

A Study on Less Than Container Load (LCL) Import and Export Operations

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Abstract

Less than Container Load (LCL) shipping lets exporters and importers who don't have enough goods to fill an entire container share space with other shippers, combining several smaller consignments into one container. How well an LCL operation runs comes down to a handful of moving parts working together: paperwork, customs clearance, the way cargo gets grouped and later split apart, activity at the Container Freight Station (CFS), physical handling and storage, staff skill, use of automation, and how well customers are kept in the loop.

This paper looks closely at LCL import and export work on the ground, drawing on a structured questionnaire filled in by people actually doing the job, backed up by direct observation and conversations with employees, plus relevant published material. Thirty respondents took part in this descriptive study, and the results were worked through using percentage analysis.

Customs clearance and cargo consolidation tied for the activities demanding the most coordination, each picked by 30% of respondents. Documentation was rated "very important" by 77%. On the export side, the Commercial Invoice and Packing List were named the most critical documents, each by 33%, while on the import side the Delivery Order topped the list at 44% as the document that actually gets cargo released. Errors in paperwork happen "occasionally" according to 40% of the sample, and 90% said safety practices during handling are followed well (agree or strongly agree). Export consolidation was called efficient or very efficient by 90% of respondents, and import deconsolidation scored even better at 93%. Customs delays cited by 40%. Automation drew a positive response from 83%, storage facilities from 67%, and 90% agreed

that LCL's shared-container model genuinely saves money for smaller shipments.

Taken together, the findings point to one clear message: getting the paperwork right, coordinating with customs early, keeping staff well trained, running the CFS tightly, using automation sensibly, and talking openly with customers are what actually move the needle on LCL performance.

Keywords: Less than Container Load, Import, Export, Container Freight Station, Cargo Consolidation, Deconsolidation, Customs Clearance, Documentation.

I. INTRODUCTION

1.1 MAJOR CONCEPTS AND THEORETICAL FOUNDATION

This study sits at the intersection of two familiar ideas in logistics and supply chain management. Logistics, in the narrow sense, is about physically getting goods where they need to go — moving, handling, storing, and tracking them. Supply chain management is the wider lens, covering how a whole network of players, from the original supplier down to the end customer, works together. LCL operations are really a practical demonstration of both: consolidation, deconsolidation, transport, paperwork, customs compliance, and final delivery all have to line up.

The role of systems is also an important aspect to consider. An LCL shipment moves through documentation, then customs, then the CFS, then transport as isolated steps. That's precisely why coordination and information flow matter as much as they do here.

1.2 RESEARCH OBJECTIVES

- Map out how LCL import and export operations actually unfold, step by step.

- Look closely at documentation and customs procedures tied to LCL shipments.
- Recognise the operational problems that crop up most often.
- Examine what the CFS actually does storage, consolidation, deconsolidation, and handling.
- To measure how people view safety, training, automation, storage capacity, and customer communication.
- Put forward practical ideas for tightening up LCL efficiency.

1.3 RESEARCH QUESTIONS

- Which activities call for the highest coordination?
- How much weight do people put on documentation and customs procedures?
- What's actually causing the delays?
- How well are consolidation and deconsolidation being carried out?
- What do people think of automation, storage, staffing levels, and customer communication?

1.4 HYPOTHESIS DEVELOPMENT

Since this is a descriptive study built on percentage analysis rather than inferential statistics, there's no formal hypothesis testing here. Instead, three propositions frame the discussion:

- LCL efficiency rides heavily on accurate documentation and tight customs coordination.
- Automation and skilled staff can meaningfully lift operational performance.
- Solid CFS management paired with clear customer communication keeps cargo moving reliably.

1.5 STATEMENT OF THE PROBLEM

An LCL shipment isn't one consignment — it's several, bundled together, each with its own paperwork and passing through multiple hands. A mistake in documentation can trigger delays and extra cost. Customs procedures can stretch out how long cargo sits idle. Getting consolidation and deconsolidation wrong means goods get mixed up. Port congestion and transport hold-ups throw schedules off. Physical handling brings its own risk of damage, and if communication with the customer breaks down, visibility suffers. This study sets out to examine how these pieces actually play out in practice, and where people feel the friction is.

