The bridge to reality

SCM Optimization and Simulation

SimChain Toolset

Dr. Till Fechteler

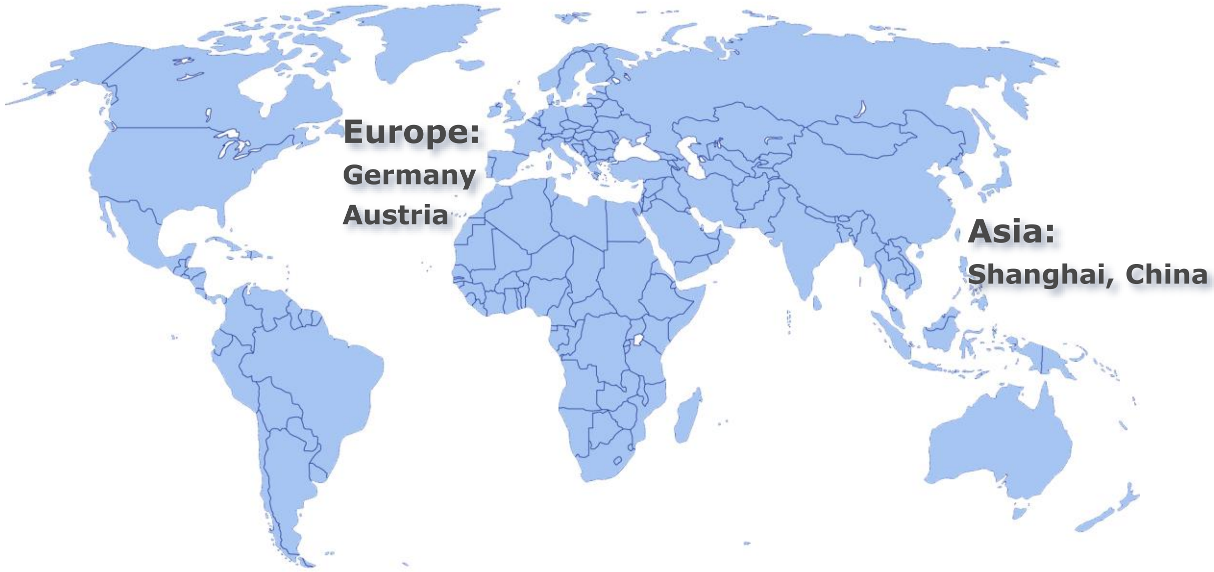
SIMULATION SOLUTIONS FOR
PRODUCTION AND LOGISTICS PROCESSES

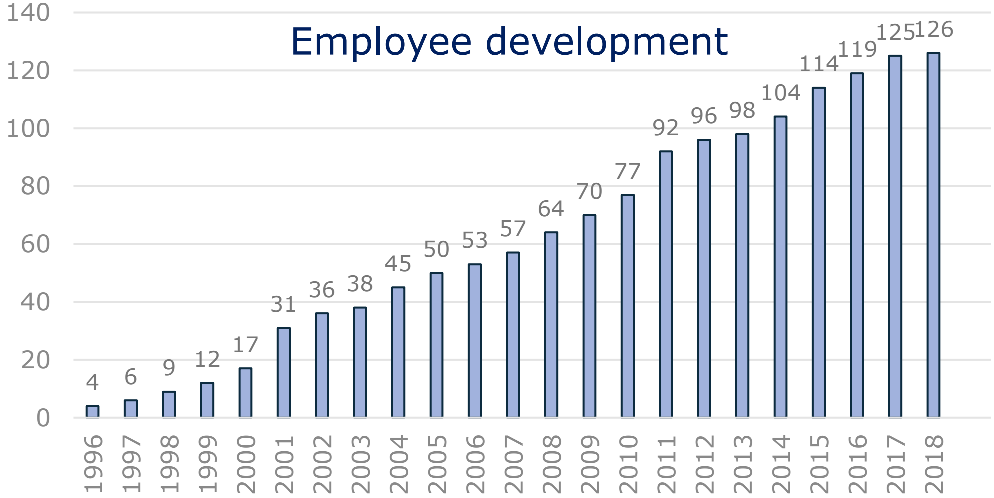
Content

SimPlan AG

Short Introduction

SimPlan AG
Company Locations and History



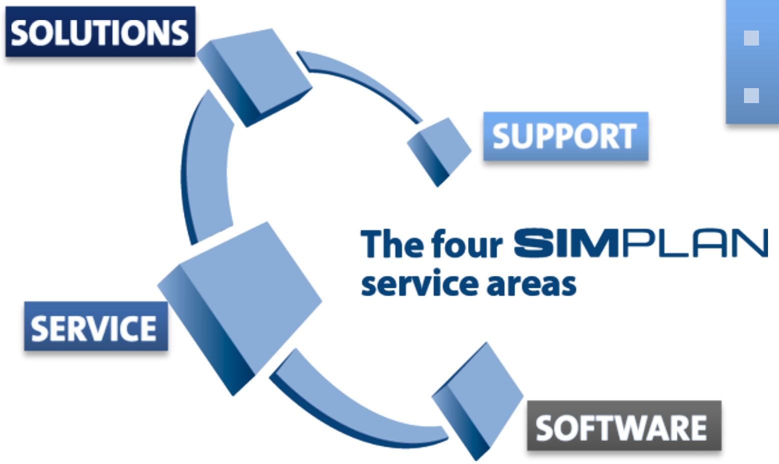


1992	Formation
1996	**Sales Partner AESOP (Simple++), today SPLM**
2000	Transition to AG (plc)
2001	SimPlan Integrations GmbH, Witten
2002	Branch offices: Brunswick, Regensburg
2004	induSim GmbH, Langenau
2006	Branch office Munich
2007	Branch office Holzgerlingen
2009	SimPlan Austria; Business extension: Planning & Consulting
2010	SimPlan China, Shanghai
2012	SimPlan Systems GmbH
2015	Branch office Dresden
2016	Branch office Bremen
	Relocation of the headquarter from Maintal to Hanau
2017	SimPlan Optimizations, Vienna

Today
126 Employees
12 Locations
16 Mio. EUR turnover

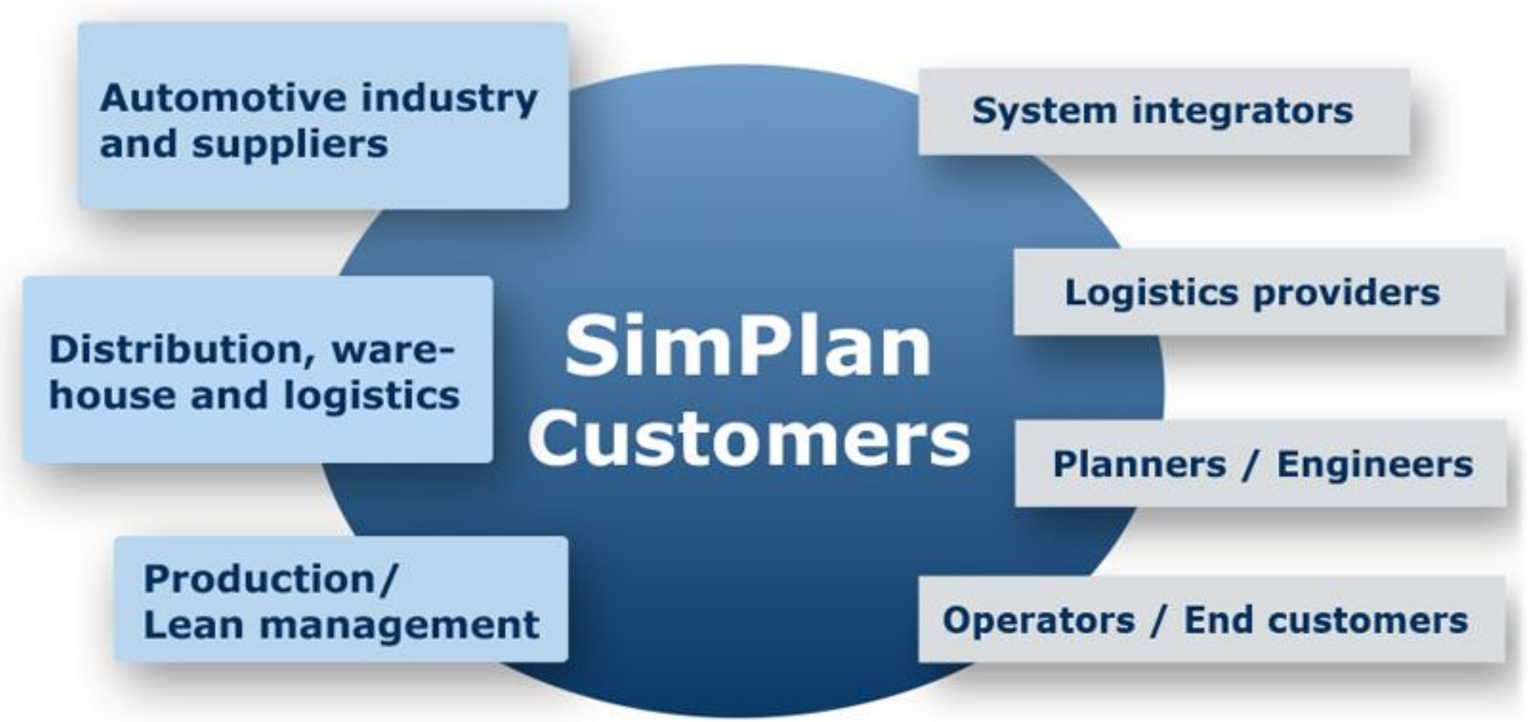
- Simulation-based control centre
- Advanced production planning
- Sequence optimisation

- Trainings
- Hotline
- Maintenance



- Plant Simulation
- Preactor
- SimAssist
- SimVSM

- Animation
- Emulation / Virtual commissioning
- Studies
- Model creation / „Extended workbench“
- Building blocks / Libraries
- Software consulting


Automotive industry and suppliers
Distribution, ware-house and logistics
Production/ Lean management
SimPlan Customers
System integrators
Logistics providers
Planners / Engineers
Operators / End customers

SimPlan AG
Projects and Customer Base

SIMPLAN

Automotive
Audi, Opel, BMW, VW, DAIMLER, Porsche

Retail
REWE, coop, Kaufland Logistik, EDEKA, HEMA, IKEA, Walgreens, zalando, ROSSMANN, ALDI SUISSE, Müller

Engineering
HILTI, STIHL, HEIDELBERG, KASTO, AERZEN, SMS SIEMAG (SMS group), KIENER, KÄRCHER

Garment
BOSS HUGO BOSS, MARKS & SPENCER, Gabor, Desigual, H&M, wortmann, Levi's, ESPRIT, FALK&ROSS GROUP EUROPE

Chemistry Pharma
Merckle ratiopharm, Pfizer, Roche, Bayer, sanofi aventis, P&G, BDF Beiersdorf, BASF, EVONIK INDUSTRIES, Henkel, FRESENIUS, 3M, WACKER, HYDRO

Furniture
nobilia, nolte MÖBEL, SieMatic, Hettich INTERNATIONAL, ASSMANN BÜROMÖBEL GUTE ARBEIT., HÄCKER systemat

