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# Supplier Quality Management

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## Abstract

*The paper examines supplier quality management (SQM) within a single manufacturing company, focusing on procedure standardisation and employee training as internal prerequisites for supplier-related quality work. The theoretical part discusses SQM through supplier monitoring, non-conformity resolution, supplier development and data-supported risk assessment, with reference to Quality 4.0 and sustainable procurement. The empirical part is based on a cross-sectional survey of 101 employees involved in quality processes, process improvement or supplier cooperation. As the data were collected through self-reported Likert-type items, the study evaluates perceived rather than objectively measured effects. One-sample t-tests showed that all analysed items were significantly above the neutral midpoint. Respondents perceived standardised procedures as reducing errors and the need for direct supervision, and regular training as strengthening professionalism, problem-solving ability, and self-confidence. The findings suggest that standardisation and competence development enable perceived SQM maturity, while KPI-based verification remains necessary for assessing actual performance effects.*

**Keywords:** quality, process standardisation, supplier quality management, supply chain, employee training, ISO standards

## INTRODUCTION

Supplier quality management (SQM) is an important part of quality management in manufacturing companies, as the quality of incoming materials and components directly affects process stability, production costs, delivery reliability and customer satisfaction. In contemporary supply chains, quality can no longer be managed only within the boundaries of the focal organisation. It also requires clearly defined supplier requirements, supplier performance monitoring, structured handling of non-conformities, corrective actions and supplier development (ISO, 2016; van Weele, 2018).

The relevance of SQM has increased because manufacturing companies operate in technologically complex and unstable supply chains. Supplier quality is no longer limited to the technical conformity of delivered materials. It also includes responsiveness, traceability, documentation, risk management, process discipline and the supplier's ability to participate in continuous improvement. Quality 4.0, AI-supported analytics, and ESG-oriented procurement further underscore the need for data-driven and preventive approaches to supplier quality (ISO, 2017; Javaid et al., 2021).

Although SQM is externally oriented, its effectiveness depends strongly on internal organisational conditions. A company can manage suppliers effectively only if its procedures are clear, responsibilities are defined, and employees have the competence to identify, document and resolve supplier-related deviations. Standardised procedures reduce ambiguity and support consistent execution of work, while training strengthens employees' professionalism, problem-solving abilities, and confidence in applying quality procedures (Goetsch & Davis, 2020; Madanhire & Mbohwa, 2016; Oakland, 2018).

The purpose of this paper is to examine the perceived effects of procedure standardisation and regular employee training on selected aspects of SQM in a single manufacturing company context. More specifically, the paper analyses whether employees perceive standardised procedures as contributing to fewer work errors and a reduced need for direct supervision, and whether they perceive regular training as improving professionalism, problem-solving ability and self-confidence.

In line with this purpose, two hypotheses are formulated:

- H1: Employees perceive standardised procedures as reducing the likelihood of errors and the need for direct supervision.
- H2: Employees perceive regular training as positively affecting their professionalism, problem-solving ability and self-confidence in performing work tasks.

The empirical part is based on a quantitative cross-sectional survey of 101 employees. Data were collected with an online questionnaire prepared in the 1KA tool and analysed using descriptive statistics and one-sample t-tests. Since the data are based on self-reported employee assessments, the study does not provide objective proof of reduced supplier complaints, fewer production errors or lower supervision frequency. It therefore examines perceived effectiveness rather than objectively measured SQM performance. Objective verification would require operational KPIs such as complaint rates, defect trends, audit results or corrective-action closure times (Field, 2018; Pallant, 2020).

## CONCEPT OF QUALITY IN SUPPLIER QUALITY MANAGEMENT

### Quality as a process and supply-chain concept

In contemporary quality management, quality is not understood only as technical conformity of a final product with predefined specifications. It is created through stable processes, clearly defined responsibilities, systematic monitoring, employee competence and continuous improvement (Goetsch & Davis, 2020; Oakland, 2018). This process-oriented understanding is especially relevant in manufacturing companies, where final product quality depends not only on internal production activities but also on the quality, reliability and responsiveness of suppliers.

From the perspective of SQM, quality must therefore be understood as a broader organisational and supply-chain capability. A supplier may deliver a technically conforming material. However, supplier

quality also depends on delivery consistency, documentation accuracy, traceability, responsiveness to complaints, corrective-action discipline and prevention of recurring non-conformities. SQM thus extends the concept of quality from product conformity to the stability and reliability of the buyer-supplier relationship (ISO, 2016; van Weele, 2018).

In supplier relationships, quality also has an important relational dimension. The buying organisation depends on the supplier's ability not only to meet technical specifications, but also to communicate deviations, provide documentation, respond to complaints and participate in corrective actions. For this reason, supplier quality cannot be assessed only through the conformity of individual deliveries. It should also be evaluated based on the stability of cooperation, the transparency of information exchange, and the supplier's willingness to improve processes over time. This is especially relevant in manufacturing environments, where even technically minor deviations may have broader consequences for production planning, internal control, delivery reliability and customer satisfaction. SQM therefore connects technical quality, process quality and relationship quality into a broader concept of supply-chain reliability (Oakland, 2018; van Weele, 2018).

### From inspection to prevention and supplier development

The development of quality management has shifted from final inspection to prevention, process control, and continuous improvement. Modern quality management aims to reduce defects by controlling process variability, standardising procedures and using data to identify causes of deviations (Madanhire & Mbohwa, 2016; Oakland, 2018). This shift is central to SQM because supplier-related problems detected only after materials enter production can cause production stoppages, rework, additional inspections, and higher non-quality costs.

