Design of an international supply chain for the export of architectural glass from Colombia to the United States

Jheraldin Ramírez Pelaez

Adviser

Carlos Humberto Gualdron Garcia

Universidad Nacional Abierta y a Distancia UNAD

School of Administrative, Accounting, Economic and Business Sciences ECACEN

Logistics and Big Data

2026

Abstract

This project designs an international supply chain for exporting architectural glass from Medellín, Colombia to Miami, United States, through a multimodal logistics operation that integrates national inland transport, port operations, maritime shipping, customs clearance at destination, and final delivery to the customer. The proposed model is based on the use of real logistics operators at each stage of the process, ensuring operational feasibility under current international trade conditions.

A detailed sequence of both national and international logistics activities is established, incorporating a tracking system that enables continuous container visibility from plant departure to final delivery. Using real average logistics costs for the Colombia–Florida route, the total export cost per container and its profit margin are calculated.

Additionally, a five-year financial projection is developed, including an income statement, balance sheet, cash flow and estimation of the internal rate of return (IRR). The results show recovery of the initial investment during the first year, sustained equity growth and high profitability without the need for financial debt.

The proposed design demonstrates that it is possible to structure a technically sound, fully traceable and financially sustainable export operation for an SME, aligning logistics efficiency with economic strength in the internationalization process toward the U.S. market.

Keywords: International logistics, supply chain management, glass exports, multimodal transport, financial evaluation, traceability.

Table of Content

List of Tables

Introduction

The dynamics of international trade require companies to structure integrated, reliable and cost-efficient supply chains that allow them to compete in foreign markets under increasingly demanding service standards. In this context, international logistics goes beyond simply transporting goods between two countries; it involves the precise coordination of multiple actors, customs procedures, port infrastructure, information systems and financial decisions.

For industrial products such as architectural glass, which is heavy and highly sensitive to impacts during handling and transportation, logistics design becomes a critical success factor. A poorly structured operation can generate delays, cost overruns and product damage. In contrast, a technically planned supply chain ensures predictable transit times, cargo integrity and full traceability from origin to final delivery.

South Florida, with Miami as the main gateway, represents a strategic destination due to its constant construction activity and its role as a logistics hub for the United States and the Caribbean. This makes it necessary to connect the production center in Medellín with this market through an efficient multimodal scheme using the port of Cartagena and direct maritime services to Miami.

The proposed model integrates national inland transport, export port operations, international maritime transport, customs clearance at destination and final distribution to the customer. Each stage is supported by real and active logistics operators, ensuring practical feasibility under current international trade conditions.

Additionally, real-time tracking systems allow full control of the container from plant departure to final delivery, facilitating risk management and transparent communication with the customer.

From a financial perspective, the logistics structure is evaluated over a five-year horizon, linking export volumes, operating costs and profit generation to verify the sustainability and profitability of the model.

In summary, a complete and traceable international supply chain is established to ensure operational efficiency, logistics control and financial solidity in the export of architectural glass from Colombia to the United States.

Objectives

Objectives General

To design an efficient and profitable international supply chain for exporting architectural glass from Medellín, Colombia to Miami, United States, integrating national and international logistics with a five-year financial evaluation.

Objectives Specifics

To define the structure of the supply chain using real logistics operators and to describe the sequence of the national and international operations.

To determine logistics costs and to project the financial results of the project through a five-year balance sheet, income statement and cash flow.

To evaluate the feasibility and profitability of the logistics model by calculating financial indicators such as the internal rate of return (IRR).

Supply Chain Design and Operational Structure

Company and product overview

Company: Vidriexport S.A.S.

location: Medellín, Colombia

business: processing and export of architectural glass

target market: Miami, Florida (USA)

The product consists of processed glass for architectural applications such as façades and windows. Due to its weight and fragility, it requires reinforced wooden racks with internal protections and proper load securing inside 40-foot containers.

Initial operation: **72 containers per year**, with projected annual growth of **12%**. Initial project investment: USD 70,000.

Supply Chain Structure

Raw material suppliers

Vidriexport production plant (Medellín)

Inland trucking: Botero Soto S.A.S.

