Design of survey to evaluate the core industrial ecosystem of lean, health and safety, quality, and organisational culture

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Abstract

Context: Efficient industrial operations require the integration of lean practices, quality systems, safe methods of work, and a supportive organisational climate.

Need: There is a need to manage work-related risks and ensure the safety and well-being of workers while maintaining operational efficiency and quality. While surveys exist for each of these facets and may be used to evaluate performance, there is no integrated survey of the core industrial ecosystem.

Objectives: The objective was to develop a survey to measure the adoption of effective work practices- lean methodologies, the presence of health and safety in the workplace, the effectiveness of quality systems, and the role of organisational support and culture.

Method: The survey combines extracts from existing surveys with new questions created to capture all the research objectives.

Outcomes: A composite survey was designed to measure workers' perspectives of lean practices, occupational and health system, quality systems, and organisational support and culture. This is original as there is no holistic survey instrument for this in the literature.

Keywords: Industrial Ecosystem; Lean; Safety; Quality; Organisational Culture; Survey

1 Introduction

Industrial operations involve a complex set of interactions between the need to operate efficiently (hence also continuous improvement and minimisation of waste), maintain quality of outputs (hence also customer satisfaction), minimise the safety of workers (hence also safe methods of work), and create a supportive organisational climate (hence also psychological well-being). We refer to this as the "core industrial ecosystem", the term "core" referring to the internal operations. In contrast "industrial ecosystem" is sometimes applied to the business value chain, and the term "industrial ecology" is applied to the intersection of manufacturing and the natural environment.

The integration of the core is difficult because of the conflicting requirements and the multidisciplinary nature of the specialist areas. The literature highlights that the organisational settings, such as quality systems (Douglas et al., 2015; Thanki & Thakkar, 2014), employee well-being (Jayaraman et al., 2012; Nzuva & Kimanzi, 2022; G. Tortorella et al., 2017), and workplace safety (Brawner et al., 2022; Brenner et al., 2004; Longoni et al., 2013), combined with engaged and committed employees, were more likely to embrace lean principles and contribute to process improvements (Jeon & Jeong, 2016). Hence, it is critical to address challenges from the facets of the organisational settings (Albliwi et al., 2014; G. Tortorella et al., 2017).

From the perspective of a manufacturing organisation existing at all, efficiency of operations and hence lean, is a necessary priority. The other dimensions of quality, safety, and organisational climate are essential in the longer-term survival of the firm. The adoption of lean principles, which originated from the Toyota Production System, focus on waste reduction, and continuous improvement has become increasingly widespread across industries as organisations strive for operational excellence in today's dynamic business environment (Womack & Jones, 1997). Lean implementation also interacts in complex ways with the other areas. For example, surveys comparing companies with and without lean practices consistently shown that lean-implementing firms report positive outcomes, including enhanced process quality and productivity (Pinto et al., 2022).

Surveys are typically used to evaluate the maturity of the organisation in each of these areas. However, the existing surveys are facet-based: they evaluate only one or at most two of the above areas. This does not allow for holistic consideration of the interactions between the facets. There is no integrated survey in the literature for the simultaneous evaluation of lean practices, quality systems, safe methods of work, and organisational climate. Creating such a survey has the potential to assist manage work-related risks and ensure the safety and well-being of workers while maintaining operational efficiency and quality.

The objective of the current work was to develop a survey to measure the lean adoption of effective work practices- such as lean methodologies, health and safety in the workplace, the presence and effectiveness of quality systems, and organisational support and culture. This was achieved by collating and adapting existing questionnaires from the literature, creating a coherent measurement scale, and validating the survey.

2   Review of interactions within the core industrial ecosystem

This review is of the interactions within the core industrial ecosystem of lean, health and safety, quality, and organisational culture. From the outset it is assumed that lean is a given. This is because the adoption of Lean principles has become increasingly widespread across industries to achieve operational excellence in today's dynamic business environment. Lean practices do not simply just optimise process and eliminate wastes, it is far more complex in real-world scenarios. They require integration with safety management frameworks and established quality systems. Additionally, for Lean practices to be successful, workers need adequate support, and the organisational culture must be conducive to these practices (Titus & Hoole, 2021).

The existing surveys in each of the four areas of the core industrial ecosystem are described in section 4.

2.1 Health and Safety

The integration of Lean practices with workplace safety presents both challenges and opportunities. Lean tools like 5S promote order and cleanliness, create safer workplaces, and reduce the likelihood of accidents (Cierniak-Emerych & Golej, 2020; Dieste et al., 2020). For example, 5S has been shown to improve workplace ergonomics and standardise operations, which reduces the risk of injuries (Srinivasan et al., 2016).

Lean practices like Kaizen and Total Productive Maintenance (TPM) enhance working conditions, reduce accidents and occupational hazards (Díaz-Reza et al., 2024). This aligns with the findings of another study (G. L. Tortorella et al., 2019) demonstrated that well-structured organisational practices and effective work-design, can optimise ergonomics and improve workers' safety. However, the success of these initiatives largely depends on how well organisational practices are designed to support both productivity and safety.

However, Lean is not without risks, methods such as Just-In-Time can increase work intensity and reduce buffer times (Main et al., 2008), at the same time can result in rushed tasks and reduced attention to safety (Stimec, 2020), increasing the chance of accidents. Improper Lean implementation that focuses on machine and material optimisation and sometimes neglects the human considerations would increase the potential risks leading to repetitive strain injuries due to shortened cycle times (Brenner et al., 2004; Longoni et al., 2013). These findings underscore the importance of involving safety professionals early in Lean initiatives to anticipate and mitigate potential hazards.

Moreover, the existing literature often does not fully explore the potential negative consequences of improper Lean practices, such as increased work intensity and its impact on psychosocial factors. This suggests a gap in understanding the trade-offs between productivity and worker well-being in Lean environments. Additionally, the role of organisational culture in moderating the effects of Lean on safety outcomes is not fully understood and warrants further investigation. There is an evident need for future research to discover a balanced view of impact on health and safety to enhance efficiency and worker welfare.

2.2 Quality Management Systems

Lean practices and Quality Systems share a common goal of improving efficiency, reducing waste, and improving product quality. Quality tools such as Statistical Process Control, Six Sigma, and 5S are integral to both Lean and Quality Systems, facilitating the identification of defects, process standardisation, and continuous improvement.

Studies demonstrate that integrating Lean and Quality Systems, can enhance production efficiency, reduce cycle times, and improve overall quality (Khalfallah & Lakhal, 2021). However, the success of these integrations often influenced by organisational factors such as the industry type and size (Terziovski & Samson, 1999), national organisational culture (M. Kumar et al., 2014), and organisations that promote continuous improvement, employee involvement, and open communication is essential for the effective adoption of quality initiatives (Agarwal et al., 2013). The successful integration also depends on committed leadership (N. Kumar et al., 2013) and employee involvement, especially in overcoming barriers such as inadequate training and resistance to change (Cadden et al., 2020).

