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Pension Asset Management

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Simulation Software R&D

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Director Advanced Practice Providers & Clinical Services
An Analysis of Puerto Rico’s Pharmaceutical Temperature-Controlled Logistics Market & Recommendations for Competitiveness
Table of Contents

- Research methodology
- Problem definition
- Stakeholder interviews
- Challenges as heard
- Takeaways
- Recommendations
  1. Build pharma temperature-controlled ecosystem
     A. Infrastructure
     B. Energy
     C. Training & Certifications
  2. Market Pharma Logistics Capabilities
- Implementation Plan
- Appendix
Research Methodology
Problem Definition

1. How might pharma temperature-controlled logistics enable Puerto Rico to retain its competitiveness as a top 10 pharma destination?

2. How might Puerto Rico position itself to remain competitive in the long-run?
The last few years have seen industry terminology shifting from “cold chain” to “temperature-controlled” to account for the growing controlled room temperature market.

Stakeholder Interviews

- Industry Associations
- Government Agencies
- University
- Pharma Companies
- Logistics / Other

- INVEST Puerto Rico
- DDEC
- Universidad de Puerto Rico
- Bristol Myers Squibb
- VIATRIS
- AstraZeneca
- TOTE
- PRIME
- Cesar Castillo
- PACIV
CHALLENGES AS HEARD

CORE ISSUES

1. Limited Strategic Warehousing
2. RKN Availability
3. Airport To/From Infrastructure
4. Route Connectivity
5. Poor Road Infrastructure
6. Processing Delays, Manual Paperwork

ENABLERS

7. Unreliable and Costly Electricity
8. Limited Large Move-in Ready Facilities
9. Talent Retention
10. Short-Term Vision; Gov’t every 4 Years

Insufficient Collaboration
**CORE ISSUES**

1. "We need temperature-controlled warehousing at the airport"

2. "Cold chain is another challenge, especially getting CRT containers"

3. "No direct routes for heavy cargo .. up to 3 hours to cross the island via local traffic."

4. "In terms of air cargo, there are limited routes in and out of PR"

5. "Roads are full of potholes due to weather events like Maria"

6. "This export declaration with domestic shipments is ridiculous. Need less complexity and become more reliable."

**ENABLERS**

1. "Power issues with frequent outages need generators and then back up of generators"

2. "Approximately 20% of the units need repair ... no new buildings are being constructed at present"

3. "They will interview students for permanent positions that take our talent out of PR to U.S. mainland."

4. "Our capacity on PR is 4 years because the administration changes every 4 years and so do the priorities"

"Implement and manage best practices on how to manage and store good in a way that it provides consistent result” .... “As an island come together to make the whole better”
Benchmarking of current conditions against top jurisdictions indicates risks to competitiveness

- PR’s strategic geographic location and foreign trade zone designation support pharma exports, but recent lackluster export performance signals risks to the outlook
- Declining pharma manufacturing contribution to economic growth
- Fragmented pharma temperature-controlled logistics
- Siloed information without sharing of best practices
- No coordinated planning for shared resources and routes
- Suboptimal cataloging and marketing of pharma and logistics assets
- Insufficient marketing of the island’s capabilities
- Poor energy infrastructure for temperature-controlled logistics
- Bottlenecks in manual customs processes

Long-term competitiveness must address logistics infrastructure, data challenges and lack of visibility

- Global pharma cold chain trend requires strategic temperature-controlled warehousing
- Benchmarked jurisdictions score higher in key logistics categories impacting cold chain
- Cost reduction pressures drive need for reliable logistics cost data, frequent reporting and KPI monitoring
- Coordination among stakeholders is essential to protect the island’s position in the global pharmaceutical market
- Need to stay current with industry marketing trends

KEY TAKEAWAYS
Build Pharma Temperature-Controlled Ecosystem

Market Pharma Logistics Capabilities

Recommendations
Favorable global pharma cold chain market outlook and reshoring trend present opportunity to further develop pharma cold chain logistics market

Pharma remains critical to PR’s manufacturing industry and economic growth, but must address declining trend

Pharma represents ~80% of total PR exports; PR is top 8 pharma world exporter, 4.5% of global pharma exports

Risk of losing competitiveness to major global pharma manufacturing jurisdictions with similar attributes to PR, such as Ireland or Singapore
Global Pharmaceutical & Medical Equipment Industry Overview

- Global $1.3 trillion pharma industry expected to grow by 4-5% annually to reach $1.5-$1.6 trillion by 2024.
- Pharma cold chain market accounts for 26%; expected to reach 28% by 2024, or $440 billion.

Sources: Fitch Solutions, Euromonitor International: Global Overview of the Pharmaceutical and Medical Equipment Industry, Pharmaceutical Commerce: 2020 Biopharma Cold Chain Sourcebook, EMAP Team Calculations.
Top Pharma Exporters

- PR is top 8 pharma exporter and represents 4.5% of global exports ($1.0 trillion)

- Pharma production forecast to grow fastest in Singapore and slowest in PR

Top Pharma Exporters 2020 ($, Billion)

<table>
<thead>
<tr>
<th>Country</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>123.8</td>
</tr>
<tr>
<td>Switzerland</td>
<td>113.8</td>
</tr>
<tr>
<td>Ireland</td>
<td>106.3</td>
</tr>
<tr>
<td>USA*</td>
<td>87.9</td>
</tr>
<tr>
<td>China</td>
<td>70.2</td>
</tr>
<tr>
<td>Belgium</td>
<td>66.4</td>
</tr>
<tr>
<td>Netherlands</td>
<td>48.9</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>48.6</td>
</tr>
<tr>
<td>France</td>
<td>48.4</td>
</tr>
<tr>
<td>Italy</td>
<td>43.8</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>38.1</td>
</tr>
<tr>
<td>India</td>
<td>35.9</td>
</tr>
<tr>
<td>Rep. of Korea</td>
<td>22.5</td>
</tr>
<tr>
<td>Japan</td>
<td>22.4</td>
</tr>
<tr>
<td>Denmark</td>
<td>21.3</td>
</tr>
</tbody>
</table>

Pharma Production Outlook (Cumulative annual growth %)

<table>
<thead>
<tr>
<th>Country</th>
<th>2015-2020</th>
<th>2021-2026 Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>4.9%</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>3.3%</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>3.1%</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>3.1%</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>-0.8%</td>
<td></td>
</tr>
</tbody>
</table>

Sources: UNCTAD (HS29+HS30). U.S. Includes PR data. PR data from Junta de Planificación de Puerto Rico’s External Trade 2020 Tables (Table 10).

Source: Euromonitor International: Global Overview of the Pharmaceutical and Medical Equipment Industry
Puerto Rico Pharmaceutical Contribution To GDP, Manufacturing & Exports

-PR’s pharma contribution to manufacturing and GDP on the decline, suggesting actions must be taken now to avoid becoming a stagnant market

- While the pharma contribution to total exports has been rising, this has been driven by a relatively larger decline in total exports

Source: Junta de Planificación de Puerto Rico. Puerto Rico’s Income and Product 2020 Tables (Table 10).
Puerto Rico Pharmaceutical Exports

Top Export Destinations

<table>
<thead>
<tr>
<th>Country</th>
<th>USD $Billions</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>$36.1B</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2.39</td>
</tr>
<tr>
<td>Italy</td>
<td>1.65</td>
</tr>
<tr>
<td>Spain</td>
<td>1.53</td>
</tr>
<tr>
<td>Germany</td>
<td>1.43</td>
</tr>
<tr>
<td>Japan</td>
<td>1.37</td>
</tr>
<tr>
<td>Austria</td>
<td>0.99</td>
</tr>
<tr>
<td>Rest of World</td>
<td>0.98</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.94</td>
</tr>
<tr>
<td>China</td>
<td>0.59</td>
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<tr>
<td>France</td>
<td>0.42</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.22</td>
</tr>
</tbody>
</table>


Export Share

- U.S.: 74%
- Netherlands: 3%
- Spain: 3%
- Italy: 3%
- Japan: 3%
- Belgium: 2%
- Rest of World: 5%

$48.6 Billion
Puerto Rico Pharma Cold Chain Market

Puerto Rico Pharma Cold Chain Market ($ Billions)

- 2020 Est.
  - Domestic: $3.1
  - Exports: $12.9
- 2024 Fcst.
  - Domestic: $3.9
  - Exports: $16.7

Source: Pharmaceutical Commerce: 2020 Biopharma Cold Chain Sourcebook, Junta de Planificación de Puerto Rico: Puerto Rico's External Trade 2020 Tables (Table 10) and EMAP team calculations.
Benchmarking-Based Recommendations
Puerto Rico Can Help The U.S. End Its Dependence On Chinese Pharma Ingredients

Congress phased out the tax break between 1996 and 2006... spurred the worst recession in Puerto Rico’s history. Many companies left. 

