

**63° Congreso Internacional**  
de Ingeniería Naval  
e Industria Marítima

Madrid, 24-26 abril, 2024



TRANSFORMANDO  
LOS OCÉANOS:  
INNOVACIÓN e ingeniería naval para  
un mundo CONECTADO y SOSTENIBLE



Ship Manoeuvring Simulation, Port Engineering and Maritime Safety Consulting Company



## Predictive Simulation of Onshore Power Supply Requirements For Ports

**Raúl Atienza**

Technical, Innovation and  
Quality Management Director  
Siport21



COMPANY WITH  
QUALITY SYSTEM  
CERTIFIED BY DNV  
ISO 9001

## 1. Features



### Port Consultancy Company (Madrid, Spain)



25  
years



+1500  
projects



58  
countries



22  
workers

### Ship Maneuvering Simulation Center - DNV



+1800  
sailors



+600 training  
courses



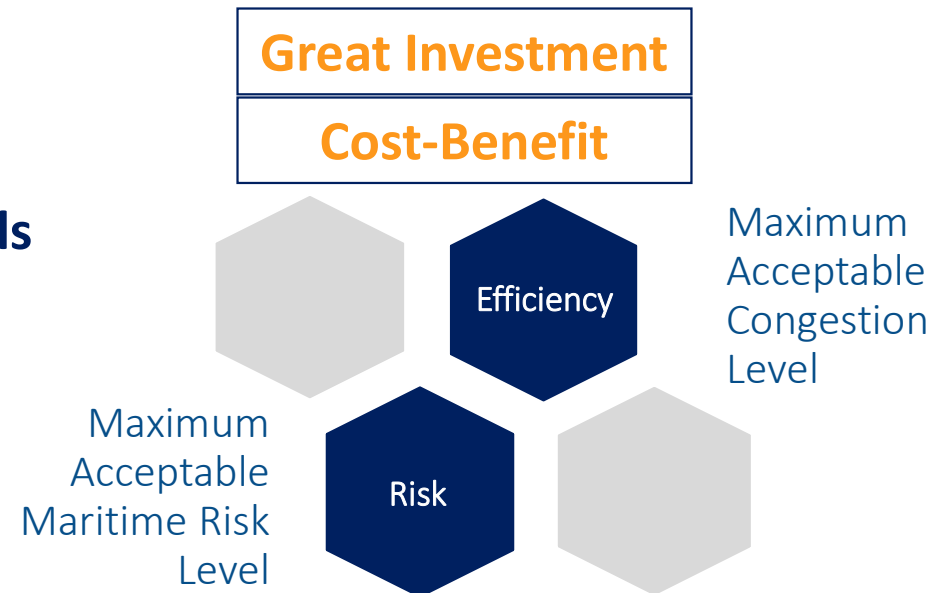
50 International  
shipping lines



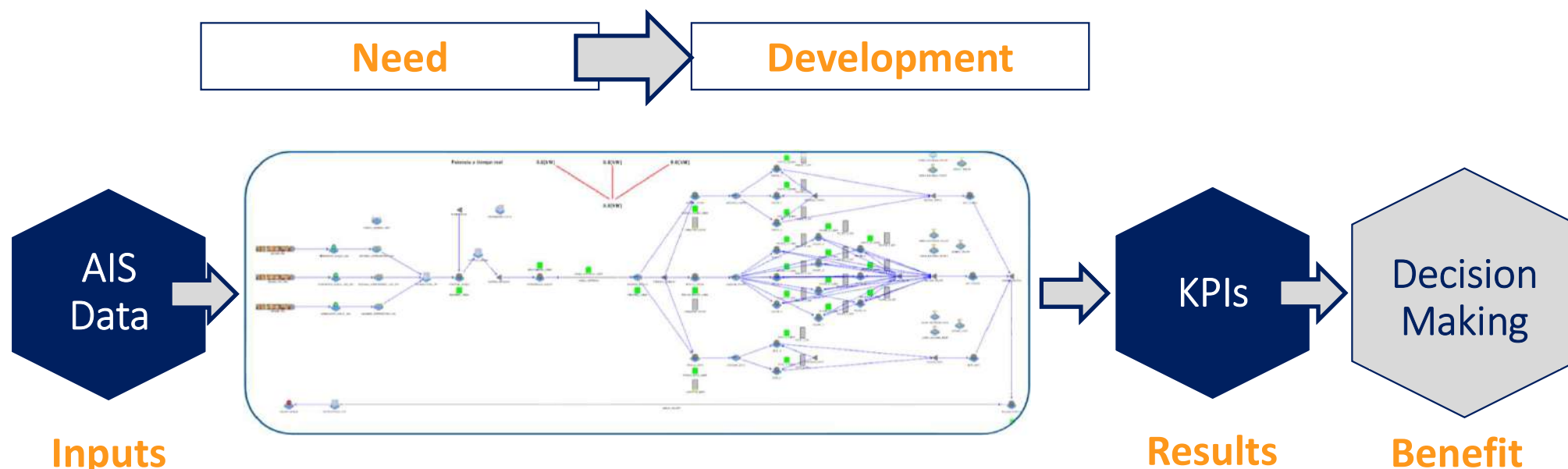
## 2. Bases

### Projects Involving **Port Infrastructure** Developments

- ↳ Dredging to Deepen Access Channels
- ↳ **Masterplans** – New Terminals
- ↳ Maritime Traffic Increase
- ↳ Changes in Rules & Regulations
- ↳ ...



### 3. Methodology



**Simulation of Maritime Traffic Flow at Port**

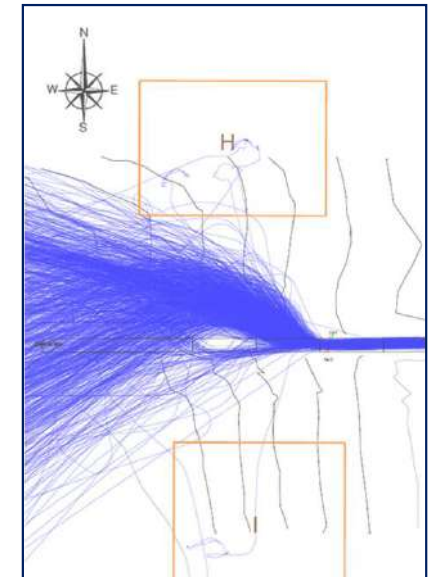
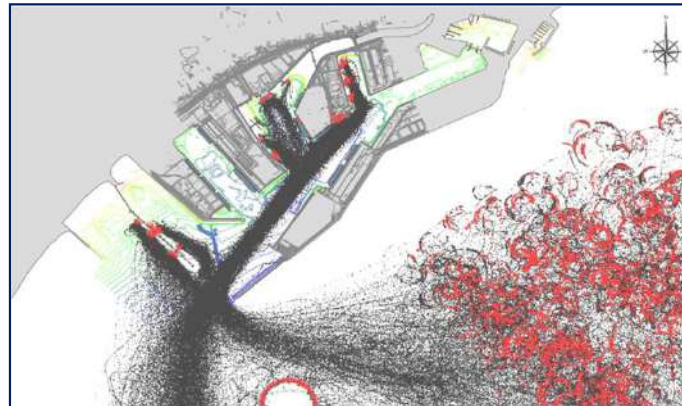
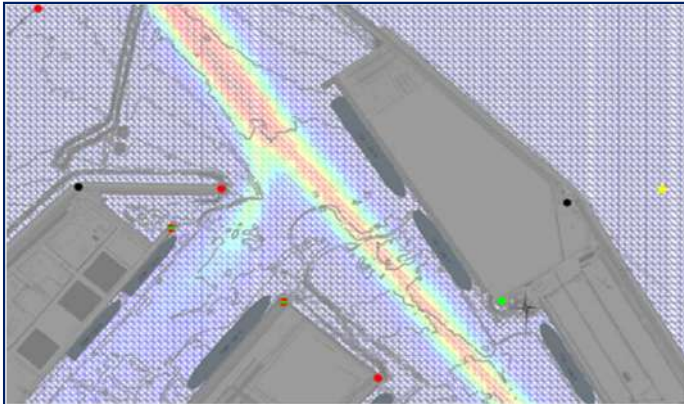
**Work Methodology for the Cost / Benefit Assessment**