Healthcare
Klinikum Esslingen – Das Qualitätskrankenhaus, LOHFERT & LOHFERT, Universitätsklinikum Hamburg-Eppendorf, GREENVILLE HEALTH SYSTEM, KLINIKEN DES LANDKREISES LÖRRACH, ARCADIS, ZEISS, ANDREE CONSULT – Beratung und Gutachten im Gesundheitswesen

Automotive Suppliers
MAGNA, Continental, BOSCH, ZF, HELLA, faurecia, Johnson Controls, PIRELLI

Food Beverage
ZENTIS, Krüger, VELTINS, Radeberger PILSNER, PISTOR, TÖNNIES FLEISCH, Emmi, Coca-Cola, campina, DANONE, GEROLSTEINER, WeserGold

White Goods
WMF, Miele, B/S/H/, Danfoss, infineon, SAHM Gläser für Marken, hager, Busch-Jaeger Elektro GmbH, OSRAM, BLANCO

Airport
Fraport, CHANGI airport singapore, SUVARNABHUMI AIRPORT, DUBAI INTERNATIONAL AIRPORT, HONG KONG INTERNATIONAL AIRPORT, PACTL, Flughafen München, FLUGHAFEN LEIPZIG · HALLE, BAA Heathrow

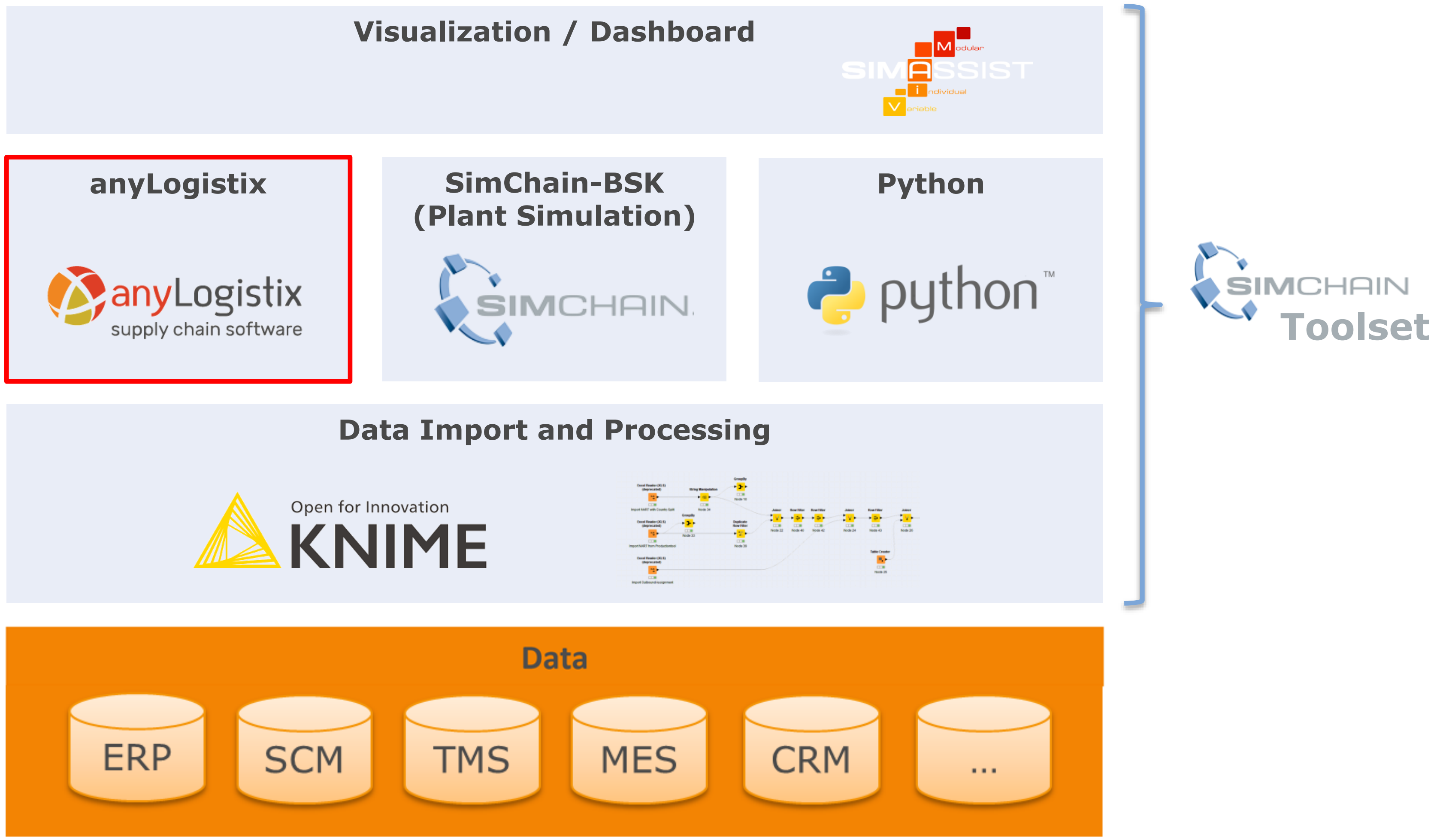
Integrators
SSI SCHÄFER, VANDERLANDE INDUSTRIES, viastore systems, TGW conveys productivity, swisslog, LÖDIGE, KRONES, DEMATIC, SIEMENS, EISENMANN, DÜRR, CTI

3PL
FedEx Express, SCHMIDT, RHENUS LOGISTICS, DHL, STUTE, DIRKS LOGISTIK, OFFERGELD LOGISTIK, BLG LOGISTICS

Traffic
AIRBUS, DB, Lufthansa, ETIHAD AIRWAYS, ALSTOM

SimChain Toolset

SimChain Toolset

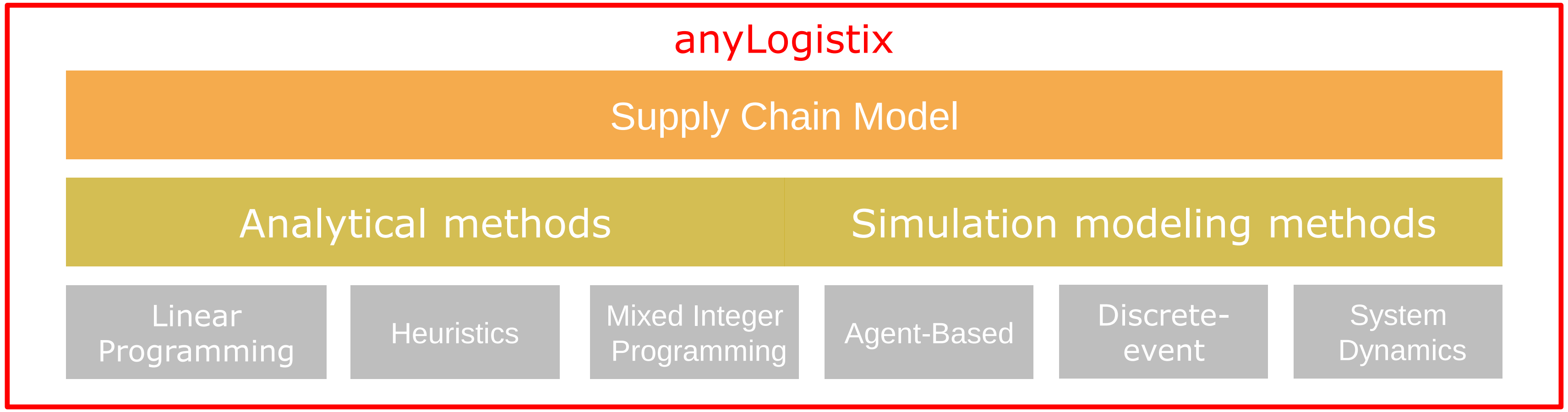


SCM Simulation with anyLogistix

SimChain Toolset

SCM Simulation with anyLogistix

- Enables you to design, optimize, experiment, analyze your supply chain and create its digital twin
- Leverage both analytical and dynamic simulation methods
- Employ the power of the leading dynamic simulation engine from AnyLogic and leading solver CPLEX from IBM for precise end-to-end supply chain analysis
- Extend standard ALX functionality: add inside 4 walls models, user-defined tables and logic
- Use powerful visualization and dashboard capabilities to observe how the supply chain works



SIMPLAN

High abstraction level
minimum details

Medium abstraction level
medium details

Low abstraction level
maximum details

Analytical methods

Customer locations
Demand per customer
Number of DCs or service distance
→ **GFA** →
Number of warehouses/DCs
Approximate location(s)

Customer locations
Demand per customer
Possible warehouse locations
Transportation cost
Real routes
→ **Network optimization** →
Number of warehouses/DCs
The best locations

Customer locations
Demand
Production capacity
Transportation cost
→ **Inventory policy / Production planning / Fleet optimization** →
Routes
Production plan
Selected Inventory policy

Simulation methods

Customers and their locations
Demand/orders
Possible warehouse locations
Real routes
Means of transportation
Sourcing policies
Inventory/replenishment policies
Transportation policies
Production policies
Costs - transportation, handling, warehousing, renting, guarding, insurance…
Uncertainty
Capacities
BOMs
…

→

- Simulation-based Network Optimization
- Optimization over simulation
- What-if
- Sensitivity Analysis
- Production planning
- Fleet optimization

→

Number of sites
Investments in inventory
Capital employed
Operational cost by category.The best sourcing, inventory, production policies.
Loss because of out-of-stock. Resources utilization & capacities.
Fleet size, service levels, budget estimations, risk assessments, time to delivery, stress testing results

Supply Chain Design

Details	Results	Method
+ Aggregated Demand + Transportation cost (m^3/km)	Areas to place the DCs	Analytical Methods (GFA)
+ Possible facility locations + Real roads + Sites throughput	Configurations of supply chains ranked by cost	Analytical Methods (CPLEX)
+ Site capacity (not throughput!) + Inventory policies + Sourcing policies	Configurations of supply chains ranked by service level	Analytical Methods + Dynamic Simulation