Moreover, the integration of sociotechnical practices with Lean systems has been found positively impact both quality performance and workers health, highlighting the need to balance technical and human factors (G. L. Tortorella et al., 2019). For example, a study in machinery industry revealed that quick setups and quality control strongly correlated with operational productivity (Ong et al., 2021). Overall, while the integration of Lean and Quality practices holds substantial potential, success relies on leadership, culture, and the ability to manage both technical and human factors effectively.

2.3 Organisational Culture

Organisational culture is defined by shared values, beliefs, and behaviours and plays a crucial role in the successful implementation of Lean methodologies (Womack & Jones, 1997). The cultural dimension of individualism versus collectivism is particularly significant (Bhasin & Burcher, 2006). Collectivistic cultures, where teamwork and group goals are prioritised, align well with Lean's emphasis on group-based decision-making and problem-solving (Wiengarten et al., 2015). Studies have shown that quality management practices are more successful in collectivistic cultures, particularly in Asian countries (Kull & Wacker, 2010; Wiengarten et al., 2011). Key enablers for successful Lean implementation include strong leadership, continuous improvement, knowledge sharing and employee involvement, while the inhibitors include a lack of management support, and poor supplier relationships (Alkhoraif & Mclaughlin, 2017).

Organisational culture also plays a mediating role in Lean's success. A study conducted in the UK manufacturing sector revealed employee-oriented and procedurally and market focused cultures are more effective than results-oriented and pragmatic cultures (Cadden et al., 2020). This highlights the need for organisations to tailor their approaches based on the organisational culture and readiness for change (G. Tortorella et al., 2019).

Small and medium-sized enterprises (SMEs) often struggle with internal operations (Alkhoraif & Mclaughlin, 2017) and resistance to change (Cadden et al., 2020). A study highlighted the importance of organisational belief in Lean Six Sigma, where a strong Lean culture enabled employees to drive initiatives with minimal reliance on expert guidance (Jayaraman et al., 2012). Overall, aligning Lean practices with organisational culture is critical for successful implementation require a balance of technical tools and cultural adaptation.

2.4   Gaps in the body of knowledge

While existing literature provides insights into various aspects of industrial operations, most studies examine these elements in isolation or pairs, e.g. organisational culture and workplace safety (Sakthi & Jeyapaul, 2021), quality and organisational culture (M. Kumar et al., 2014; Yang & Yang, 2013), or quality and workplace safety (G. L. Tortorella et al., 2019).

There is no reliable way to evaluate how the facets may interact, for example, how organisational culture interacts with quality and safety systems. To address this gap, there is a need for surveys that can take an integrative approach to the many facets of industrial operations (Albliwi et al., 2014; Díaz-Reza et al., 2024).

3   Method

3.1   Research Objective

The interconnections between Lean practices, health and safety protocols, quality systems, and organisational culture have not been fully explored. Current studies often focus on the relationships between pairs of these facets, but none evaluate the entire core industrial ecosystem encompassing Lean, health and safety, quality, and organisational culture. The purpose of this work was to design a survey tool to study the complex interplay between Lean adoption, occupational health and safety systems, quality systems, and organisational support.

3.2   Instrument Design

The core industrial ecosystem (CIE) Survey design process involved a review of literature to address key aspects of the industrial ecosystem. Reviewing previous surveys provided insights into effective approaches and helped tailor question items to the specific objectives of the current survey (Warwick & Lininger, 1975). The existing validated questionnaires and peer-reviewed literature were reviewed and adapted based on the key facets of Lean practices, health and safety, quality system and organisational culture.

In case where existing questionnaires did not cover specific areas, new questions were developed to fill gaps. A standardisation wording approach was necessary to ensure consistency across all respondents, regardless of background or education level to facilitate accurate reliable responses (Ernest L. Cowles & Edward Nelson, 2019). When creating a question, consideration was first given to the journal literature to identify the critical factors, and then sentences were constructed to capture the essence of the matter.

3.3   Survey Structure

A total of 103 measurement items were developed and structured into five key sections: demographic information, Lean practices, occupational safety, quality system and organisational culture. The response options for survey were either open-ended or close-ended, with closed-ended questions being preferred for their reliability, anonymity, and ease of analysis (Ruel, 2019).

The main scale used in the IE survey was a Likert scale ranging from -3 to +3 to allow respondents to differentiate the intensity of their responses and minimise response biases such as extreme response style and mis-response to reversed items (Weijters et al., 2010). A midpoint allows respondents with neutral opinions to reflect their stance, thereby reducing the likelihood of forced, and potentially inaccurate, responses (Nowlis et al., 2002). IE survey questions were written from a positive perspective, i.e. a positive response corresponds to a positive score on the scale. This was done to avoid inverted scales, which are potentially confusing for respondents.

3.4   Validation Process

The initial set of survey questions underwent face and content validation through various methods. The survey was distributed to faculty members at the University of Canterbury and industry professionals from the manufacturing and construction industries in New Zealand. Reviewers received the questionnaire separately and provide feedback either through ratings, verbal or written comments. Some reviewers rated the relevance of each question on a Likert scale (e.g., 1 to 5, with 1 being not relevant at all and 5 being highly relevant). Others focusing on the clarity and comprehensiveness to cover the intended topics and suggest any missing elements or topics that were not addressed by the initial survey.

Based on the feedback, items that received low ratings or were identified as unclear were revised by adding an elaboration or removed. This validation process ensured the survey captured the necessary data to explore the dependencies between Lean journey, safety management, quality systems, and organisational culture in industrial contexts. Ethics approval was obtained from the University of Canterbury Human Research Ethics Committee (HREC 2024/84/LR-PS).

4   Results – The core industrial ecosystem (CIE) survey

4.1   Demographic questions

The demographic section was designed to gather key background information about respondents. Questions in this section help identify the specific industry segment, company size, and the roles and responsibilities of respondents. By identifying the specific industry segment of the manufacturing sector, the responses help analyse industry-specific challenges, practices, and trends. Additionally, the size of the respondent's company may provide insights into the scale and scope of operations, allowing for comparisons in terms of resource allocation, organisational structure, and regulatory compliance. We were also interested in knowing the respondents' experiences, roles and responsibilities. This has the potential to offer insights into the hierarchy and decision-making authority, identifying their priorities and challenges across different levels of the organisation.

4.2   Lean Practices

This section was developed to assess the adoption and effectiveness of Lean tools such as waste minimisation, continuous improvement (CI), 5S, and Kanban systems. Drawing on established

literatures, the survey focused on key aspects such as the reduction of waste, workflow optimisation, and the involvement of employees in continuous improvement initiatives.

Waste Minimisation: Questions were designed based on definitions of waste minimisation (Ohno & Bodek, 2019; Womack & Jones, 1997) and questions which emphasise the significance of minimising waste for improving operational performance (Chauhan & Singh, 2011; Panwar et al., 2017; Wickramasinghe & Wickramasinghe, 2017).

CI, or Kaizen: is described as "a company-wide process of focused and continuous incremental innovation" (Bhuiyan & Baghel, 2005) to maintain competitiveness and enhance overall operational performance (Singh & Singh, 2015). However, the main challenge in sustaining CI is by engaging people in CI activities (Jurburg et al., 2017) and commitment from the management in the CI process (Douglas et al., 2015; Jayaraman et al., 2012; Mohd Aripin et al., 2024). To address this, we included questions such as "My organisation provides necessary resources to promote CI activities" and "Management has a clear understanding of the CI and actively helps employees to understand and participate."

