Jurnal Ilmiah Teknik Industri dan Inovasi
Volume 4, Nomor 3, Juli 2026
e-ISSN : 2964-5964; p-ISSN : 2985-315X, Hal. 321-332
DOI: https://doi.org/10.59024/jisi.v4i3.2453
Tersedia: https://jurnal.alimspublishing.co.id/index.php/JISI

Prioritizing Supply Chain Risks and Product Defects in an Abon SME: A Sequential House of Risk and Six Sigma Analysis

Nurul Fitri Annisa[1], Irwan Soejanto[2], Muhammad Shodiq Abdul Khannan[3*], Gunawan Madyono Putro[4], Tri Wibawa[5]
[1-5]Department of Industrial Engineering, Universitas Pembangunan Nasional "Veteran" Yogyakarta, Indonesia
[*]*Corresponding author: shodiq@upnyk.ac.id*

Abstract. Small food-processing firms often manage demand volatility, limited capacity, supplier dependence, and product-quality problems through informal decisions. This study prioritizes supply-chain risks and product defects in a Yogyakarta-based abon (seasoned shredded-meat) small and medium-sized enterprise using a sequential Supply Chain Operations Reference, House of Risk, and Six Sigma analysis. The dataset comprised a 22-event and 36-agent risk register, 24 proposed mitigation actions, and operational records for 52,000 units with 1,860 product returns from September 2024 to February 2025. House of Risk phase 1 showed that 15 agents accounted for 81.34% of aggregate risk potential. House of Risk phase 2 identified 10 actions accounting for 81.13% of cumulative effectiveness-to-difficulty, led by production-capacity collaboration, a structured defect-reduction program, worker supervision, retraining, and daily capacity control. The return proportion was 3.58%. Based on six recorded defect opportunities per unit, the corrected aggregate performance was 5,961.54 defects per million opportunities and a sigma level of 4.014. A provisional p-chart showed three special-cause signals, while deflated or punctured packaging was the largest defect category at 24.30%. The analysis supports an integrated action portfolio covering capacity, workforce, standard operating procedures, maintenance, supplier backup, and packaging inspection. Because no post-intervention observations were available, the findings establish priorities and a baseline rather than verified improvement effects.

Keywords: Abon; House of Risk; Product Defects; Six Sigma; Supply Chain Risk.

1. INTRODUCTION

Small and medium-sized food processors operate with narrow capacity buffers, variable order patterns, and limited formal control systems. These conditions connect supply risk, production congestion, human error, packaging failure, and customer returns. A disruption that begins with an urgent order or unavailable material can propagate into rushed work, process deviation, delayed delivery, and nonconforming products. Supply-chain risk management therefore requires more than a list of isolated hazards. It must identify the agents that trigger multiple events and select feasible preventive actions (Nel, 2024; Pujawan & Geraldin, 2009).

The House of Risk (HOR) provides a proactive prioritization mechanism. HOR phase 1 combines occurrence, severity, and event-agent relationships into aggregate risk potential (ARP). HOR phase 2 evaluates preventive actions through their expected effectiveness and implementation difficulty (Pujawan & Geraldin, 2009). Indonesian applications have used HOR in procurement, catering, poultry processing, manufacturing, and other operational settings (Asrory, 2023; Dvaipayana, Sriwana, & Prambudia, 2024; Handayani & Rabihah, 2022; Kurniawan, Marzuky, Ryanto, & Agustine, 2021; Natalia, Hutapea, Oktavia, & Hidayat, 2020; Palengka, Vikaliana, & Utami, 2024; Purwaningsih, Ramadani, Hartini, Aisyah, & Putri, 2021; Ulfah, Trenggonowati, Muharni, & Herlina, 2023). These studies demonstrate the

Naskah Masuk: 20 Meil 2026; Revisi: 20 Juni 2026; Diterima: 20 Juli 2026; Terbit: 30 Juli 2026

practical value of HOR, but many stop after generating ranked action lists. They rarely connect upstream and internal risk priorities to measured product-quality outcomes.