WSJ

Ireland will play a central role in helping to put the EU’s new pharmaceutical and industrial strategies into motion. The country is a European pharmaceutical manufacturing hub and the third largest exporter of pharmaceuticals in the world.

PharmExec.com

Singapore is one of the leading biomedical and pharmaceutical hubs in Asia. Through the government's Biomedical Sciences initiative... launched in June 2000, Singapore has been able to attract both foreign and private investors that have moved the industry forward.

statista
Pharmaceutical Production & Trade

Pharma Production
($ Billions, constant 2020 prices)

Sources: Euromonitor International, Passport database.

Pharma Net Exports*
($ Billions)

*Exports less imports
Source: UNCTAD; includes HS29 (org. chemicals) and HS30 (pharma prod.)
#1
Build Pharma Temperature-Controlled Ecosystem

How?
A. Logistics Infrastructure
B. Energy
C. Training & Certifications
We need to establish best practices on how to manage and store in a way that it provides consistent results.

If we work together among the plants and coordinate our deliveries to increase pallets to ship to other areas. We need to get better data in/out of island.

Trying to have the utilization structure on our island that when needed, capacity is available. That is something PR can do better.

Four plants have four SOPs. Try to get it standardized but it’s a culture change.

Everything is word of mouth.

Now we need to make sure as an island we can improve those costs that are not directly related to the company, but to make the whole better. As an island come together to do better with power, water, facilities...

Community of Stakeholders
- Coordinate and Collaborate to Keep the island competitive
- Ensure common understanding of the status quo
- Prioritize shared concerns and produce integrative solutions and mitigation strategies

Learn from other jurisdictions
- Singapore uses a multi-agency approach with the government playing an orchestrating role
- Many use community-based approaches with private-public sector collaboration and memberships
A. Infrastructure

Strategic

Warehousing Capacity
## Puerto Rico

### Insufficient Cataloging of Temperature - Logistics Warehousing

<table>
<thead>
<tr>
<th>Company Name</th>
<th>City</th>
<th>Capacity (Sq ft)</th>
<th>Cold 2-8C</th>
<th>CRT 15-25C</th>
<th>Freeze &lt; -20C</th>
<th>Pharma</th>
<th>Food</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cesar Castillo, Inc.</td>
<td>Guaynabo</td>
<td>850,000</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>DHL Supply Chain</td>
<td>Catano</td>
<td>400,000</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Munoz Holdings, Inc.</td>
<td>San Juan</td>
<td>270,520</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VWR Part of Avantor</td>
<td>Manati</td>
<td>133,000</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CBX Global</td>
<td>Aguadilla + Carolina</td>
<td>75,000</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Martin-Brower P.R. Inc.</td>
<td>Toa Baja</td>
<td>62,000</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td></td>
<td>✓</td>
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<tr>
<td>Sea Air Systems, Inc.</td>
<td>Guaynabo</td>
<td>35,000</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>RR Donnelley de P.R. Corp.</td>
<td>Catano</td>
<td>30,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution Integrated Services</td>
<td>Guaynabo</td>
<td>30,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isla Frio</td>
<td>Cidra</td>
<td>90,000</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>PrimeAir</td>
<td>San Juan</td>
<td>24,000</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Singapore – Changi Airport
Highly Competitive Warehousing Competencies

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Capacity (Sq ft)</th>
<th>Cold 2-8°C</th>
<th>CRT 15-25°C</th>
<th>Freeze &lt; -20°C</th>
<th>Pharma</th>
<th>Food</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolloré</td>
<td>21,000</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ceva</td>
<td>3,200</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DB Schenker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DHL Global Forwarding</td>
<td>77,000</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DSV Air &amp; Sea</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Kuehne + Nagel</td>
<td>150,000</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Global Airfreight intl</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Expeditors</td>
<td>74,000</td>
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<td></td>
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<td>✓</td>
</tr>
<tr>
<td>UPS</td>
<td>40,000</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Singapore Airlines</td>
<td>1,800 flights/week</td>
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<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dnata</td>
<td>4,600</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SATS</td>
<td>26,000</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Ireland

#### Variability by Location & Stored Product Type

<table>
<thead>
<tr>
<th>Company Name</th>
<th>City</th>
<th>Capacity (Sq ft)</th>
<th>Cold 2-8°C</th>
<th>CRT 15-25°C</th>
<th>Freeze &lt; -20°C</th>
<th>Pharma</th>
<th>Food</th>
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</thead>
<tbody>
<tr>
<td>Marken</td>
<td>Dublin</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Swift Freeze</td>
<td>Dublin</td>
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<td></td>
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<tr>
<td>Agro Merchants Group</td>
<td>Dublin</td>
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<td>✓</td>
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<tr>
<td>Seko</td>
<td>Dublin</td>
<td>20,000</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>CMLS</td>
<td>Dublin, Limerick &amp; Shannon</td>
<td>100,000</td>
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<td>✓</td>
<td>✓</td>
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<tr>
<td>Caffrey International</td>
<td>Ashbourne</td>
<td>60,000</td>
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<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Worldwide Flight Services</td>
<td>Cork Airport</td>
<td>1,525</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Dublin Airport Business Center</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>IAG Cargo</td>
<td>Terminal 1</td>
<td>20,000</td>
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<td></td>
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<td>✓</td>
</tr>
<tr>
<td>Worldwide Flight Services</td>
<td>Terminal 1</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Horizon Logistics Park</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CEVA</td>
<td>Close to Dublin Airport</td>
<td>15,000</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>DHL</td>
<td>Close to Dublin Airport</td>
<td>40,000</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Kintestu World Express</td>
<td>Close to Dublin Airport</td>
<td>9,840</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fynes Logistics</td>
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<td>25,000</td>
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<td></td>
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<td>Kuehne + Nagel</td>
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<td></td>
<td></td>
<td></td>
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<td>✓</td>
</tr>
<tr>
<td>Expeditors</td>
<td>Close to Dublin Airport</td>
<td>26,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
A. Infrastructure

Strategic Warehousing Location

“We need temperature-controlled warehousing at the airport”
Puerto Rico

SJU

- 8.4 million passengers
- Load factor 87.14
- Largest runway in the Caribbean

BQN

- 472,000+ passengers
- Substantial area for greenfield development
- 1,600 acres of idle land at southside

Are there opportunities to build logistics parks at SJU & BQN airports for pharmaceuticals?
Singapore & Ireland

**SINGAPORE: AIR LOGISTICS PARK**
- Regional distribution/fulfillment centers
- 170 acres
- > 115,000 Sq Ft warehousing capacity

**IRELAND, DUBLIN: HORIZON LOGISTIC PARK**
- Dedicated warehousing and distribution development
- 125 acres
- > 150,000 Sq Ft warehousing capacity
A. Infrastructure

Move-in-Ready Facilities

“Buildings are not in good shape and no new ones are being constructed”
Puerto Rico PRIDCO-owned facilities

107 Industrial parks with over 22 million square feet space: Opportunity to market stale website
Jurong Town Corporation (JTC) developed 7,000 hectares of industrial land and 4 million square meters of ready-built facilities.
Available: Waterford - Manufacturing Facility, Waterford

Prime self-contained manufacturing facility located on a c. 0.97 hectares (2.41 acre) site on IDA’s Waterford Industrial Estate. This property comprises c. 3,489 sq m (c. 37,555 sq ft) of manufacturing, cleanroom, warehouse and office space.