5S methodology: The role of 5S methodology in standardising the workplace and orderliness (Takashi Osada, 1991) ,and supports Lean practices (Randhawa & Ahuja, 2017) were evaluated. Questions such as "I feel that our workspace is well-organised, with everything in its designated place" and "My organisation uses visual signals to visualise workflow, manage tasks and inventory" were designed to assess the level of 5S implementation in the workplace. These questions align with the researches which underscore the role of an organised workspace in facilitating Lean practices (Ong et al., 2021; G. Tortorella et al., 2019; Wickramasinghe & Wickramasinghe, 2017).

Overall, the "Lean Practices" section was structured to assess the factors influencing the adoption and effectiveness of Lean practices within organisations. The resulting survey segment is shown in Table 1 on the next page.

4.3   Health and Safety System

The health and safety system section were crafted to explore the various dimensions that influence health and safety performance such as the working environment, task characteristics, workforce involvement, and safety culture. A study highlighted that Lean implementation is significantly influenced by the working environment, task and workforce characteristics, and organisational factors, particularly focusing on the first and third factors (Mousavi et al., 2020).

Working Environment: Questions such as "Cleanliness inspections are regularly conducted in my workplace" and "Hazards are clearly marked and communicated to all employees" were adopted from studies (Eurofound and International Labour Organisation, 2019; Stewart, 2000) to evaluate the workplace cleanliness and hazard identification practices, which are essential elements for maintaining a safe and organised work environment. The survey questions, such as "I feel safe at work" and "I receive health and safety training related to my job," were designed to capture these aspects and assess the effectiveness of Lean practices in promoting a safe and healthy work environment.

Task and Workforce Characteristics: There are several literatures investigated the role of training and job rotation in preventing repetitive strain injuries and improving overall job satisfaction (Cadden et al., 2020; Pakdil et al., 2018). By rotating tasks, workers can avoid repetitive stress and maintain a high level of engagement and satisfaction in their roles (Brawner et al., 2022; Sakthi & Jeyapaul, 2021). Hence, questions such as "I have received training on proper ergonomic and posture practices" and "Job rotation is practised in my workplace" were included to explore how organisations design tasks to ensure employee safety and satisfaction.

Studies also emphasise the importance of management commitment and employee empowerment in creating a safe work environment (Pakdil et al., 2018; Stewart, 2000). Questions like "Management takes safety concerns seriously" and "I feel empowered to stop work if I notice a safety hazard" were aimed to assess the visibility and seriousness of management's dedication to safety, as well as employee empowerment in raising concerns.

Table 1 Survey questions and associated factors for Lean. Questions are on a scale of -3 to +3, except indicated.

	Level of Lean Adoption
LA1	Has your company implemented any Lean programs? *(Category option)
LA2	My workplace is very welcoming and supportive of integrating Lean production into our processes.

	Waste Minimisation
LW1	Planning tools (e.g., project management software, scheduling techniques) are used to minimize unnecessary tasks.
LW2	Rejected or rework products (i.e., items that do not meet customer standards and need to be fixed or discarded) are minimised.
LW3	My workplace layout minimises unnecessary movement of materials and information.
LW4	Optimal resources and inventory levels (i.e., the right amount needed without excess stock) are maintained.
LW5	The workflow is a smooth and continuous operation (i.e., without significant interruptions or delays).
LW6	My workplace is organised to minimise unnecessary movement by employees.
LW7	My workplace produces minimal products that require rework or repair (i.e., items that do not meet quality standards).
LW8	I feel that my skills and talents are fully utilised in my role.

	Continuous Improvement
LC1	My organisation provides necessary resources (i.e., budget, personnel, and time) to promote continuous improvement activities.
LC2	My organisation has systems to collect and reward employee improvement ideas and suggestions.
LC3	Management has a clear understanding of the continuous improvement system and actively helps employees to understand and participate.
LC4	Machines and tools are regularly upgraded to maintain efficiency and quality.
LC5	I am encouraged to contribute ideas for process improvements.

	5S
LS1	My workplace prioritises keeping only essential items easily accessible.
LS2	I regularly review my workspace to remove unnecessary items.
LS3	My workplace has clear labels and signage to help locate items and information quickly and reduces time spent searching for items.
LS4	I feel that our workspace is well-organised, with everything in its designated place.
LS5	I feel my work environment is clean and well-maintained.
LS6	The standard procedures are in place for organising and maintaining the workspace.
LS7	Management provides ongoing support to ensure workplaces are well-organised for workers.

	Visual Management
LV1	My organisation uses visual sign/ signals to visualise workflow and manage tasks and inventory.
LV2	Work tasks are clearly defined and prioritised to balance workload.
LV3	The workflow system is reviewed and adjusted regularly to meet changing needs.

Safety Culture: Studies (Tortorella et al., 2019) have shown that integrating Lean practices, specifically Just-In-Time, with socio-technical practices can improve both quality and workers' health outcomes. The questions such as "I am encouraged to suggest improvements to safety practices" and "My colleagues are supportive in maintaining a safe work environment," were developed to evaluate the safety practices and culture in the workplace.

Overall, this section provides evaluation of how Lean practices intersect with health and safety systems within organisations. The resulting survey segment is shown in Table 3.

Table 3 Survey questions and associated factors for Safety system. Questions are on a scale of -3 to +3, except indicated.

Working Environment	
SE1	I have never experienced physical discomfort or pain due to my work tasks.
SE2	Ergonomic (i.e., refers to the process to makes the item easy for people who use it) assessments are conducted regularly in my workplace.
SE3	I have received training on proper ergonomic and posture practices.
SE4	I feel safe at work.
SE5	Cleanliness inspections are regularly conducted in my workplace.
SE6	I have easy access to cleaning supplies and equipment.
SE7	I feel that my workspace is well-organised.
SE8	Hazard reports are promptly followed up with corrective actions.
SE9	Hazards are clearly marked and communicated to all employees.
Task and Workforce Characteristics	
ST1	Job rotation (i.e., working in different roles or departments) is practiced in my workplace.
ST2	Job rotation effectively improves my overall job satisfaction.
ST3	I receive adequate training when rotated to a new task.
ST4	I work less than 10 hours a day.
ST5	I receive health and safety training related to my job.
ST6	I receive adequate training when rotated to a new task.
ST7	I feel skilled to perform my tasks safely.
ST8	I am encouraged to suggest improvements to safety practices.
ST9	I feel empowered to stop work if I notice a safety hazard (i.e., unsafe working conditions that can cause injury, illness, and death).
ST10	Employee opinions are considered in safety initiatives.
ST11	Safety program goals are clearly communicated to all employees.
Safety Culture	
SC1	I feel that safety is a top priority for my management.
SC2	Safety policies and procedures are consistently followed.
SC3	My colleagues are supportive in maintaining a safe work environment.
SC4	Management takes safety concerns seriously.
SC5	Resources are allocated for safety improvements in my workplace.
SC6	There is a formal process to report health and safety issues (i.e. Incident reporting system, health and safety committee, safety toolbox or meetings, and etc)

4.4   Quality Management System

This part starts with questions about the current quality tools practices (Douglas et al., 2015) in the company. Drawing from the literature and surveys, this section was focused on support and resources, motivation and engagement, quality culture, and collaboration.