Six Sigma offers a complementary diagnostic view. It measures defect performance, distinguishes common-cause and special-cause variation, and uses Pareto and root-cause tools to focus improvement efforts (Ariyanti, Widodo, & Natalina, 2020; Jasmine, Salma, & Susanto, 2024; Kusumo, Susanti, & Hartini, 2022; Mittal et al., 2023; Sukwadi, Harijanto, Inderawati, & Huang, 2021). Studies in food packaging and manufacturing show that DMAIC can support systematic defect reduction when corrective actions are implemented and performance is measured again (Mittal et al., 2023; Sukwadi et al., 2021). A baseline analysis alone, however, cannot demonstrate improvement. Removing undesirable observations or relabeling historical data as post-improvement evidence would overstate the findings.

The case company produces chicken and beef abon, a seasoned, shredded-meat product, in Yogyakarta. Its operational records indicate uncertainty in raw-material deliveries, production scheduling problems, machine interruptions, inconsistent packaging practices, and 1,860 customer returns from 52,000 units produced between September 2024 and February 2025. The problem is not only to identify many possible risks, but to determine which underlying agents and feasible actions deserve attention and how product-return data should inform those priorities.

This study addresses that problem through a sequential analysis. First, SCOR structures the supply-chain activities and risk events. Second, HOR identifies priority agents and actions. Third, Six Sigma metrics quantify the return baseline and the distribution of recorded defect categories. Finally, both evidence streams are combined into an action portfolio. The contribution is an auditable decision sequence for a resource-constrained food-processing SME. The study does not propose a new algorithm and does not claim a verified reduction in defects, as post-intervention data were unavailable.

The objectives are to: (1) map supply-chain risk events, (2) identify the risk agents that dominate aggregate exposure, (3) prioritize feasible mitigation actions, (4) estimate the baseline product-return performance correctly, and (5) translate the combined findings into operational recommendations.

2. METHODS

Study design and data

The research used a single-case, applied decision-analysis design. The unit of analysis was the end-to-end operating process of an abon SME, from planning and material sourcing to

e-ISSN : 2964-5964; p-ISSN : 2985-315X, Hal. 321-332

production, delivery, and returns. Two datasets were analyzed. The first was an organizational HOR matrix containing 22 risk events, 36 risk agents, severity and occurrence scores, event-agent relationships, 24 proposed actions, action-agent relationships, and difficulty scores. The second comprised monthly production and return records for September 2024 to February 2025. Product returns were classified into six recorded defect categories. Table 1 summarizes the coverage, variables, and analytical role of each dataset.

Table 1. Data Sources and Analytical Roles.

Data source	Coverage	Variables	Analytical role
SCOR risk register	Plan, source, make, deliver, return	Activities and 22 risk events	Map the risk landscape
HOR phase 1 matrix	36 risk agents	Severity, occurrence, and relationship scores	Calculate ARP and select priority agents
HOR phase 2 matrix	24 proposed actions	Action relationships and difficulty scores	Calculate TE and ETD; prioritize actions
Operational records	Sep 2024-Feb 2025	52,000 units, 1,860 returns, six defect categories	Estimate return proportion, p-chart, DPMO, sigma level, and Pareto shares

The analysis uses the values contained in the company study file. No observations were removed from the baseline dataset.

Sequential analytical framework

Figure 1 shows the analytical sequence. SCOR and HOR address broad supply-chain exposure, whereas the Six Sigma component diagnoses the observed product-return baseline. The final action portfolio retains recommendations that respond to both risk priority and quality evidence.

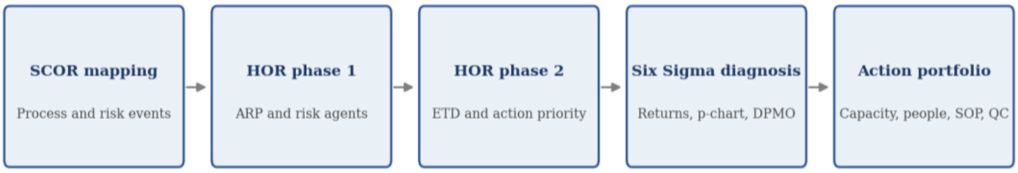

Figure 1. Sequential Analytical Framework.