Dublin/East - College Park Dublin

College Park has been developed as a joint venture between Fingal County Council and IDA Ireland.

Dublin/East - Grange Castle Business Park

Grange Castle Business Park is a world class campus with world leading clients, largely because of their model of continuous investment and planning over 20 years.
A. Infrastructure

Logistics Key Performance Indicators (KPIs)

The International Association of Refrigerated Warehouses observed strong correlation of cold chain performance with a country’s transport rating.
Logistics KPIs

- Puerto Rico lacks logistics performance metrics for global benchmarking

<table>
<thead>
<tr>
<th>Country</th>
<th>Singapore</th>
<th>United States</th>
<th>Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LPI</strong></td>
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<tr>
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<td>14</td>
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<tr>
<td>Score</td>
<td>4.0</td>
<td>3.9</td>
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<td><strong>Customs</strong></td>
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<tr>
<td>Rank (out of 160)</td>
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<tr>
<td>Score</td>
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<td>3.4</td>
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<tr>
<td>Score</td>
<td>4.1</td>
<td>4.1</td>
<td>3.3</td>
</tr>
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<td><strong>International shipments</strong></td>
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<td>Score</td>
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<td>3.5</td>
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<tr>
<td><strong>Logistics competence</strong></td>
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<tr>
<td>Rank (out of 160)</td>
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<td>16</td>
<td>26</td>
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<tr>
<td>Score</td>
<td>4.1</td>
<td>3.9</td>
<td>3.6</td>
</tr>
<tr>
<td><strong>Tracking &amp; tracing</strong></td>
<td></td>
<td></td>
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<tr>
<td>Rank (out of 160)</td>
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<td>6</td>
<td>28</td>
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<tr>
<td>Score</td>
<td>4.1</td>
<td>4.1</td>
<td>3.6</td>
</tr>
<tr>
<td><strong>Timeliness</strong></td>
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</tr>
<tr>
<td>Rank (out of 160)</td>
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<td>19</td>
<td>33</td>
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<tr>
<td>Score</td>
<td>4.3</td>
<td>4.1</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Sources: World Bank, 2018 Logistics Performance Index; UNCTAD Port Call & Performance Statistics. * Port efficiency calculated by using median time in port and average container carrying capacity (TEU) per container ship.
Recommendations - Infrastructure

- FILL GAP ON TEMPERATURE-CONTROLLED WAREHOUSING CAPACITY DATA
- ADMINISTER TEMPERATURE-CONTROLLED SURVEY
- CATALOG MOVE-IN READY LARGE FACILITIES
- DEVELOP LOGISTICS KPIS FOR BENCHMARKING
Puerto Rico Warehouse Capacity Survey

Administer annual temperature-controlled survey to catalog warehousing capabilities

<table>
<thead>
<tr>
<th>Puerto Rico - Warehouse Capacity Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is the name of your business?</td>
</tr>
<tr>
<td>2. What type of business are you considered? (select one)</td>
</tr>
<tr>
<td>Manufacturing</td>
</tr>
<tr>
<td>Logistics Provider</td>
</tr>
<tr>
<td>Carrier</td>
</tr>
<tr>
<td>3. What type of products do you warehouse/store? (select all that apply)</td>
</tr>
<tr>
<td>Pharmaceutical</td>
</tr>
<tr>
<td>Food</td>
</tr>
<tr>
<td>Other (please specify)</td>
</tr>
<tr>
<td>4. What is your current total warehouse / storage capacity? SqFt</td>
</tr>
<tr>
<td>5. What is your average number of pallet positions dedicated to pharma? pallet positions</td>
</tr>
<tr>
<td>6. Do you have plans to increase your total warehouse / storage capacity?</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>7. Do you offer temperature-controlled storage?</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>8. If yes, please select all that apply. If no, select Not Applicable.</td>
</tr>
<tr>
<td>controlled room temp 15 °C to 25 °C</td>
</tr>
<tr>
<td>cold chain 2 °C to 8 °C</td>
</tr>
<tr>
<td>freezer -25 °C to -10 °C</td>
</tr>
<tr>
<td>other (please specify) °C to °C</td>
</tr>
<tr>
<td>Not Applicable</td>
</tr>
<tr>
<td>9. If you selected yes in the previous question, how many square feet (SqFt) for each temperature? If you selected no, select Not Applicable.</td>
</tr>
<tr>
<td>controlled room temp 15 °C to 25 °C SqFt</td>
</tr>
<tr>
<td>cold chain 2 °C to 8 °C SqFt</td>
</tr>
<tr>
<td>freezer -25 °C to -10 °C SqFt</td>
</tr>
<tr>
<td>other (please specify) SqFt</td>
</tr>
<tr>
<td>Not Applicable</td>
</tr>
<tr>
<td>10. What supply chain training does your company have? (select all that apply)</td>
</tr>
<tr>
<td>GDP</td>
</tr>
<tr>
<td>Other (please specify)</td>
</tr>
<tr>
<td>11. What certification does your company have? (select all that apply)</td>
</tr>
<tr>
<td>CEIV</td>
</tr>
<tr>
<td>Other (please specify)</td>
</tr>
<tr>
<td>12. Do have any of these additional capabilities? (select all that apply)</td>
</tr>
<tr>
<td>Dry ice top up</td>
</tr>
<tr>
<td>Liquid nitrogen top-up</td>
</tr>
<tr>
<td>Charging facilities for active containers</td>
</tr>
<tr>
<td>Replacement of gel packs</td>
</tr>
<tr>
<td>Hazardous waste management</td>
</tr>
<tr>
<td>Other (please specify)</td>
</tr>
<tr>
<td>13. For energy reliability, what redundancy (backup) do you have? (select all that apply)</td>
</tr>
<tr>
<td>Gas generator</td>
</tr>
<tr>
<td>Solar panels</td>
</tr>
<tr>
<td>Other (please specify)</td>
</tr>
</tbody>
</table>
B. Energy

Electricity Costs & Reliability

15% of total cold chain pharmaceutical logistics operation costs is power.

55% of cost in temperature-controlled warehousing due to refrigeration.
Puerto Rico Electricity Supply

- A resilient electricity grid is necessary to support rising demand for temperature-controlled logistics
- Electricity supply is heavily dependent on imported petroleum and natural gas, contributing to high costs
- Under Puerto Rico’s 2019 Energy Public Policy Act, PREPA* must obtain 40% of electricity from renewable sources by 2025
- As of 2020, renewables only made up 2.5%
- Explore renewable power generation to make the electricity grid more resilient to disruptions
- Include PREPA and the Puerto Rico Energy Bureau in temperature-controlled ecosystem

* Puerto Rico Electric Power Authority

Source: EIA: Puerto Rico Territory Energy Profile
Electricity Costs

- Puerto Rico has one of the world’s highest commercial electricity prices; 2X as much as mainland U.S.