1.6 NEED AND IMPORTANCE OF THE STUDY

- It builds a clear picture of the full LCL flow, along with what documentation and customs actually demand.
- It looks at how well the different players and activities coordinate with each other.
- It surfaces recurring problems — documentation slip-ups, customs delays, port congestion.
- It weighs how much CFS facilities, staff training, automation, and customer communication actually contribute.
- It points toward realistic ways to lift both efficiency and service quality.

1.7 SCOPE OF THE STUDY

The study covers the LCL journey end to end — receiving cargo, consolidating and deconsolidating it, CFS activity, documentation, customs clearance, physical handling, storage, container movement, staff capability, automation, and customer communication. It steers clear of any company-specific financial, confidential, or internal organizational detail.

II. REVIEW OF LITERATURE

1. Sandaruwan & Nathan (2026)

Sandaruwan and Nathan look at how supply chains are shifting toward more sustainable models through digital tools and closer collaboration between partners. Their work points to paperless documentation and smarter route planning as ways to cut both delays and emissions, arguing that digital adoption tends to sharpen coordination and day-to-day efficiency across the board.

2. Lyu, Tierney & Schulte (2026)

Lyu, Tierney, and Schulte make the case that maritime and port transport simply cannot function well without solid information sharing. Shipping lines, freight forwarders, port authorities, customs officials, and inland transport providers all need to be on the same page, and better data exchange between them cuts down on the kind of misunderstandings that cause delays. They argue for shared digital platforms as the way forward for port coordination.

3. Zhou et al. (2026)

Zhou and colleagues studied container relocation and yard planning, finding that smarter yard strategies cut down on unnecessary re-handling of boxes. Well-structured planning, in their view, shortens dwell time and lifts overall terminal productivity a straightforward case for tighter yard management.

4. Fellah & Mabrouki (2026)

Fellah and Mabrouki focus on the relationship between dry ports and seaports, showing that better alignment between the two eases congestion and speeds up customs processing. Their central argument is that integrated planning between inland and coastal facilities removes bottlenecks that would otherwise slow the whole chain down.

5. Karisik, Skerlic & Tuljak-Suban (2026)

Karisik, Skerlic, and Tuljak-Suban examined empty container management, finding that integrated planning combined with digital visibility tools helps cut repositioning costs and inland logistics expenses. Better data access, they argue, speeds up decisions around where empty containers should go next.

6. Linh, Nguyen & Sang (2026)

Linh, Nguyen, and Sang studied LCL sea-freight forwarding specifically, concluding that digitizing documentation and standardizing procedures reduces errors and speeds up consolidation. Their findings support the idea that a more structured, transparent process pays off directly in LCL efficiency.

7. Cerci et al. (2026)

Cerci and colleagues examined horizontal collaboration among logistics companies — essentially, competitors or peers sharing resources like warehouse space or transport capacity. Their research shows this kind of shared-asset model cuts empty runs, reduces waste, and lowers transportation costs across participating firms.

8. Martínez Ferguson et al. (2025)

Martínez Ferguson and colleagues looked at intermodal transport paired with digital tracking technology, finding that better visibility across different transport modes reduces uncertainty and supports more sustainable, better-coordinated logistics planning.

9. Benbrik, Benmansour & Rodrigues (2025)

Benbrik, Benmansour, and Rodrigues studied how automation, scheduling, and equipment utilization affect cargo handling speed, concluding that better planning cuts idle time and that technology plays a real role in reducing delays caused by manual processes.

10. Weerasinghe, Perera & Bai (2024)

Weerasinghe, Perera, and Bai examined automation and simulation tools in yard planning, finding that digital modelling helps terminals make faster,

better-informed decisions and ultimately improves how quickly cargo moves through the yard.

11. Murdiono et al. (2024)

Murdiono and colleagues stress just how much accurate documentation matters in international trade and customs clearance, cargo release gets delayed, and penalties can follow. Their work makes a strong case for disciplined documentation practices as a baseline requirement in global trade.

12. Jahani, Jain & Ivanov (2023)

Jahani, Jain, and Ivanov looked at data science and predictive analytics in logistics, finding that dashboards and forecasting tools give planners much better visibility, cutting down uncertainty and supporting sharper decision-making across the supply chain.