Omni Channel Supply Chain

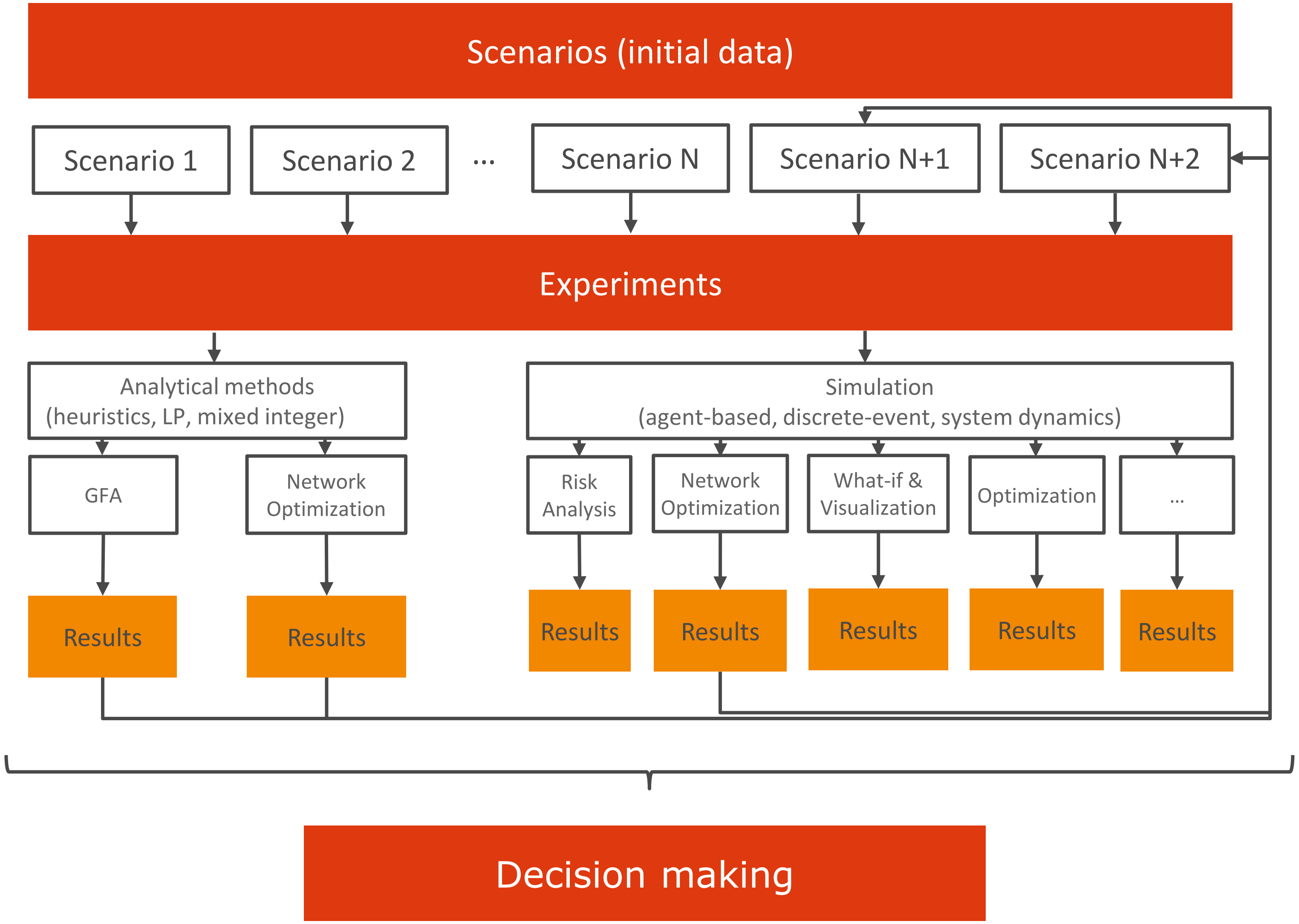
Details		Results		Method
+ Aggregated demand / month + Production throughput / month + Transportation cost (m^3/km)	→	Supply chain configurations ranked by cost	→	Analytical Methods (GFA, NO)
+ Processes inside 4 walls + Sites capacity + Working hours + Resource sharing + Refunds/returns + Inventory policies + Transportation policies	→	How should the omnichannel supply chain operate? (service level, resources capacity and utilization, reliability…)	→	Dynamic Simulation

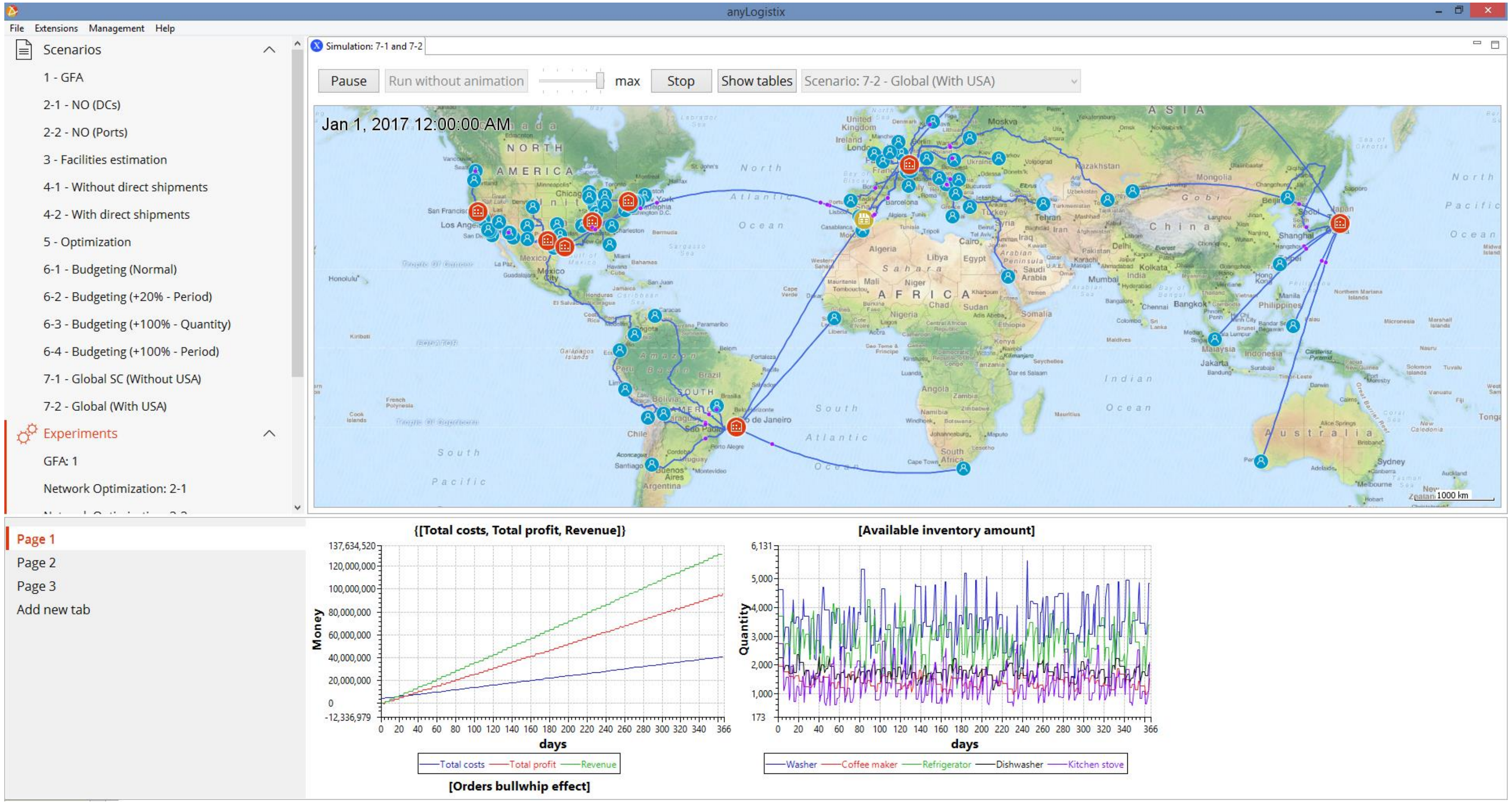
Risk Analysis

Details	Results	Method
+ Operational risks + Demand changes + Lead time changes + Supplier reliability + Strikes	Supply chain robustness Service level Costs Utilization	Dynamic Simulation
+ Disruption risks + Natural disasters + Terrorism + Political & financial crisis	Supply chain robustness Service level Costs	Dynamic Simulation

Budgeting & Cash Flow

Details	Results	Method
+ Product flows + Transportation cost (m^3/km) + Flows processing cost + Labor and facility costs	Budget Cost-to-serve	Excel
+ Time-based costs e.g.: + Resources cost + Operations cost + Handling\carrying cost + Idle cost	Activity based budget	Analytical Methods (CPLEX) Dynamic Simulation
+ Payment terms + Randomness + Production processes + Production schedule	**Cash-to-Serve** When and how much cash do you need to operate	Dynamic Simulation


Scenarios (initial data)
Scenario 1
Scenario 2
...
Scenario N
Scenario N+1
Scenario N+2
Experiments
Analytical methods
(heuristics, LP, mixed integer)
Simulation
(agent-based, discrete-event, system dynamics)
GFA
Network Optimization
Risk Analysis
Network Optimization
What-if & Visualization
Optimization
...
Results
Results
Results
Results
Results
Results
Results
Decision making


anyLogistix
File Extensions Management Help
Scenarios
1 - GFA
2-1 - NO (DCs)
2-2 - NO (Ports)
3 - Facilities estimation
4-1 - Without direct shipments
4-2 - With direct shipments
5 - Optimization
6-1 - Budgeting (Normal)
6-2 - Budgeting (+20% - Period)
6-3 - Budgeting (+100% - Quantity)
6-4 - Budgeting (+100% - Period)
7-1 - Global SC (Without USA)
7-2 - Global (With USA)
Experiments
GFA: 1
Network Optimization: 2-1
Simulation: 7-1 and 7-2
Pause
Run without animation
max
Stop
Show tables
Scenario: 7-2 - Global (With USA)
Jan 1, 2017 12:00:00 AM
Page 1
Page 2
Page 3
Add new tab
[Total costs, Total profit, Revenue]
Money
days
Total costs
Total profit
Revenue
[Available inventory amount]
Quantity
days
Washer
Coffee maker
Refrigerator
Dishwasher
Kitchen stove
[Orders bullwhip effect]

SCM Simulation with SimChain PS

SimChain Toolset

SCM Simulation as a Digital Twin

Visualization / Dashboard

SIMASSIST (Modular, individual, variable)

anyLogistix

anyLogistix supply chain software

SimChain-BSK (Plant Simulation)

SIMCHAIN

Python

python™

Data Import and Processing

Open for Innovation KNIME

Data

ERP | SCM | TMS | MES | CRM | ...

SIMCHAIN Toolset

History

2002 Common tool of the companies SimPlan and ICON

- → Building block library under Plant Simulation
- → Generic model
- → Interface to other tools from ICON (monitoring and collaboration tools)

2004 Further development by SimPlan

- → Various project-related additions in different industries

2010 Re-design in cooperation with ZF Friedrichshafen

- → Development of a database-based front-end for modelling as well as for scenario and result management