Quality tools such as Pareto analysis, Ishikawa diagrams, the 5 Whys method, 8D reports, FMEA, SPC, and Six Sigma are relevant in SQM when they support concrete supplier-related problem-solving. Their value lies in root-cause identification, risk prioritisation and corrective action verification. However, tools alone do not improve supplier quality if they are applied only formally. Their effectiveness depends on accurate data, employee competence, cross-functional cooperation and management support (Hočevar, 2017; MSI Certified, 2024; Tang, 2022; van Weele, 2018).

In this paper, quality is understood as a process-based, supply-chain-oriented capability that connects product conformity, process stability, employee competence, supplier performance, and continuous improvement. This understanding provides the theoretical basis for analysing how employees perceive the role of procedure standardisation and regular training in supporting SQM.

## QUALITY STANDARDS AS A FRAMEWORK FOR SUPPLIER QUALITY MANAGEMENT

### Standardisation and ISO 9001 in supplier quality management

Standardisation is a key mechanism for ensuring consistency, traceability and repeatability in quality-related processes. In SQM, standardised procedures are important because supplier-related quality work involves several departments, including quality, purchasing, production, development, logistics and incoming inspection. Without clearly defined procedures, responsibilities, and criteria, the handling of supplier-related deviations may rely too heavily on individual interpretation or informal communication (ISO, 2016; Novak et al., 2017).

ISO 9001 is the central management system standard for this topic because it provides a general framework for establishing and improving a quality management system. It emphasises process orientation, risk-based thinking, documented information, performance evaluation and continual improvement. These principles are directly connected with supplier quality because externally supplied materials, components and services affect the organisation's ability to meet customer and process requirements (ISO, 2016; van Weele, 2018).

For SQM, ISO 9001 is relevant not only as a certification framework but also as a managerial logic. It encourages organisations to define processes, responsibilities, records and performance indicators in a way that enables evidence-based monitoring and improvement. This is important in supplier-related quality work, where decisions should be based on documented evidence such as complaint records, audit findings, supplier ratings, defect trends and corrective-action effectiveness (ISO, 2016; Oakland, 2018).

**Risk-based supplier classification and control intensity**

A standardised SQM system should also include risk-based supplier classification. Not all suppliers have the same impact on the buyer's quality performance, and therefore, they should not all be managed with the same level of control. Suppliers of critical materials, technologically demanding components or inputs that directly affect product safety and customer satisfaction require more intensive monitoring, clearer documentation requirements and more frequent performance evaluation. In contrast, suppliers with stable performance and lower impact on final product quality may require less intensive control. This risk-based logic enables the organisation to use quality resources more efficiently and to focus attention on suppliers with the greatest potential effect on operational stability (ISO, 2016; Oakland, 2018; van Weele, 2018).

Risk-based classification may include several criteria, such as the criticality of supplied materials, complaint history, frequency of recurring non-conformities, audit results, responsiveness, corrective-action effectiveness, and the supplier's certification status. In more developed SQM systems, environmental, safety and sustainability-related risks may also be included. Such classification supports more differentiated supplier management: high-risk suppliers may require audits, development meetings and intensified monitoring, while stable suppliers may be managed through periodic performance reviews. In this way, standardisation does not mean mechanically applying the same procedure to all suppliers, but rather establishing a structured basis for proportionate and evidence-based control (ISO, 2016; Giacomelli & Mencigar, 2020; van Weele, 2018).

**Environmental, safety and sustainability standards**

Supplier quality management is increasingly aligned with requirements that go beyond traditional technical conformity. Manufacturing companies are expected to consider whether suppliers comply with environmental, occupational health and safety, ethical, and sustainability-related expectations. ISO 14001 supports environmental management, ISO 45001 focuses on occupational health and safety, and ISO 20400 guides sustainable procurement (ISO, 2026; ISO, 2017; ISO, 2018).

From the SQM perspective, these standards broaden supplier evaluation criteria beyond price, delivery and technical quality. Supplier quality may also include environmental compliance, safe working practices, transparency and long-term risk exposure. This does not replace technical supplier quality indicators such as complaint rates, audit results or corrective-action effectiveness, but complements

them with ESG-related risk and sustainability criteria (Giacomelli & Mencigar, 2020; ISO, 2017; van Weele, 2018).

The integration of sustainability into SQM also changes how supplier performance is interpreted. A supplier may achieve acceptable technical quality in the short term, but still represent a long-term risk if it does not manage environmental impacts, occupational safety or transparency in its own supply chain. For this reason, ESG-related supplier assessment should not be treated as separate from quality management. Instead, it can be understood as an extension of supplier risk management. Technical quality, compliance, sustainability, and resilience increasingly form the basis for evaluating whether a supplier is suitable for long-term cooperation (ISO, 2017; ISO, 2018; van Weele, 2018).

### Standards, Quality 4.0 and relevance for this research

The role of standards is also changing due to digitalisation and Quality 4.0. Digital dashboards, analytics, and AI-supported tools can support supplier risk monitoring and trend analysis, but they require reliable data, clear indicator definitions, and consistent complaint classification. Standardisation is therefore a prerequisite for meaningful digital SQM because it ensures that the data used for analysis are comparable, traceable and operationally useful (ISO, 2016; Javaid et al., 2021).

For this study, quality standards are understood as a framework that supports procedure standardisation, supplier monitoring and continuous improvement. They provide the basis for the hypothesis that standardised procedures can contribute to more reliable execution of work. However, because the empirical part relies on employee perceptions, the study can show how employees perceive standardisation but cannot demonstrate objective improvements in supplier quality indicators (Field, 2018; Pallant, 2020).