13. Tsantis et al. (2022)

Tsantis and colleagues studied how port infrastructure and liner connectivity affect transit times, concluding that stronger connections between ports translate directly into more reliable delivery timelines a clear argument for continued investment in port infrastructure.

14. Song (2021)

Song argues that freight forwarding, terminal operations, inland transport, and container management all need to be planned as one connected system rather than separate silos, and that better information sharing across these pieces removes bottlenecks that otherwise build up at the seams.

15. Khaslavskaya & Roso (2020)

Khaslavskaya and Roso examined the role of dry ports and inland facilities in easing seaport congestion, finding that these inland hubs speed up consolidation and deconsolidation and take pressure off crowded coastal terminals a strong case for continued dry-port development.

III. RESEARCH DESIGN AND METHODOLOGY

A descriptive research design was adopted. Primary information was collected through observation, employee interaction and a structured questionnaire, while secondary information supported the theoretical discussion. The supplied draft reports 30 respondents selected through convenience sampling.

Table 3.1: Research Methodology

Research Element	Description
Research design	Descriptive research
Research method	Survey method
Primary data	Structured questionnaire, observation and employee

	discussions
Secondary data	Textbooks, journals and reference material
Sample size	30 respondents
Sampling technique	Convenience sampling
Questionnaire	Multiple-choice and five-point Likert-scale questions
Analysis method	Percentage analysis

3.1 DATA COLLECTION

The questionnaire based on documentation, customs procedures, cargo handling, day-to-day operational challenges, coordination between departments, customer service, and the use of technology and automation. Published reference material was used alongside this to ground the discussion theoretically.

- Time available for direct observation was limited.
- Some operational details couldn't be shared due to confidentiality.
- Respondents had limited time available to give fuller, more detailed answers.
- The study uses descriptive percentage analysis and does not establish causal relationships.

3.2 LIMITATIONS OF THE STUDY

- Thirty respondents is a small sample and doesn't necessarily represent the LCL sector as a whole.

IV. DEMOGRAPHIC AND OPERATIONAL ANALYSIS

Table 4.1: Department Distribution

Department	Frequency	Percentage
Import Operations	8	27%
Export Operations	4	13%
Documentation	3	10%
Gate Operations	4	13%
Warehouse Department	7	24%
Billing Department	4	13%
Total	30	100%

Import Operations makes up the largest single group at 27%, with Warehouse close behind at 24%.

Table 4.2: Years of Experience

Experience	Frequency	Percentage
Less than 1 year	7	23%
1–3 years	9	30%
3–5 years	8	27%
More than 5 years	6	20%
Total	30	100%

Most respondents (30%) fall in the 1–3 years of experience.

Table 4.3: LCL Operations Distribution

Activity	Frequency	Percentage
Import	10	34%
Export	6	21%
Both	14	45%
Total	30	100%

Nearly half the respondents (45%) work across both import and export sides.

Table 4.4: Highest Coordination Requirement

Area	Frequency	Percentage
Documentation	8	26%
Customs Clearance	9	30%
Cargo Consolidation	9	30%

Cargo Delivery	2	7%
Transportation	2	7%
Total	30	100%

Customs clearance and cargo consolidation tie for top spot, each demanding the highest level of coordination at 30%.

Table 4.5: Importance of Documentation

Response	Frequency	Percentage
Very Important	23	77%
Important	7	23%
Moderately Important	0	0%
Less Important	0	0%
Not Important	0	0%
Total	30	100%

Not a single respondent rated documentation as anything less than important -77% called it very important.

Table 4.6: Critical Export Document

Document	Frequency	Percentage
Commercial Invoice	10	33%
Packing List	10	33%
Bill of Lading	4	14%
Certificate of Origin	0	0%
Shipping Bill	6	20%
Total	30	100%

The Commercial Invoice and Packing List are tied at the top, each named by 33% of respondents.