2013 Extension for the modeling of FMCG distribution and consider CO_2 emissions

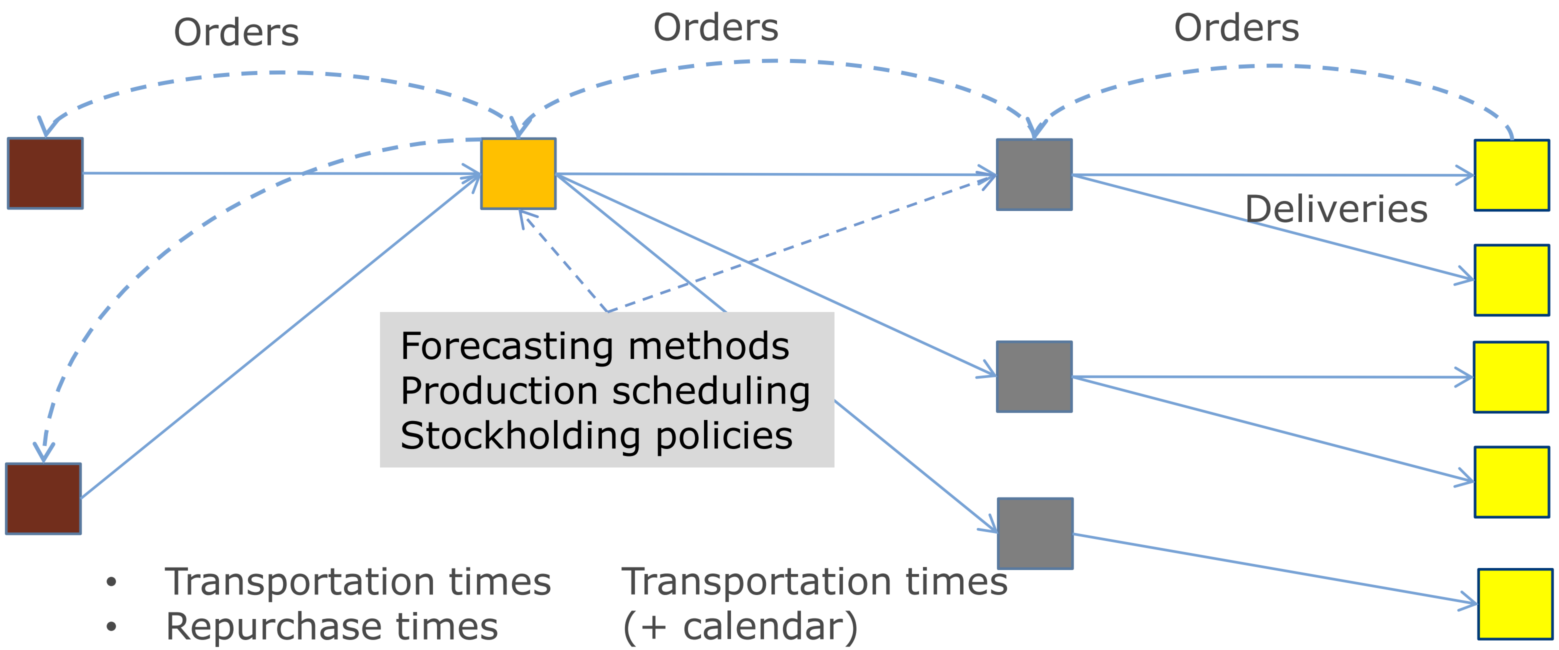
2017 Extension for the modeling of distribution in urban areas

Sources:
Ports/
Production sites

Central Warehouses
Further warehouses on this level, if applicable

Regional Warehouses

Customers
(grouped by geographical proximity)



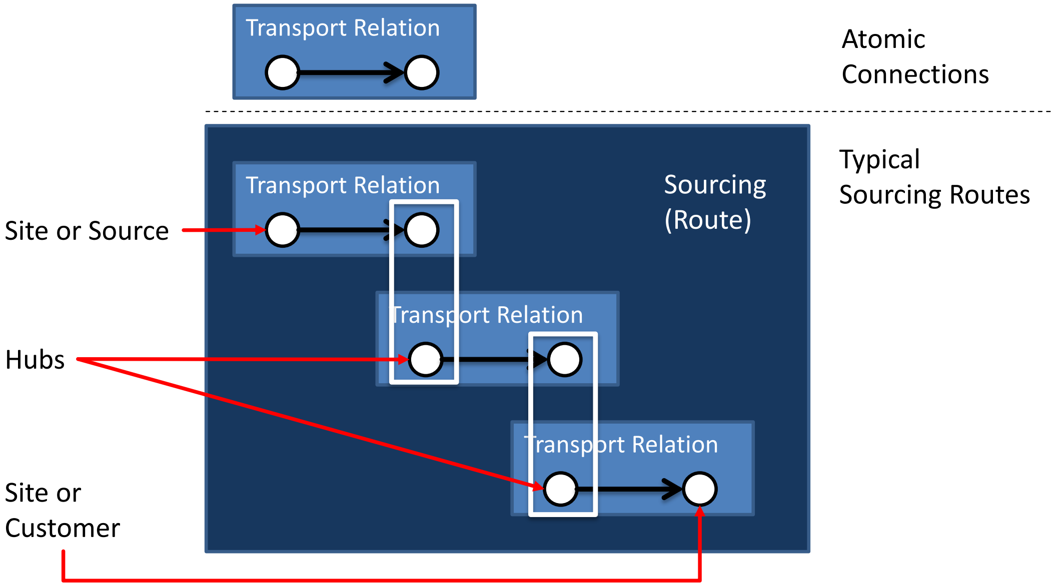
- Transportation times
- Repurchase times
- Means of transport
- Cost rates

Transportation times
(+ calendar)
Means of transport
Cost rates

Modelling Approach – Objects for Modeling

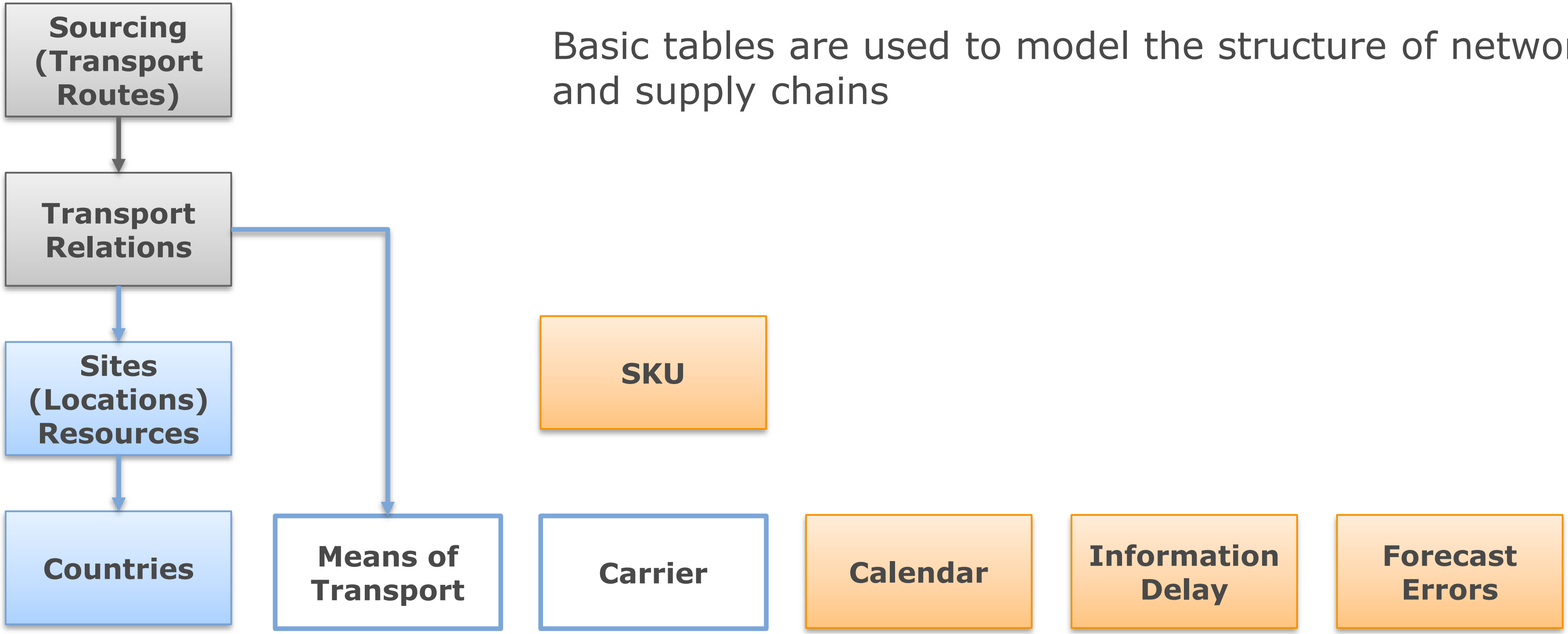
1. Customers (generation of demands)
2. Sites (production locations and warehouses with ERP functionality)
3. Hubs and plain Supplier (sources with replenishment time)
4. Transport relations

Basic objects for location modeling (items 1–3)