* Puerto Rico & U.S. prices as of July 21 (average of commercial + residential), Singapore as of March 21, Ireland as of Second Half 2020.
Electricity Reliability

J.D. Power - Electric Utility Residential Customer Satisfaction Study
- Puerto Rico Electric Power Authority (PREPA) ranked last out of 144 U.S. utility companies measured
- PREPA score was approximately 50% lower than the average utility company
- 47% lower than the next comparable lowest ranking utility

LUMA Energy performance metrics submitted to the Puerto Rico Energy Bureau (PREB)
- Power outage frequencies are 300% worse than the next worse performer
- Duration of outages is 200% worse
- PREPA’s performance is continuing to degrade by more than 20% annually
Electricity Reliability KPIs

- High frequency of service interruptions and duration represent major challenges for cold chain in the form of redundancy costs and excursion potential

- Puerto Rico’s quality of electricity data frequency lagging relative to top pharma jurisdictions

### Doing Business Survey Quality of Electricity Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>PR</th>
<th>Ireland</th>
<th>Singapore</th>
<th>US NYC</th>
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<tbody>
<tr>
<td>Reliability of supply (0-8)</td>
<td>3</td>
<td>8</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Average interruption duration*</td>
<td>14.4</td>
<td>0.8</td>
<td>0.1</td>
<td>0.2</td>
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<tr>
<td>Average interruption frequency**</td>
<td>4.8</td>
<td>0.6</td>
<td>0.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>


### Quality of Electricity Supply Rank (1-7) Top 30 Countries


*In your country, how reliable is the electricity supply (lack of interruptions and lack of voltage fluctuations)? (1 = extremely unreliable; 7 = extremely reliable)*
Energy Redundancy Costs

Initial Energy Redundancy Capital Expenditure
$2-$3 Million for generators

Monthly Preventative Equipment Maintenance
$400-$500 (not including parts)

Per Power Outage Operational Costs
average power outage 3 hrs
$342 - $855 per event

Source: World Bank Doing Business (“Getting Electricity”)
Recommendations - Energy

INCLUDE INFLUENTIAL ENERGY DECISION MAKERS (I.E. PREPA AND PREB) IN ECOSYSTEM TO JOINTLY ADDRESS ENERGY RELIABILITY & COST ISSUES

INCENTIVIZE PRIVATE-SECTOR ADOPTION OF ALTERNATIVE SOLUTIONS, SUCH AS RENEWABLES, TO IMPROVE AFFORDABILITY & RELIABILITY OF ENERGY SUPPLY IMPACTING COLD CHAIN
C. Training & Certifications

Training and developing the manpower on the technology and handling the products involve heavy capital involvement and it remains the necessity of industry...
Due to broken cold chain...

20% Products Wasted
$35b Annual Loss Globally

Risk of damaged or degraded products getting to patients

Expensive retrospective root cause analysis

Demand is surging for specialized, temperature-controlled logistics services to safely, reliably and cost-effectively distribute high value, high-sensitivity products.

Highest Risk of Excursions during transport and product handling, 90% from human error
Industry Trends

- Community training and Certification, e.g. IATA CEIV Pharma
- High performance packaging materials, technology, and methods
- End-to-end shared visibility
- Real-time monitoring & analytics
  Connected monitoring used with advanced analytics to readjust temperatures, reroute shipments
- Monitoring beyond temperature

Shared excellence
- Ensure uniform product handling processes through community training
- Create a forum to share best practices
- Market your qualifications

Push to the frontier of technology
- Prepare for the future
- Gain expertise on 360 environmental monitoring
- Follow the latest industry technology trends in real-time monitoring and analytics to stay ahead of the game

Training, Technology

- We secure our cargo with extra insulation to prevent excursions...
- When excursions happen, we work with our 3PLs to improve...
- You want to be aware where your product is at what temperature, etc. Some of the key companies use sensors that provide data. In PR, there are only a few that do this..... but many do not. There is room for more companies to have this capability.

Changi has highly trained specialists to handle temperature-controlled shipments

Schiphol brands itself as Qualified and Transparent

Humidity
- Yes: 35%
- Not Yet: 56%
- No Need: 22%

Vibration
- Yes: 22%
- Not Yet: 61%
- No Need: 16%

Light
- Yes: 17%
- Not Yet: 69%
- No Need: 14%
Puerto Rico
Limited shared training and certification prohibits shared level of excellence

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Product Tracking Capability</th>
<th>Temp. Monitoring</th>
<th>Additional Capability</th>
<th>Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cesar Castillo, Inc.</td>
<td>End-to-end visibility</td>
<td>✓</td>
<td>Hazardous Waste</td>
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<tr>
<td>DHL Supply Chain</td>
<td>Life science DHL IT Platform</td>
<td>✓</td>
<td></td>
<td>GDP &amp; CEIV</td>
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<tr>
<td>Munoz Holdings, Inc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VWR Part of Avantor</td>
<td>Order Status tracking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBX Global</td>
<td>Shiptrax &amp; Quictrax</td>
<td>✓</td>
<td></td>
<td>GDP</td>
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<tr>
<td>Martin-Brower P.R. Inc.</td>
<td>End-to-end visibility</td>
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<td></td>
<td></td>
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<tr>
<td>Sea Air Systems, Inc.</td>
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<td></td>
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<tr>
<td>RR Donnelley de P.R. Corp.</td>
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<tr>
<td>Distribution Integrated Services</td>
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<tr>
<td>Isla Frio</td>
<td>Real time visibility</td>
<td>✓</td>
<td></td>
<td></td>
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<tr>
<td>PrimeAir</td>
<td>GPS tracking</td>
<td>✓</td>
<td>Hazmat certified</td>
<td>CEIV</td>
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</table>
Singapore – Changi Airport  
Leading in training and certification with Pharma@Changi CEIV Community

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Product Tracking Capability</th>
<th>Temp. Monitoring</th>
<th>Additional Capability</th>
<th>Certification</th>
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<tbody>
<tr>
<td>Bolloré</td>
<td>End-to-end Traceability</td>
<td>✓</td>
<td>Mobile freezers &amp; charging</td>
<td>GDP &amp; CEIV</td>
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<tr>
<td>Ceva</td>
<td>Monitor shipments 24/7</td>
<td>✓</td>
<td>Dy ice</td>
<td>GDP &amp; CEIV</td>
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<tr>
<td>DB Schenker</td>
<td>AirTrack - GPS tracking</td>
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<td>Dry ice</td>
<td>GDP &amp; CEIV</td>
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<tr>
<td>DHL Global</td>
<td>DHL IT platform</td>
<td>✓</td>
<td>Charging for Envirotainers</td>
<td>GDP &amp; CEIV</td>
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<td>DSV Air &amp; Sea</td>
<td>SmartView online platform</td>
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<td>GDP &amp; CEIV</td>
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<td>Kuehne + Nagel</td>
<td>Cargo Signal</td>
<td>✓</td>
<td>Dry Ice &amp; Liquid Nitrogen</td>
<td>GDP &amp; CEIV</td>
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<tr>
<td>Global Airfreight intl</td>
<td>GPS tracking</td>
<td>✓</td>
<td>Dry Ice &amp; Liquid Nitrogen</td>
<td>GDP &amp; CEIV</td>
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<tr>
<td>Expeditors</td>
<td>Cargo Signal</td>
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<td>Generator with standby fuel tank</td>
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<tr>
<td>UPS</td>
<td>GPS tracking</td>
<td>✓</td>
<td></td>
<td>GDP &amp; CEIV</td>
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<td>Singapore Airlines</td>
<td>Real-time digital control tower</td>
<td>✓</td>
<td>Charging for containers</td>
<td>CEIV</td>
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<tr>
<td>Dnata</td>
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<td>✓</td>
<td>Charging for containers</td>
<td>CEIV</td>
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<tr>
<td>SATS</td>
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<td>✓</td>
<td>Dry-ice production</td>
<td>CEIV</td>
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### Ireland