SCOR mapping and House of Risk

Supply-chain activities were grouped into plan, source, make, deliver, and return processes (Sekarjati, Pribadi, & Nuryakin, 2022). Risk events were assigned to the process in which their immediate operational consequence appeared. HOR phase 1 then ranked the causes of those events. Severity (S) and occurrence (O) used 1-10 ordinal scales, while event-agent relationships (R) used 0, 1, 3, and 9 for none, low, moderate, and strong relationships. For risk agent j, aggregate risk potential was calculated as proposed by Pujawan and Geraldin (2009):

$$ARP_j = O_j \sum_i (S_i R_{ij})$$

Risk agents were ordered by ARP, and the cumulative share was used to identify the smallest set exceeding approximately 80% of total ARP. HOR phase 2 linked the selected agents to preventive actions. Action-agent relationships (E) used the same 0, 1, 3, and 9 scale. Difficulty (D) used the source matrix scale of 3 for relatively easy, 4 for moderate, and 5 for difficult implementation. Total effectiveness and effectiveness-to-difficulty were calculated as:

$$TE_k = \sum_j (ARP_j E_{jk}) \qquad and \qquad ETD_k = TE_k / D_k$$

Actions were ranked by ETD. Codes were retained throughout the analysis so that each rank remained connected to the correct action description.

Product-return and Six Sigma analysis

The Six Sigma component was used as a baseline diagnostic rather than as evidence of a completed DMAIC intervention. Define identified the six recorded return categories. Measure estimated the monthly return proportions, provisional p-chart limits, defects per million opportunities (DPMO), and sigma level. Analyze used a corrected descending Pareto order and the qualitative cause records. Improve generated recommendations. Control was not claimed because the dataset contained no post-action observations.

For month t, the return proportion was $p_t = d_t/n_t$, where d_t is the number of returned units and n_t is production. The pooled center line was p-bar = $\sum d_t/\sum n_t$. Because monthly production varied, the control limits were calculated separately for each sample size:

$$UCL_t = p\text{-}bar + 3\sqrt{[p\text{-}bar(1 - p\text{-}bar)/n_t]}$$

$$LCL_t = max\{0, p\text{-}bar - 3\sqrt{[p\text{-}bar(1 - p\text{-}bar)/n_t]}\}$$

The DPMO calculation assumes one recorded defect category for each returned unit and six inspection opportunities per unit. Aggregate DPMO and sigma level were calculated from the pooled totals, not by summing monthly DPMO values:

$$DPMO = defects / (units \times opportunities) \times 1{,}000{,}000$$

$$Sigma\ level = \Phi^{-1}(1 - DPMO/1{,}000{,}000) + 1.5$$

Scope of inference

The results are case-specific priorities. HOR inputs are ordinal organizational judgments, and the available source file did not preserve assessor-level scores needed to estimate inter-rater agreement. The p-chart contains only six monthly subgroups, so it is treated as a provisional diagnostic rather than a mature control baseline. These constraints limit statistical generalization but do not prevent transparent correction of the calculations and ranking logic.

3. RESULTS AND DISCUSSION

Supply-chain risk landscape

SCOR mapping identified 22 risk events. Planning contributed seven events, followed by sourcing and production with five each, delivery with three, and returns with two. The distribution shows that the case is not dominated by one isolated quality problem. Demand changes, raw-material availability, limited capacity, production discipline, delivery performance, and product returns are connected within the same operating system. Table 2 summarizes the distribution and representative events by SCOR process.

Table 2. SCOR-Based Summary of Risk Events.

SCOR process	Main activities	Risk events	Representative events
Plan	Production and material planning	7	Overlapping orders; rushed production; planning error; inability to meet quantity
Source	Ordering, procurement, and delivery	5	Quantity mismatch; emergency ordering; unavailable stock; delayed material
Make	Production and packaging	5	Quality deviation; burnt product; work accident; SOP deviation; machine downtime
Deliver	Customer delivery	3	Late delivery; schedule mismatch; transport damage
Return	Customer and supplier returns	2	Product return due to defects; raw-material return due to poor quality

This pattern is consistent with HOR applications that identify operational risk clusters across planning, procurement, production, and quality control rather than within a single department (Asrory, 2023; Dvaipayana et al., 2024; Handayani & Rabihah, 2022; Kurniawan et al., 2021; Natalia et al., 2020; Palengka et al., 2024; Purwaningsih et al., 2021; Ulfah et al., 2023). For a small processor, risk coordination is especially important because the same people, machines, and workspace support several stages.