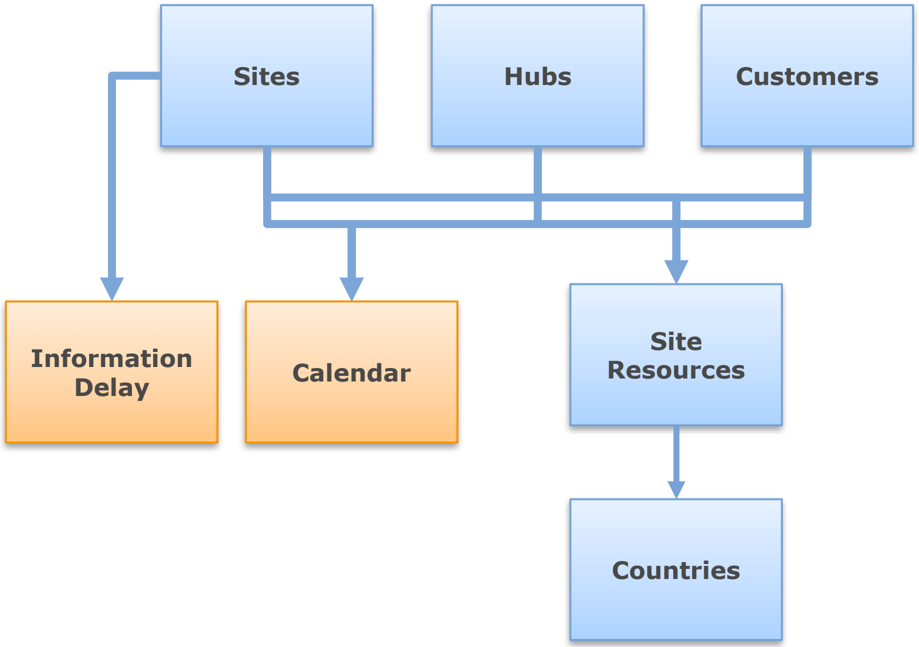


Basic Tables

Basic tables are used to model the structure of networks and supply chains



Configuration Tables



Configuration tables are used to specify model parameters

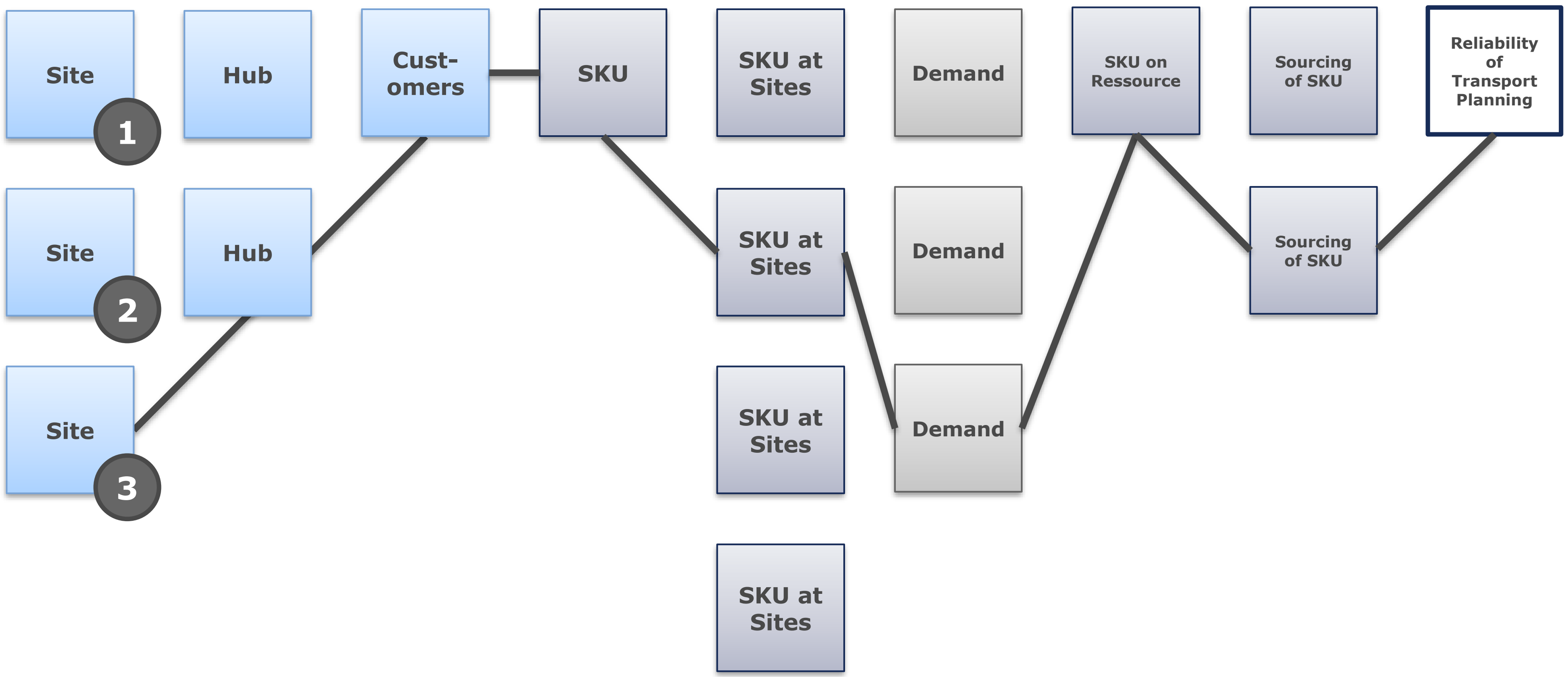
Procedure:

1. Select **locations** for a scenario und specify parameters
2. Select **SKU**
3. Setup **customer demands** (quantity, forecast errors)
4. Setup the **sourcing of SKU** from the site to the customer
5. Specify **SKU at locations**
6. Setup **resources** und **SKU at resources**
7. Specify **reliability of transport planning** for all sourcing options

Scenarios

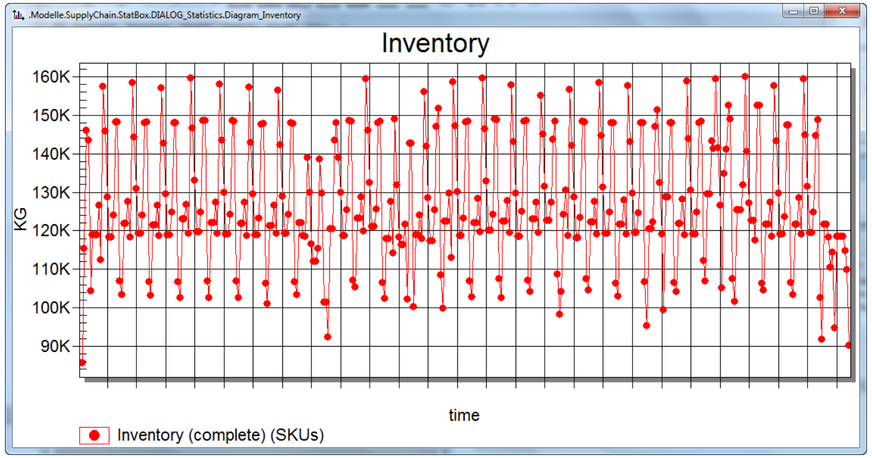
- A scenario consists of a set (combination) of configurations
- Advantages:
  - → No redundant data
  - → Copying of configurations possible
  - → Increased level of transparency (differences between scenarios are obvious by examining their configurations)

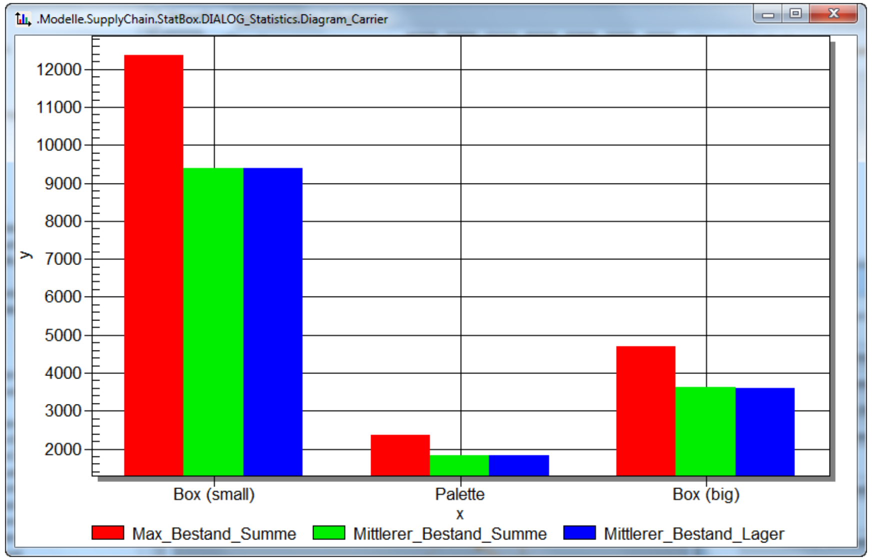
Scenarios


Site
1
Hub
Cust-omers
SKU
SKU at Sites
Demand
SKU on Ressource
Sourcing of SKU
Reliability of Transport Planning
Site
2
Hub
SKU at Sites
Demand
Sourcing of SKU
Site
3
SKU at Sites
Demand
SKU at Sites

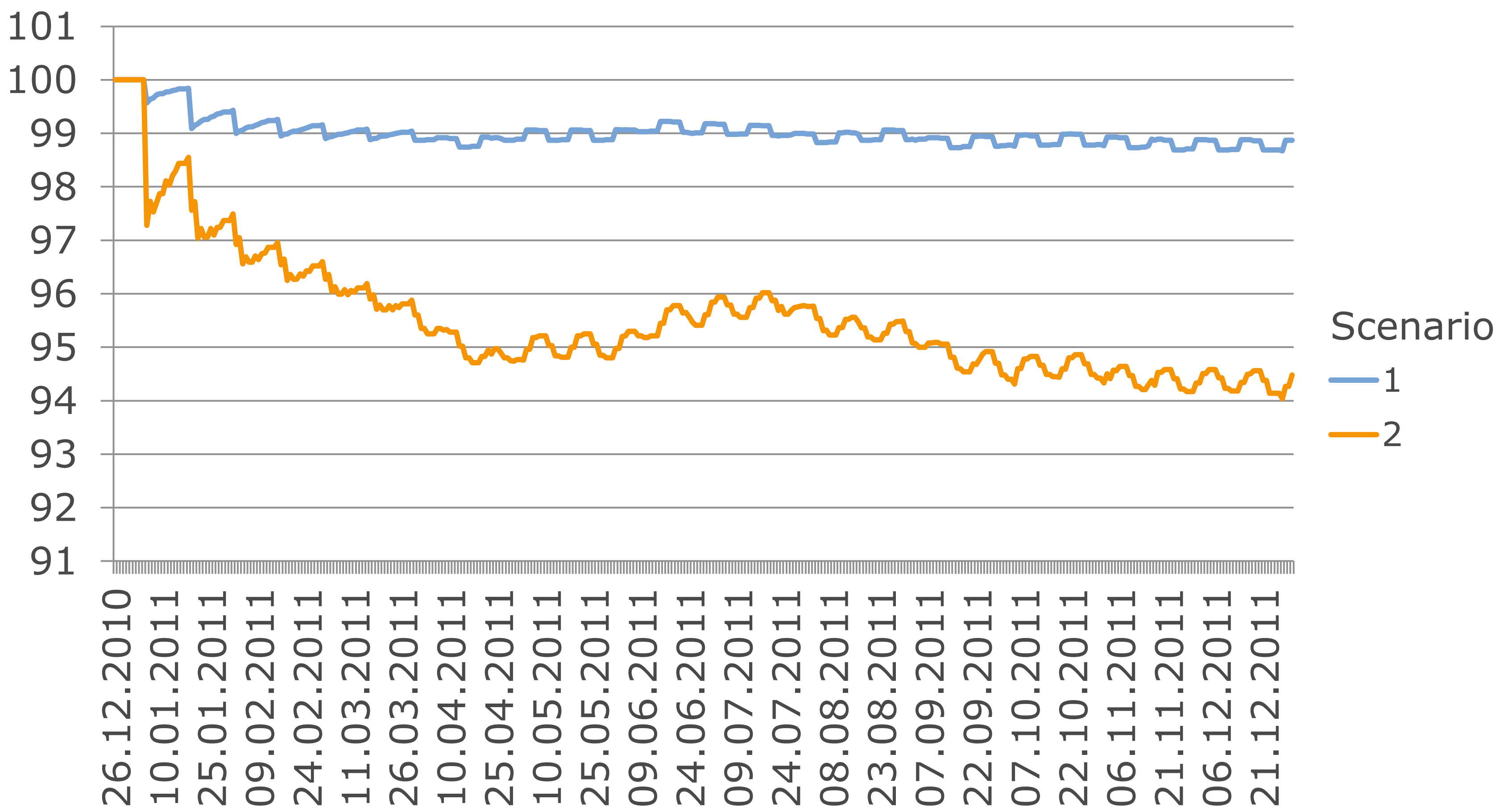
Model Statistics

- Results can be viewed under Plant Simulation
- Export of the results to the database
  - Key figures on costs, inventories, delivery service levels (aggregated and over time)
  - Utilization of resources, transport relations and means of transport
  - Container volume over time
- Simple analysis and comparison of scenarios by using SimAssist