## QUALITY CONTROL AND IMPROVEMENT APPROACHES IN SUPPLIER QUALITY MANAGEMENT

### Data-driven monitoring and prioritisation of supplier quality

Quality control in SQM is not limited to final inspection or defect detection. It is part of a broader improvement system that includes supplier monitoring, identification of non-conformities, root-cause analysis, corrective actions and prevention of recurrence (Oakland, 2018; van Weele, 2018). Supplier deviations can affect production continuity, inspection costs, rework and delivery reliability; therefore, supplier quality should be monitored systematically.

Supplier performance can be monitored through indicators such as complaint rates, share of non-conforming deliveries, repeated deviations, responsiveness, audit results and corrective-action effectiveness. Such indicators help distinguish isolated deviations from recurring supplier problems and support risk-based supplier management (Giacomelli & Mencigar, 2020; ISO, 2016). SPC can support monitoring of variability and trends, while Pareto analysis helps identify suppliers, materials, or defect types that account for the largest share of quality problems (Germanova Krasteva & Dimcheva, 2020; Madanhire & Mbohwa, 2016).

### Root-cause analysis and corrective actions

When a supplier-related non-conformity occurs, it is not sufficient to eliminate only the immediate consequence. The organisation must identify why the problem occurred and why the existing control system did not prevent or detect it earlier. Root-cause analysis is therefore central to supplier complaint handling (Oakland, 2018; van Weele, 2018).

The Ishikawa diagram supports structured analysis of possible causes, while the 5 Whys method helps move from visible symptoms to deeper causes. The 8D method is particularly relevant for supplier complaints because it provides a structured approach from problem description and containment to root-cause analysis, corrective actions and verification of effectiveness. In supplier relationships, the 8D report also functions as a communication and accountability mechanism between the buyer and supplier (EASE, 2021; Hočevar, 2017; MSI Certified, 2024).

**Preventive methods and Quality 4.0 support**

Preventive methods are important because effective SQM should not rely only on complaint handling after problems occur. FMEA enables the identification of possible failure modes and risk-reduction actions before non-conformities occur. Poka-Yoke supports prevention of errors at the source, while Six Sigma contributes through structured reduction of variability and process improvement using the DMAIC logic (Council for Six Sigma Certification, 2018; Mittal et al., 2023; Tang, 2022; Varntanian & Pancera, 2020).

Quality 4.0 adds digital support to supplier quality decisions. Integrated data from complaints, audits, corrective actions and supplier ratings can help identify patterns and supplier risks earlier. However, digital tools cannot replace standardised procedures, reliable data entry or professional judgement. Their value depends on the combination of technology, quality maturity, employee competence and supplier communication (Goetsch & Davis, 2020; Javaid et al., 2021; Oakland, 2018).

Data quality is a particularly important condition for digital SQM. Supplier-related data must be entered consistently, classified into clear categories, and linked to relevant corrective-action records. If the same type of non-conformity is recorded under different names, or if supplier responses are documented inconsistently, trend analysis becomes unreliable. This is relevant because Quality 4.0 tools depend not only on advanced analytics but also on the quality of the underlying process data. Standardised complaint categories, clear definitions of defect types, consistent recording of root causes and structured follow-up of corrective actions are therefore necessary prerequisites for meaningful digital supplier quality analysis (ISO, 2016; Javaid et al., 2021; Oakland, 2018).

Data quality is also connected with employee competence. Employees must understand why accurate documentation is important, how to select complaint categories, and how to verify the effectiveness of corrective actions. If employees treat data entry as an administrative burden, the organisation may collect large amounts of data that have limited analytical value. In contrast, when employees understand the purpose of data collection, supplier quality data can serve as a basis for identifying recurring problems, monitoring supplier risk, and supporting preventive decision-making. This again shows the connection between standardised procedures, employee training and data-supported SQM (Goetsch & Davis, 2020; Javaid et al., 2021).

These approaches are directly relevant to the empirical part of the paper. Standardised procedures support consistent use of quality tools, while regular training helps employees apply these tools correctly

in supplier-related situations. At the same time, actual improvement in supplier quality would require objective KPI verification, not only employee perceptions (Field, 2018; van Weele, 2018).

## SUPPLIER QUALITY MANAGEMENT AS A STRATEGIC PROCESS

### SQM as an extension of quality management

SQM represents a systematic approach to ensuring that externally supplied materials, components, products and services meet the buyer's requirements. In manufacturing companies, poor supplier quality can lead to problems with incoming inspection, production delays, rework, increased complaint costs, and disruptions in the wider supply chain (Oakland, 2018; van Weele, 2018).

SQM should not be understood only as the inspection of incoming materials. A developed SQM system includes supplier selection, supplier evaluation, definition of quality requirements, performance monitoring, handling of non-conformities, corrective actions, supplier audits and supplier development. It extends the logic of internal quality management to external partners and integrates suppliers into the broader quality system (ISO, 2016; van Weele, 2018).

### Supplier selection, evaluation and approval

Supplier quality begins before regular deliveries start. Supplier selection and approval should consider not only price and delivery conditions, but also quality capability, process stability, certification status, audit results, responsiveness, corrective-action discipline and risk exposure (ISO, 2016; van Weele, 2018). In more advanced systems, supplier evaluation also includes environmental, occupational health and safety, and sustainability-related criteria (Giacomelli & Mencigar, 2020; ISO, 2017; ISO, 2018).

After approval, continuous supplier monitoring becomes central to the process. Common indicators include the number of complaints, share of non-conforming deliveries, repeated non-conformities, delivery reliability, responsiveness, corrective-action closure time, audit results and supplier rating trends. These indicators provide a basis for deciding whether a supplier requires additional control, development measures or changes in cooperation conditions (Giacomelli & Mencigar, 2020; ISO, 2016).