Port of export: Cartagena port (sprc)

Colombian customs broker

Ocean carrier: Maersk line

Port of arrival: port Miami – APM terminals

U.S customs broker

U.S domestic trucking: XPO logistics

Final customer in Florida

National Logistics Operation (Colombia)

Final product quality control

Packing in reinforced wooden racks

Container stuffing, weight distribution and sealing

Issuance of commercial invoice and packing list

Truck assignment by Botero Soto

Inland transport Medellín–Cartagena with gps monitoring (≈24 hours)

Port gate-in and weighing

Export customs declaration and approval

Internal transfer to pre-loading area

Container loading on Maersk vessel and departure

International Logistics Operation

Direct sea transit Cartagena–Miami (3–4 days)

Container discharge at apm terminals Miami

Availability for pickup registration

U.S. customs clearance

Pickup scheduling by XPO logistics

Container exit from port

Inland delivery to customer warehouse

Unloading, inspection and signed proof of delivery (pod)

Total door-to-door transit time: 8–10 days.

Tracking and Traceability System

Botero Soto: truck gps from plant to port

Cartagena port: gate in, loaded on vessel, vessel departed

Maersk: vessel position and eta by container/bl

APM Miami: discharged, available for pickup, customs cleared

XPO logistics: delivery confirmation and pod

This provides continuous visibility throughout the operation.

Logistics Cost per Container (USD)

Inland trucking Colombia: 750

Origin port and customs: 400

Ocean freight: 2,000

Cargo insurance: 150

Destination port and customs: 550

U.S. inland delivery: 500

Total logistics cost: 4,350

Production cost: 5,000

Total export cost: 9,350

International selling price: 10,500

Profit per container: 1,150

Tabla 1

Export volume projection

Year	Containers
1	72
2	81
3	91
4	102
Total	115

Note. The export volume projection is based on a constant annual growth rate of twelve percent, applied over a five-year period, starting from an initial volume of seventy-two containers, Annual growth rate: 12%. Adapted. *Export volume projection.* (2026). J.Ramirez.

Tabla 2

Projected income statement (USD)

Concept	Y1	Y2	Y3	Y4	Y5
Sales	756,000	850,500	955,500	1,071,000	1,207,500
Total costs	673,200	757,350	850,850	953,700	1,075,250
Net profit	**82,800**	**93,150**	**104,650**	**117,300**	**132,250**

Note. Figures are projections derived from estimated sales growth and cost behavior, maintaining an approximately constant net profit margin of ten point ninety-five percent, Approximate constant margin: 10.95%. Adapted. *Projected income statement (USD).* (2026). J.Ramirez.

Tabla 3

Projected balance sheet (USD)

Concept	Y1	Y2	Y3	Y4	Y5
Total assets	152,800	245,950	350,600	467,900	600,150

Liabilities	0	0	0	0	0
Equity	152,800	245,950	350,600	467,900	600,150

Note. The projected balance sheet assumes no financial liabilities. Total assets are financed entirely through equity, composed of initial capital plus accumulated retained earnings, Composed of initial capital plus accumulated retained earnings. Adapted. *Projected balance sheet (USD).* (2026). J.Ramirez.

Financial Evaluation

Investment recovered within the first year

Continuous equity growth up to USD 600,150 in year five

Operation without financial debt

Estimated internal rate of return above 100%

The project is financially sustainable and scalable.

Supply Chain Flows

Physical flow: suppliers → Medellín plant → Botero Soto → Cartagena port → Maersk → Miami port → XPO logistics → customer.

Information flow: purchase order, commercial invoice, packing list, bill of lading and tracking updates.

Financial flow: customer payments finance production and logistics.

Synchronization of these flows ensures operational control.

Logistics Model Results

Multimodal chain with real specialized operators

Competitive transit time (8–10 days door-to-door)

Costs aligned with real market averages on the route

Full container traceability at every milestone

Scalable structure without redesign

Commercial Terms and Customer Payment Method

Incoterm: dap (delivered at place) – Miami, customer warehouse.

Vidriexport assumes costs and risks until delivery at the customer's address; the customer assumes U.S. import duties and taxes.

