System digital twin solution provided by © Systemic Intelligence

WorldLab™ is a system digital twin modeling & simulation platform based on the formal modeling language Sigma™ developed by Systemic Intelligence

- **CONTEXT**

Logistics and supply chain involve the management of the flow of goods from their origin to the end consumers, including the intermediary steps of storage, transformation, and transportation.

Making decisions for the design, transformation or tactical and strategic operational planning of logistic infrastructures & networks is complex given the intricate nature of logistics systems which have a multitude of internal components with diverse characteristics, managing various stages such as storage, merging, splitting and transportation through various means. These logistic systems also grapple with a range of dynamic flows and constraints —frequently characterized by high levels of uncertainty— emanating from various external sources.

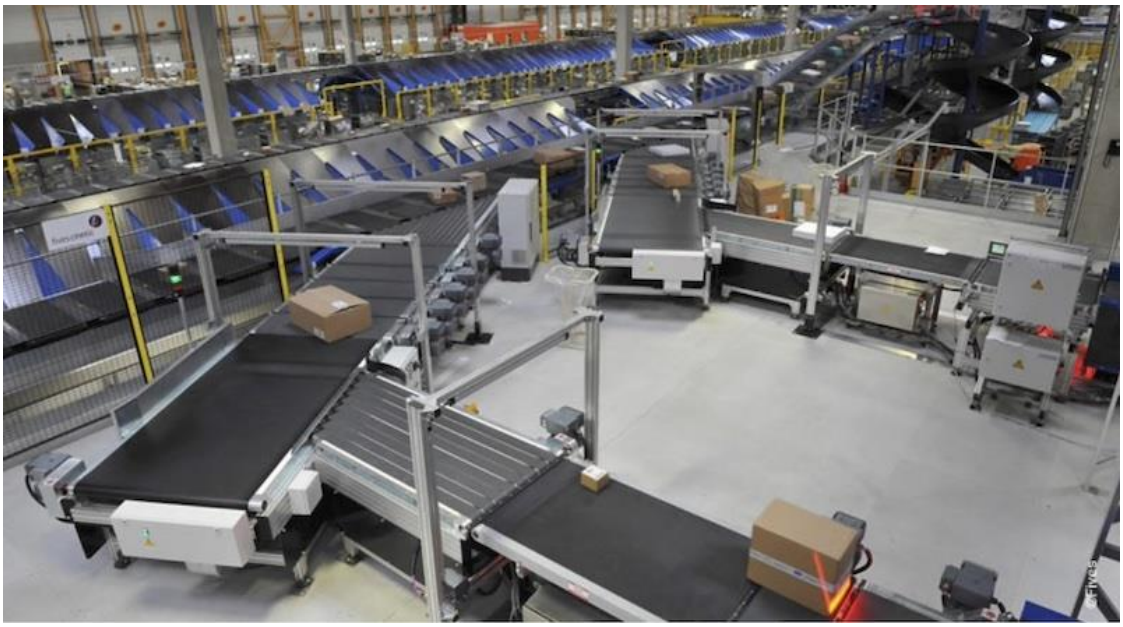
This complexity introduces a layer of challenge to decision-making processes, necessitating thoughtful consideration of diverse elements both within and beyond the logistics environment.

Whatever the systemic level of your concern: intralogistics, logistic node, medium-size logistic hub, large-scale logistic network, etc. WorldLab™ can help you finding optimum architectures & configurations for existing / new logistic infrastructures or logistic transformation projects, and facilitate your day-to-day / month-to-month decision making for the logistic systems that you operate.