### Handling non-conformities and developing suppliers

Supplier non-conformity management should follow a standardised procedure that includes problem identification, documentation, severity classification, containment measures, communication with the supplier, root-cause analysis, corrective actions and verification of effectiveness. The purpose is not only to solve the immediate problem but also to prevent recurrence (Hočevar, 2017; MSI Certified, 2024).

Modern SQM is not limited to controlling or sanctioning suppliers. Long-term quality improvement often requires supplier development, including technical meetings, process audits, joint root-cause analysis, improvement plans and clearer communication of requirements. Such activities should be based on data, measurable targets, deadlines and verification criteria. Cross-functional cooperation between quality, purchasing, production, logistics and development is essential because supplier quality problems often involve several organisational functions (Goetsch & Davis, 2020; van Weele, 2018).

### Supplier development as a learning process

Supplier development should be understood not only as a corrective response to poor performance, but also as a learning process between the buyer and the supplier. When deviations recur, the buyer may increase control, but this does not necessarily eliminate the underlying cause of the problem. A more developmental approach involves analysing why the supplier's process is unstable, what kind of support or clarification is needed, and how improvement measures can be verified over time. This may include technical meetings, shared analysis of complaints, supplier training, process audits and follow-up reviews of corrective actions (Goetsch & Davis, 2020; Oakland, 2018; van Weele, 2018).

The developmental role of SQM is particularly important when suppliers are strategically important or difficult to replace. In such cases, replacing a supplier may be costly, slow or operationally risky. Supplier development can therefore represent a more sustainable approach, provided that it is based on measurable objectives and clear responsibilities. Improvement activities should be linked to specific indicators, such as reductions in repeated complaints, shorter corrective-action closure times, improved audit results, or better documentation quality. This allows the buying organisation to distinguish between formal cooperation and actual supplier improvement (Giacomelli & Mencigar, 2020; ISO, 2016; van Weele, 2018).

This perspective is also relevant for the empirical part of the paper. Employees who work with suppliers need not only formal procedural knowledge, but also problem-solving skills, communication competence and the ability to interpret quality data. Regular training and knowledge exchange can therefore strengthen the organisation's ability to participate more effectively in supplier development. Supplier development is thus connected with both research factors examined in this paper: procedure standardisation and employee competence.

### KPI monitoring, Quality 4.0 and sustainability

A scientifically rigorous assessment of SQM effectiveness requires objective KPIs. Relevant indicators include supplier complaint rates, repeated non-conformities, defect rates, supplier audit scores, corrective-action closure times, recurrence rates and cost of poor supplier quality. Employee perceptions are useful for understanding how the quality system is experienced, but they do not provide direct evidence of objectively improved supplier quality (Field, 2018; Pallant, 2020; van Weele, 2018).

Future SQM development is connected with Quality 4.0 and sustainable procurement. Digital tools can support supplier risk monitoring, automated trend analysis and earlier detection of deteriorating supplier performance. At the same time, ISO 20400, ISO 14001 and ISO 45001 show that supplier quality increasingly includes environmental, safety and governance-related requirements. Effective SQM should therefore connect standardised procedures, trained employees, supplier performance monitoring, corrective-action discipline, digital analytics and sustainable supplier development (ISO, 2026; ISO, 2017; ISO, 2018; Javaid et al., 2021).

## CONDUCTING THE RESEARCH

### Research design and sample

The empirical part of the study was designed as a quantitative, cross-sectional survey. A quantitative approach was selected because the aim was to measure employees' assessments of selected SQM factors and statistically test whether their average agreement differed from the neutral midpoint of the scale.

Survey research is appropriate when comparable responses from a larger group of participants are needed to analyse attitudes, perceptions or self-reported experiences (Creswell & Creswell, 2018; Saunders et al., 2019).

The study focused on two internal organisational factors identified in the theoretical part: procedure standardisation and regular employee training. The final sample consisted of 101 employees involved in quality processes, process improvement, supplier cooperation or related organisational activities. Since the research was conducted in a single organisational context, the findings should be interpreted as a single-case insight. They cannot be generalised to all manufacturing companies or SQM systems (Saunders et al., 2019).

**Research instrument and operationalisation**

Data were collected using a structured online questionnaire prepared in the 1KA tool. The questionnaire included demographic questions and substantive statements measured on a five-point Likert-type scale, with 1 representing disagreement and 5 representing complete agreement. Likert-type scales are commonly used to measure attitudes, perceptions, and subjective evaluations in survey research (Boone & Boone, 2012; Joshi et al., 2015).

H1 was tested with two statements: Standardised procedures reduce the need for supervision by superiors, and the introduction of standardised procedures reduces workplace errors. These items measure employees' perceptions of whether standardisation reduces the need for supervision and work errors.

H2 was tested with three statements: Professionalism at work increases through continuous training, Problem-solving ability is enhanced by sharing knowledge with experienced experts, and Regular internal training increases confidence in performing one's work. These items measure perceived competence-related outcomes of training and knowledge exchange.

**Data collection and analysis**

The survey was distributed online to employees involved in quality processes, process improvement, or supplier cooperation. Participation was anonymous, and results were analysed only at the aggregate level. The collected data were exported and analysed in SPSS.

The analysis included descriptive statistics and one-sample t-tests. Descriptive statistics were used to present the mean, standard deviation and number of valid responses. One-sample t-tests were used to test whether the mean values were statistically significantly above the neutral midpoint of the five-point scale. The test value was set at 3 (Field, 2018; Pallant, 2020).

The one-sample t-test does not prove causal impact. It only shows whether the average agreement differs from a predefined comparison value. Therefore, in this study, statistically significant results are interpreted as evidence of positive employee perceptions, not as objective proof of reduced errors, fewer complaints or improved supplier performance (Field, 2018; Pallant, 2020).