Leadership Support and Resources: Leadership plays an important role in driving quality initiatives (Lagrosen, 2003) and developing motivations for employee willingness to participate in improvement efforts (Bacoup et al., 2018). For the support and resources aspect, the survey included Questions like "Management promptly addresses any issues that arise related to quality" (G. Tortorella et al., 2019; Wickramasinghe & Wickramasinghe, 2017), and "Inspection and test equipment are regularly inspected and calibrated" Pakdil (2018) to evaluate whether leaders or managers provided resources and support to maintain quality performance.

Motivation and Engagement: Regarding motivation and engagement, the study (Ong et al., 2021) revealed that a rational culture plays a significant quasi-moderating role in enhancing the relationship between quality control and productivity. This is further supported by a collaborative approach to problem-solving, which was highlighted as one of the key contributors to improved operational productivity. Questions like "I feel a sense of ownership over quality issues and work to improve them"

and "Peer involvement in quality processes is promoted and valued" were included to assess the extent where employees are encouraged to take initiative and participate actively in quality-related activities. These questions also align with the findings of Pakdil (2018), which highlight the need for increased attention to the human aspects of Lean implementation, such as employee engagement, training, and development. By examining these questions, the survey aimed to understand the factors that motivate employees to adhere to quality standards and participate in continuous improvement initiatives.

Quality Culture: Quality culture refers to the collective behaviours that support quality standards (Zarbo & D'Angelo, 2006). The questions were adapted from established questionnaires (ESCC Manufacturer Questionnaire, 2020; Quality Assurance Survey/Questionnaire, 2012) to assess the role of communication, transparency, and peer involvement.

Collaboration: Effective collaboration across departments is essential for implementing quality initiatives (Chauhan & Singh, 2011; Mittal et al., 2024; Ong et al., 2021). Questions such as "Cross-functional collaboration is encouraged and supported by management" and "My work team communicates well." were included to assess how well teams work together, whether communication tools were used to enhance coordination, and whether information sharing and mutual support culture is present.

Overall, this section provides an assessment on factors that influence the relationship between quality systems and other industry ecosystem aspects. The resulting survey segment is shown in Table 4.

Table 4 Survey questions and associated factors for Quality system. Questions are on a scale of -3 to +3, except indicated.

	Current quality practices
QA1	What basic quality improvement tools are regularly used in your workplace? *(Category option)
QA2	What advanced quality management tools are utilised in your organisation? *(Category option)
	Leadership Support and Resources
QR1	Quality improvement projects are usually supported by management through provision of sufficient funds and resources.
QR2	Management provides induction training and quality related training periodically to employee.
	Motivation and Engagement
QE1	Management recognises and rewards employee contributions to quality improvements.
QE2	Management regularly communicates the importance of quality to all employees.
QE3	Management promptly addresses any issues that arise related to quality.
	Quality Culture
QC1	Employees follow to established quality standards and procedures.
QC2	Inspection and test equipment are regularly inspected and calibrated.
QC3	My organisation encouraged open discussions about quality issues at all levels.
QC4	Quality concerns are addressed in a timely and transparent manner.
QC5	Quality-related information is readily available and communicated to all employees.
QC6	I feel a sense of ownership over quality issues and work to improve them.
QC7	Peer involvement in quality processes is promoted and valued.
	Collaboration
QT1	Cross-functional collaboration is encouraged and supported by management.
QT2	My work team communicates well.
QT3	Regular meetings and discussions are held to address quality issues.
QT4	Employees voluntarily share useful information with each other.
QT5	There is a culture of mutual support and knowledge sharing.

4.5   Organisational Culture

This section was designed to evaluate the influence of organisational culture on successful implementation of Lean practices, particularly in shaping the behaviours, attitudes, and values of employees. Several studies have highlighted the critical role of organisational culture in determining the effectiveness of Lean initiatives (Cadden et al., 2020; Jayaraman et al., 2012).

Psychological Health: Psychological well-being plays a role in shaping the organisational culture, with a focus on mental well-being (Hall et al., 2010) and work-related stress management (Eurofound and International Labour Organisation, 2019). Questions like "My current salary aligns with the average salary for my position and industry" (Chari et al., 2024) and "My workload is reasonable" (Tortorella et al., 2019) were designed to evaluate whether employees feel fairly compensated and valued. This insight helps in understanding the factors that contribute to employee motivation and the prevention of burnout, which are critical for maintaining a productive work environment.

Supportive Work Environment: A supportive work environment is another component that affects the adoption of Lean (Tortorella et al., 2019). This aspect of the survey assessed the level of support and collaboration among colleagues and supervisors, as well as the fairness of conflict resolution mechanisms. Effective management and communication are key to creating a supportive environment that promotes psychological well-being (Cadden et al., 2020; Ong et al., 2021).

The survey included questions to assess the effectiveness of management's role in supporting employees. A culture of open communication and supportive management can foster a positive work environment, where employees feel empowered to contribute to the organisation's success (Jayaraman et al., 2012).

Work-Life Balance: Work-life balance is another important aspect of organisational culture that can impact the success of Lean (Brougham & Haar, 2013; Cadden et al., 2020). The questions related to work-life balance were designed to evaluate the organisation's commitment to support workers in balancing their professional and personal responsibilities effectively. Ensuring a good work-life balance is important for burnout prevention, reducing stress, and ensuring sustainable productivity and career satisfaction (Akdemir, 2019).

Career Growth and Opportunity: This section of the survey included questions about opportunities for career growth and professional development, as well as the cultural aspects of the organisation that support the employee. Questions such as "I feel that my contributions are recognised and appreciated" and "My job allows me to develop new technical or soft skills" were designed to assess how the organisation fosters employee growth and development.

Overall, this section is designed to assess the role of organisational culture in supporting Lean practices, promoting employee well-being, and ensuring career growth opportunities. The resulting survey segment is shown in Table 5.

Table 5 Survey questions and associated factors for Organisational Culture. Questions are on a scale of -3 to +3, except indicated.

| Psychological Health	
OP1	My workload is reasonable.
OP2	My workplace prioritises psychological well-being of staff.
OP3	My current salary aligns with the average salary for my position and industry.
OP4	My work is distributed fairly.
OP5	I am satisfied with my working conditions.
OP6	I feel that my job is manageable.
OP7	I am confident in my job security.
OP8	I have received training provided by my organisation on managing work-related stress.
OP9	I feel comfortable discussing mental health issues with my supervisor.
OP10	I feel supported by my colleagues during stressful times.
Supportive Work Environment	
OE1	My workplace has clear policies to address workplace bullying and harassment.
OE2	Conflicts are resolved fairly in our workplace.
OE3	My coworkers or colleagues help and support me.
OE4	My supervisor or manager helps and supports me.
OE5	My supervisor or manager is helpful in getting the job done.
OE6	My supervisor or manager provides useful feedback on my job.
OE7	My workplace respects and recognises my cultural values.
OE8	My workplace boosts my motivation and career satisfaction.
Work-Life Balance	
OB1	I have enough time to relax after work.
OB2	I can take breaks and vacations without feeling guilty.
OB3	My workplace promotes a healthy work-life balance.
OB4	My workload does not interfere with my personal and/or family life.
Career Growth and Opportunity	
OC1	My job allows me to develop new technical or soft skills.
OC2	I feel that my contributions are recognised and appreciated.
OC3	I feel safe to voice my concerns (psychological safety).
OC4	I feel emotionally connected to this organisation.