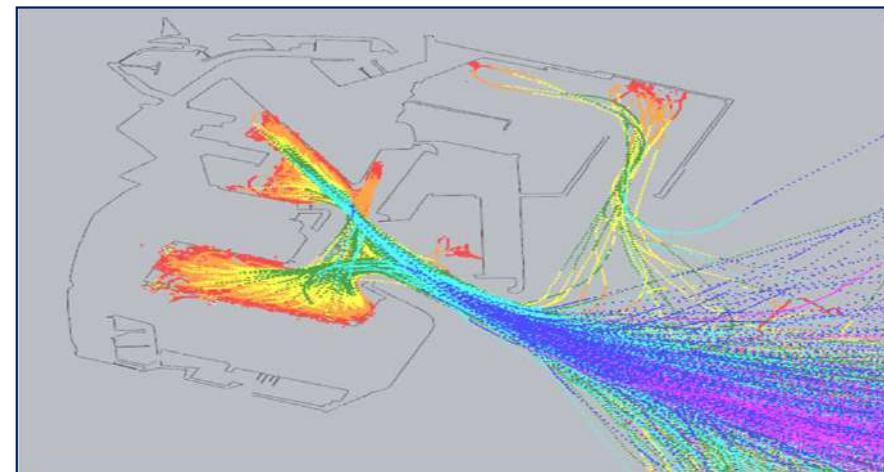
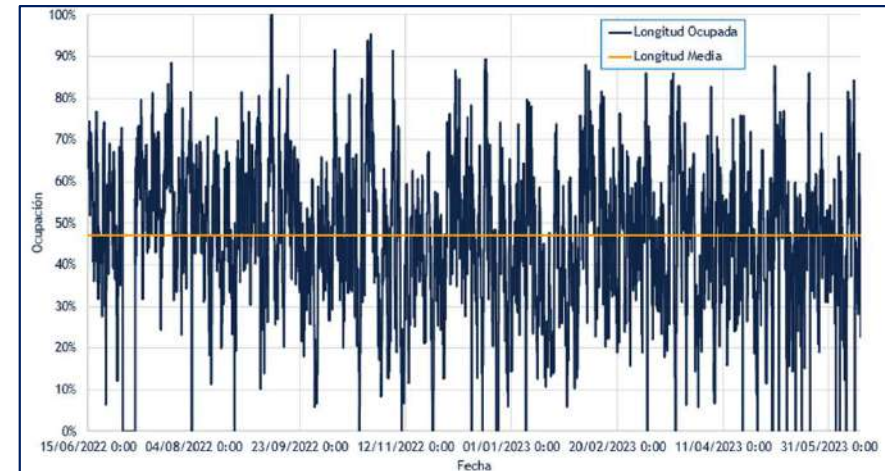
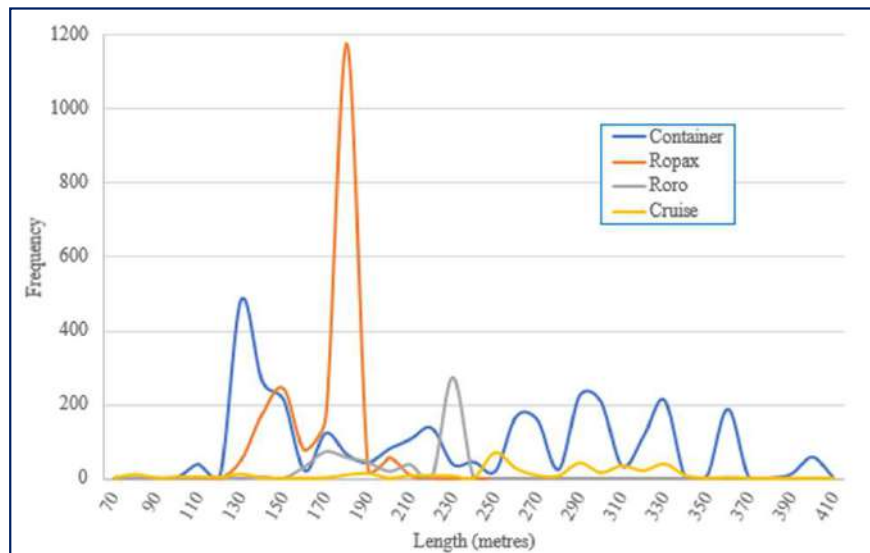
## 4. AIS Data Analysis