**Reliability, validity and limitations**

The questionnaire was based on concepts discussed in the theoretical part, especially procedure standardisation, employee competence and SQM. This supports the instrument's content relevance. However, the questionnaire was not a previously validated psychometric scale, and the item groups were short. Future research should include more items per construct and test reliability and validity more rigorously, for example, using Cronbach's alpha and factor analysis (Tavakol & Dennick, 2011).

Several limitations must be acknowledged. The research was conducted in a single organisational context, which limits generalisability. The study is based on self-reported employee perceptions and therefore does not provide objective evidence of actual process improvement. The design is cross-sectional, so it cannot determine changes over time. Finally, the statistical analysis is limited to descriptive statistics and one-sample t-tests. Future research should combine survey data with operational KPIs, including supplier complaint rates, repeated non-conformities, defect rates, audit scores, corrective-action closure times, and supervision frequency.

## RESULTS AND INTERPRETATION

### Descriptive overview of the analysed items

The empirical analysis focused on five questionnaire items directly connected with the two research hypotheses. Two items were used to analyse employees' perceptions of procedure standardisation, while three items were used to analyse employees' perceptions of regular training. All items were measured on a five-point Likert-type scale, where 1 indicated disagreement and 5 indicated complete agreement.

The descriptive results show that all analysed mean values were above the neutral midpoint of the scale. This indicates that respondents generally agreed with the statements regarding both procedure standardisation and regular training. However, these results must be interpreted as employees' perceptions. They do not represent objective operational evidence of reduced errors, lower supervision frequency or improved supplier quality performance.

The use of mean values and standard deviations enables a basic overview of the direction and dispersion of responses. The one-sample t-test was then used to assess whether the mean values statistically significantly differed from the neutral test value of 3. This statistical test is suitable for determining whether a sample mean differs from a predefined comparison value, but it does not demonstrate causality or objective process improvement (Field, 2018; Pallant, 2020).

### Results for H1: Perceived effects of procedure standardisation

The first research hypothesis was formulated as follows:

- H1: Employees perceive standardised procedures as reducing the likelihood of errors and the need for direct supervision.

The results show that both analysed statements related to standardisation were rated above the neutral midpoint. The statement "Standardised procedures reduce the need for supervision by superiors" achieved a mean of 4.1 with a standard deviation of 0.997. The statement "The introduction of standardised procedures reduces workplace errors" achieved a mean value of 3.7 with a standard deviation of 1.110.

The one-sample t-test showed that both mean values were statistically significantly higher than the test value of 3. For the reduced supervision statement, the result was statistically significant, $t(100) = 11.382$, $p < .001$. For the statement on reduced workplace errors, the result was also statistically significant, $t(100) = 6.721$, $p < .001$. These results indicate that respondents perceived standardised procedures as contributing to clearer work execution, fewer errors and a reduced need for direct supervision.

In addition to statistical significance, the effect sizes were also considered. For the statement on reduced supervision, Cohen's d was approximately 1.13, indicating a large effect. For the statement on reduced workplace errors, Cohen's d was approximately 0.67, indicating a medium-to-large effect. These values suggest that the respondents' agreement was not only statistically significant but also substantively meaningful (Cohen, 1988; Field, 2018).

Nevertheless, the results should be interpreted with caution regarding methodological limitations. The analysis does not prove that standardised procedures objectively reduced the actual number of errors or the actual frequency of supervision. Rather, it shows that employees perceive standardisation as beneficial for clarity in work and process reliability. Objective verification would require operational indicators such as error records, complaint rates, supervision logs or before-and-after process data.

**Table 1: One-sample t-test results for perceived effects of standardised procedures**

| Statement | N | Mean | SD | t | df | p | Mean difference | 95% CI lower | 95% CI upper |
|---|---|---|---|---|---|---|---|---|---|
| Standardised procedures reduce the need for supervision by superiors. | 101 | 4.1 | 0.997 | 11.382 | 100 | < .001 | 1.129 | 0.93 | 1.33 |
| The introduction of standardised procedures reduces workplace errors. | 101 | 3.7 | 1.110 | 6.721 | 100 | < .001 | 0.743 | 0.52 | 0.96 |

The results support H1 regarding employee perceptions. Respondents perceived standardised procedures as reducing the need for supervision and as contributing to fewer workplace errors. This is consistent with the theoretical view that standardisation reduces ambiguity, supports repeatability and improves consistency in quality-related work (ISO, 2016; Madanhire & Mbohwa, 2016; Novak et al., 2017).

**Results for H2: Perceived effects of regular training**

The second research hypothesis was formulated as follows:

- H2: Employees perceive regular training as positively affecting their professionalism, problem-solving ability and self-confidence in performing work tasks.

The results show high levels of agreement with all three training-related statements. The statement "Professionalism at work increases through continuous training" achieved a mean of 4.6 with a standard deviation of 0.768. The statement "Problem-solving ability is enhanced by sharing knowledge with experienced experts" also achieved a mean value of 4.6, with a standard deviation of 0.684. The statement "Regular internal training increases confidence in performing one's work" achieved a mean of 4.4 with a standard deviation of 0.778.

The one-sample t-test showed statistically significant results for all three statements. For professionalism, the result was $t(100) = 20.347$, $p < .001$. For problem-solving ability, the result was $t(100) = 22.973$, $p < .001$. For self-confidence, the result was $t(100) = 18.288$, $p < .001$. These results show that respondents strongly perceived regular training and knowledge exchange as important factors in developing quality-related competence.