Table 4.7: Important Import Release Document

Document	Frequency	Percentage
Delivery Order	13	44%
Bill of Entry	9	30%
Import General Manifest (IGM)	4	13%
Equipment Interchange Receipt (EIR)	1	3%
Invoice	3	10%
Total	30	100%

Delivery Order clearly leads at 44% — the document people most associate with getting import cargo released.

Table 4.8: Frequency of Documentation Errors

Frequency	Count	Percentage
Very Frequently	0	0%
Frequently	7	23%
Occasionally	12	40%
Rarely	11	37%
Never	0	0%
Total	30	100%

Most respondents describe errors as occasional (40%) and rare (37%).

Table 4.9: Safety Measures During Cargo Handling

Response	Frequency	Percentage
Strongly Agree	12	40%
Agree	15	50%
Neutral	3	10%
Disagree	0	0%
Strongly Disagree	0	0%

Total	30	100%
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90% agree or strongly agree that safety practices are properly followed during handling.

Table 4.10: Major Contributors to LCL Delays

Factor	Frequency	Percentage
Documentation Issues	8	28%
Customs Delays	7	23%
Port Congestion	7	23%
Transport Delays	4	13%
Space Availability	4	13%
Total	30	100%

Documentation issues top the list at 28%, with customs delays and port congestion tied close behind at 23% each.

Table 4.11: Export Cargo Consolidation Efficiency

Response	Frequency	Percentage
Very Efficient	14	47%
Efficient	13	43%
Average	3	10%
Inefficient	0	0%
Very Inefficient	0	0%
Total	30	100%

Nine in ten respondents (90%) rate export consolidation as efficient or better.

Table 4.12: Import Cargo Deconsolidation Efficiency

Response	Frequency	Percentage
Very Efficient	15	50%
Efficient	13	43%
Average	2	7%
Inefficient	0	0%
Very Inefficient	0	0%
Total	30	100%

Import deconsolidation scores even better as 93% call it efficient or very efficient.

Table 4.13: Importance of CFS

Response	Frequency	Percentage
Very Important	17	57%
Important	11	37%
Moderately Important	1	3%
Less Important	1	3%
Not Important	0	0%
Total	30	100%

94% rate the CFS as important or very important to how operations run.

Table 4.14: Common LCL Challenges

Challenge	Frequency	Percentage
Documentation Errors	8	26%
Customs Delays	12	40%
Cargo Damage	2	7%
Port Congestion	5	17%
Communication Issues	3	10%
Total	30	100%

Customs delays stand out clearly as the top-cited problem, named by 40% of respondents.

Table 4.15: Employee Experience and Training

Response	Frequency	Percentage
Very Important	16	54%
Important	12	40%
Moderately Important	0	0%
Less Important	1	3%
Not Important	1	3%
Total	30	100%

94% see employee experience and training as important or very important.

Table 4.16: Adoption of Automation

Response	Frequency	Percentage
Strongly Agree	8	26%
Agree	17	57%
Neutral	5	17%
Disagree	0	0%
Strongly Disagree	0	0%
Total	30	100%

83% respond positively to automation adoption with a solid vote of confidence, with no outright disagreement.

Table 4.17: Adequacy of Storage Facilities

Response	Frequency	Percentage
Strongly Agree	8	27%
Agree	12	40%
Neutral	8	27%
Disagree	2	6%
Strongly Disagree	0	0%
Total	30	100%

67% respond positively here, noticeably lower than most other categories

Table 4.18: Adequacy of CFS Employees

Response	Frequency	Percentage
Yes	23	77%
No	7	23%
Total	30	100%

77% say staffing levels at the CFS are adequate.

Table 4.19: LCL Cost Advantage

Response	Frequency	Percentage
Strongly Agree	10	33%
Agree	17	57%
Neutral	2	7%
Disagree	1	3%
Strongly Disagree	0	0%
Total	30	100%

90% agree or strongly agree that LCL delivers real cost savings for smaller shipments.

Table 4.20: Customer Communication

Response	Frequency	Percentage
Strongly Agree	9	30%
Agree	18	60%
Neutral	3	10%
Disagree	0	0%
Strongly Disagree	0	0%

Total	30	100%
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90% rate customer communication positively, with none disagreeing.