### AIS Data

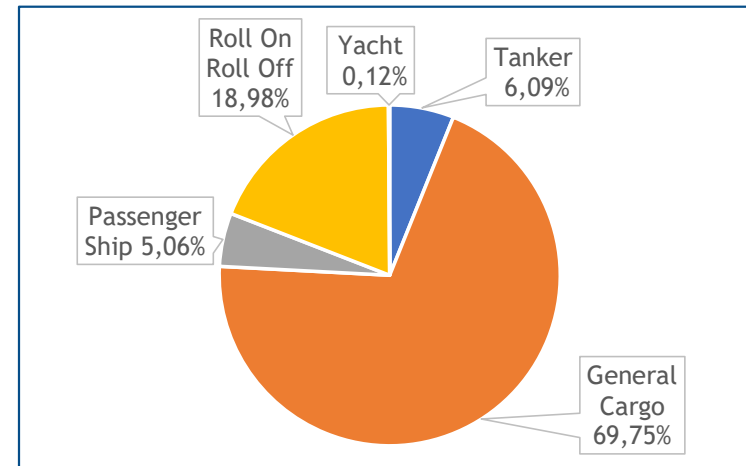
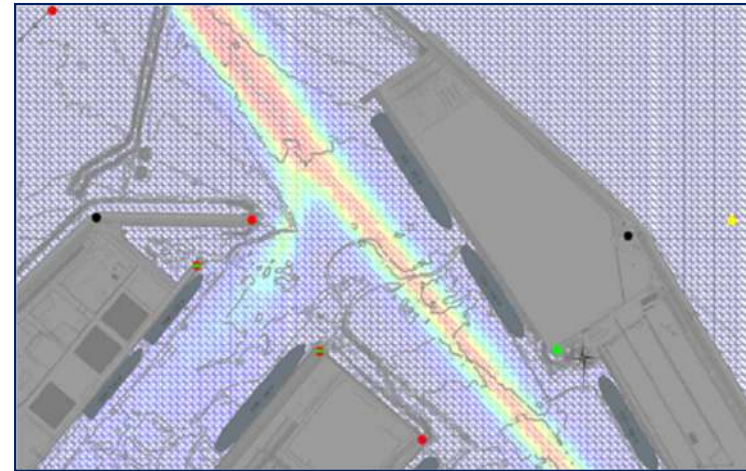
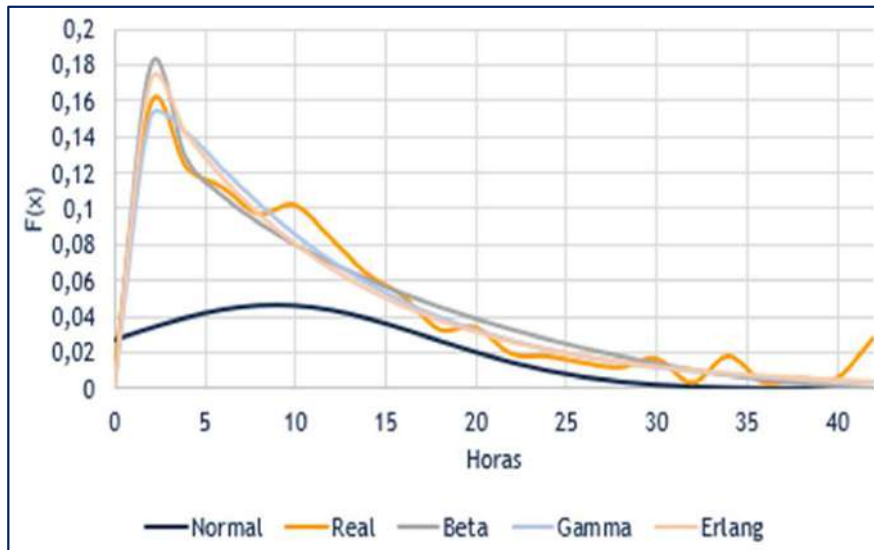
- Large Data Volume
  - **Big Data, DataAnalytics & DataViz** techniques
  - Detailed Quantitative Description of the **Traffic Flow**
- 
- **Vessel Types, Size Distributions** and Draught
  - **Routes & Speed, Seasonality**
  - **Berth Stays (Number & Time)**