The effect sizes were also large. Cohen's d was approximately 2.02 for professionalism, 2.29 for problem-solving ability and 1.82 for self-confidence. These values indicate very strong agreement with the analysed statements. The particularly high result for knowledge exchange with experienced experts suggests that employees consider practical experience and internal knowledge transfer especially important for solving quality-related problems.

As with H1, these results should be interpreted as perceived effects. The findings do not prove that regular training objectively improved employee performance or supplier quality outcomes. They show that employees perceive training as beneficial for professionalism, problem-solving ability and confidence. Objective verification would require additional data, such as training records, performance evaluations, corrective-action quality, audit results or changes in supplier quality KPIs before and after training activities.

**Table 2: One-sample t-test results for perceived effects of regular training**

| Statement | N | Mean | SD | t | df | p | Mean difference | 95% CI lower | 95% CI upper |
|---|---|---|---|---|---|---|---|---|---|
| Professionalism at work increases through continuous training. | 101 | 4.6 | 0.768 | 20.347 | 100 | < .001 | 1.554 | 1.40 | 1.71 |
| Problem-solving ability is enhanced by sharing knowledge with experienced experts. | 101 | 4.6 | 0.684 | 22.973 | 100 | < .001 | 1.564 | 1.43 | 1.70 |
| Regular internal training increases confidence in performing one's work. | 101 | 4.4 | 0.778 | 18.288 | 100 | < .001 | 1.416 | 1.26 | 1.57 |

The results support H2 regarding employee perceptions. Respondents perceived regular training as strengthening professionalism, problem-solving ability and self-confidence. This is consistent with the theoretical assumption that employee competence and organisational learning are important for the effective functioning of quality systems and supplier-related quality work (Goetsch & Davis, 2020; Oakland, 2018; van Weele, 2018).

**Interpretation of the statistical findings**

The statistical results show that all analysed items were rated significantly above the scale's neutral midpoint. This means that respondents did not evaluate standardisation and training neutrally, but expressed clear agreement with their positive role in quality-related work. The findings therefore indicate a strong perceived importance of both procedure standardisation and regular training.

However, the statistical method used in this study must be interpreted correctly. The one-sample t-test determines whether the mean value of a variable differs from a predefined test value. In this study, the

test value was 3, which represented the neutral midpoint of the five-point Likert-type scale. The test, therefore, shows whether respondents' agreement was significantly above neutrality. It does not show causal impact, correlation between variables or actual operational improvement (Field, 2018; Pallant, 2020).

This distinction is essential for interpreting the hypotheses. The results support the hypotheses only with respect to perceived effects. They show that employees perceive standardised procedures and regular training as beneficial, but they do not prove that these factors caused measurable reductions in errors, complaints or supervision. Such claims would require secondary operational data and a different research design, such as a before-and-after analysis, a longitudinal comparison, or a regression model using objective KPIs.

From a practical perspective, the results are still relevant. Employee perceptions are important because quality systems depend on the people who apply procedures, document deviations, analyse problems and communicate with suppliers. If employees perceive standardisation and training positively, this may indicate that these factors support the internal acceptance and practical functioning of SQM. Nevertheless, employee perceptions should be treated as one part of SQM evaluation, not as a substitute for objective performance measurement.

### Summary of findings

The empirical results provide support for both research hypotheses, but only within the limits of the research design.

First, H1 is supported at the employee-perception level. Respondents perceived standardised procedures as reducing the need for direct supervision and as contributing to fewer workplace errors. This suggests that procedure standardisation may strengthen perceived clarity, consistency and reliability in quality-related work.

Second, H2 is supported at the level of employee perceptions. Respondents perceived regular training as improving professionalism, problem-solving ability and self-confidence. The highest agreement was observed regarding knowledge exchange with experienced experts, indicating the practical importance of internal learning and experience-based competence development.

Third, the results should not be interpreted as objective proof of improved SQM performance. The research did not analyse operational KPIs such as supplier complaint rates, defect rates, repeated non-conformities, supplier audit scores or corrective-action closure times. Therefore, the findings indicate perceived benefits of SQM rather than objective measures of effectiveness.

Fourth, the results provide a basis for managerial reflection. They suggest that employees recognise procedure standardisation and regular training as important internal conditions for quality-related work. Future improvement activities should therefore combine clearer procedures, systematic training, structured knowledge transfer and objective KPI monitoring. Such an approach would allow the organisation to connect employee perceptions with measurable supplier quality performance.

## MANAGERIAL IMPLICATIONS AND IMPROVEMENT RECOMMENDATIONS

### Strengthening standardisation and employee training

The results of the study show that employees perceive standardised procedures as contributing to fewer errors and a reduced need for direct supervision. From a managerial perspective, this indicates that standardising procedures should remain a key development priority in supplier quality management (SQM). Standardisation is particularly important in supplier-related quality work because such processes usually involve several organisational functions, including quality, purchasing, production, logistics and development. Clearly defined procedures reduce ambiguity, support consistency and enable more uniform handling of supplier-related deviations (ISO, 2016; Novak et al., 2017; van Weele, 2018).

In practice, standardised procedures should define how supplier requirements are communicated, how incoming material deviations are documented, how complaints are classified, how corrective actions are initiated and how their effectiveness is verified. Procedures should also clarify responsibilities and escalation paths. This is important because supplier quality issues often require rapid coordination among internal departments and timely communication with suppliers. If responsibilities are unclear, deviations may be handled inconsistently or too late, increasing the risk of recurring problems (ISO, 2016; Oakland, 2018).

