistent reinforcement of the vision, employees are likely to feel disconnected from long-term strategic objectives, which can lead to a decline in both engagement and productivity. To address these gaps, companies must prioritise balanced leadership practices that combine structured

communication with inclusive decision-making processes. Effective lean leadership requires consistent reinforcement of the vision, ensuring it reaches all organisational levels [5]. By encouraging collaboration and empowering employees to actively contribute to organisational goals, companies can create a cohesive workforce that aligns with lean principles and drives sustainable success. The lean leadership framework, as illustrated in Figure 2, emphasises the importance of a collective vision at its core, as it promotes alignment among managers and employees. A collective vision also aids in enhancing innovation, as collaboration across different levels is facilitated when companies share a common purpose. This aligns with the Diamond Model, where core principles are centred around true north [7].

In addition to vision alignment, employee relationships are fundamental to building trust, fostering collaboration, and enhancing employee engagement — essential components for effective lean leadership. While the survey results highlight positive teamwork preferences, the limited opportunities for participation undermine the potential to build strong relationships and trust between employees and managers. Managers across all three companies describe communication within the organisation positively. In Company A, cultural differences were evident between the more open and easy-going chemical plant and the steel plant, which exhibits a more rigid and reserved culture. These disparities highlight the complexities of aligning cultural practices with leadership strategies. These divisions, along with the absence of formal team-building initiatives across the three companies, weaken collaboration and impede the effectiveness of leadership practices.

Regarding development practices, the findings reveal varying approaches, highlighting gaps in inclusivity and the need for structured training opportunities for managers and frontline workers. Survey results show that 80% of respondents reported receiving no training, with only 6.67% participating in regularly scheduled programmes and 13.33% in occasional training. These statistics demonstrate a significant lack of organisational commitment to continuous learning, reflected by a highly significant p-value of <0.0001 . This deficiency hinders the broader implementation of lean principles, which emphasise continuous improvement through the systematic development of both individuals and processes [7]. Interviews confirmed this gap, revealing that training programmes across all three

companies primarily target senior management and exclude frontline workers. At Company A, training opportunities are determined by perceived necessity rather than a systematic approach. Only two out of five managers interviewed had participated in these programmes, leaving others without opportunities for skills development. Similarly, Company B's training is restricted to employees under the applications manager, with no initiatives for other staff. In contrast, Company C offers more structured programmes, but they are still limited to managerial roles. These practices diverge from lean leadership frameworks, such as the Toyota Kata, which emphasise inclusive training to foster problem-solving and continuous improvement across all organisational levels. Excluding frontline workers not only limits their growth but also prevents companies from leveraging their insights to enhance processes and promote innovation.

Self-development among managers was found to be equally limited. While a few managers reported engaging in informal self-improvement activities such as reading industry-related books, attending conferences, and conducting online research, most cited time constraints and work-life balance as significant barriers. This is also evident in the existing literature, which highlights the challenges that managers face in adopting self-development practices due to competing priorities. Relying solely on informal methods lacks the structured guidance and depth offered by formal training programmes, reducing their impact on managerial growth. The Diamond Model and Liker's 4P Model emphasise self-development as a foundational principle of lean leadership, suggesting that structured programmes are essential for building resilient and effective leaders [7] [23]. Based on the gaps identified at the companies, as well as the frameworks from the literature, coaching and development were recognised as the foundation for building trust between managers and employees. The proposed framework in Figure 2 emphasises coaching and development as a core value to enhance leadership skills in the technology sector, which in turn leads to operational excellence.

Relationships between managers and frontline workers were highlighted as critical aspects of workplace dynamics. Survey results revealed that 71.67% of respondents reported high levels of motivation, while relationships between frontline workers and their managers were

rated as average by 40% of respondents and as poor by 28.33%. This suggests a significant room for improvement, as strong relationships with managers are essential within the organisation. The strained relationships limit opportunities for building trust and engagement, creating potential barriers between employees and their managers, thus negatively impacting their relationships. Addressing this can significantly improve employee relationships within the technology sector, ensuring the social sustainability of the lean leadership practices in the industry.

5.1 Implications of the study

The findings carry significant implications for leadership practices within the technology sector. While the industry demonstrates specific strengths, such as fostering teamwork and motivation among employees, the gaps in vision alignment, employee relationships, and self-development reveal misalignments with established lean leadership frameworks. These misalignments, if left unaddressed, could hinder the sector's ability to fully realise the benefits of lean principles. A key implication lies in the sector's autonomy to experiment with new solutions for frontline workers. This limited involvement reflects a failure to incorporate decentralized problem-solving and employee empowerment, both of which are foundational to lean leadership frameworks, such as Liker's 4P Model and the Toyota Kata. The Improvement Kata emphasises experimentation and problem-solving across all organisational levels; however, the current hierarchical structures hinder the full implementation of these principles.