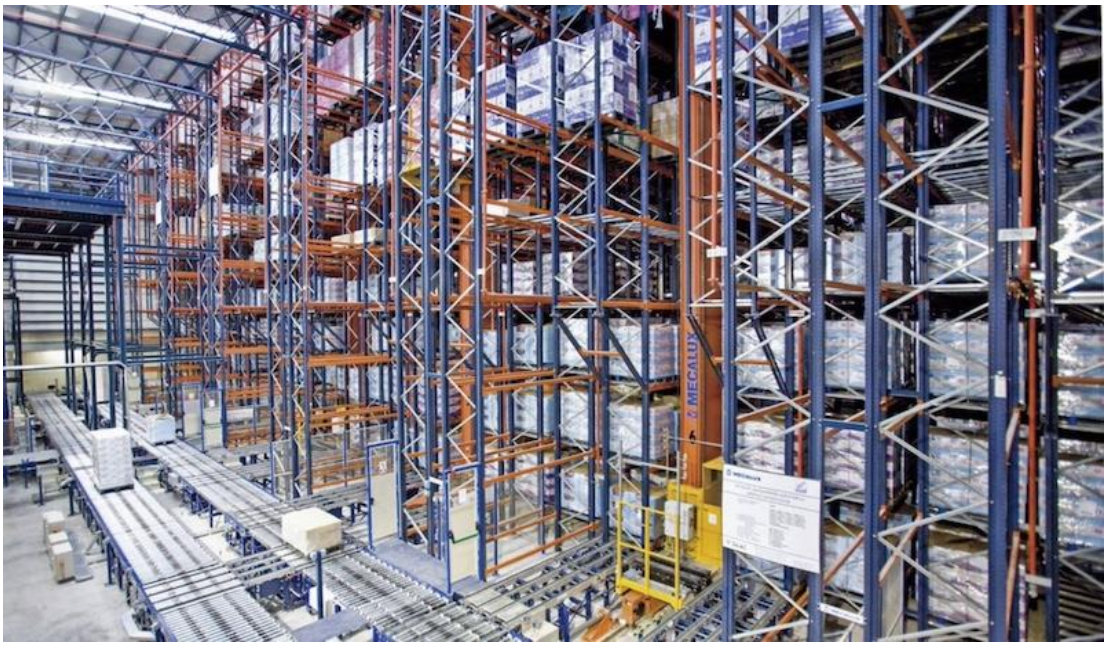
Study case 1: Finding optimum architectural design for an automated warehouse

- **The challenge**

Our client sells highly automated warehouses. However, the operations of a warehouse depend greatly on the season and of the availability of human & technical resources which may vary over time. In order to make the best system-level design decisions, it was necessary to obtain, for a given warehouse configuration and in a given operating scenario, key quantitative insights on the logistic macro-performances of the automated warehouse in order to be able to compare various possible competing industrial architectures and find the best solution to efficiently prepare more in-depth engineering analyses using dedicated tools.



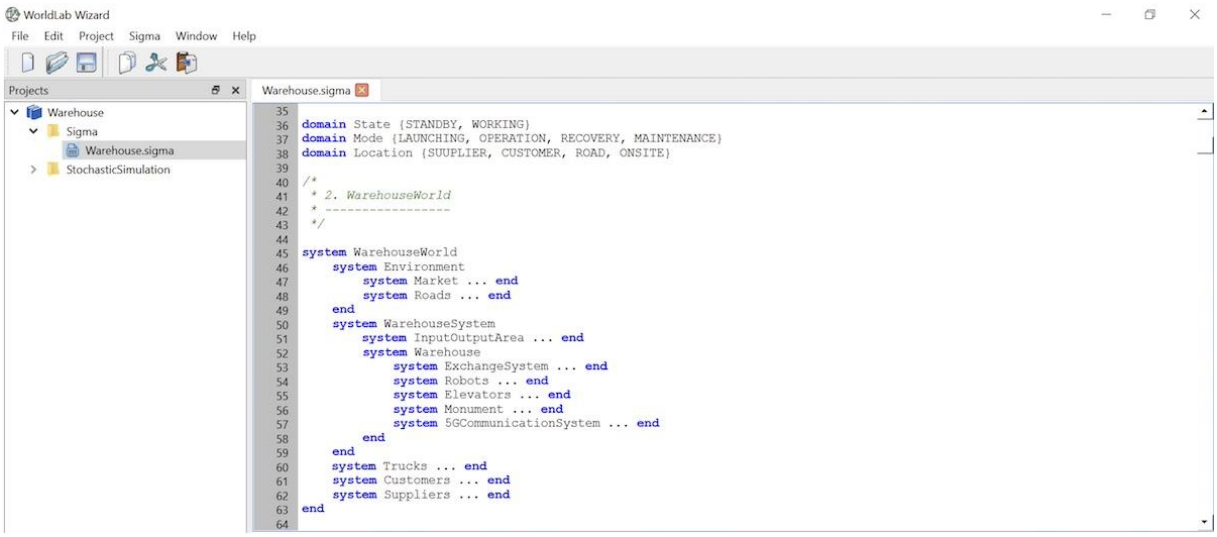
Exchange areas of an automated warehouse



Storing areas of an automated warehouse

- **APPROACH**

To answer our customer design & operation challenge, we constructed a systemic digital twin of a generic automated warehouse that included an exchange infrastructure, an automated storing zone and a number of robots that are moving back & forth packs from outside the warehouse to the storage zone. We equipped then the design process of such a warehouse with it, which allowed the warehouse design team to simulate & evaluate a number of design variants for each customer and to identify the best ones. The same tool can then also be used in operation mode to alert the operators of an abnormal behavior of the automated warehouse during operations.