Priority risk agents and mitigation actions

Table 3. Priority Risk Agents Based on Aggregate Risk Potential.

Rank	Code	Risk agent	ARP	Cumulative ARP (%)
1	A3	Sudden or urgent customer demand changes	1,785	11.01
2	A8	Imbalance in workload	1,701	21.49
3	A1	Rushed production targets or overload	1,575	31.21
4	A9	Inaccuracy or worker error	1,266	39.01
5	A27	Production performed in a hurry	1,080	45.67
6	A6	Worker fatigue	1,008	51.89
7	A12	No written production or packaging SOP	864	57.21
8	A19	Supplier raw-material stockout	774	61.99
9	A35	Damaged packaging	576	65.54
10	A36	Defective product or nonstandard quality	576	69.09
11	A4	Limited production facilities and machines	516	72.27
12	A30	Delay in production completion	378	74.60
13	A31	Nonstandard packaging techniques	378	76.93
14	A33	No quality check during packing	378	79.26
15	A10	Fluctuating customer demand	336	81.34

Total ARP across 36 agents was 16,218. The first 15 agents accumulated 13,191, or 81.34% of the total. Demand urgency, workload imbalance, production overload, worker error, rushed processing, and fatigue were the first six agents and together accounted for 51.89% of total ARP. The next group added missing SOPs, supplier stockouts, packaging damage, nonstandard quality, capacity constraints, completion delays, nonstandard packaging, absence of packing quality checks, and fluctuating demand. Table 3 reports the ranked risk agents. Table 4 reports the priority mitigation actions. Figure 2 shows their cumulative Pareto profiles.

Table 4. Priority Mitigation Actions Based on Effectiveness-To-Difficulty.

Rank	Code	Mitigation action	ETD	Cumulative ETD (%)
1	P2	Collaborate with qualified manufacturers during demand peaks	15,183	22.26
2	P1	Run a structured DMAIC defect-reduction program	8,811	35.17
3	P8	Conduct periodic worker supervision	5,310	42.96
4	P9	Provide periodic production and packaging retraining	4,932	50.18
5	P4	Set a realistic daily production-capacity limit	4,687.20	57.06
6	P3	Balance workloads and apply job rotation	3,827.25	62.67
7	P11	Use small recognition rewards for consistent accuracy	3,798	68.23
8	P16	Create concise written production and packaging SOPs	3,726	73.69
9	P17	Conduct short pre-production briefings	2,592	77.49
10	P14	Use trained part-time workers during demand peaks	2,478	81.13