Employee relationships, central to effective leadership, also reveal areas of concern, underscoring the need for leaders to shift their focus from frequent communication to meaningful interactions that foster trust and engagement. The absence of formal team-building initiatives across all three companies limits opportunities to strengthen these relationships. In contrast, lean frameworks, such as the Diamond Model, emphasise inclusive leadership practices, continuous communication, and structured collaboration — practices that are crucial for enhancing organisational cohesion. Addressing these gaps through structured initiatives could create stronger bonds between employees and managers, improving engagement

and fostering a more cohesive culture.

In comparison to established frameworks, the sector's current practices fall short in leader self-development, structured training for frontline workers, and employee involvement and contribution to solutions. To align more closely with lean leadership principles, organisations must prioritise structured and inclusive approaches that extend beyond senior management. Initiatives such as vision-focused communication, team-building activities, decentralised problem-solving, and comprehensive training programmes can bridge the existing gaps, empowering employees at all levels to contribute meaningfully. These steps are essential for cultivating a sustainable leadership culture that aligns with the principles of continuous improvement and innovation central to lean leadership.

6 CONCLUSIONS

The research question for the study was: What are the key leadership skills required for effective lean management in the technology sector? The proposed framework, presented in Figure 2, addresses the question by considering three key dimensions necessary for effective leadership: the Head (strategic skills), Hands (operational/practical skills), and the Heart (interpersonal skills). The core of the framework integrates the three dimensions to present the essential skills that are the foundation for lean leaders in the technology sector. Leaders must prioritise the involvement of frontline workers in problem-solving, ensuring that employees at all levels are empowered to make meaningful contributions to organisational goals. This would help foster buy-in for a collective vision that provides a clear direction and purpose (true north), thereby enhancing collaboration across different levels within the company. A collective vision enhances the team members' ability to support one another, increasing resilience and adaptability in a fast-paced and ever-evolving technology landscape. To facilitate cultural transformation, a lean leader must serve as a sensei, committing not only to their own self-development but also to coaching and developing their teams by addressing skills development gaps, fostering a culture of continuous improvement, and shared learning. Leaders must invest in their team's growth through formal training programmes, as

well as helping them develop problem-solving skills by asking questions to help guide them towards their own solutions, rather than providing direct answers. Structured team-building initiatives are also essential for strengthening relationships between employees and managers, which are often strained in the current state.

The primary managerial implication of the proposed framework is that it helps identify the core skills necessary for leaders to facilitate transformation within the technology sector. Focusing on the core of the framework makes the other skills achievable, as it provides a strong building block for the associated skills to be assimilated. While the framework is developed specifically for the technology sector, it is adaptable to other industries and can help unlock the full potential of leaders. The framework provides a human-centered approach to transformation, empowering leaders to become the drivers of change within their organisations.

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APPENDIX A: Interview protocol

THEME 1: Aligning a Shared Vision with Daily Improvement Efforts

1. Can you describe the scope of your job and the main tasks you perform?

Probes: How do these tasks align with the overall goals of the company?

How long have you been in your current position at the company?

2. What are your professional goals within the company?
3. How do you define success within the company?
4. How do you communicate the organization's vision to employees at all levels?

Probes: How do you ensure that the vision is understood and effectively communicated?

How often is the vision revisited with the team?

5. In what ways do employees contribute to achieving the organization's vision through their daily tasks?

Probe: Are there specific goals or metrics that align daily tasks with the vision?

6. What strategies do you use to motivate employees to align their efforts with the organization's vision?

Probe: How much freedom do the employees have to experiment and try new approaches to come up with solutions?

THEME 2: Employee Relationships

1. How would you describe the leadership style within the company?
2. What leadership behaviors or styles do you believe are most effective in promoting a lean culture within the company?

Probe: Can you briefly explain why?

3. How would you describe the current organizational culture within the company?

Probe: Do you believe organizational culture influences the success or failure of lean leadership within the company? Can you briefly explain why?

4. How do you promote a sense of community and belonging within the organization?

Probe: Are there any programs or initiatives focused on team building?

5. How would you describe the communication style among employees in the company?

Probes: How often do you communicate with the employees you oversee?

How often do you give them feedback on their performance?

THEME 3: Commitment to Self-Development and Coaching Practices

1. How does the company support the continuous professional development of its employees?
2. Does the company provide any training programs for employees?

o Probes if yes: What types of training programs are available?