Variability in type of training and certifications

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Product Tracking Capability</th>
<th>Temp. Monitoring</th>
<th>Additional Capability</th>
<th>Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marken</td>
<td>Marken Maestro™ &amp; Sentry</td>
<td>✓</td>
<td>Temp controlled pack</td>
<td>GDP &amp; GMP</td>
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<tr>
<td>Swift Freeze (Tower Co. partnership)</td>
<td>Data Loggers</td>
<td>✓</td>
<td>Temp controlled ship &amp; pack</td>
<td>CEIV</td>
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<tr>
<td>Agro Merchants Group</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Seko</td>
<td>Track and Manage</td>
<td>✓</td>
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<td>GDP</td>
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<tr>
<td>CMLS</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caffrey International</td>
<td>Tracking of fleet</td>
<td>✓</td>
<td></td>
<td>GDP</td>
</tr>
<tr>
<td><strong>Dublin Airport Business Center</strong></td>
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<tr>
<td>IAG Cargo</td>
<td>Door to Door visibility</td>
<td>✓</td>
<td>Dry ice</td>
<td>GDP &amp; CEIV</td>
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<td>Worldwide Flight services</td>
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<td>✓</td>
<td></td>
<td>GDP</td>
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<td><strong>Horizon Logistics Park</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEVA</td>
<td>Monitor shipments 24/7</td>
<td>✓</td>
<td></td>
<td>GDP &amp; CEIV</td>
</tr>
<tr>
<td>DHL Supply Chain Life Sciences</td>
<td>End to end traceability</td>
<td>✓</td>
<td></td>
<td>CEIV</td>
</tr>
<tr>
<td>Kintestu World Express</td>
<td>End to end traceability</td>
<td>✓</td>
<td></td>
<td>GDP</td>
</tr>
<tr>
<td>Fynes Logistics</td>
<td>Live online tracking</td>
<td>✓</td>
<td></td>
<td>GDP &amp; CEIV</td>
</tr>
<tr>
<td>Kuehne + Nagel</td>
<td>Cargo Signal real time location</td>
<td>✓</td>
<td></td>
<td>GDP &amp; CEIV</td>
</tr>
<tr>
<td>Expeditors</td>
<td>Cargo Signal real time location</td>
<td>✓</td>
<td></td>
<td>GDP &amp; CEIV</td>
</tr>
</tbody>
</table>
Recommendations - Training & Certification

- STAKEHOLDER COLLABORATION FOR COMPLETE SUPPLY CHAIN VISIBILITY
- JOINT CEIV TRAINING TO ENSURE PROCESS UNIFORMITY AND TO FACILITATE KNOWLEDGE SHARING
- CERTIFY TO SIGNAL CAPABILITIES
- STAY CURRENT WITH TECHNOLOGY TRENDS THROUGH INDUSTRY MEMBERSHIPS, EVENTS
Singapore temperature-controlled Ecosystem

- Multi stakeholder collaboration creates innovative pharmaceutical hub
Market Pharma Logistics Capabilities

- Insufficient advertising of existing pharma logistics assets; fragmented information
- Urgent need to capitalize on global pharma logistics growth
- Benchmarked airports marketing pharma hubs
<table>
<thead>
<tr>
<th>Marketing Lessons From Miami, Brussels, and Schiphol Airports</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Updated</strong> cargo specific user-friendly website</td>
</tr>
<tr>
<td><strong>Cargo specific data &amp; statistics</strong></td>
</tr>
<tr>
<td><strong>Articles &amp; newsletters</strong> highlighting advancements in logistics competencies</td>
</tr>
<tr>
<td><strong>Dedicated downloadable pharma brochure</strong> with capacity details</td>
</tr>
<tr>
<td><strong>Collaborations &amp; Certifications</strong> with pharma cold supply chain stakeholders (3PLs, FF, shippers)</td>
</tr>
<tr>
<td><strong>Contact details</strong> for further information</td>
</tr>
</tbody>
</table>
San Juan (SJU) International Airport

No mention of cargo competencies!
Miami International Airport

- Advocating for pharmaceutical industry’s best interests
- Pharma logistics assets readily accessible
- Community partnerships
- Marketing Foreign Trade Zone

“Foster collaboration among CEIV pharma certified airport communities around the world.”
Brussels International Airport

- Emphasizing cargo competencies for a pharmaceutical gateway
- Market pharma refrigerated warehouse space
- Highlighting community-based certification

Local Cooperation Whiten Brucargo Pharma Hub Project Group

**Who?**
- BRUcargo Pharma Forum
- BRUcargo Pharma Hub

**How?**
- Direct dialog and local workshops with manufacturers.
- Continuous local pharma working group with all involved stakeholders.

**Target?**
- Mapping of improvements
- Implementation of cargo community innovations
- Continuous quality improvements
- Performance evaluation of pharma KPI's

The Preferred Pharma Gateway

- Biggest number of CEIV pharma certified companies
- Biggest concentration of dedicated pharma infrastructure
- Controlled temperature through the entire cool chain at the airport
- Excellent geographic location for pharma consolidation and storage

www.brusselsairport.be | brucargo@brusselsairport.be
Schiphol International Airport

- Highlighting cross-industry collaboration to achieve excellence in reliable end-to-end air transportation for pharmaceuticals shippers

**Excellent connectivity**
Schiphol is Europe’s best-connected airport, with the most direct air destinations.

**Cooperative customs**
A close relationship with customs provides for a smooth clearance process.

**Quality ground operations**
Supply chain innovations support the high quality and efficiency of our ground handling operations.

**Each pharmaceutical journey is unique**
Recommendations - Marketing

- Conduct study to unveil white space marketing opportunities
- Create marketing product to advertise temperature-controlled capabilities
- Revamp SJU web to market cargo capabilities
<table>
<thead>
<tr>
<th>Categories</th>
<th>Puerto Rico</th>
<th>Singapore</th>
<th>Ireland</th>
<th>Amsterdam-AMS</th>
<th>U.S.-MIA</th>
<th>Belgium-BRU</th>
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</thead>
<tbody>
<tr>
<td>Cold chain ecosystem</td>
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<td>H</td>
<td>M</td>
<td>H</td>
<td>M/H</td>
<td>M/H</td>
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<td>Cold chain airport capacity</td>
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<td>H</td>
<td>M</td>
<td>M</td>
<td>M/H</td>
<td>M/H</td>
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<tr>
<td>Temperature range</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>M/H</td>
<td>H</td>
</tr>
<tr>
<td>Training</td>
<td>M</td>
<td>H</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Marketing Quality</td>
<td>L</td>
<td>H</td>
<td>L/M</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>CEIV- airport certification</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Low: 1
- Low/Medium: 2
- Medium: 3
- Medium/High: 4
- High: 5
IMPLEMENTATION PLAN

**Infrastructure**
- Fill gap on temperature-controlled warehousing capacity data
- Administer temperature-controlled survey annually
- Catalog move-in ready large facilities
- Develop logistics KPIs for benchmarking

**Energy**
- Include energy decision-makers in ecosystem to jointly address energy reliability & cost issues
- Incentivize private-sector adoption of alternative solutions, such as renewables, to improve energy supply affordability & reliability

**Training & Certification**
- Stakeholder supply chain visibility
- Joint CEIV trainings to ensure process uniformity and to facilitate knowledge sharing
- Stay current with technology trends through industry memberships, events
- Certify to signal capabilities

**Strategic Marketing**
- Conduct future study to unveil white space marketing opportunities
- Create marketing product to advertise temperature-controlled capabilities
- Update SJU website

- Resource Intensity
  - Low
  - Med
  - High

- 64
Puerto Rico must build and market a robust pharma temperature-controlled ecosystem to 1) maintain competitiveness as a top pharma destination and 2) remain competitive in the long run.