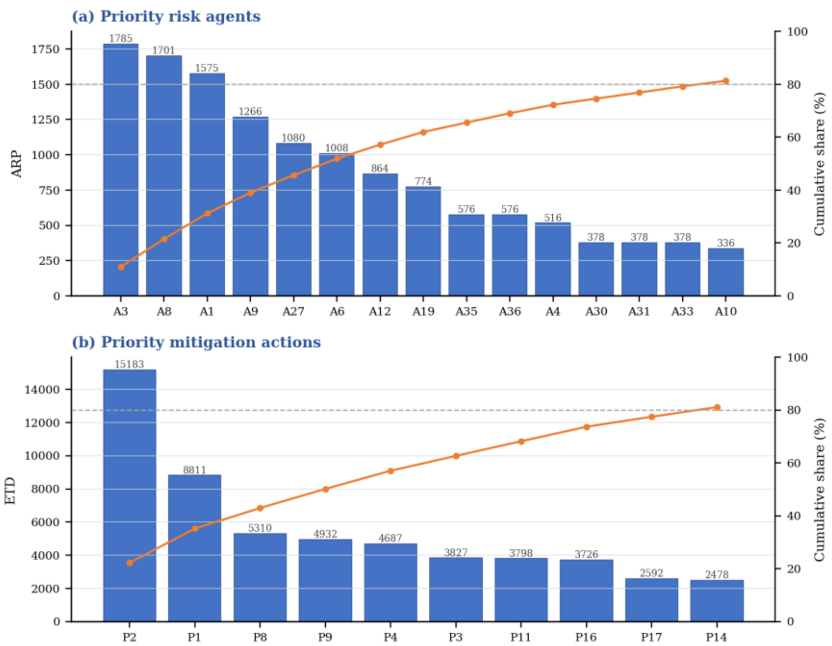

Figure 2. Pareto Profiles of Priority Risk Agents and Mitigation Actions.

e-ISSN : 2964-5964; p-ISSN : 2985-315X, Hal. 321-332

The first-ranked action, collaboration with qualified manufacturers, responds directly to urgent demand and capacity imbalance. It should not be interpreted as unrestricted outsourcing. Product specifications, traceability, delivery responsibility, and acceptance criteria must be agreed before use. The remaining priorities form a coherent internal-control package: a defect-reduction program, supervision, retraining, capacity limits, workload balancing, written SOPs, briefings, and temporary staffing. Similar HOR studies also emphasize cross-functional actions, supplier coordination, standardization, and operational control (Dvaipayana et al., 2024; Handayani & Rabihah, 2022; Kurniawan et al., 2021; Natalia et al., 2020; Oktarina & Gunawan, 2022; Radistya & Handayani, 2024; Salasamuharram et al., 2024; Ulfah et al., 2023).

Baseline product-return performance

Table 5 presents monthly production, return proportions, provisional control limits, and the detected special-cause signals.

Table 5. Monthly Production, Returns, and Provisional P-Chart Results.

Month	Production	Returns	p	UCL	LCL	Signal
Sep 2024	6,500	323	0.0497	0.0427	0.0289	Above UCL
Oct 2024	6,500	245	0.0377	0.0427	0.0289	Within limits
Nov 2024	6,500	276	0.0425	0.0427	0.0289	Within limits
Dec 2024	13,000	356	0.0274	0.0407	0.0309	Below LCL
Jan 2025	13,000	400	0.0308	0.0407	0.0309	Below LCL
Feb 2025	6,500	260	0.0400	0.0427	0.0289	Within limits
Total / pooled	52,000	1,860	0.0358	-	-	Baseline

Limits were calculated from unrounded pooled values. Points below the LCL are special-cause signals, not automatically poor outcomes.

The pooled return proportion was 0.03577, equivalent to 3.58%. September was above the upper control limit. December and January were slightly below their lower limits when calculated with unrounded values. A low point can indicate a beneficial special cause, a change in inspection or return classification, or an operational difference. It should be investigated and retained, not deleted. With only six monthly subgroups, Figure 3 provides an initial diagnostic rather than a stable long-term control chart.

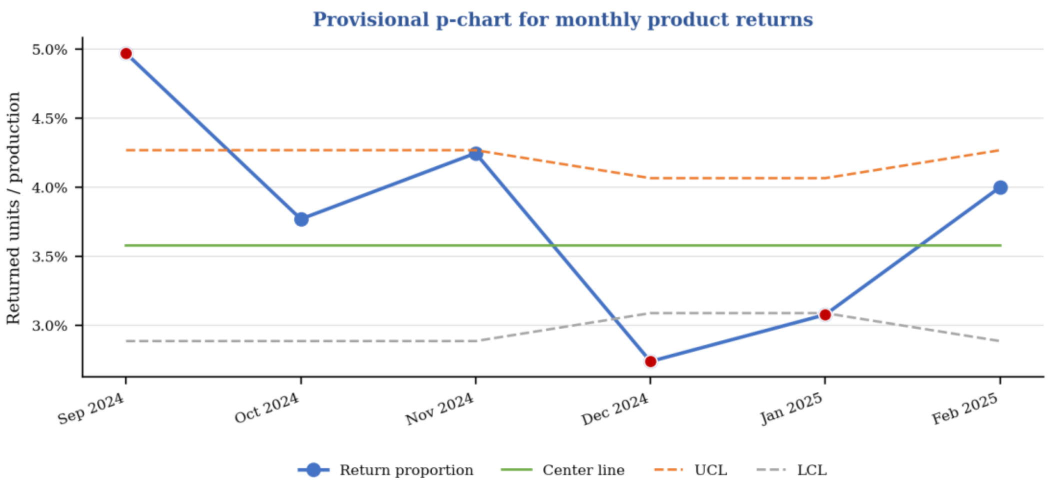

Figure 3. Provisional P-Chart for Monthly Product Returns.