5   Discussion

5.1   Outcomes

The core industrial ecosystem (CIE) survey was developed to fill a gap in the existing research by offering a tool to evaluate the complex relation between Lean practices, health and safety management, quality systems, and organisational culture. Unlike previous studies that have predominantly focused on isolated elements or the interaction between pairs of these domains, the CIE survey was designed to provide a view of the entire industrial ecosystem. This survey was developed through a review of existing literature and integrating existing questionnaires from the literature, ensuring that the instrument covered a wide range of relevant topics and was grounded in established research.

The creation of the CIE survey was driven by the recognition that Lean practices do not exist in isolation; they operate within a complex organisational framework that includes quality systems and health and safety management systems. Moreover, the success of Lean initiatives relies heavily on organisational support and the cultural environment. To address this, the IE survey captures data across multiple dimensions to provide insights into how they interact and influence each other.

The primary contribution of the CIE survey is to provide a multi-faceted assessment of an industrial organisation's ecosystem. Conceptually, these different facets interact see Figure 1. It not only

identifies the level of Lean adoption but also provides insights into the effectiveness of health and safety management and quality systems. Furthermore, the survey examines the influence of organisational culture helping organisations identify areas of strength and weakness within their operational framework. For instance, the survey can reveal misalignments between safety and existing culture, allowing organisations to take targeted actions such as refining integration strategies or providing additional training to employees.
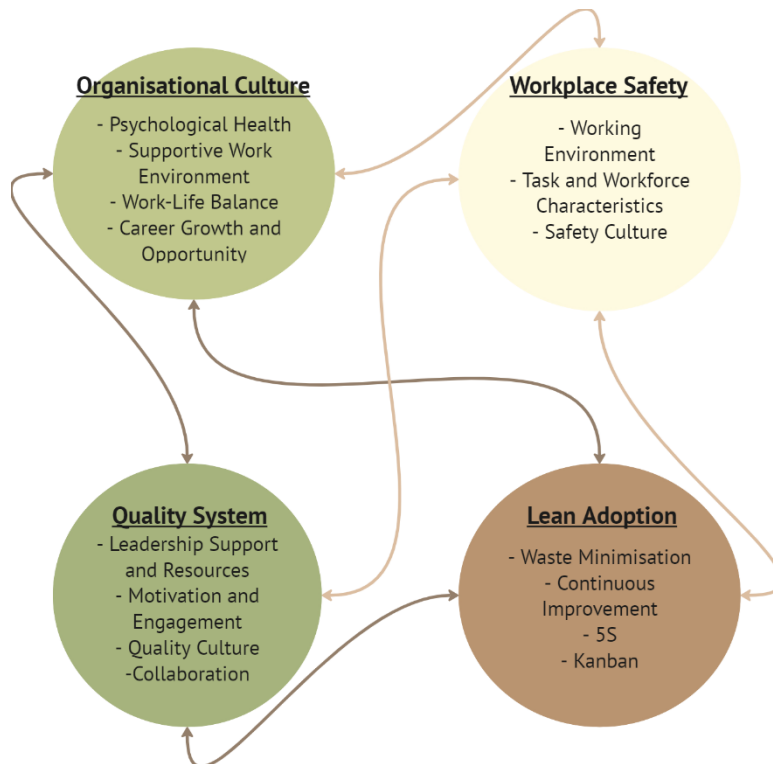
Figure 1. Conceptual model of the industrial ecosystem.

5.2   Implications for Practitioners

For organisations, the survey has the potential to serve as a diagnostic tool that helps pinpoint critical areas for improvement by providing a clear understanding of the interconnected nature of Lean, health and safety management, quality systems, and culture.

Moreover, the findings from the survey can potentially inform the development of policies and practices that support a positive organisational culture, which is crucial for sustaining Lean initiatives. Overall, the CIE survey not only advances academic research in the field of the industrial ecosystem but also provides potentially valuable practical guidance for organisations to optimise their operations and develop a conducive industrial operational environment.

5.3   Implications for future research

The CIE survey lays the foundation for further exploration into the interactions between multi-facets. Future research could explore deeper into the impact of Lean methodologies on workplace safety, including how these practices contribute to the risk management, identification and mitigation of workplace hazards compared to traditional approaches. Research could also explore how Lean tools influence an organisation safety culture, potentially leading to reductions in workplace accidents and incidents.

Future studies could investigate how Lean practices integrate with existing quality management systems, focusing on how Lean tools such as 5S, Kaizen, and Kanban interact with quality control measures. Researchers can study which combinations of Lean tools with quality control measures into the optimal integration strategies for more efficient processes. Future research could also examine the cultural shifts for the successful adoption of Lean methodologies and identifies which cultural traits support or challenge Lean implementation.

Finally, the CIE survey might help future research to explore the essential support and resources for employees during Lean implementation. This includes exploring the impact of leadership engagement, peer support, and training programs, on the adoption and success of Lean practices.

By addressing these questions, future studies can provide further insights into the broader industrial ecosystem to optimise Lean implementations, enhance quality and safety outcomes, and create a supportive organisational culture that promotes continuous improvement.

5.4   Limitations

The current work has developed a survey tool to assess the entire industrial ecosystem. However, this has resulted in a large set of questions, and hence the issue of participant fatigue is a risk. Participant fatigue can impact the quality of responses and the overall response rate, potentially affecting the reliability and validity of the survey results.

To address this issue, future work could consider reducing the number of survey questions while retaining the survey's ability to capture the necessary information. One approach could be to conduct a factor analysis, which would help identify the critical factors and restructure the survey. Factor analysis can help pinpoint less informative questions, allowing for a more focused and manageable survey instrument. This is left for future work.

6   Conclusions

This work develops a survey to evaluate Lean adoption, quality system, health and safety system, and organisational support. This has not previously been shown in the literature and hence is a novel contribution to the field of industrial engineering. Face and content validation were performed. The full version of the CIE survey is available in Appendix A.

7   Conflict of Interest Statement

The authors declare no financial conflict of interest.