How are employees selected or enrolled in these programs?

How frequently are the training programs conducted for employees?

o Probes if no: Are there plans to implement training programs in the future?

How do employees currently develop their skills and knowledge?

3. How do you prioritize your own self-development as a leader, and what strategies do you use to improve your skills and knowledge continually?

Probes: What specific resources or tools do you find most helpful in your self-development?

How do you stay updated with the latest trends and best practices in leadership?

4. How do you approach coaching your team members to enhance their skills and performance?

Probes: What coaching techniques or methods do you find most effective?

How do you tailor your coaching approach to meet the individual needs of each client?

APPENDIX B: Survey questionnaire

SURVEY QUESTIONNAIRE

1. How long have you been working at the company?
 - ☐ Less than 1 year
 - ☐ 1-3 years
 - ☐ 3-5 years
 - ☐ More than 5 years

2. How would you describe the scope of your job and the main tasks you perform daily?
 - ☐ I perform specialized tasks with a clear focus.
 - ☐ My job involves a wide range of responsibilities.
 - ☐ I work on routine tasks with occasional special projects
 - ☐ Other

3. Overall satisfaction with your current role at the company
 - ☐ Very Dissatisfied
 - ☐ Dissatisfied
 - ☐ Neutral
 - ☐ Satisfied
 - ☐ Very Satisfied

4. What are your professional goals within the company for the next year or two?
 - ☐ Advancement to a higher position
 - ☐ Gaining new skills or certifications
 - ☐ Taking on more responsibility

☐ Other: _____

5. Clarity of your job responsibilities and tasks

- ☐ Very Unclear
- ☐ Unclear
- ☐ Neutral
- ☐ Clear
- ☐ Very Clear

6. Level of challenge and motivation from your daily task responsibility

- ☐ Very Low
- ☐ Low
- ☐ Neutral
- ☐ High
- ☐ Very High

7. How involved are you in contributing to solutions for challenges faced by the company?

- ☐ Very involved
- ☐ Somewhat involved
- ☐ Rarely involved
- ☐ Not involved

8. How much freedom do you have to experiment and try new approaches in your job?

- ☐ A lot of freedom
- ☐ Some freedom
- ☐ Limited freedom
- ☐ No freedom

9. Effectiveness of communication within your department

- ☐ Very Ineffective
- ☐ Ineffective
- ☐ Neutral
- ☐ Effective
- ☐ Very Effective

10. Collaboration with colleagues on projects or tasks

- ☐ Very Rarely
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Very Often

11. Relationship with your immediate supervisors/management

- ☐ Poor
- ☐ Fair
- ☐ Average
- ☐ Good
- ☐ Excellent

12. Relationship with other managers

- ☐ Poor
- ☐ Fair
- ☐ Average
- ☐ Good
- ☐ Excellent

13. How often do you receive feedback on your work performance?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often

14. How much are your ideas and suggestions valued in the company?

- ☐ Highly Valued
- ☐ Somewhat Valued
- ☐ Neutral
- ☐ Not valued

15. Comfort level in approaching coworkers for assistance or collaboration

- ☐ Very Uncomfortable
- ☐ Uncomfortable
- ☐ Neutral
- ☐ Comfortable
- ☐ Very Comfortable

16. Do you prefer working individually or in teams?

- ☐ Individually
- ☐ In teams

17. Does the company provide you with any training or development programs?

- ☐ Yes, regularly scheduled programs
- ☐ Yes, but only occasionally
- ☐ No, not at all

18. Satisfaction with the training and development opportunities provided

- ☐ Very Dissatisfied
- ☐ Dissatisfied
- ☐ Neutral
- ☐ Satisfied
- ☐ Very Satisfied

19. Participation in improvement workshops provided by the company in the past year

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Always

20. Organizational culture at the company

- ☐ Poor
- ☐ Average
- ☐ Good
- ☐ Excellent

21. Work-life balance at the company

- ☐ Very Poor
- ☐ Poor
- ☐ Neutral
- ☐ Good
- ☐ Very Good

22. Recognition and rewards for employee contributions

- ☐ Very Inadequate
- ☐ Inadequate
- ☐ Neutral
- ☐ Adequate
- ☐ Very Adequate

23. Support received from your colleagues in achieving your job objectives

- ☐ No Support
- ☐ Less Supportive
- ☐ Supportive
- ☐ Very Supportive

24. How well do you understand the company's goals and objectives

- ☐ Very Poorly
- ☐ Poorly
- ☐ Neutral
- ☐ Well
- ☐ Very Well