To build and market Puerto Rico’s pharma temperature-controlled ecosystem, we recommend addressing gaps in:

- **A. Infrastructure**
- **B. Energy**
- **C. Training & Certifications**

Ecosystem should be supported with marketing of pharma logistics assets:

- **A.** Update SJU website with cargo storage and handling capabilities
- **B.** Create marketing product to highlight PR’s temperature-controlled pharma competencies
- **C.** Conduct future study to unveil white space marketing opportunities to differentiate against top global jurisdictions
Appendix

- SLIDE 67: Global Pharma Industry Porter’s 5 Forces
- SLIDE 68: Global Pharma Industry Trends
- SLIDE 69: Global Pharma Regulatory Agencies
- SLIDES 70-77: Global Pharma Temperature-Controlled Logistics Market
- SLIDE 78: Puerto Rico Economic Overview
- SLIDE 79: Puerto Rico Top Export Destinations & Import Sources
- SLIDE 80: Puerto Rico Pharma Industry Corridor
- SLIDE 81: Puerto Rico SWOT
- SLIDES 82-86: Puerto Rico Pharma Trade
- SLIDES 87-88: Puerto Rico Electricity Reliability Report
- SLIDES 89-92: Puerto Rico Detailed Stakeholder Interviews
- SLIDE 93: Global Logistics Cost Trends
- SLIDE 94-96: Singapore Pharma Industry
- SLIDE 97: Singapore SWOT
- SLIDE 98: Singapore Pharma Industry Stakeholders
- SLIDES 99-101: Ireland Pharma Industry
- SLIDE 102: Ireland SWOT
- SLIDE 103: Ireland Pharma Industry Stakeholders
Global Pharma Industry

Porter’s 5 Forces

**Competitive Rivalry**

High

- Large R&D, brand monopoly, low differentiation in generics, high innovation, moderate industry growth

**New Entry Threat**

Low

- Large CapEx, R&D and know-how, heavy government regulation

**Buyer Power**

Mod-High

- Large number of insurance companies & hospitals, low-moderate switching costs

**Supplier Power**

Mod-High

- Large number of suppliers, moderate product differentiation and switching costs

**Substitutes**

Mod-High

- Generic drugs, brand drugs patent expirations, price sensitive customers, counterfeits
Global Industry Trends

01 Supply Chain
Resilience, risk mitigation, reshoring

02 Manufacturing
Cost reduction efforts, growth in generic drug market, small batch precision medicine

03 Clinical Innovation
Biologics, gene & cell therapy, clinical trials, R&D

04 Technological Integration
Digitalization, IoT, integrated management systems, automation, AI
### Global Pharma Regulatory Agencies

<table>
<thead>
<tr>
<th>Global</th>
<th>U.S.</th>
<th>EU</th>
<th>ASEAN</th>
</tr>
</thead>
</table>
| - The International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use (ICH) | - FDA - Current Good Manufacturing Practice (CGMP) Regulations  
- Federal Food, Drug and Cosmetic Act is the basic food and drug law of the U.S.  
- 21 CFR | - European Medicines Agency (EMA)  
- ~50 regulatory authorities from the 31 EEA countries (28 EU Member States plus Iceland, Liechtenstein and Norway)  
- GCP, GMP, GDP, GVP | - Association of Southeast Asian Nations (ASEAN)  
- many ASEAN regulatory guidelines are harmonized with ICH and EU guidelines |
Global Pharma Temperature - Controlled Logistics Market

- Overview
- Segments & Value Chain
- 5 Forces Industry Analysis
- Drivers, Challenges, Trends
- Main Players
Temperature controlled uninterrupted series of transportation, storage, and distribution of products including trucking, shipping, warehousing, and parcel delivery

- Cold chain logistics via air transportation is the fastest way of shipping pharmaceutical products with minimal damage
- Seaborne transportation is increasing due to advances in technology and reduced costs

Market by region

$17b Market in 2020
$21b Forecast for 2024
5.4% CAGR
Segments & Value Chain

Warehousing (68%)
Storage of finished and semi-finished goods in a storehouse or at a distribution center. The warehousing activity is capital-intensive and critical in the supply chain. Services include loading and unloading, and inventory management tools.

Transportation (32%)
The movement of products through the air, water, and land modes of transport. Asset tracking systems (GPS), temperature data loggers, and real-time environmental monitoring systems, are used to improve transportation efficiency.

Value Chain
Fragmented market, with multiple layers in the supply chain

Freight Forwarders ➔ Air/Ocean Carriers ➔ Handling Agents
Drivers

Growth drivers

The cold chain industry is driven by rising global demand for pharmaceutical products due to:

1. Growing demand for the latest high-value biopharma products (biologics & biosimilars), gene-based therapies, clinical trials which are highly temperature-sensitive

2. Initiatives to reduce communicable and infectious diseases (malaria, AIDS) by World Health Org, governmental, and non-governmental organizations

3. Rising demand to combat chronic and lifestyle-related diseases especially due to growing elderly population

By 2022, 30 of the top 50 biopharma products will require cold chain
Temperature Controlled Logistics - Porter’s 5 Forces

**Competitive Rivalry**
High

Little or no differentiation;
Multinational companies expand their businesses in new geographies with the formation of alliances or acquisitions

**New Entry Threat**
High

Many players and high capital intensity;
Nonetheless, the expanding global market of pharmaceutical products will encourage new businesses to enter the market.

**Buyer Power**
Moderate

Long-term relationships by contracts or agreements;
However, products are generally undifferentiated and switching cost is low.

**Supplier Power**
Moderate

Warehouse providers, IT solutions (WMS, tracking, temperature-monitoring), Transportation and industrial equipment industries;
High in number, however, switching costs are high and contracts are long

**Substitutes**
Low

No direct substitutes;
Majority of the manufacturing companies do not prefer in-house logistics (threat of backward integration is low).
Challenges

1. Securing strategic warehousing near the production facility and ports
2. High energy consumption and reliability:
   • 15% of the total operating cost
   • 55% of warehousing cost
3. Stringent government regulations to adopt better safety measures
4. Excursions caused by:
   a. Inconsistent logistics infrastructure
   b. Old-fashioned technology
   c. Lack of trained personnel
1. Consolidation of global market, growth by acquisition of local players
2. Increased use of IoT and technological solutions

- Chain **monitoring systems** with real-time environmental data monitoring, condition & location monitoring, constant connectivity and analytics
- **Shared end-to-end visibility** of inventory, location tracking, environmental conditions
- **Automated storage/retrieval systems** will make warehousing operations lean, resulting in cost savings. Storage of the same volume of pharmaceuticals, warehouses equipped with AS/RS use 40% less space than conventional warehouses
Global Main Players

- Numerous international and regional vendors
- M&A allow companies to deliver services at all end-to-end points
- Revenue from the global cold chain market for pharmaceuticals contributes to overall revenues but is not a key revenue stream for the companies
Puerto Rico Economic Growth & Population

- Shrinking population complicates prolonged recession dynamics
Puerto Rico’s Top Export & Import Destinations