8   Author Contributions Statement

Conceptualization KL, DP, MT, AE; Investigation KL; Methodology KL, DP; Supervision DP; YZ, AE; Validation KL; Visualisation KL; Writing – original draft KL; Writing – review & editing KL, DP, YZ, MT, AE

9   Funding

10   References

Agarwal, R., Green, R., Brown, P. J., Tan, H., & Randhawa, K. (2013). Determinants of quality management practices: An empirical study of New Zealand manufacturing firms. *International Journal of Production Economics*, *142*(1), 130–145. https://doi.org/https://doi.org/10.1016/j.ijpe.2012.09.024

Akdemir, Ö. A. (2019). The Effect of Teacher Burnout on Organizational Commitment in Turkish Context. *Journal of Education and Training Studies*, *7*(4), 171. https://doi.org/10.11114/jets.v7i4.4067

Albliwi, S., Antony, J., Abdul Halim Lim, S., & van der Wiele, T. (2014). Critical failure factors of Lean Six Sigma: a systematic literature review. *International Journal of Quality & Reliability Management*, *31*(9), 1012–1030. https://doi.org/10.1108/IJQRM-09-2013-0147

Alkhoraif, A., & Mclaughlin, P. (2017). Organisational culture - Enablers and inhibitors factors for the effective implementation of lean. *International Journal of Lean Thinking*, *8*(2). https://dspace.lib.cranfield.ac.uk/handle/1826/12952

Bacoup, P., Michel, C., Habchi, G., & Pralus, M. (2018). From a Quality Management System (QMS) to a Lean Quality Management System (LQMS). *The TQM Journal*, *30*(1), 20–42. https://doi.org/10.1108/TQM-06-2016-0053

Bhasin, S., & Burcher, P. (2006). Lean viewed as a philosophy. *Journal of Manufacturing Technology Management*, *17*(1), 56–72. https://doi.org/10.1108/17410380610639506

Bhuiyan, N., & Baghel, A. (2005). An overview of continuous improvement: from the past to the present. *Management Decision*, *43*(5), 761–771. https://doi.org/10.1108/00251740510597761

Brawner, J. G., Harris, G. A., & Davis, G. A. (2022). Will the real relationship between lean and safety/ergonomics please stand up? *Applied Ergonomics*, *100*, 103673. https://doi.org/10.1016/j.apergo.2021.103673

Brenner, M. D., Fairris, D., & Ruser, J. (2004). "Flexible" Work Practices and Occupational Safety and Health: Exploring the Relationship Between Cumulative Trauma Disorders and Workplace Transformation. *Industrial Relations: A Journal of Economy and Society*, *43*(1), 242–266. https://doi.org/10.1111/j.0019-8676.2004.00325.x

Brougham, D., & Haar, J. M. (2013). Collectivism, Cultural Identity and Employee Mental Health: A Study of New Zealand Māori. *Social Indicators Research*, *114*(3), 1143–1160. https://doi.org/10.1007/s11205-012-0194-6

Cadden, T., Millar, K., Treacy, R., & Humphreys, P. (2020). The mediating influence of organisational cultural practices in successful lean management implementation. *International Journal of Production Economics*, *229*, 107744. https://doi.org/10.1016/j.ijpe.2020.107744

Chari, R., Chang, C.-C., Sauter, S., Sayers, E., Huang, W., & Fisher, G. (2024). *NIOSH Worker Well-Being Questionnaire (WellBQ)*. https://doi.org/10.26616/NIOSHPUB2021110revised032024

Chauhan, G., & Singh, T. P. (2011). Lean Manufacturing through Management of Labor and Machine Flexibility : A Comprehensive Review. *Global Journal of Flexible Systems Management*, *12*, 59–80. https://doi.org/10.1007/BF03396599

Cierniak-Emerych, A., & Golej, R. (2020). Changes in safety of Working Conditions as a Result of Introducing 5S Practices. *IBIMA Business Review*, 1–13. https://doi.org/10.5171/2020.141027

Díaz-Reza, J. R., García-Alcaraz, J. L., Sánchez-Ramírez, C., & Vargas, A. R. (2024). Assessing the impact of Lean manufacturing on the Social Sustainability through Structural Equation Modeling and System Dynamics. *Jordan Journal of Mechanical and Industrial Engineering*, *18*(01), 113–130. https://doi.org/10.59038/jjmie/180109

Dieste, M., Panizzolo, R., & Garza-Reyes, J. A. (2020). Evaluating the impact of lean practices on environmental performance: evidences from five manufacturing companies. *Production Planning & Control*, *31*(9), 739–756. https://doi.org/10.1080/09537287.2019.1681535

Douglas, A., Douglas, J., & Ochieng, J. (2015). Lean Six Sigma implementation in East Africa: findings from a pilot study. *The TQM Journal*, *27*(6), 772–780. https://doi.org/10.1108/TQM-05-2015-0066

ESCC Manufacturer Questionnaire. (2020). https://escies.org/webdocument/showArticle?id=131&groupid=6

Eurofound and International Labour Organization. (2019). *Working conditions in a global perspective*. https://doi.org/10.2806/870542

Hall, G. B., Dollard, M. F., & Coward, J. (2010). Psychosocial safety climate: Development of the PSC-12. *International Journal of Stress Management*, *17*(4), 353–383. https://doi.org/10.1037/a0021320

Jayaraman, K., Leam Kee, T., & Lin Soh, K. (2012). The perceptions and perspectives of Lean Six Sigma (LSS) practitioners. *The TQM Journal*, *24*(5), 433–446. https://doi.org/10.1108/17542731211261584

Jeon, I. S., & Jeong, B. Y. (2016). Effect of Job Rotation Types on Productivity, Accident Rate, and Satisfaction in the Automotive Assembly Line Workers. *Human Factors and Ergonomics in Manufacturing & Service Industries*, *26*(4), 455–462. https://doi.org/10.1002/hfm.20667

Jurburg, D., Viles, E., Tanco, M., & Mateo, R. (2017). What motivates employees to participate in continuous improvement activities? *Total Quality Management & Business Excellence*, *28*(13–14), 1469–1488. https://doi.org/10.1080/14783363.2016.1150170

Khalfallah, M., & Lakhal, L. (2021). The relationships between TQM, TPM, JIT and agile manufacturing: an empirical study in industrial companies. *The TQM Journal*, *33*(8), 1735–1752. https://doi.org/10.1108/TQM-12-2020-0306

Kull, T. J., & Wacker, J. G. (2010). Quality management effectiveness in Asia: The influence of culture. *Journal of Operations Management*, *28*(3), 223–239. https://doi.org/10.1016/j.jom.2009.11.003

Kumar, M., Khurshid, K. K., & Waddell, D. (2014). Status of Quality Management practices in manufacturing SMEs: a comparative study between Australia and the UK. *International Journal of Production Research*, *52*(21), 6482–6495. https://doi.org/10.1080/00207543.2014.948574

Kumar, N., Kumar, S., Haleem, A., & Gahlot, P. (2013). Implementing lean manufacturing system: ISM approach. *Journal of Industrial Engineering and Management*, *6*(4), 996–1012. https://doi.org/10.3926/jiem.508

Lagrosen, S. (2003). Exploring the impact of culture on quality management. *International Journal of Quality & Reliability Management*, *20*(4), 473–487. https://doi.org/10.1108/02656710310468632

Longoni, A., Pagell, M., Johnston, D., & Veltri, A. (2013). When does lean hurt? – an exploration of lean practices and worker health and safety outcomes. *International Journal of Production Research*, *51*(11), 3300–3320. https://doi.org/10.1080/00207543.2013.765072

Main, B., Taubitz, M., & Willard Wood. (2008). You Cannot Get Lean Without Safety Understanding the Common Goals. *Professional Safety 53*, *53*, 38–42.