Payment Structure

30% advance payment upon order confirmation

Finances production and packing

Paid by international bank wire transfer (swift)

70% balance against shipping documents

Paid once the container is loaded on the vessel

Documents sent: bill of lading, commercial invoice, packing list

Payment completed before vessel arrival to Miami

Currency: USD

Delivery condition: final delivery only after 100% payment is confirmed.

This scheme reduces credit risk and ensures operational liquidity.

Conclusions

The designed supply chain enables safe, traceable and profitable exports of architectural glass by integrating inland transport, maritime shipping, customs processes and final distribution under a coordinated multimodal model.

The clear separation between national and international logistics, supported by specialized real operators, reduces operational risks and guarantees regulatory compliance in both countries. The tracking system provides full visibility of the container from plant to final customer. Defined logistics costs allow sustainable profit margins, while the financial evaluation demonstrates rapid investment recovery and continuous equity growth without the need for debt.

Commercial and payment conditions protect cash flow and minimize default risk by aligning financial milestones with logistics milestones. Overall, the model constitutes a technically viable, operationally controlled and financially solid solution for exporting architectural glass from Colombia to the United States.

Bibliographic References

Avagyan, V., Camacho, N., Van der Stede, W. A., & Stremersch, S. (2022). *Financial projections in innovation selection: The role of scenario presentation, expertise, and risk*. https://research-ebsco-com.bibliotecavirtual.unad.edu.co/linkprocessor/plink?id=ee2736cf-9377-3e6d-a424-e4f8eb5f74ea

Ballou, R. H. (2004). *Business logistics/supply chain management* (5th ed.). Pearson Prentice Hall. https://www.pearson.com/en-us/subject-catalog/p/business-logistics-supply-chain-management/P200000006143

Campbell, J. (2024). *Competitiveness*. Salem Press Encyclopedia. https://research-ebsco-com.bibliotecavirtual.unad.edu.co/linkprocessor/plink?id=01a827ed-3df9-3223-aba3-655b53fd80e5

Chopra, S., & Meindl, P. (2022). *Supply chain management: Strategy, planning, and operation* (7th ed.). Pearson Education. https://www.pearson.com/en-us/subject-catalog/p/supply-chain-management-strategy-planning-and-operation/P200000006080

Christopher, M. (2016). *Logistics & supply chain management* (5th ed.). Pearson Education. https://www.pearson.com/en-gb/subject-catalog/p/logistics-and-supply-chain-management/P200000004646

Harper, G. D. J. (2024). *Innovation*. Salem Press Encyclopedia. https://research-ebsco-

com.bibliotecavirtual.unad.edu.co/linkprocessor/plink?id=b03a81a4-9b79-3e60-ad01-ba30fe73aa80

Horvat, D., Jäger, A., & Lerch, C. M. (2024). *Fostering innovation by complementing human competences and emerging technologies: An Industry 5.0 perspective*. *International Journal of Production Research*, 1–24. https://doi.org/10.1080/00207543.2024.2311195

Institute for Supply Management. (n.d.). *Incoterms basics for logistics and trade guide*. https://www.ism.ws/resources/incoterms/

International Chamber of Commerce. (2020). *Incoterms® 2020 rules*. ICC. https://iccwbo.org/business-solutions/incoterms-rules/

Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining supply chain management. *Journal of Business Logistics, 22*(2), 1–25. https://doi.org/10.1002/j.2158-1592.2001.tb00001.x

Pooja, & Ailawalia, P. (2024). *Supply chain optimization with data science*. *Grenze International Journal of Engineering & Technology (GIJET), 10*(2, Part 1), 137–144. https://research-ebsco-com.bibliotecavirtual.unad.edu.co/linkprocessor/plink?id=cd086d3a-0234-3c70-939b-7124110b21d9

Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. Free Press. https://www.hbs.edu/faculty/Pages/item.aspx?num=193

World Bank. (2018). *Connecting to compete 2018: Trade logistics in the global economy – The logistics performance index and its indicators*. World Bank. https://openknowledge.worldbank.org/items/80be2d53-8d12-55a6-b48b-5d3465fb9cdb