<table>
<thead>
<tr>
<th>Country</th>
<th>Exports</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>47,266,271,574</td>
<td>22,642,507,335</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2,644,917,886</td>
<td>8,447,211,394</td>
</tr>
<tr>
<td>Italy</td>
<td>1,691,560,870</td>
<td>1,740,179,881</td>
</tr>
<tr>
<td>Germany</td>
<td>1,665,268,091</td>
<td>1,360,561,398</td>
</tr>
<tr>
<td>Spain</td>
<td>1,541,359,433</td>
<td>1,014,896,206</td>
</tr>
<tr>
<td>Japan</td>
<td>1,432,257,066</td>
<td>721,740,394</td>
</tr>
<tr>
<td>Belgium</td>
<td>1,060,781,714</td>
<td>689,978,250</td>
</tr>
<tr>
<td>Austria</td>
<td>985,967,649</td>
<td>684,444,834</td>
</tr>
<tr>
<td>China</td>
<td>655,746,325</td>
<td>602,362,458</td>
</tr>
<tr>
<td>France</td>
<td>450,302,069</td>
<td>600,538,542</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>396,257,804</td>
<td>547,179,987</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>240,421,089</td>
<td>469,041,978</td>
</tr>
<tr>
<td>Virgin Islands</td>
<td>236,865,276</td>
<td>461,896,318</td>
</tr>
<tr>
<td>Mexico</td>
<td>222,926,059</td>
<td>458,844,844</td>
</tr>
<tr>
<td>Brazil</td>
<td>170,487,894</td>
<td>383,175,946</td>
</tr>
<tr>
<td>Ireland</td>
<td>170,200,893</td>
<td>366,576,490</td>
</tr>
<tr>
<td>South Korea</td>
<td>127,070,742</td>
<td>337,777,702</td>
</tr>
<tr>
<td>Canada</td>
<td>118,243,146</td>
<td>302,851,480</td>
</tr>
<tr>
<td>Argentina</td>
<td>93,139,116</td>
<td>258,183,574</td>
</tr>
<tr>
<td>Singapore</td>
<td>61,970,725</td>
<td>189,358,870</td>
</tr>
</tbody>
</table>

Source: Junta de Planificación de Puerto Rico. Puerto Rico’s External Trade 2020 Tables.
Puerto Rico Pharma Corridors
Puerto Rico Pharma Industry

**Strengths**
- Strong manufacturing capabilities
- Skilled, productive and low-cost labor
- FDA regulations and local SOPs
- Robust IP protection
- Strategic geographic location
- Foreign Trade Zone designation
- Local and federal incentives
- Top 8 pharma exporter
- Supply chain reshoring trend
- Clinical trials, novel therapy R&D
- Temperature-controlled logistics
- Cargo capacity
- Stakeholder collaborations
- LATAM expansion

**Weaknesses**
- Declining pharma contribution to GDP
- Energy reliability / high costs
- Small domestic market
- Low R&D intensity
- Fiscal healthcare spend cuts
- Inefficient Intermodal capacity (e.g. rail, roads)
- Limited large move-in facilities

**Opportunities**
- Declining population growth / ageing demographics
- Skilled labor migration
- Rising demand for generics
- Rival state of the art manufacturing jurisdictions
- Regulated drug pricing

**Threats**
- Energy reliability / high costs
- Small domestic market
- Low R&D intensity
- Fiscal healthcare spend cuts
- Inefficient Intermodal capacity (e.g. rail, roads)
- Limited large move-in facilities
Puerto Rico Trade Trends

- Total PR exports on the rise since 2018, led by pharma which represent 74% of total exports and primarily go to mainland U.S.

Trade Balance Trends

- U.S. is major contributor of PR’s trade surplus

Puerto Rico Pharmaceutical Imports

Top Import Destinations

USD $Billions

- Ireland: $8.36B
- U.S.: $7.81B
- Switzerland: $1.71B
- Singapore: $1.35B
- Korea, South: $0.36B
- Rest of World: $0.21B
- Belgium: $0.19B
- Germany: $0.15B
- Canada: $0.13B
- Netherlands: $0.07B
- Italy: $0.06B
- China: $0.06B

Import Share

- Ireland, 41%
- U.S., 38%
- Switzerland, 8%
- Singapore, 7%
- Korea, South, 5%
- Rest of World, 6%
- Belgium, 3%
- Germany, 2%
- Canada, 2%
- Netherlands, 1%
- Italy, 1%
- China, 1%

PUERTO RICO PHARMA IMPORTS/EXPORTS

- **Active Ingredient**: 51 kilo tons/year, $20.5b/year
- **Drug Product**: 89 kilo tons/year, $48.6b/year
- **Finished Goods**
### Puerto Rico Pharmaceutical Trade by Value & Volume

<table>
<thead>
<tr>
<th></th>
<th>Exports</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$</td>
<td>KG</td>
</tr>
<tr>
<td><strong>U.S.</strong></td>
<td>36,118,914,280</td>
<td>54,131,369</td>
</tr>
<tr>
<td><strong>Virgin Islands</strong></td>
<td>26,712,448</td>
<td>259,193</td>
</tr>
<tr>
<td><strong>Rest of World</strong></td>
<td>12,463,604,322</td>
<td>34,955,569</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>48,609,231,050</td>
<td>89,346,130</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Imports</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$</td>
<td>KG</td>
</tr>
<tr>
<td><strong>U.S.</strong></td>
<td>7,808,718,794</td>
<td>35,848,835</td>
</tr>
<tr>
<td><strong>Virgin Islands</strong></td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td><strong>Rest of World</strong></td>
<td>12,649,359,971</td>
<td>15,048,958</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20,458,078,765</td>
<td>50,897,793</td>
</tr>
</tbody>
</table>

**Trade Balance**: 28,151,152,285

**Total volume**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>U.S.</strong></td>
<td>89,980,203</td>
<td>64%</td>
</tr>
<tr>
<td><strong>Virgin Islands</strong></td>
<td>259,193</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Rest of World</strong></td>
<td>50,004,527</td>
<td>36%</td>
</tr>
</tbody>
</table>

DOE Report:
Energy Resilience Solutions for the PR Grid (2018)

- PREPA’s SAIFI was calculated at 11.61, which is an order of magnitude higher than the U.S. average
- PREPA exceeded its SAIDI goal of 10 hours by 60%
- PREPA’s CAIDI was 180 minutes, up from 140 in 2013

System Average Interruption Duration Index (SAIDI)
System Average Interruption Frequency Index (SAIFI)
Customer Average Interruption Duration Index (CAIDI)
Electricity Reliability Report Data

January 2019: 0.2561
February 2019: 0.2619
March 2019: 0.2929
April 2019: 0.3438
May 2019: 0.4134
June 2019: 0.4010
July 2019: 0.4414
August 2019: 0.4331
September 2019: 0.4693
October 2019: 0.3768
November 2019: 0.4258
December 2019: 0.4308
January 2020: 0.2973
February 2020: 0.3281
March 2020: 0.3316
April 2020: 0.3999

Monthly Electric Reliability Report
<table>
<thead>
<tr>
<th>Stakeholder Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interview #1</strong></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
</tr>
<tr>
<td><strong>Opportunity</strong></td>
</tr>
<tr>
<td><strong>Interview #2</strong></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
</tr>
<tr>
<td><strong>Opportunity</strong></td>
</tr>
<tr>
<td><strong>Interview #3</strong></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
</tr>
<tr>
<td><strong>Opportunity</strong></td>
</tr>
<tr>
<td><strong>Interview #4</strong></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
</tr>
<tr>
<td><strong>Opportunity</strong></td>
</tr>
</tbody>
</table>
## Stakeholder Interviews