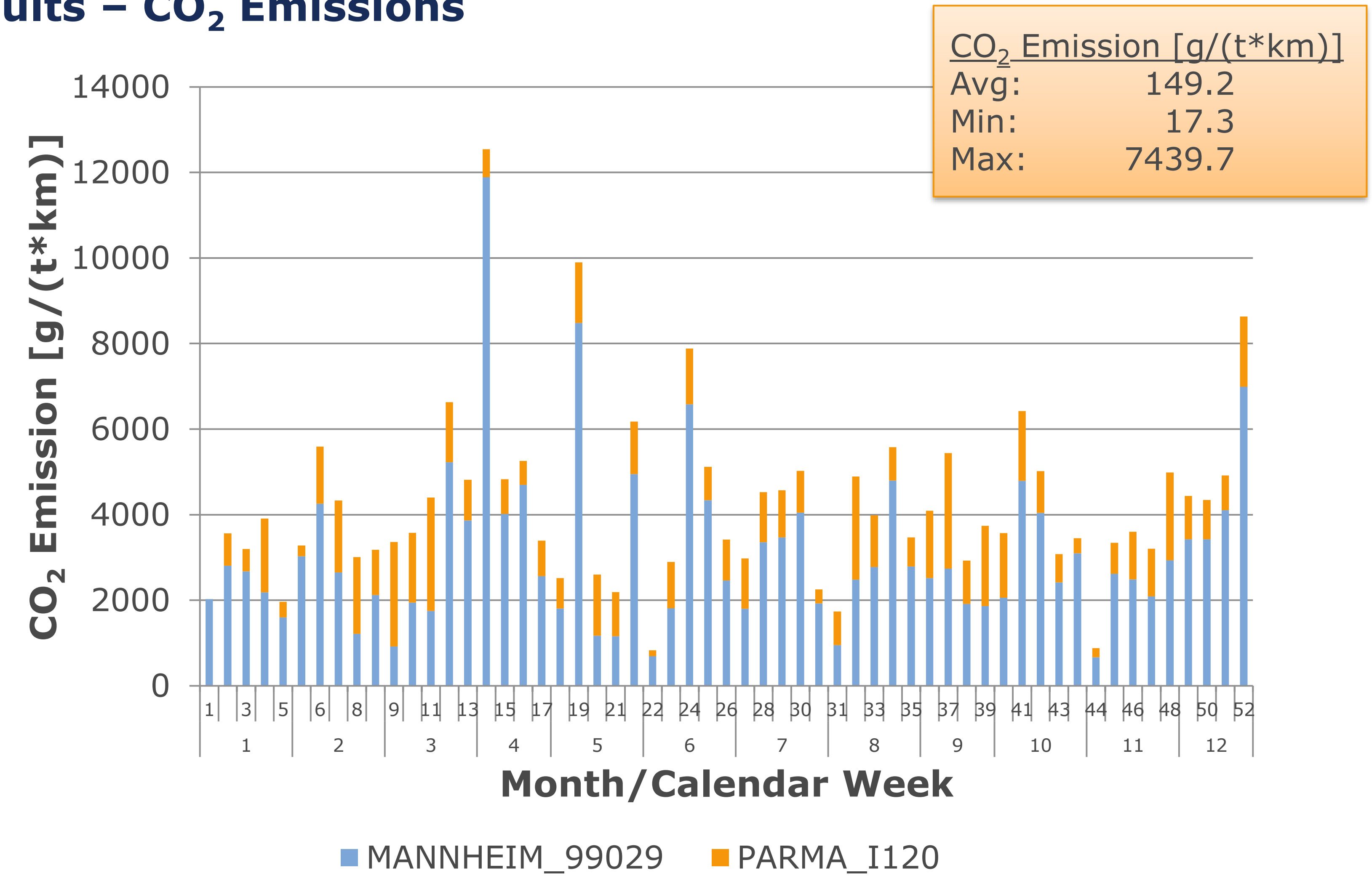




Example Results – Service Level



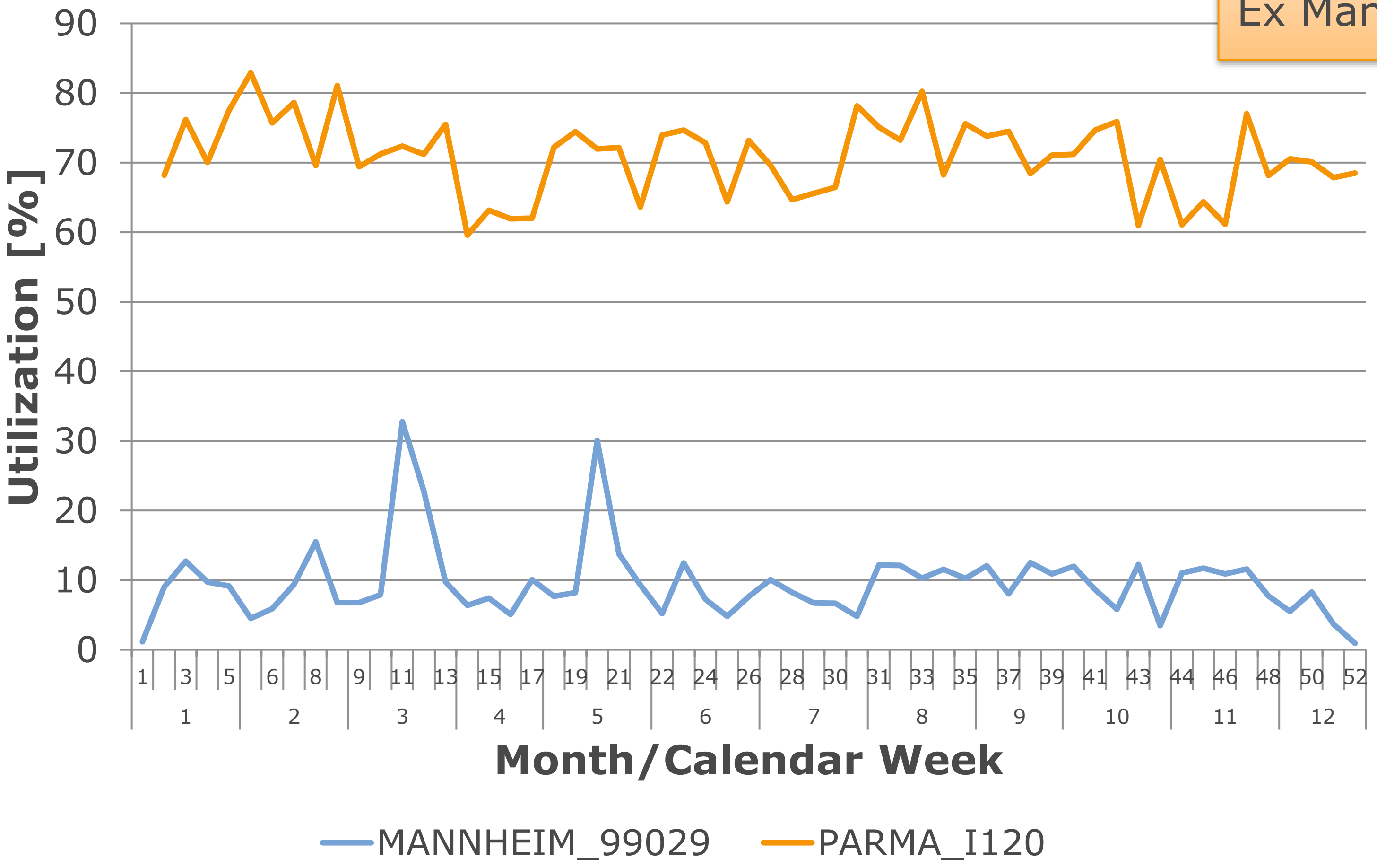
Example Results – CO_2 Emissions



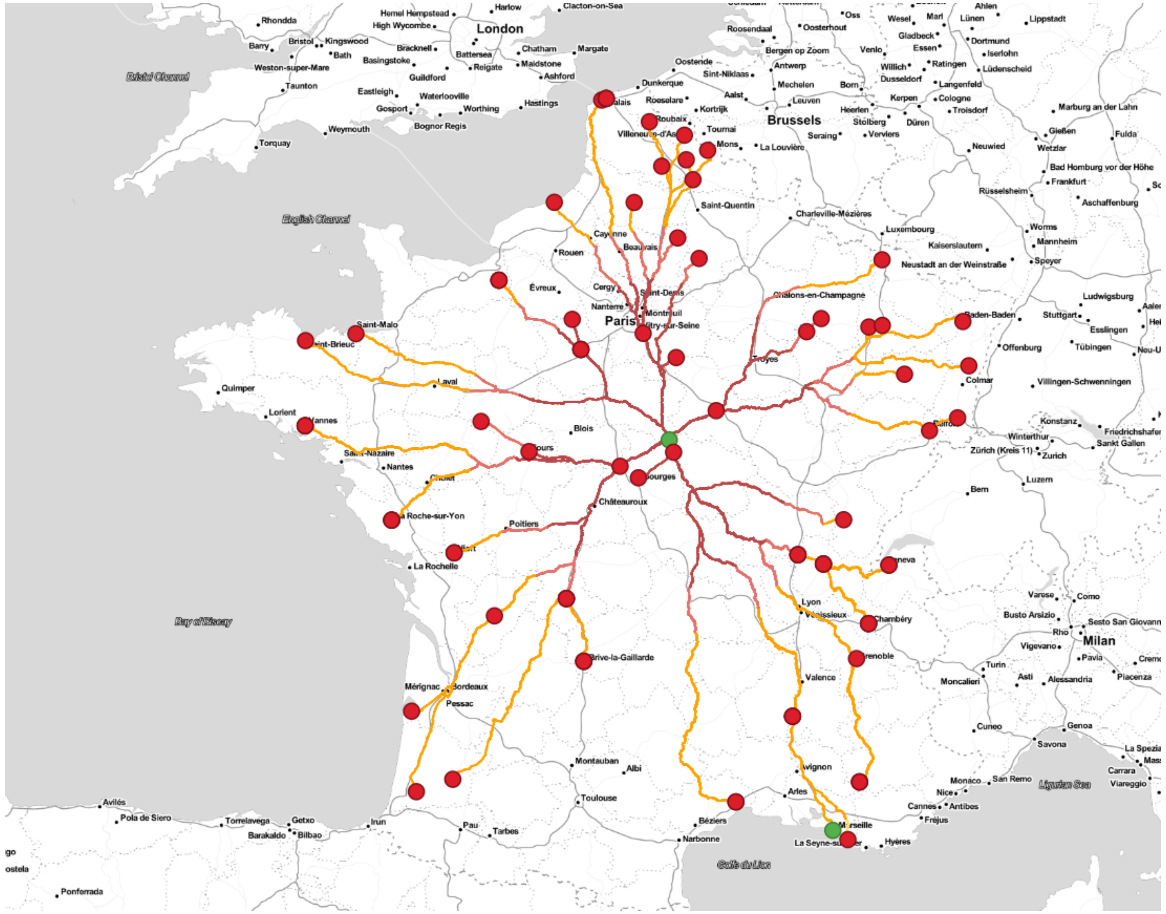
SIMPLAN

Example Results – Truck Utilization

Average Truck Utilization
ex Parma: 71.7 %
Ex Mannheim: 10.1 %

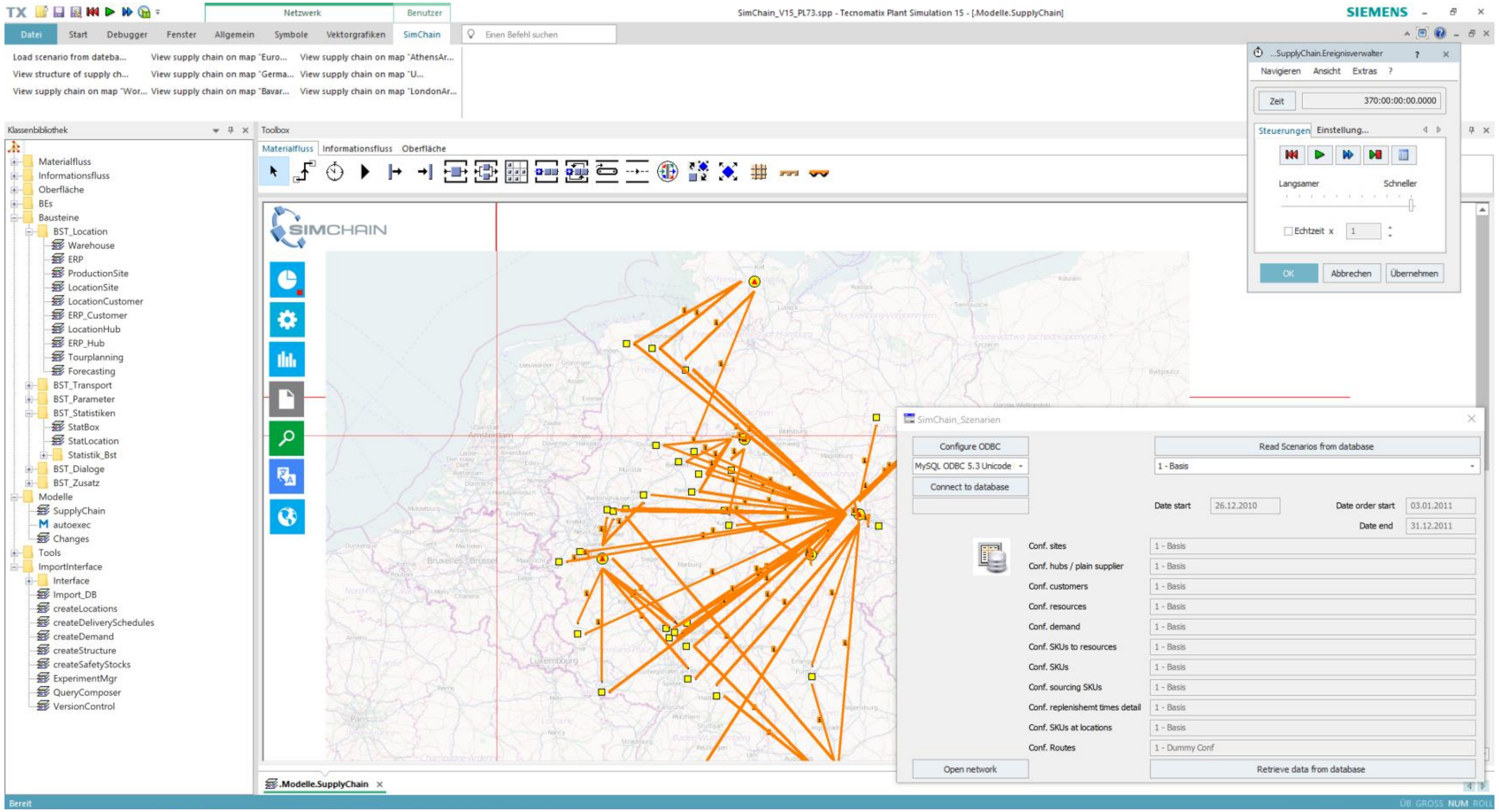


Example Results – Service Area Analysis



Service Area 4 h:	10,7 % of the stores are reached
Service Area 8 h:	17,8 % of the stores are reached
Service Area 12 h:	98,8 % of the stores are reached
Service Area 16 h:	100,0 % of the stores are reached

Demonstration



SCM Optimization with Python

SimChain Toolset

SCM Simulation as a Digital Twin

SIMPLAN

Visualization / Dashboard

SIMASSIST (Modular, individual, Variable)

anyLogistix

anyLogistix supply chain software

SimChain-BSK (Plant Simulation)

SIMCHAIN

Python

python™

Data Import and Processing

Open for Innovation KNIME

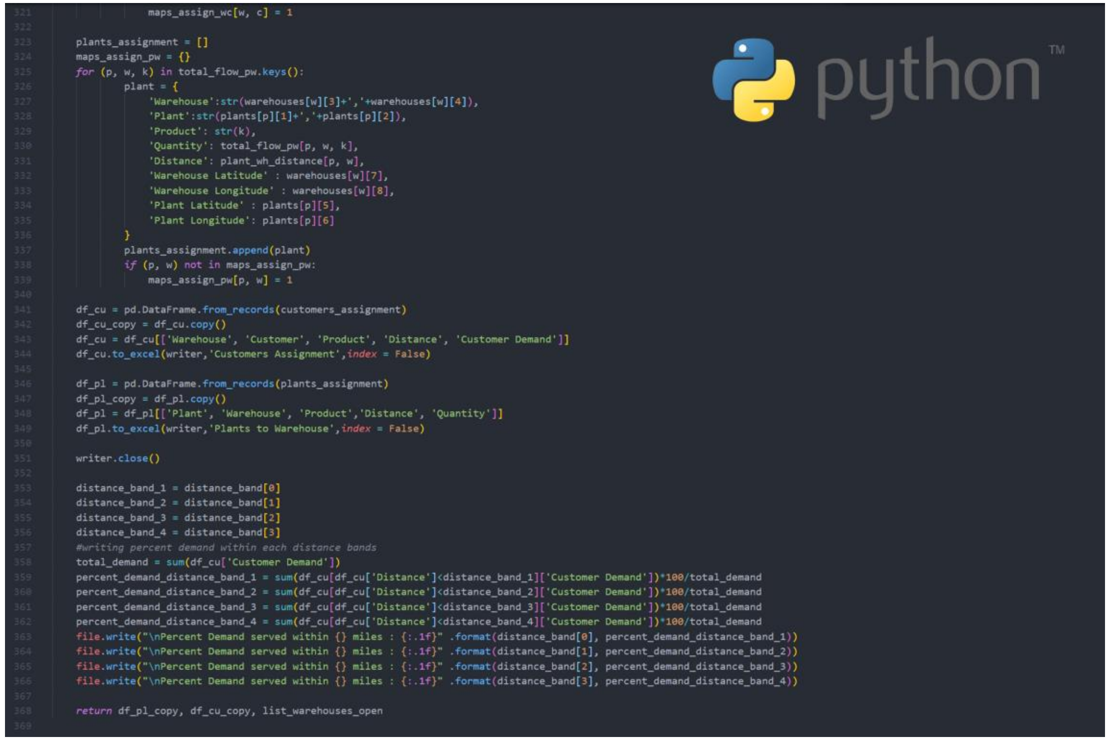
Data

ERP | SCM | TMS | MES | CRM | ...

SIMCHAIN Toolset

Fields of Application

- Data analysis and processing (beyond KNIME)
- Simple location selection problems
- Tour planning and optimization (milkruns)
- Application of optimization algorithms
  (e.g. Tabu Search, GA)
- Use of AI and ML methods



Experiences from SCM Projects

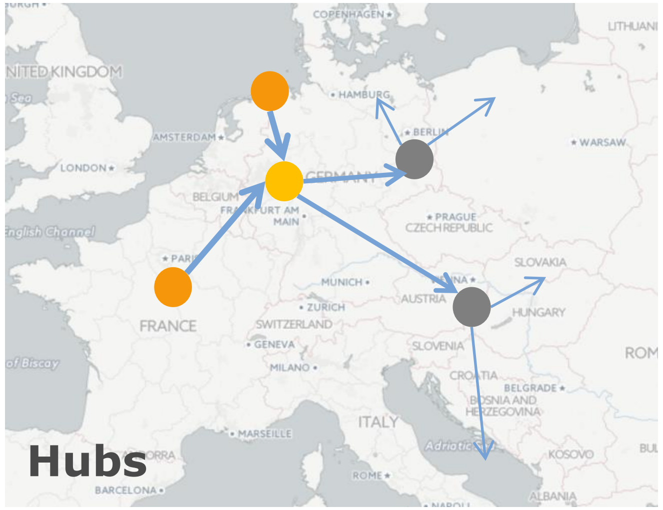
SCM Simulation - Potentials of Application

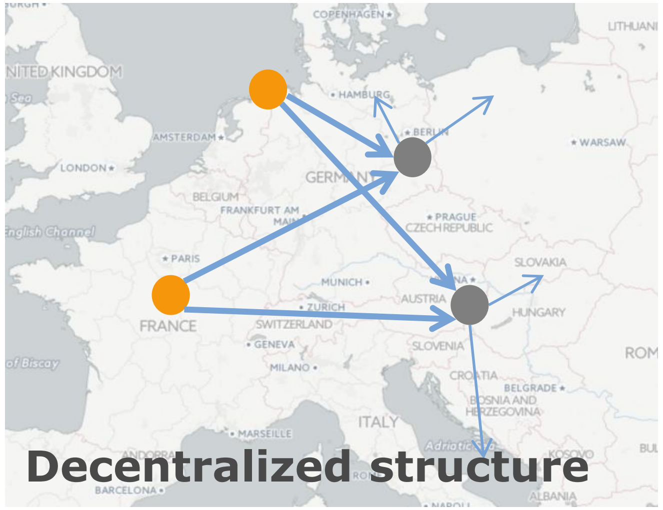
- Comparison of different network design alternatives
  - ➔ Structure of distribution networks
  - ➔ Production strategies
  - ➔ Sourcing strategies
- Configuration of networks
  - ➔ Dimensioning of stock coverage
  - ➔ Determination of suitable transport solutions (delivery cycles, minimum order quantities, delivery lot sizes, transport modes)
  - ➔ Dimensioning of resources (e.g. number of production machines)
  - ➔ Dimensioning of the number of (special) containers required
- Recognition of interdependencies in (complex) networks