## 4. AIS Data Analysis



## 4. AIS Data Analysis



## 5. KPIs Definition

### KPIs

- Key Performance Indicators ad-hoc for each Project
- Aligned with Individual Projects Aims & Particularities
- Parameters for **Calibration** (Base Model) & **Evaluation** (Alternative Scenarios)



#### Efficiency

- Terminals Occupancy Level
- Service Time (Loading / Unloading)
- Waiting Time & Causes (Bottlenecks)



#### Power Demand

- Substations Requirements (Trends, Average, Peaks, etc.)
- Percentage to Cover (Regulations)



#### Financial

- Electricity Fees
- Required System Sources (Operators, Cranes, etc.)



#### Environmental

- Carbon Footprint Reduction
- Elimination of Noise and Vibrations

## 6. Model Building



- **Simulation** of Port Traffic & OPS Connection
- **OPS Connection** at Terminal
- **Discrete Event Simulator**

- **Sequential Process**
- **Joint Decision-Making**: Rules, Infrastructure, ...
- **Analyze Period**: One Year (Seasonality), Several Random Repetitions (**Statistical Analysis**)



### COMPONENTS

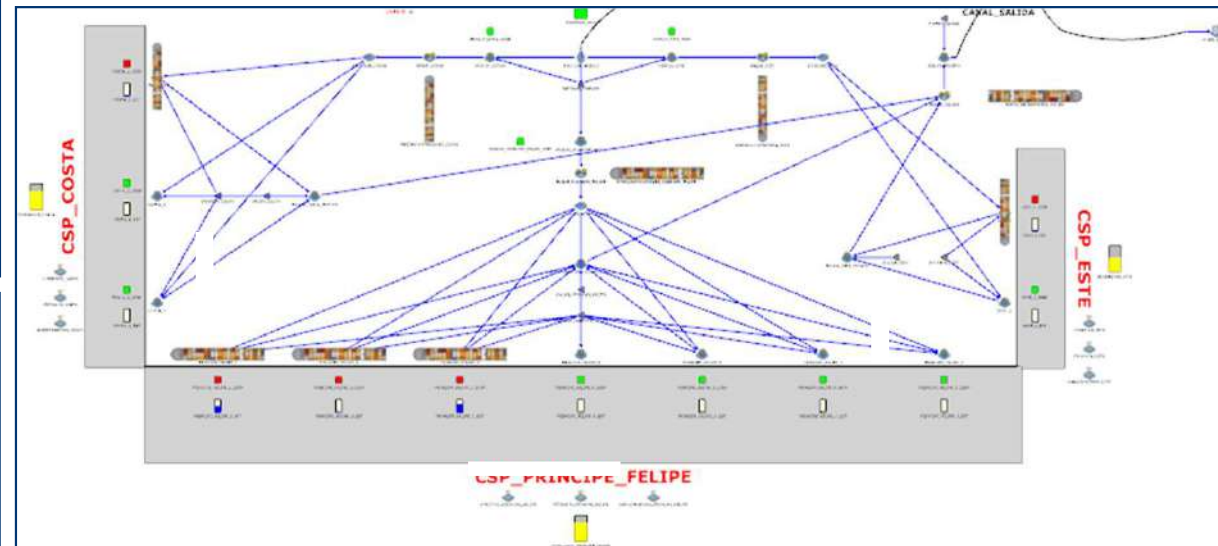