Mittal, A., Kumar, V., Verma, P., & Singh, A. (2024). Evaluation of organizational variables of quality 4.0 in digital transformation: the study of an Indian manufacturing company. *The TQM Journal*, *36*(1), 178–207. https://doi.org/10.1108/TQM-07-2022-0236

Mohd Aripin, N., Nawanir, G., Hussain, S., Mahmud, F., & Lee, K. L. (2024). Sustenance Strategies for Lean Manufacturing Implementation in Malaysian Manufacturing Industries. *International Journal of Automotive and Mechanical Engineering*, *21*(1), 11018–11035. https://doi.org/10.15282/ijame.21.1.2024.06.0852

Mousavi, S. S., Khani Jazani, R., Cudney, E. A., & Trucco, P. (2020). Quantifying the relationship between lean maturity and occupational health and safety. *International Journal of Lean Six Sigma*, *11*(1), 150–170. https://doi.org/10.1108/IJLSS-04-2018-0043

Nowlis, S. M., Kahn, B. E., & Dhar, R. (2002). Coping with Ambivalence: The Effect of Removing a Neutral Option on Consumer Attitude and Preference Judgments. *Journal of Consumer Research*, *29*(3), 319–334. https://doi.org/10.1086/344431

Nzuva, S. M., & Kimanzi, P. M. (2022). The Impact of Organisational Culture on Employees' Productivity: A Comprehensive Systematic Review. *European Journal of Business and Management*. https://doi.org/10.7176/EJBM/14-4-05

Ohno, T., & Bodek, N. (2019). *Toyota Production System*. Productivity Press. https://doi.org/10.4324/9780429273018

Ong, C. H., Koo, Y. Y., Tan, O. K., & Goh, C. F. (2021). Does rational culture matter in the relationship between lean manufacturing practices and operational productivity? *Journal of Manufacturing Technology Management*, *32*(5), 994–1015. https://doi.org/10.1108/JMTM-09-2020-0345

Pakdil, F., Toktaş, P., & Leonard, K. M. (2018). Validation of qualitative aspects of the Lean Assessment Tool (LAT). *Journal of Manufacturing Technology Management*, *29*(7), 1094–1114. https://doi.org/10.1108/JMTM-12-2017-0268

Panwar, A., Nepal, B., Jain, R., Rathore, A. P. S., & Lyons, A. (2017). Understanding the linkages between lean practices and performance improvements in Indian process industries. *Industrial Management & Data Systems*, *117*(2), 346–364. https://doi.org/10.1108/IMDS-01-2016-0035

Pinto, C. M. A., Mendonça, J., Babo, L., Silva, F. J. G., & Fernandes, J. L. R. (2022). Analyzing the Implementation of Lean Methodologies and Practices in the Portuguese Industry: A Survey. *Sustainability*, *14*(3), 1929. https://doi.org/10.3390/su14031929

Quality Assurance Survey/Questionnaire. (2012). https://www.metalmart.com/downloads/Survey.pdf

Randhawa, J. S., & Ahuja, I. S. (2017). 5S – a quality improvement tool for sustainable performance: literature review and directions. *International Journal of Quality & Reliability Management*, *34*(3), 334–361. https://doi.org/10.1108/IJQRM-03-2015-0045

Ruel, E. (2019). *100 Questions (and Answers) About Survey Research*. SAGE Publications, Inc. https://doi.org/10.4135/9781506348803

Sakthi, N. T., & Jeyapaul, R. (2021). An empirical investigation on association between human factors, ergonomics and lean manufacturing. *Production Planning & Control*, *32*(16), 1337–1351. https://doi.org/10.1080/09537287.2020.1810815

Singh, J., & Singh, H. (2015). Continuous improvement philosophy – literature review and directions. *Benchmarking: An International Journal*, *22*(1), 75–119. https://doi.org/10.1108/BIJ-06-2012-0038

Srinivasan, S., Ikuma, L. H., Shakouri, M., Nahmens, I., & Harvey, C. (2016). 5S impact on safety climate of manufacturing workers. *Journal of Manufacturing Technology Management*, *27*(3), 364–378. https://doi.org/10.1108/JMTM-07-2015-0053

Stewart, J. M. (2000). The Safety Questionnaire. In *Managing for World Class Safety* (pp. 213–229). J.M. Stewart Enterprises. https://doi.org/10.1002/9781118591444.app5

Stimec, A. (2020). Lean management and occupational health: team learning as a key factor. *Journal of Workplace Learning*, *32*(5), 363–375. https://doi.org/10.1108/JWL-08-2019-0104

Takashi Osada. (1991). *The 5S's: Five keys to a total quality environment* (2nd ed.). Asian Productivity Organization.

Terziovski, M., & Samson, D. (1999). The link between total quality management practice and organisational performance. *International Journal of Quality & Reliability Management*, *16*(3), 226–237. https://doi.org/10.1108/02656719910223728

Thanki, S. J., & Thakkar, J. (2014). Status of lean manufacturing practices in Indian industries and government initiatives. *Journal of Manufacturing Technology Management*, *25*(5), 655–675. https://doi.org/10.1108/JMTM-05-2012-0057

Titus, S., & Hoole, C. (2021). The development of an organisational effectiveness model. *SA Journal of Human Resource Management*, *19*. https://doi.org/10.4102/sajhrm.v19i0.1509

Tortorella, G., Fettermann, D., Anzanello, M., & Sawhney, R. (2017). Lean manufacturing implementation, context and behaviors of multi-level leadership. *Journal of Manufacturing Technology Management*, *28*(7), 867–891. https://doi.org/10.1108/JMTM-06-2017-0128

Tortorella, G. L., Fettermann, D. C., Piñeres, A., & Gaiardelli, P. (2019). The moderating role of just-in-time on sociotechnical practices' effect over quality and workers' health. *Human Factors and Ergonomics in Manufacturing & Service Industries*, *29*(3), 210–223. https://doi.org/10.1002/hfm.20776

Tortorella, G., Miorando, R., Meiriño, M., & Sawhney, R. (2019). Managing practitioners' experience and generational differences for adopting lean production principles. *The TQM Journal*, *31*(5), 758–771. https://doi.org/10.1108/TQM-02-2019-0041

Weijters, B., Cabooter, E., & Schillewaert, N. (2010). The effect of rating scale format on response styles: The number of response categories and response category labels. *International Journal of Research in Marketing*, *27*(3), 236–247. https://doi.org/10.1016/j.ijresmar.2010.02.004

Wickramasinghe, G. L. D., & Wickramasinghe, V. (2017). Implementation of lean production practices and manufacturing performance. *Journal of Manufacturing Technology Management*, *28*(4), 531–550. https://doi.org/10.1108/JMTM-08-2016-0112

Wiengarten, F., Fynes, B., Pagell, M., & de Búrca, S. (2011). Exploring the impact of national culture on investments in manufacturing practices and performance. *International Journal of Operations & Production Management*, *31*(5), 554–578. https://doi.org/10.1108/01443571111126328