However, standardisation should not become excessive bureaucracy. Procedures are useful only if they are understandable, accessible, regularly updated and connected with actual work situations. Managers should therefore periodically review procedures together with employees who use them in practice. Such reviews can help identify unclear instructions, duplicated steps, outdated templates or unnecessary documentation requirements. This is important because a quality system that is too formal or administratively demanding may reduce employee motivation and weaken practical implementation (Goetsch & Davis, 2020; Oakland, 2018).

The findings also show that employees strongly perceive regular training as improving professionalism, problem-solving ability and self-confidence. This has direct managerial relevance. Employees involved in SQM must understand technical requirements, complaint procedures, root-cause analysis, supplier communication and corrective-action logic. Training should therefore not be limited to general quality topics, but should be closely linked to supplier-related work. Relevant training areas include 8D reporting, Ishikawa diagrams, the 5 Whys method, supplier audits, KPI interpretation, corrective-action verification and communication with suppliers (Hočevar, 2017; MSI Certified, 2024; van Weele, 2018).

In addition to formal training, internal knowledge transfer should be strengthened. The high agreement with the statement on knowledge exchange with experienced experts suggests that employees value practical, experience-based learning. Mentoring, case-based workshops, internal examples of successfully resolved supplier complaints and the “train the trainer” approach could therefore support the practical development of SQM competence. Training effectiveness should also be evaluated. It is not sufficient to record that training was carried out; the organisation should assess whether training improves the quality of complaint analyses, corrective-action closure, documentation consistency or recognition of recurring supplier problems (Goetsch & Davis, 2020; Oakland, 2018).

**Introducing KPI-based SQM monitoring**

A key recommendation is to complement employee perceptions with objective supplier quality indicators. The empirical part of this study shows how employees perceive standardisation and training, but it does not measure whether supplier quality actually improved. For this reason, managers should

introduce or strengthen KPI-based monitoring of SQM effectiveness. Employee perceptions are useful for understanding how the system is experienced internally, but they should be interpreted together with operational data (Field, 2018; Pallant, 2020).

Relevant SQM indicators include supplier complaint rates, repeated non-conformities, defect rates, share of non-conforming deliveries, supplier audit scores, corrective-action closure time, recurrence rate after corrective actions, number of blocked deliveries, and cost of poor supplier quality. These indicators enable the organisation to evaluate whether supplier quality is improving, deteriorating or remaining stable over time. They also make it possible to distinguish isolated deviations from systematic supplier problems (Giacomelli & Mencigar, 2020; ISO, 2016; van Weele, 2018).

KPI monitoring is also important for evaluating the practical effects of standardisation and training. For example, if procedure standardisation is expected to reduce errors, this should be monitored by tracking trends in complaint records, repeated errors, documentation errors, and delays in corrective action. If training is expected to improve problem-solving, this could be assessed by the quality of root-cause analyses, the timeliness of corrective actions, fewer repeated complaints, and improved supplier audit results. Such monitoring would allow managers to connect perceived improvements with measurable performance outcomes (Field, 2018; Pallant, 2020; van Weele, 2018).

A practical step would be to develop a simple SQM dashboard that includes the most relevant indicators. The dashboard should not be overly complex at the beginning. It could initially include supplier complaints, repeated non-conformities, open corrective actions, corrective-action closure time and supplier audit results. Over time, it could be expanded to include trend analysis, supplier-risk categories, and cost-related indicators. This would support evidence-based decision-making and reduce dependence on subjective impressions or isolated events (Giacomelli & Mencigar, 2020; Oakland, 2018).

**Integrating Quality 4.0 and ESG criteria**

Quality 4.0 offers opportunities for more data-supported and preventive SQM. Digital dashboards, integrated information systems, analytics and AI-supported tools can help managers identify recurring supplier problems, suppliers with increasing risk and materials that require additional attention. In this sense, digital tools can support earlier detection of supplier risks and more systematic monitoring of quality trends (Javaid et al., 2021).

However, the introduction of digital tools should be realistic and gradual. Digitalisation does not solve supplier quality problems if the underlying data are incomplete, inconsistent or incorrectly classified. Before introducing advanced analytics, the organisation must ensure reliable complaint records, standardised defect categories, consistent data entry and disciplined corrective-action follow-up. Quality 4.0, therefore, depends on basic quality maturity and should be treated as decision support rather than a substitute for professional judgement (ISO, 2016; Javaid et al., 2021; Oakland, 2018).

SQM should also gradually integrate ESG and sustainable procurement criteria. Traditional SQM focuses mainly on technical conformity, complaint handling and supplier responsiveness. However, contemporary supplier management increasingly includes environmental compliance, occupational health and safety, ethical conduct, transparency and long-term risk exposure. ISO 20400 guides sustainable procurement, while ISO 14001 and ISO 45001 provide relevant frameworks for environmental management and occupational health and safety (ISO, 2026; ISO, 2017; ISO, 2018).

This does not mean that technical supplier quality becomes less important. Product conformity, complaint rates and corrective-action effectiveness remain central SQM indicators. ESG criteria should complement them by broadening supplier evaluation and development. For key suppliers, managers could gradually introduce sustainability-related audit questions, environmental performance indicators, supplier self-assessments, or specific development plans. Such integration would align SQM with contemporary expectations related to sustainable sourcing and long-term supply-chain resilience (Giacomelli & Mencigar, 2020; ISO, 2017; van Weele, 2018).

**Proposed managerial framework**

Based on the theoretical discussion and empirical findings, SQM development should connect five elements: procedure standardisation, employee competence, operational KPI monitoring, Quality 4.0 and ESG-oriented supplier development. These elements should not be treated as separate initiatives but as connected parts of a single managerial framework. Procedure standardisation provides operational clarity, employee competence supports correct application of quality tools, KPI monitoring enables objective verification, Quality 4.0 strengthens data-supported decision-making, and ESG criteria broaden supplier evaluation beyond technical conformity (Goetsch & Davis, 2020; ISO, 2016; Javaid et al., 2021; van Weele, 2018).