Fragement of a system model – written in ∑ – for an automated warehouse、

- ## CREATED VALUE by CESAMES

a. FEATURES

Service features that were deployed:

- Structural & behavioral modeling of an automated warehouse
- Analysis of operational data of an automated warehouse environment

Product features that were used:

- Implementation of a systemic model in Σ™
- Connection with external & internal data sources
- Step-by-step and stochastic simulation
- Scenario simulation and evaluation

b. ADVANTAGES

Traffic trends were modeled & simulated in order to capture the evolution among time of distribution traffics which are the core outputs that trigger the inputs of an automated warehouse.

All business & industrial hazards & perturbations (e.g. failures & maintenance periods of the warehouse industrial devices, evolution of the warehouse structure, seasonality of operations, lack of resources, etc.) that an automated warehouse has to deal with, was modeled without any problem

Systemic digital twin maintenance & evolution could be regularly achieved with a very low effort

c. BENEFITS

Benefit #1: the very first benefit of our approach mentioned by our client was the construction of a shared global & transversal quantitative vision of an automated warehouse which was currently lacking.

Benefit #2: our approach led to the identification of optimal design choices for an automated warehouse, taking into account all the commercial & industrial constraints and hazards that it must face.

Study case 2: Analyzing the transformation of the logistic activities of a maritime hub

- ### The challenge

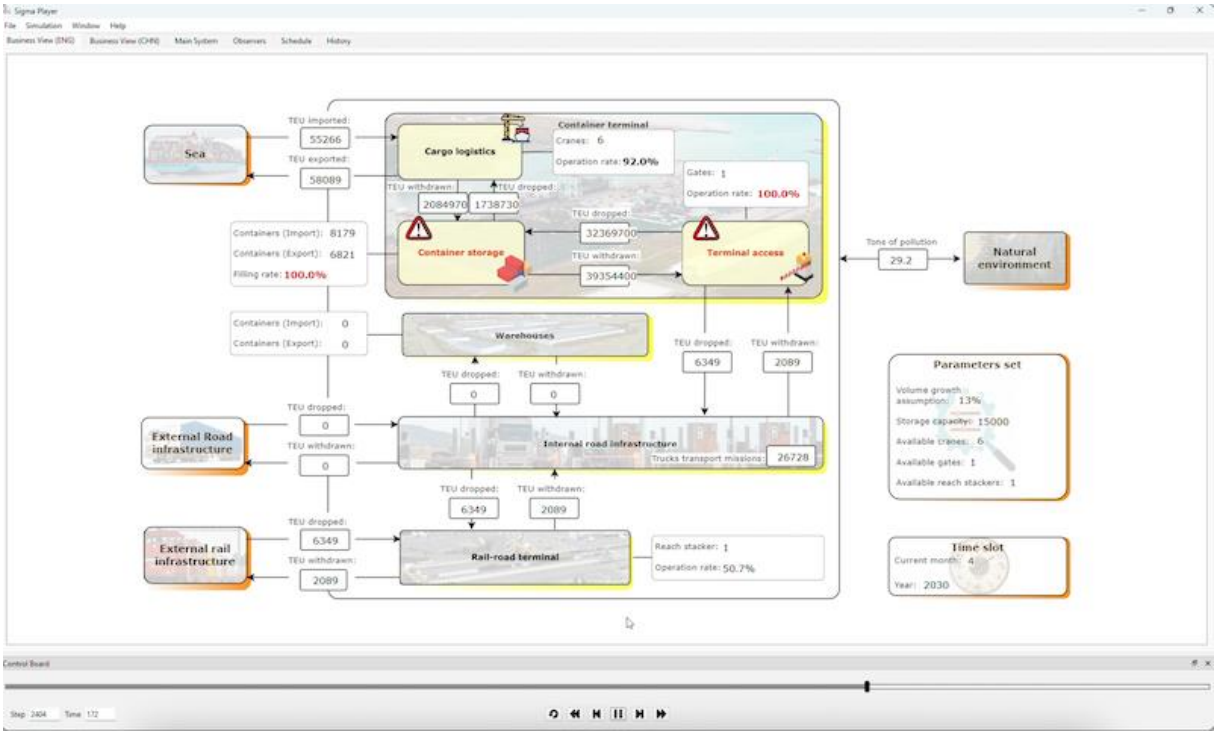
In the context of an expected, but still uncertain, strong forthcoming growth of its container traffic, a large French industrial seaport must secure a major investment plan dedicated to the construction of new logistic infrastructures to support that growth and assess the resilience of its current logistics facilities in order to minimize the impacts of its logistic transformation on these facilities which are managing the different traffic (i.e. ships, containers, trucks, railways and river barges) supported by the port.