V. STATISTICAL ANALYSIS

Percentage analysis is the backbone of this study — frequencies converted into percentages to surface the dominant patterns in each response category. No correlation, ANOVA, or other inferential statistics are included here, simply because the underlying dataset wasn't designed or collected to support that kind of testing.

VI. DISCUSSION

Two things are clearly important for LCL performance: documentation and customs coordination. That tracks with how LCL actually works you've got multiple separate consignments that all need to be correctly identified, grouped, and cleared, so any weak link there causes real friction. On the cargo release side, the Delivery Order and Bill of Entry carry the most weight for import cargo, while the Commercial Invoice and Packing List dominate on the export side.

The physical side of operations comes off well in this survey. Both export consolidation and import deconsolidation get strong efficiency ratings, and CFS facilities are widely seen as important. Still, customs delays, paperwork problems, and port congestion are seen as important challenges and a reminder that how information flows between parties matters just as much as how cargo is physically handled.

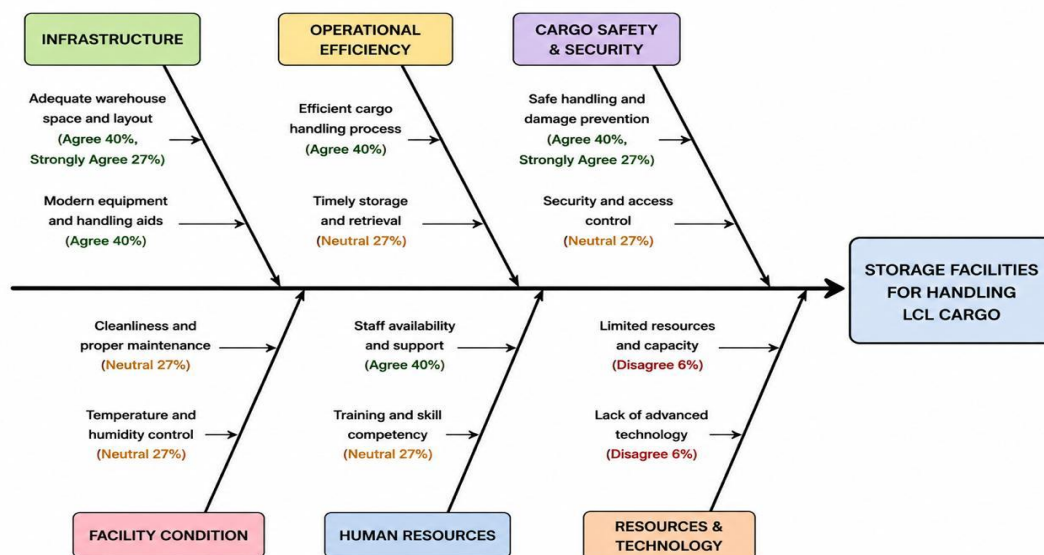
Technology is the other piece worth dwelling on. Eighty-three percent respond positively to automation, which is a strong signal, but the 17% sitting on the fence suggests there's still work to do on training and making digital systems reliable and consistent day to day. Positive views on customer communication and LCL's cost advantage both point back to the same underlying theme: visibility and shared costs are what make LCL attractive in the first place.

6.1 SWOC ANALYSIS OF AUTOMATION

- **Strengths:** 83% positive response signals real, broad-based acceptance. Digital workflows can tighten documentation, sharpen tracking, and cut down manual mistakes.
- **Weaknesses:** That 17% sitting neutral hints at gaps in training or awareness; without investment in both technology and skills, adoption.
- **Opportunities:** AI, IoT, blockchain, predictive analytics, and live dashboards all have room to improve tracking, planning, and how customers experience service.
- **Challenges:** Resistance to changing established habits, cybersecurity exposure, system outages, and regulatory requirements can all chip away at how effective automation actually is in practice.