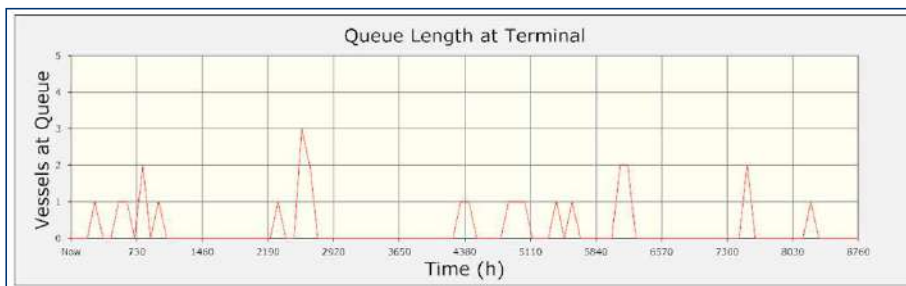
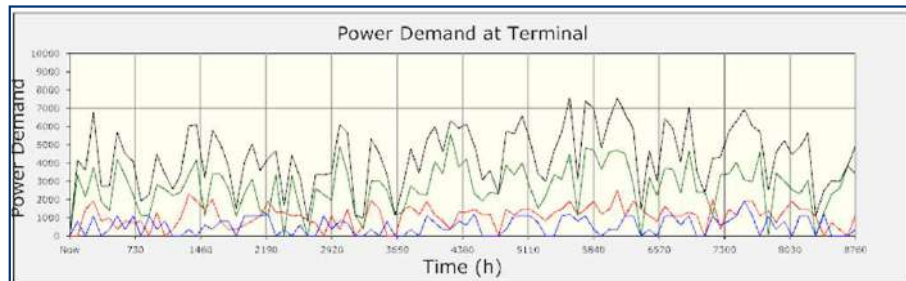
|                        |                                                                                                                                                                      |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vessels (Dynamic)      | <ul style="list-style-type: none"><li>• <b>SIZE</b>: Length, Beam, Draught</li><li>• <b>ROUTE</b>: Destination, Time at Berth</li><li>• <b>SEASONALITY</b></li></ul> |
| Port Elements (Static) | <ul style="list-style-type: none"><li>• <b>BERTHS</b>: Number of Berths, Berthing Length</li><li>• <b>CAPACITY</b>: Length, Simultaneity, Power Demand</li></ul>     |
| Other Conditions       | <ul style="list-style-type: none"><li>• <b>ENVIROMENTAL</b>: Wind, Tide, Waves</li><li>• <b>REGULATIONS</b>: Carbon Footprint, OPS</li></ul>                         |

## 6. Model Building - JaamSim



SiOPS21

- Discrete Event Simulation Software
- Input & Output Processing - Performance Analysis
- Planning & Decision-Making