<table>
<thead>
<tr>
<th>Interviewer #5</th>
<th>Strength / Opportunity</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strength</strong></td>
<td>clinical Trials &amp; manufacturing, 90% of seeds grown in PR are used over the world, largest supplier of Spanish researchers/educators/scientists/workers</td>
<td></td>
</tr>
<tr>
<td><strong>Opportunity</strong></td>
<td>international transportation, manufacture effectiveness, silos (who &amp; how to target), airport infrastructure, refueling capacity, Aguadilla airport</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interviewer #6</th>
<th>Strength / Opportunity</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strength</strong></td>
<td>communications systems, KPI ship turn around</td>
<td></td>
</tr>
<tr>
<td><strong>Opportunity</strong></td>
<td>cost of cold chain materials (blankets), weak infrastructure outside of terminal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interviewer #7</th>
<th>Strength / Opportunity</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strength</strong></td>
<td>energy redundancy with generators (+/-), warehouse management systems, knowledge/skill of local workforce</td>
<td></td>
</tr>
<tr>
<td><strong>Opportunity</strong></td>
<td>unreliable energy, cost of energy, release at port &amp; customs with lengthy manual paperwork forms</td>
<td></td>
</tr>
<tr>
<td>Stakeholder Interviews</td>
<td>Non-Pharmaceutical Interviews</td>
<td>Strength / Opportunity</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td><strong>Interviewer #8</strong></td>
<td><strong>Strength</strong></td>
<td>robust infrastructure of industrial park, companies don’t pay real estate tax if it’s a PRIDCO building, rental price is $6/SqFt for manufacturing vs $12/SqFt private sector</td>
</tr>
<tr>
<td></td>
<td><strong>Opportunity</strong></td>
<td>~21% of buildings not move-in-ready, need repairs/updates, need access to more relief funds, need more lobbying for better requirements in PR</td>
</tr>
<tr>
<td><strong>Interviewer #9</strong></td>
<td><strong>Strength</strong></td>
<td>3PL logistics are all documented &amp; certified, opportunity as U.S. is short over 2 million SqFt of temp controlled space</td>
</tr>
<tr>
<td></td>
<td><strong>Opportunity</strong></td>
<td>unreliable energy, cost of energy + redundancy, cost of bldg materials is 3X what it was, facility availability (demand &gt; capacity), time for compliance/certification of retrofitting ~1yr</td>
</tr>
<tr>
<td><strong>Interviewer #10</strong></td>
<td><strong>Strength</strong></td>
<td>we have a cold in-transit storage / freight forwarder at airport that is expanding, + CEIV certified, pharma needs more 15-25 storage capacity (~4000 skits)</td>
</tr>
<tr>
<td></td>
<td><strong>Opportunity</strong></td>
<td>very expensive cost (several million $) to build coolers with redundancy</td>
</tr>
<tr>
<td>Interviewer</td>
<td>Strength</td>
<td>Opportunity</td>
</tr>
<tr>
<td>--------------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>#11</td>
<td>Strength</td>
<td></td>
</tr>
<tr>
<td>#12</td>
<td>Strength</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Opportunity</td>
<td></td>
</tr>
</tbody>
</table>
Global Reefer Container Freight Trends

- Cargo demand growth and supply chain disruptions contributing to reefer shortages and rising freight rates

Source: https://www.drewry.co.uk/news/reefer-con
Singapore Pharmaceutical Industry
Pharmaceutical & Medical Device Companies
Singapore Pharma Market Outlook

Pharmaceutical & Organic Chemicals Trade Balance

• Pharmaceutical production market $29.3bn
  – Forecast to grow at a CAGR of 4.9% between 2021-2026 (Euromonitor)

• Singapore’s pharmaceutical and organic chemical exports account for ~2% of global exports
  – $20 bn exports; ranks #15 globally
  – $10 bn trade surplus and positioned for continued growth

Source: UNCTAD; includes HS29 & HS30 commodities only
Singapore Pharma Industry

S:
- Strong manufacturing hub
- Availability of ready-built facilities
- Large government spending on research, innovation and education
- Strong skilled pharmaceutical workforce
- ASEAN logistic hub
- Hosts top 20 of 25 logistics companies
- Robust technological advancements
- Strong regulations
- Stable political landscape
- Investment to gain market share in neighboring countries as regional hub
- Global pharmaceutical exports growth
- Lead a role in trade and commerce as part of China’s Belt and Road Initiative
- Advancing pharmaceutical infrastructure with cutting edge expertise (e.g., automation)
- Establishing a lead in precision medicine for Asian genotypes

W:
- Lack of expert local manpower for niche positions (especially in innovation)
- High labor costs
- Rising costs of living and doing business
- Small domestic pharmaceutical market
- Small domestic population for clinical trials
- Growth of logistics infrastructure in neighboring countries (China, Malaysia, Thailand)
- Increased competition both domestically and regionally
- Heavy reliance on China and India for APIs
- Rising counterfeit pharmaceutical market
- Loss of revenue due to patent expirations

O:
- Strong regulations
- Stable political landscape
- ASEAN logistic hub
- Hosts top 20 of 25 logistics companies
- Robust technological advancements
- Strong skilled pharmaceutical workforce
- Large government spending on research, innovation and education
- Strong manufacturing hub
- Availability of ready-built facilities
- Investment to gain market share in neighboring countries as regional hub
- Global pharmaceutical exports growth
- Lead a role in trade and commerce as part of China’s Belt and Road Initiative
- Advancing pharmaceutical infrastructure with cutting edge expertise (e.g., automation)
- Establishing a lead in precision medicine for Asian genotypes

T:
- Loss of revenue due to patent expirations
- Heavy reliance on China and India for APIs
- Rising counterfeit pharmaceutical market
- Increased competition both domestically and regionally
- Robust technological advancements
- Strong skilled pharmaceutical workforce
- Large government spending on research, innovation and education
- Strong manufacturing hub
- Availability of ready-built facilities
- Investment to gain market share in neighboring countries as regional hub
- Global pharmaceutical exports growth
- Lead a role in trade and commerce as part of China’s Belt and Road Initiative
- Advancing pharmaceutical infrastructure with cutting edge expertise (e.g., automation)
- Establishing a lead in precision medicine for Asian genotypes
Ireland
Pharmaceutical Industry
Pharmaceutical & Medical Device Companies

- 85+ biopharma companies
- 50 out of 90 facilities are FDA approved

• Pharmaceutical production market $119 billion
  – Forecast to grow at a CAGR of 3.2% between 2021-2026 (Euromonitor)

• Ireland’s pharmaceutical and organic chemical exports account for ~10% of global exports
  – $106 bn exports; Third behind Germany
  – $90 bn trade surplus and positioned for continued growth
Ireland Pharma Industry

Strengths:
- Manufacturing hub with state of art strategic facilities
- Consistent industry strategy
- Largest net exporter of pharma in the EU
- Young, talented and skilled population
- Below EU average labor costs
- 1st for adaptability & flexibility
- 1st in Europe for investment incentives
  - Low corporate tax rate (12.5%)
  - 25% R&D tax credit
- 2nd most competitive economy in EU
- Hosts top 10 pharma companies
- Strong regulatory framework; FDA approved
- Cross-industry collaborations
- Only remaining English-speaking EU nation
- Well positioned to serve EU and U.S.
- Expansion at new manufacturing facilities
- Brexit – former UK capacity going to Ireland

Weaknesses:
- Small domestic market
- Limited Irish public awareness of life science sector
- FDI dependence
- EU convergence pricing system
- Federal cost-containment measures
- Low logistics performance index
- Fragmented logistics market
- Low container port throughput
- Small vessels & low container carrying capacity

Opportunities:
- 1st for adaptability & flexibility
- 1st in Europe for investment incentives
- Low corporate tax rate (12.5%)
- 25% R&D tax credit
- 2nd most competitive economy in EU
- Hosts top 10 pharma companies
- Strong regulatory framework; FDA approved
- Cross-industry collaborations

Threats:
- Low-value manufacturing
- Patent expirations / generic drug competition
- U.S. and OECD tax laws aimed at reducing Ireland’s tax haven attractiveness
Ireland’s Pharma Stakeholders

Industry Associations
  - IDA Ireland
  - Irish Center for Business Excellence
  - IBEC
  - Irish Pharma. & Healthcare Assoc.

Alliances
  - Health Products Regulatory Authority
  - The National Institute for Bioprocessing Research and Training (NIBRT)
  - European Federation of Pharma Industries and Assoc.

Government-Supported
  - University College Dublin
  - Trinity College Dublin

University
  - Dublin City University
  - The Institute of Technology, Sligo

Pharma Companies
  - 85+ biopharma companies All World’s top 10

Cold Chain Logistics
  - Marken
  - CMLS
  - Caffrey International
  - Swift Freeze (new)
  - DawsonPharma