- Faster start-up of supply chains
- Use in operational operation (forecast function of the simulation)

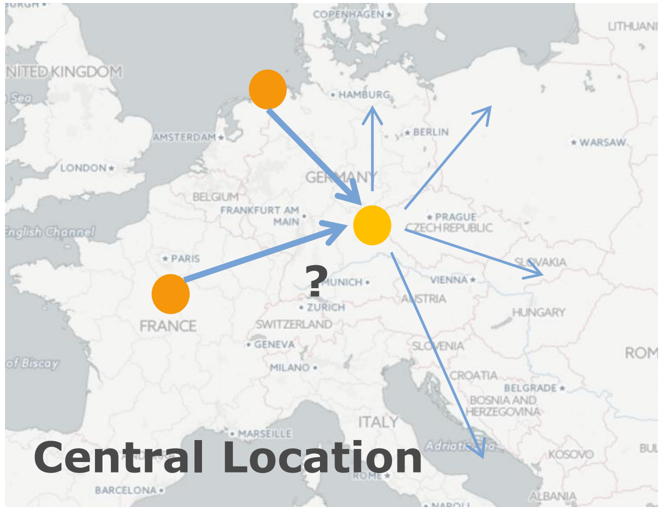
Typical Questions or Requirements

- There is a central warehouse from which all customers are supplied.
- Central warehouse at an "optimal/new" location (evaluation of delivery speed and costs)?
- Use of an existing central warehouse and introduction of additional regional warehouses or hubs?
- Storage in a completely decentralized structure?
- Introduction of an own vehicle fleet?

Target Figure: "Find the cheapest variant!"







Typical Questions or Requirements

- Typical requirements / restrictions for **distribution networks**
  - "The number of possible hubs is limited to ten locations."
  - "The maximum distance to customers is 250 km."
  - "The delivery service level should be at least 99%."
  - "Each branch must be supplied at least once a week."
  - "Up to ten trucks are available for delivery every day. How should the route planning be structured?"
  - "Time windows for delivery should be observed for each customer."

Typical Questions or Requirements

- Typical requirements / restrictions for **production networks**
  - "There are several suggestions for assigning production steps to locations."
  - "Some products are only produced three times a year."
  - "In the event of flooding, no ships can dock. Tank wagons are then to be used as replacements."
  - "The parts must be transported on special containers and the return transports to production must also be planned, as these are only available in limited quantities.

Modelling Approach – When to Optimize? When to Simulate?

- **Central Question**: Are results required for processes?
- **Examples**:
  - → Which inventory levels must be set in order to achieve a delivery service level of 99%?
  - → How high is the proportion of special deliveries by helicopter to ensure the supply of components on the assembly line?
  - → How often should production planning be carried out?