Using six recorded defect opportunities per unit, the pooled DPU was 0.03577, DPO was 0.005962, DPMO was 5,961.54, and the corresponding sigma level was 4.014. Monthly DPMO values were not summed. Summation would count the same one-million-opportunity scale repeatedly and inflate the aggregate estimate. The corrected result places the process near a four-sigma baseline, but this value depends on the assumption that each returned unit contributed one recorded defect category and that all six opportunities were assessed consistently. Table 6 reports the corrected descending order of defect categories, and Figure 4 presents the corresponding Pareto profile.

Table 6. Corrected Pareto Order of Recorded Defect Categories.

Rank	Defect category	Returned units	Share (%)	Cumulative (%)
1	Deflated or punctured packaging	452	24.30	24.30
2	Burnt or reddish	334	17.96	42.26
3	Uneven product color	308	16.56	58.82
4	Bone fragments	278	14.95	73.76
5	Crumbly or lacking fibre	248	13.33	87.10
6	Clumping	240	12.90	100.00

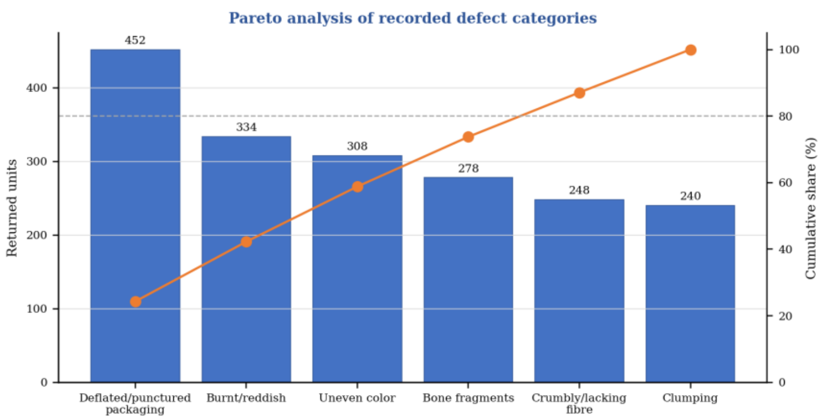

Figure 4. Pareto analysis of Recorded Defect Categories.

Packaging deflation or puncture was the largest single category at 24.30%, followed by burnt or reddish product and uneven color. The first three categories represented 58.82% of returns. The distribution is relatively broad, so no single defect explains most returns. Nevertheless, packaging deserves the first focused project because it is the largest category and is directly connected to several high-priority agents: damaged packaging (A35), nonstandard packaging technique (A31), absence of packing quality checks (A33), worker error (A9), rushed work (A27), and missing written SOPs (A12). Food-packaging studies similarly identify sealing standards, preventive maintenance, operator discipline, and inspection as practical DMAIC targets (Sukwadi et al., 2021).

Integrated action portfolio

The combined evidence suggests that the company should not treat supply risk and product quality as separate programs. Capacity and demand controls reduce the pressure that produces rushed work. Workforce controls improve execution. SOPs and inspection translate quality requirements into repeatable checks. Supplier and partner arrangements protect continuity, but they also require specifications so that risk is not transferred into new quality failures. Table 7 consolidates these relationships into an action portfolio and monitoring indicators.

Table 7. Integrated Action Portfolio and Monitoring Indicators.