Procedure standardisation underpins the framework's operational foundation. It defines how supplier-related quality activities are performed and documented. Employee competence ensures that procedures and tools are not applied only formally, but are used meaningfully in concrete supplier-related situations. KPI monitoring provides the empirical basis for evaluating whether perceived improvements are reflected in measurable performance. Quality 4.0 can improve visibility of supplier risks and quality trends, while ESG-oriented supplier development supports broader responsibility and resilience in supplier relationships.

The proposed framework also addresses the study's main methodological limitation. The survey results show that employees perceive standardisation and training as useful internal enablers of SQM. However, future managerial action should connect these perceived benefits with objective KPI monitoring. Only by combining employee perceptions with operational data can the organisation evaluate whether SQM measures actually improve supplier quality performance. This would provide a stronger basis for decision-making and for future research on the effectiveness of SQM practices (Field, 2018; Pallant, 2020; van Weele, 2018).

## CONCLUSION

This paper examined supplier quality management (SQM) as an important part of the quality management system in a manufacturing company context. The theoretical discussion showed that SQM should not be understood only as incoming-material inspection or complaint handling, but as a broader managerial system that includes supplier selection, supplier evaluation, performance monitoring, non-conformity management, corrective actions, supplier development and risk-based decision-making. Such an understanding is consistent with contemporary quality management and supply-chain literature, which emphasises process stability, standardised procedures, documented information, supplier cooperation and continuous improvement (ISO, 2016; Oakland, 2018; van Weele, 2018).

The paper focused on two internal prerequisites of effective SQM: procedure standardisation and regular employee training. Although SQM is externally oriented because it deals with suppliers, its effectiveness also depends on the internal maturity of the buying organisation. A company can consistently manage suppliers only if supplier-related procedures are clearly defined, responsibilities are understood, deviations are documented in a structured way, and employees are competent to apply quality tools in practice. From this perspective, standardisation and employee training are not only internal organisational issues, but important enablers of reliable supplier quality work (Goetsch & Davis, 2020; Oakland, 2018; van Weele, 2018).

The empirical results support both research hypotheses at the level of employee perceptions. Respondents perceived standardised procedures as reducing the need for direct supervision and as contributing to fewer workplace errors. They also perceived regular training as improving professionalism, problem-solving ability and self-confidence. These findings indicate that employees recognise standardisation and competence development as relevant internal conditions for higher-quality, more reliable work. This is important because SQM depends on employees who apply procedures, identify and document supplier-related deviations, use problem-solving tools, communicate with suppliers and participate in corrective-action processes.

However, the findings must be interpreted cautiously. The study does not provide objective evidence that standardised procedures actually reduced the number of errors, supplier complaints or supervision frequency. The empirical data were collected through self-reported Likert-type items and therefore reflect perceived effects rather than objectively measured SQM performance. The one-sample t-test showed that respondents' agreement with the analysed statements was statistically significantly above the neutral midpoint, but this statistical method does not demonstrate causal impact, correlation between variables or operational improvement (Field, 2018; Pallant, 2020).

The main practical implication is that manufacturing companies should not rely only on formal procedures or individual employee experience when developing SQM. Instead, they should combine clear procedure standardisation, systematic training, internal knowledge transfer and objective KPI monitoring. Relevant SQM indicators include supplier complaint rates, repeated non-conformities, defect rates, supplier audit scores, corrective-action closure times, recurrence rates after corrective actions, and the cost of poor supplier quality. Such indicators would enable verification that perceived improvements are also reflected in measurable supplier quality performance (Giacomelli & Mencigar, 2020; ISO, 2016; van Weele, 2018).

The findings also suggest that future SQM development should consider Quality 4.0 and ESG-oriented supplier development. Digital tools, dashboards, data analytics and AI-supported monitoring can support earlier identification of supplier risks and recurring quality problems, but only if they are based on reliable data and standardised procedures. At the same time, sustainable procurement broadens supplier evaluation beyond technical conformity by including environmental, safety, ethical and governance-related criteria. This means that modern SQM should connect traditional supplier quality indicators with broader risk, sustainability and resilience considerations (ISO, 2017; ISO, 2018; Javaid et al., 2021).

The study has several limitations. It was conducted in a single organisational context, which limits the generalisability of the findings. The results may reflect the specific quality culture, procedures and employee experience of the observed organisation. In addition, the research is based on employee

perceptions and does not include secondary operational data. The cross-sectional design also prevents conclusions about changes over time. Finally, the statistical analysis was limited to descriptive statistics and one-sample t-tests, which are appropriate for analysing agreement with selected statements but do not explain causal relationships.

Future research should therefore combine survey data with objective operational indicators. A stronger research design could compare employee perceptions with supplier complaint trends, repeated non-conformities, audit results, corrective-action closure times or defect rates before and after improvements in standardisation or training. A longitudinal or before-and-after design would enable more robust conclusions about whether SQM measures actually improve supplier quality performance. Future studies should also include several companies, sectors, or geographical contexts to test whether the findings apply beyond the specific organisational setting analysed in this paper.

Overall, the paper contributes a cautious, practice-oriented insight into the perceived role of procedure standardisation and employee training in SQM. It shows that employees perceive these factors as important for clearer, more reliable and more professional quality-related work. At the same time, it emphasises that perceived effectiveness should be complemented with objective KPI verification. In this way, SQM can develop from a primarily procedural and reactive function into a more data-supported, preventive and strategically relevant capability for managing supplier quality and strengthening supply-chain resilience.

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