## 6. Model Building



*Video*

## 6. Model Building - Calibration



SiOPS21

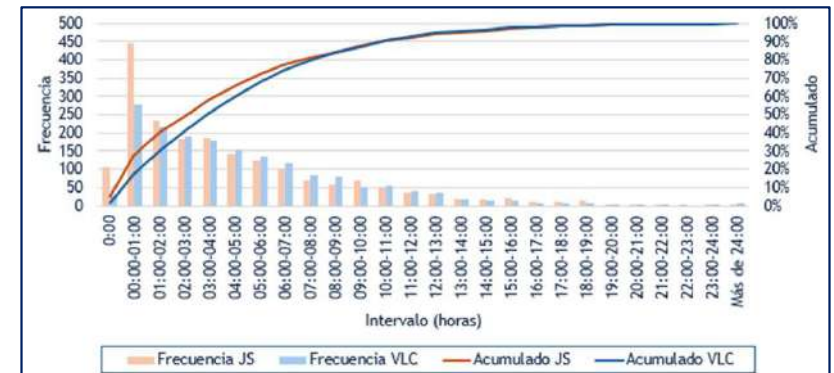
Calibration  
Simulations

- Current Situation
- Inputs from Analyzed Info (AIS data)
- Other Aspects to Consider

Fine-Tuning

Comparison  
(KPIs)

- Model Parameters
- Level of Detail
- Additional Inputs
- Model Results vs. AIS Data
- Acceptable Deviations

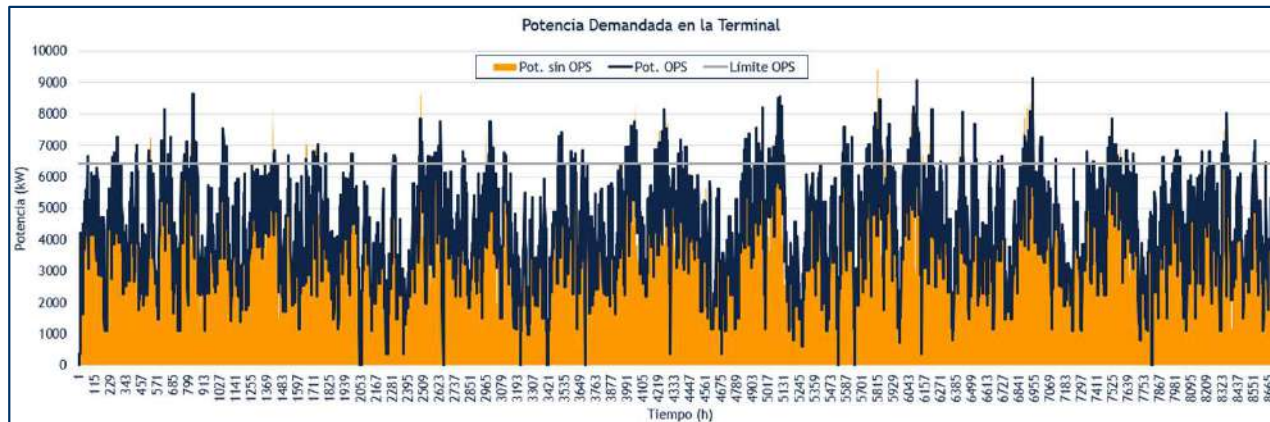


## 6. Model Building - Decision Making



- Queue length
- Power Demand
- Arrival Times

| Entorno        | Promedio | Desviación | 99%  | 95%  | 90%  | 85%  | 80%  |
|----------------|----------|------------|------|------|------|------|------|
| <i>Port</i>    | 4109     | 1553       | 7720 | 6662 | 6098 | 5718 | 5415 |
| <i>JaamSim</i> | 4317     | 1635       | 8120 | 7006 | 6412 | 6011 | 5693 |



| Tiempo de Cola      | N.º Buques |
|---------------------|------------|
| Menos de 6 horas    | 257        |
| Entre 6 y 12 horas  | 134        |
| Entre 12 y 24 horas | 66         |
| Más de 24 horas     | 54         |