Wiengarten, F., Gimenez, C., Fynes, B., & Ferdows, K. (2015). Exploring the importance of cultural collectivism on the efficacy of lean practices. *International Journal of Operations & Production Management*, *35*(3), 370–391. https://doi.org/10.1108/IJOPM-09-2012-0357

Womack, J. P., & Jones, D. T. (1997). Lean Thinking—Banish Waste and Create Wealth in your Corporation. *Journal of the Operational Research Society*, *48*(11), 1148–1148. https://doi.org/10.1057/palgrave.jors.2600967

Yang, C. C., & Yang, K. J. (2013). An Integrated Model of the Toyota Production System with Total Quality Management and People Factors. *Human Factors and Ergonomics in Manufacturing & Service Industries*, *23*(5), 450–461. https://doi.org/10.1002/HFM.20335

Zarbo, R. J., & D'Angelo, R. (2006). Transforming to a Quality Culture. *Pathology Patterns Reviews*, *126*(suppl_1), S21–S29. https://doi.org/10.1309/KVT7NWVPJR73T4K6

Supplementary Data

Appendix A   Industrial Ecosystem Survey

Survey questions

Demographic Questions

1. Where is your primary workplace located?
2. Which industry does your company primarily operate in?
3. What is your company size?
4. What is your job category?
5. What is your age?
6. How long have you been working with this company?

Lean Questions

1. Has your company implemented any Lean programs? (Lean is a practice to improve efficiency and effectiveness of process by eliminating waste)
2. My workplace is very welcoming and supportive of integrating Lean production into our processes.
3. Planning tools (e.g., project management software, scheduling techniques) are used to minimize unnecessary tasks.
4. Rejected or rework products (i.e., items that do not meet customer standards and need to be fixed or discarded) are minimised.
5. My workplace layout minimises unnecessary movement of materials and information.
6. Optimal resources and inventory levels (i.e., the right amount needed without excess stock) are maintained.
7. The workflow is a smooth and continuous operation (i.e., without significant interruptions or delays).
8. My workplace is organised to minimise unnecessary movement by employees.
9. My workplace produces minimal products that require rework or repair (i.e., items that do not meet quality standards).
10. I feel that my skills and talents are fully utilised in my role.

11. My organisation provides necessary resources (i.e., budget, personnel, and time) to promote continuous improvement activities.
12. My organisation has systems to collect and reward employee improvement ideas and suggestions.
13. Management has a clear understanding of the continuous improvement system and actively helps employees to understand and participate.
14. Machines and tools are regularly upgraded to maintain efficiency and quality.
15. I am encouraged to contribute ideas for process improvements.
16. My workplace prioritises keeping only essential items easily accessible.
17. I regularly review my workspace to remove unnecessary items.
18. My workplace has clear labels and signage to help locate items and information quickly and reduces time spent searching for items.
19. I feel that our workspace is well-organised, with everything in its designated place.
20. I feel my work environment is clean and well-maintained.
21. The standard procedures are in place for organising and maintaining the workspace.
22. Management provides ongoing support to ensure workplaces are well-organised for workers.
23. My organisation uses visual sign/ signals to visualise workflow and manage tasks and inventory.
24. Work tasks are clearly defined and prioritised to balance workload.
25. The workflow system is reviewed and adjusted regularly to meet changing needs.

Health and Safety System Questions

1. I have never experienced physical discomfort or pain due to my work tasks.
2. Ergonomic (i.e., refers to the process to makes the item easy for people who use it) assessments are conducted regularly in my workplace.
3. I have received training on proper ergonomic and posture practices.
4. I feel safe at work.
5. Cleanliness inspections are regularly conducted in my workplace.
6. I have easy access to cleaning supplies and equipment.
7. I feel that my workspace is well-organised.
8. Hazard reports are promptly followed up with corrective actions.
9. Hazards are clearly marked and communicated to all employees.
10. Job rotation (i.e., working in different roles or departments) is practiced in my workplace.
11. Job rotation effectively improves my overall job satisfaction.
12. I receive adequate training when rotated to a new task.
13. I work less than 10 hours a day.
14. I receive health and safety training related to my job.
15. I receive adequate training when rotated to a new task.
16. I feel skilled to perform my tasks safely.
17. I am encouraged to suggest improvements to safety practices.
18. I feel empowered to stop work if I notice a safety hazard (i.e., unsafe working conditions that can cause injury, illness, and death).
19. Employee opinions are considered in safety initiatives.
20. Safety program goals are clearly communicated to all employees.
21. I feel that safety is a top priority for my management.
22. Safety policies and procedures are consistently followed.
23. My colleagues are supportive in maintaining a safe work environment.
24. Management takes safety concerns seriously.
25. Resources are allocated for safety improvements in my workplace.
26. There is a formal process to report health and safety issues (i.e. Incident reporting system, health and safety committee, safety toolbox or meetings, and etc)

Quality Management System Questions

1. What basic quality improvement tools are regularly used in your workplace?
2. What advanced quality management tools are utilised in your organisation?
3. Quality improvement projects are usually supported by management through provision of sufficient funds and resources.
4. Management provides induction training and quality related training periodically to employee.

5. Management recognises and rewards employee contributions to quality improvements.
6. Management regularly communicates the importance of quality to all employees.
7. Management promptly addresses any issues that arise related to quality.
8. Employees follow to established quality standards and procedures.
9. Inspection and test equipment are regularly inspected and calibrated.
10. My organisation encouraged open discussions about quality issues at all levels.
11. Quality concerns are addressed in a timely and transparent manner.
12. Quality-related information is readily available and communicated to all employees.
13. I feel a sense of ownership over quality issues and work to improve them.
14. Peer involvement in quality processes is promoted and valued.
15. Cross-functional collaboration is encouraged and supported by management.
16. My work team communicates well.
17. Regular meetings and discussions are held to address quality issues.
18. Employees voluntarily share useful information with each other.
19. There is a culture of mutual support and knowledge sharing.

Organisational Culture Questions

1. My workload is reasonable.
2. My workload is reasonable.
3. My workplace prioritises psychological well-being of staff.
4. My current salary aligns with the average salary for my position and industry.
5. My work is distributed fairly.
6. I am satisfied with my working conditions.
7. I feel that my job is manageable.
8. I am confident in my job security.
9. I have received training provided by my organisation on managing work-related stress.
10. I feel comfortable discussing mental health issues with my supervisor.
11. I feel supported by my colleagues during stressful times.
12. I have enough time to relax after work.
13. I can take breaks and vacations without feeling guilty.
14. My workplace promotes a healthy work-life balance.
15. My workload does not interfere with my personal and/or family life.
16. My workplace has clear policies to address workplace bullying and harassment.
17. Conflicts are resolved fairly in our workplace.
18. My coworkers or colleagues help and support me.
19. My supervisor or manager helps and supports me.
20. My supervisor or manager is helpful in getting the job done.
21. My supervisor or manager provides useful feedback on my job.
22. My workplace respects and recognises my cultural values.
23. My workplace boosts my motivation and career satisfaction.
24. My job allows me to develop new technical or soft skills.
25. I feel that my contributions are recognised and appreciated.
26. I feel safe to voice my concerns (psychological safety).
27. I feel emotionally connected to this organisation.