Control theme	Priority agents	Evidence	Recommended action	Monitoring indicator
Demand and capacity	A3, A8, A1, A10	Peak demand, workload imbalance, and rushed production	Order cut-off and pre-order rules; capacity limit; qualified partner and trained temporary-worker protocol	Backlog, schedule adherence, overtime, late completion
Workforce execution	A9, A27, A6	Worker error, rushing, and fatigue	Job rotation; short briefings; periodic retraining and supervision; planned breaks	Errors by process, rework, overtime, training completion
Packaging control	A35, A31, A33, A12	Largest return category and weak packaging control	Packaging-material specification; sealing SOP; first-piece and periodic checks; machine cleaning and maintenance	Leakage or puncture rate, sealing failures, packaging returns
Product process control	A36, A12	Burnt product, uneven color, texture, and foreign material	Standard time and temperature; batch record; sorting and in-process quality checks	Defects by CTQ, batch rejection, customer returns
Supply continuity	A19	Supplier stockout and material substitution pressure	Approved backup suppliers; minimum stock trigger; incoming-material inspection	Stockout events, emergency purchases, incoming rejection

A practical implementation sequence is to stabilize order acceptance and daily capacity first, establish packaging and production SOPs second, train workers and start routine checks third, and then collect at least 20-25 rational subgroups before resetting control limits. The company should also record defect opportunities consistently and distinguish returned units from multiple defect occurrences. Only after these steps can a before-after comparison support a claim of improvement.

Limitations

This study has four main limitations. First, it examines one SME, so the priorities are not statistically generalizable. Second, HOR scores are ordinal and assessor-level data were unavailable, preventing an inter-rater reliability assessment. Third, the p-chart contains six aggregate monthly subgroups, which is insufficient for a mature control baseline. Fourth, the dataset contains no post-intervention observations. The study therefore supports prioritization and baseline diagnosis, not a causal claim that the proposed actions reduced returns.

4. CONCLUSION

The sequential SCOR, HOR, and Six Sigma analysis produced a defensible priority structure for the case company. Fifteen risk agents accounted for 81.34% of total aggregate risk potential. Ten actions accounted for 81.13% of cumulative effectiveness-to-difficulty, led by capacity collaboration, a structured defect-reduction program, supervision, retraining, capacity limits, workload balancing, and written SOPs. Product records showed a 3.58% return proportion. The corrected pooled DPMO was 5,961.54 with a sigma level of 4.014. Packaging deflation or puncture was the largest defect category at 24.30%, while the first three categories represented 58.82% of returns.

The main managerial implication is that quality control cannot be separated from decisions on demand, capacity, workforce, and suppliers. The proposed action portfolio should be implemented with clear operational indicators and followed by new observations. A future study should document the assessor panel, test agreement among raters, collect a longer sequence of rational subgroups, and evaluate changes in return rate, DPMO, and risk exposure after implementation.

REFERENCES

Ariyanti, S., Widodo, L., & Natalina, M. C. (2020). Carton sheet quality control in PT. XYZ using Six Sigma approach method with DMAIC tools. *IOP Conference Series: Materials Science and Engineering, 852*, 012118. https://doi.org/10.1088/1757-899X/852/1/012118

Asrory, F. F. (2023). Analisis risiko rantai pasok menggunakan metode Supply Chain Operation Reference (SCOR) dan House of Risk (HOR) pada PT Indo Pusaka Berau. *Sebatik, 27*(2), 535-545. https://doi.org/10.46984/sebatik.v27i2.2415

Dvaipayana, M. A. T., Sriwana, I. K., & Prambudia, Y. (2024). Design of supply chain risk mitigation system using House of Risk and fuzzy AHP methods in precast concrete. *SINERGI, 28*(1), 93-102. https://doi.org/10.22441/sinergi.2024.1.010

Handayani, W., & Rabihah, S. E. (2022). Risk mitigation in supply chain management process: Procurement using House of Risk method at PT. Pertamina EP Asset 4. *Jurnal Siasat Bisnis, 26*(1), 70-84. https://doi.org/10.20885/jsb.vol26.iss1.art5

Jasmine, I. A., Salma, S. A., & Susanto, H. (2024). Jersey production quality control using Six Sigma and FMEA methods to minimize product defects. *Jurnal Teknik Industri: Jurnal Hasil Penelitian dan Karya Ilmiah dalam Bidang Teknik Industri, 10*(2), 413-423.