6.2 FISHBONE- BASED CAUSE ANALYSIS

Cause-and-Effect Analysis of Less Than Container Load (LCL) Cargo Storage Facilities



Cause Category	Key Factor	Frequency / Percentage	Analysis
Infrastructure	Warehouse space & layout	Agree: 12 (40%); Strongly Agree: 8 (27%)	67% positive overall that warehouse space and layout are generally holding up well for LCL cargo.
Operational Efficiency	Cargo handling & storage process	Agree: 12 (40%); Neutral: 8 (27%)	Decent efficiency, but that 27% neutral block hints at room to sharpen retrieval and handling steps.
Cargo Safety & Security	Safe handling & security measures	Agree: 12 (40%); Strongly Agree: 8 (27%)	67% positive that security and safe-handling arrangements are seen as broadly fit for purpose.
Facility Condition	Cleanliness & maintenance	Agree: 12 (40%); Neutral: 8 (27%)	Facilities are acceptable, though the neutral share points to inconsistent upkeep.
Human Resources	Staff availability & competency	Agree: 12 (40%); Strongly Agree: 8 (27%)	67% positive that staffing and competency levels are generally sufficient.
Resources & Technology	Equipment, capacity & technology	Agree: 12 (40%); Disagree: 2 (6%)	Mostly adequate, but that small disagreement flags real gaps in equipment or tech support.

6.3 RESULT

The overall picture on storage is positive 67% agree or strongly agree the facilities work well, 27% sit on the fence, and only 6% actively disagree, with nobody strongly disagreeing. Indicating that the existing storage facilities are largely satisfactory but has clear room to tighten up on consistency

VII. FINDINGS

- Import Operations accounts for the largest respondent share at 27%, with Warehouse close behind at 24%.
- Three in ten respondents (30%) have between 1 and 3 years of experience.
- Nearly half (45%) work across both import and export sides of LCL.
- Customs clearance and cargo consolidation tie as the activities demanding the most coordination, each at 30%.
- 77% rate documentation as very important.
- Commercial Invoice and Packing List tie as the most critical export documents, each at 33%.
- Delivery Order leads as the key import release document at 44%.
- Documentation happen occasionally for 40% of respondents and rarely for 37%.
- 90% agree or strongly agree that safety practices are properly followed.
- Documentation issues, customs delays, and port congestion are the main drivers behind delays.

- Export consolidation gets an efficient-or-better rating from 90%.
- Import deconsolidation does even better at 93%.
- 94% consider the CFS important or very important.
- Customs delays are the single most cited challenge, at 40%.
- 94% see employee training and experience as important or very important.
- 83% respond positively to automation adoption.
- 67% respond positively on storage adequacy — the softest score in the survey.
- 77% say CFS staffing levels are adequate.
- 90% agree LCL delivers real cost advantages for smaller shipments.
- 90% rate customer communication as effective.

VIII. SUGGESTIONS

- Tighten documentation controls move toward digital records, standard checklists, and routine document verification before submission.
- Get ahead of customs coordination by submitting complete paperwork early and actively tracking clearance status rather than waiting for updates.
- Run regular training sessions covering customs rules, documentation, cargo

handling, safety, and the logistics technology in use.

- Sharpen CFS operations through better planning around consolidation timing, deconsolidation scheduling, storage use, and cargo segregation.
- Push automation and real-time tracking further, while still keeping manual backup procedures ready for when systems go down.
- Plan storage more deliberately for peak periods and specialized or oversized cargo.
- Keep staffing levels steady and cross-train employees so operations don't stall when someone's out.
- Keep customers better informed with timely status updates and digital alerts rather than reactive communication.
- Track documentation error rates, customs dwell time, consolidation turnaround, and cargo damage rates as ongoing performance indicators.
- Build contingency plans for port congestion, transport delays, system outages, and sudden regulatory changes.

IX. CONCLUSION

LCL import and export operations hinge on a lot of moving parts working in sync with documentation, customs clearance, consolidation and deconsolidation, CFS handling, transport, storage, technology, and how well customers are kept informed. Across the 30 respondents surveyed, documentation, CFS work, staff training, automation, and customer communication all came through as strong points, and consolidation and deconsolidation are viewed favorably too.

However, customs delays, documentation problems, and port congestion remain persistent drags on performance. Tightening up digital documentation, getting ahead of customs earlier, investing in staff capability, planning storage more carefully, and communicating in real time all have real potential to cut delays and make operations more dependable. For smaller shipments, LCL still makes sense precisely because it lets shippers split container space and share transport costs rather than paying for capacity they don't need.

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