View of an industrial seaport

Areas of interest in the industrial seaport

Our approach

Our answer was based on the construction of a systemic digital twin of the transformation perimeter within the industrial port, relying on a realistic systemic model of this industrial system, including its environment, which allowed us to simulate it and evaluate the key performance indicators that are measuring the impacts of the transformation of the container traffic of the port on the logistic infrastructures that it manages.



Simulation of the time evolution of the industrial port under a contrainer trafic evolution hypothesis

CREATED VALUE by CESAMES

a. FEATURES

Service features that were deployed in this case:

- Structural & behavioral modeling of an industrial port
- Analysis of operational data of an industrial port environment

Product features that were used in this case:

- Implementation of a systemic model in Σ™
- Connection with external data sources
- Step-by-step and stochastic simulation
- Scenario simulation and evaluation

b. ADVANTAGES

Container traffic trends were modeled and simulated in order to capture the evolution over time of the main logistic inputs of the industrial port under study.

All business & industrial hazards and disruptions (e.g. variations & changes in operating modes, seasonality of operations, weather conditions, traffic jams, lack of resources, etc.) that the industrial port must face were integrated in our model.

Systemic digital twin maintenance & evolution could be regularly achieved with a very low effort.

c. BENEFITS

Benefit #1: the very first benefit of our approach mentioned by our client was the construction of a shared global & transversal quantitative vision of the scope of interest in the industrial port which was lacking within the port teams.

Benefit #2: our approach made it possible to identify the main business impacts of the targeted logistic transformation on the port’s existing logistic infrastructures and made it possible to make the optimal design choices for the new logistic facilities to construct.

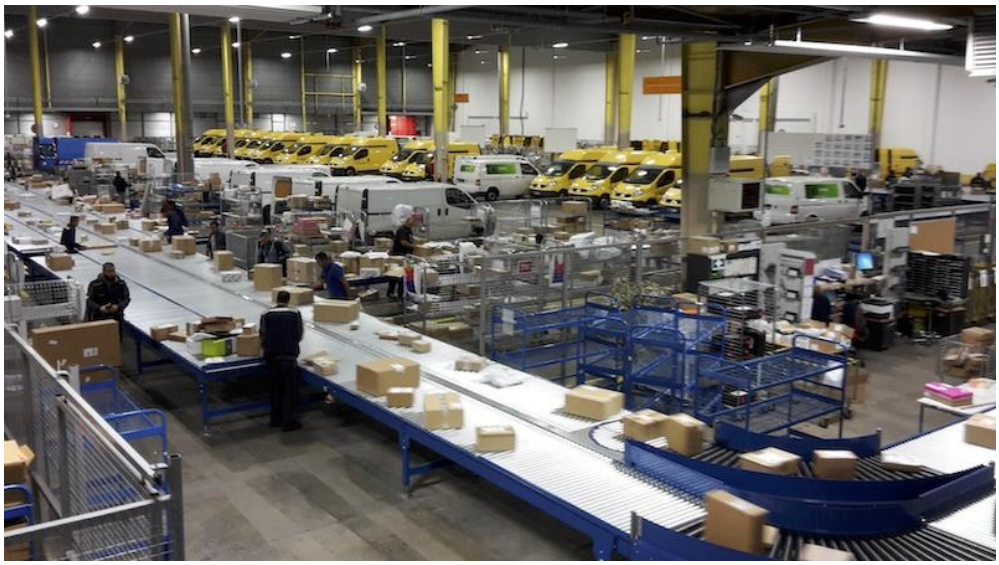
Study case 3: Facilitating decision making for the evolution of a large logistic network

- ### The challenge

Our client is a historic mail operator: it operates a large-scale mail distribution network together with the associated industrial infrastructure which manages the collection, transportation & delivery of letters & parcels at national level. However, the constant decline in postal traffic, combined with the explosion of parcels and cross-border exchanges, is calling into question the traditional mail sorting & distribution model.

Our client is therefore faced with a critical industrial challenge consisting of modernizing its industrial letter & parcel management industrial tool in the near future in order to ensure the sustainability of its activity, while guaranteeing optimal customer satisfaction.