Kurniawan, S., Marzuky, D., Ryanto, R., & Agustine, V. (2021). Risk and supply chain mitigation analysis using House of Risk method and Analytical Network Process: A case study on a palm oil company. *The Winners, 22*(2), 123-136. https://doi.org/10.21512/tw.v22i2.7056

Kusumo, P., Susanti, A., & Hartini, S. (2022). Analysis of defective quality control of powdered drinks using the Six Sigma method on multilane machines. *Journal of Industrial Engineering Management, 7*(3), 195-202. https://doi.org/10.33536/jiem.v7i3.1082

Mittal, A., Gupta, P., Kumar, V., Owad, A., Mahlawat, S., & Singh, S. (2023). The performance improvement analysis using Six Sigma DMAIC methodology: A case study on an Indian manufacturing company. *Heliyon, 9*(3), e14625. https://doi.org/10.1016/j.heliyon.2023.e14625

Natalia, C., Hutapea, Y. F. T. B., Oktavia, C. W., & Hidayat, T. P. (2020). Interpretive structural modeling and House of Risk implementation for risk association analysis and determination of risk mitigation strategy. *Jurnal Ilmiah Teknik Industri, 19*(1), 10-21. https://doi.org/10.23917/jiti.v19i1.9014

Nel, J. D. (2024). The role of supply chain risk mitigation strategies to manage supply chain disruptions. *Journal of Transport and Supply Chain Management, 18*, a1035. https://doi.org/10.4102/jtscm.v18i0.1035

Oktarina, R., & Gunawan, S. (2022). House of Risk analysis as a supply chain risk mitigation method at CV. XYZ. In *Proceedings of the IEOM Society International* (pp. 1203-1213). https://doi.org/10.46254/sa03.20220253

Palengka, G. J., Vikaliana, R., & Utami, P. (2024). Supply chain risk mitigation using the House of Risk approach: Evidence in an Indonesian catering company. *KnE Social Sciences, 9*(16), 476-498. https://doi.org/10.18502/kss.v9i16.16265

Pujawan, I. N., & Geraldin, L. H. (2009). House of risk: A model for proactive supply chain risk management. *Business Process Management Journal, 15*(6), 953-967. https://doi.org/10.1108/14637150911003801

Purwaningsih, R., Ramadani, I., Hartini, S., Aisyah, A., & Putri, A. (2021). Supply chain risk assessment at poultry slaughterhouses using House of Risk method to define mitigation action. In *Proceedings of the Asia Pacific International Conference on Industrial Engineering and Operations Management* (pp. 2973-2982).

Radistya, D., & Handayani, W. (2024). Risk analysis and mitigation in the process of procurement of goods and services with the House of Risk method approach in the logistics department of PT Adaro Indonesia. *Jurnal Manajemen dan Keuangan, 12*(2), 341-349.

Salasamuharram, F., Hamid, A. H., Zikria, V., Ginting, L. N., Zulkarnain, Z., Marsudi, E., & Baihaqi, A. (2024). Mitigation of Gayo Arabica coffee supply chain risk using the House of Risk method in Aceh Tengah. *IOP Conference Series: Earth and Environmental Science, 1297*, 012064. https://doi.org/10.1088/1755-1315/1297/1/012064

Sekarjati, B. D., Pribadi, F., & Nuryakin, N. (2022). Measuring and evaluating supply chain management performance of a company using the SCOR method. *Interdisciplinary Social Studies, 1*(7), 922-936. https://doi.org/10.55324/iss.v1i7.165

Sukwadi, R., Harijanto, L., Inderawati, M. M. W., & Huang, P. T. B. (2021). Reduction in rejection rate of soy sauce packaging via Six Sigma. *Jurnal Teknik Industri, 22*(1), 57-70. https://doi.org/10.22219/JTIUMM.Vol22.No1.57-70

Ulfah, M., Trenggonowati, D. L., Muharni, Y., & Herlina, L. (2023). Risk mitigation action of sport shoes supply chain using the House of Risk method. *Journal Industrial Servicess, 9*(2), 115. https://doi.org/10.36055/jiss.v9i2.21858