## 7. Alternative Scenarios



SiOPS21

- Alternative Scenarios Definition
- Potential Impact on Current Traffic Flow

**KPIs Justified  
Decision-Making**

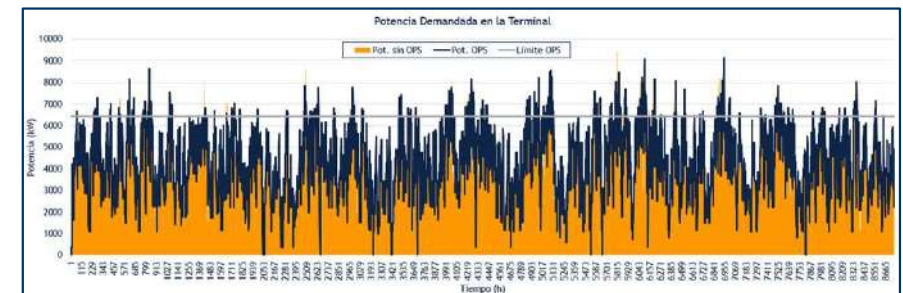
### VERSATILITY

- New Infrastructures
- Traffic Volume Increase

### LIFESPAN

- Traffic Forecast
- Historical Data
- Masterplans

**CURRENT + FUTURE (OPTIMISTIC + PESIMISTIC)**



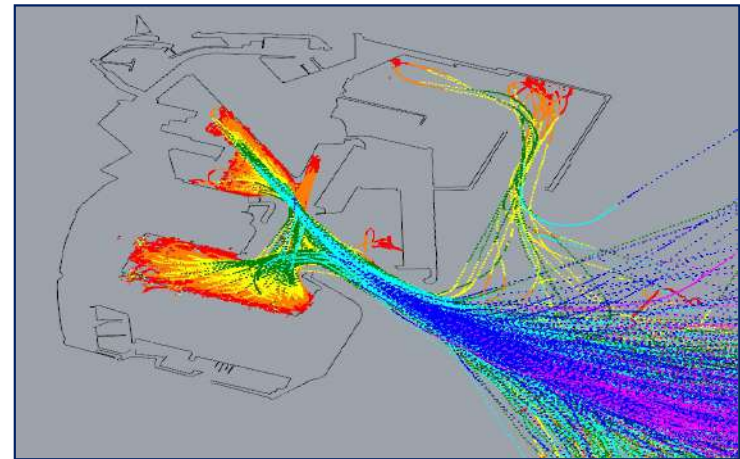
**Power  
limitation  
(90%)**

| Demanda                | Horas de Conexión | %  |
|------------------------|-------------------|----|
| Demanda Inferior a OPS | 7874              | 90 |
| Demanda Superior a OPS | 886               | 10 |

| Tiempo de Cola      | N.º Buques |
|---------------------|------------|
| Menos de 6 horas    | 282        |
| Entre 6 y 12 horas  | 121        |
| Entre 12 y 24 horas | 97         |
| Más de 24 horas     | 69         |

## 8. Conclusions

- Electricity Grid Dimensioning Tool
- Support for Green Energy Production Infrastructures
- Advanced Tool for Berthing Management
- Utilization for Risk-Efficiency Optimum Balance
- *Smart Ports working Methodologies*
- *Siport21 specialized Experience*





Consultoría Especializada en Estudios de Maniobra y Comportamiento de Buques

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Contacto:  
[siport21@siport21.es](mailto:siport21@siport21.es)

Siport21  
Chile, 8 - 28290 Las Matas (Madrid) - España  
Tel.: 0034 91 630 70 73  
[www.siport21.com](http://www.siport21.com)



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