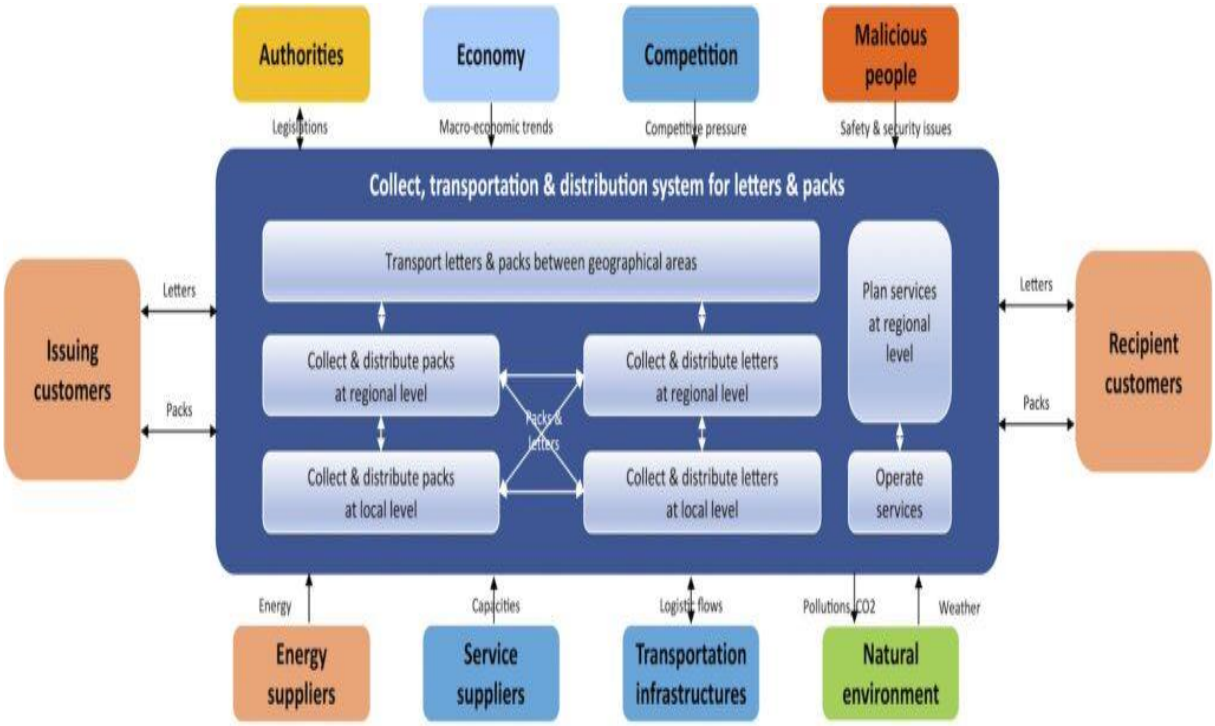
Collecting locally the mail by a postman



Example of an industrial letter & pack management platform

• Our approach

To meet the industrial challenge of our customer, we proposed to construct a systemic digital twin of the collect, transportation & distribution system for letters & packs, based on a realistic systemic model whose overall structure is presented here, which allowed us to simulate it and to evaluate & compare different coarse grain evolution scenarios for this system.



High-level systemic model of the letter & pack collect, transportation & distribution system

• CREATED VALUE by CESAMES

a. FEATURES

Service features that were deployed here:

- Structural and behavioral modeling and analysis of operational data of the system for collecting, transporting and distributing letters and packages

Product features that were used here:

- Implementation of a systemic model in Σ™
- Connection with internal operational data sources
- Step-by-step and stochastic simulation
- Scenario simulation and evaluation

b. ADVANTAGES

Customer behaviors and traffic trends were modeled and simulated in order to capture the evolution of letter and parcel traffic over time.
All commercial and industrial hazards and disruptions (e.g. breakdowns and maintenance periods of industrial distribution machines and transport devices, seasonality of traffic, lack

of resources, etc.) presented by the considered collection, transport and distribution system for letters and packages, was modeled without any problem.
Systemic digital twin maintenance & evolution could be regularly achieved with a very low effort.

BENEFITS

Benefit #1: the very first benefit of our approach mentioned by our client was the construction of a shared global & transversal quantitative vision on the considered system of collection, transport and distribution of letters and parcels.

Benefit #2: our approach led to the evaluation of different scenarios for the evolution of our client's system for collecting, transporting and distributing letters and packages and made it possible to make the optimal design choices for its transformation.

More about Systemic Intelligence, WorldLab™ and Sigma™ on:
www.systemic-intelligence.net