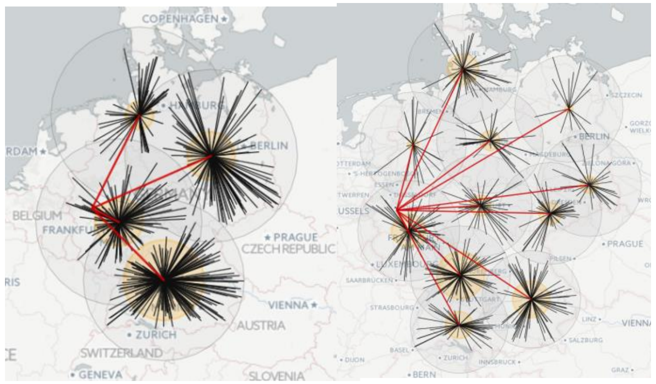
- As a rule, these questions cannot be answered with sufficient accuracy using an optimization model.
- Optimization is typical for location decisions, neglecting concrete transport, production and warehouse processes.

- **Goal:**
  - ➔ Minimize transport costs
- **Given:**
  - ➔ Customer and production locations (or ports)
  - ➔ Transport quantities
- **Variables:**
  - ➔ Coordinates and **number of warehouses**
- **Procedure:**
  - ➔ Specification of a **maximum distance** to customers

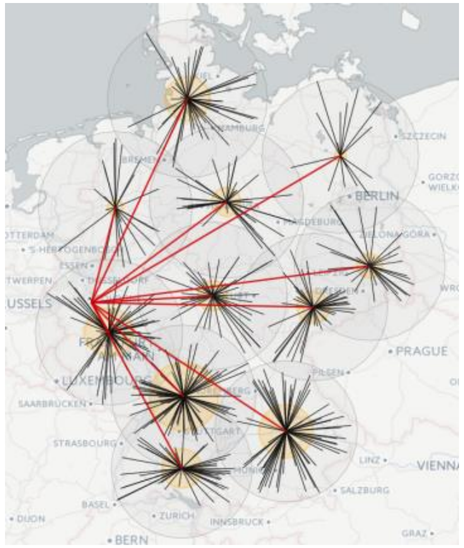
1. Specification of the minimum number of warehouses so that the specified maximum distance to at least one warehouse is kept.

2. Determination of all coordinates of the regional warehouses so that the sum of the transport costs is minimized, and the maximum distances are met.

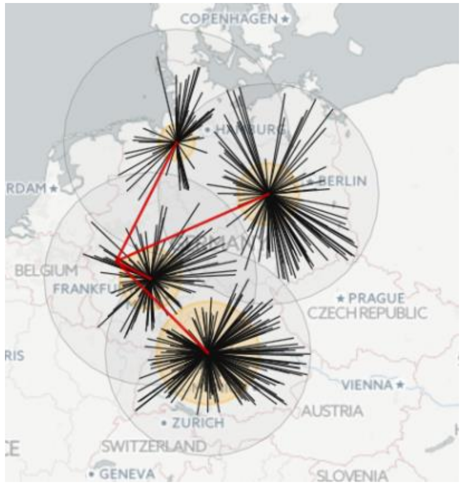
- **Distance-dependent cost rates, for example:**
  - Euro per tonne-kilometer
  - Euro per truck kilometer
  - Differences according to transport relations (inbound / outbound)
- **Further assumptions on the transports**



- **Still Open:**
  - ➔ How high must the coverage be set in the individual warehouse locations?
  - ➔ How often must deliveries be made?
  - ➔ What are the effects of different transport batch sizes?
  - ➔ Do intermediate transports have to be planned in order to cope with fluctuations in demand?



- **Solutions:**
  - ➔ Refinement of optimization models
  - ➔ Simulation of the best variants from the optimization for a better comparison of the costs and determination of parameters of the order policies, ...



Location Selection Optimization vs. Simulation

Question	OPT	SIM
The number of possible hubs is limited to ten locations.	✓	
The maximum distance to customers is 250 km.	✓	
The delivery service level should be at least 99%.		✓
Each store must be supplied at least once a week.	✓	
Up to ten trucks are available for delivery every day. How should route planning be designed?	✓	✓
There are various proposals for assigning production steps to locations.	✓	(✓)
Some products are only produced three times a year.	(✓)	✓
No ships can moor at high tide. Tank wagons must then be used as replacements.		✓
The parts have to be transported on special containers, also the return transports to the production have to be planned, as these are only available in limited quantities.		✓

Summary

- Processes should be examined in detail in the requirements or as-is analysis, precisely because many assumptions typically must be made about the operational processes and decision rules.
- Assumptions and simplifications should be appropriately documented
- A high percentage of projects have special aspects in their processes (i.e. extension of standard processes necessary)
- Conclusions
  - → The simulation tool used should enable extensions or changes in the implementation (e.g. planning functionalities)
  - → Allow sufficient time for model validation and calibration

SCM Simulation as a Digital Twin

What is a digital twin?

- Definition by Gartner:
  - ➔ A digital twin is a digital representation of a real-world entity or system
- The words most often used to describe a Digital Twin
  - ➔ Simulation, real-time data, dynamic, understanding, learning, reasoning

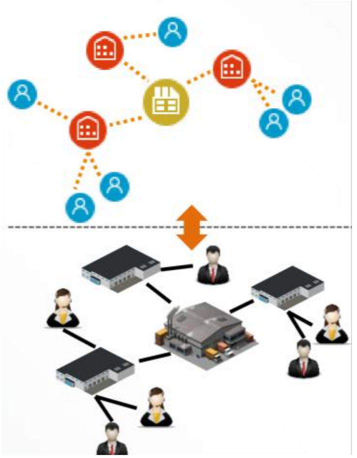
What is a digital twin?

- A supply chain digital twin is a **detailed simulation model** of an actual supply chain which predicts the behavior and dynamics of a supply chain to make:
  - Strategic and tactical decisions (midterm)
    - How should a supply chain work i.e. supply chain processes / resources / logic
    - Time horizon: a few months up to years of operations
  - Operational decisions (short-term)
    - Identification of problems and the analysis of solutions
    - Time horizon: a few days or weeks

What makes a supply chain simulation model a digital twin?

Real Time Data/Snapshot
A digital twin uses real time data to make forecasts

A digital twin is a detailed simulation model of a supply chain
A digital twin should be able to predict the behavior of a supply chain



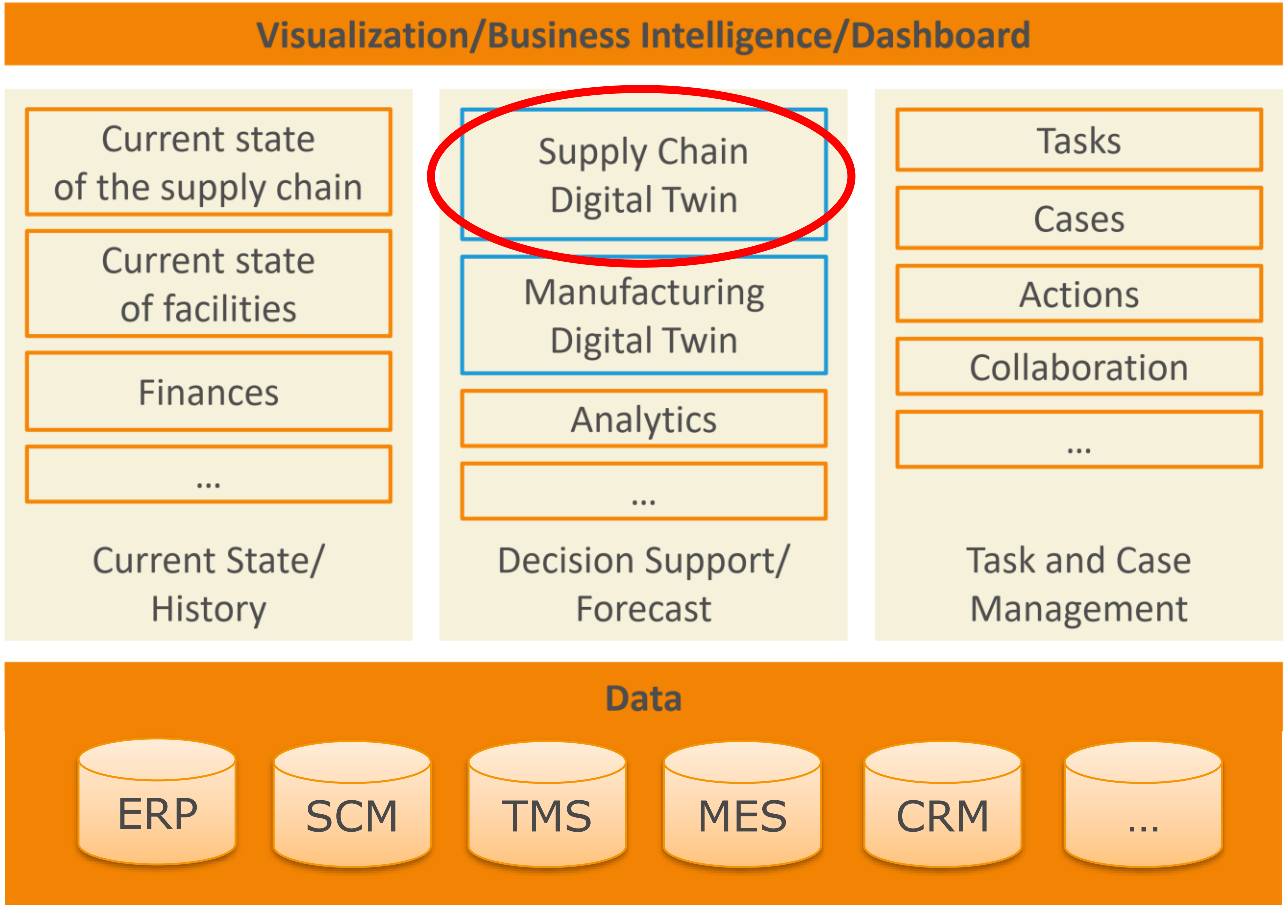
Notifications/alarms/alerts about abnormal situations
A digital twin should allow you to define what abnormal behavior is and send notifications about critical/abnormal situations

Integration with IT infrastructure
In many cases a digital twin is part of a “bigger thing” e.g. a control tower, and should be able to integrate with its surrounding IT environment

Triggers
A digital twin should allow the definition of automatic actions for some events

Test an action plan
A digital twin should allow you to test actions to efficiently manage your supply chain

What makes a supply chain simulation model a digital twin?



SCM Simulation in Risk Management

- According to the Business Continuity Institute, 65% of all companies have had at least one significant interruption in their supply chain in 2017. Consequences:
  - → Loss of productivity
  - → Reduction of delivery reliability
  - → Loss of revenue
- Between 2000 and 2018, interruptions in the supply chain due to natural or man-made disasters have increased significantly in number and impact

Risk Types

- Operational risks
  - ➔ The cause lies in the supply chain itself, or in the business processes implemented in the chain
  - ➔ Example: Fluctuations in demand and availability lead to the bullwhip effect in the supply chain, which propagates upstream

- Disruptive risks
  - ➔ Unique occurrence, but drastic impact
  - ➔ Natural disasters
  - ➔ Political changes
  - ➔ Legal changes
  - ➔ Strikes
  - ➔ Spread out in waves towards the downstream end of the supply chain (domino effect)

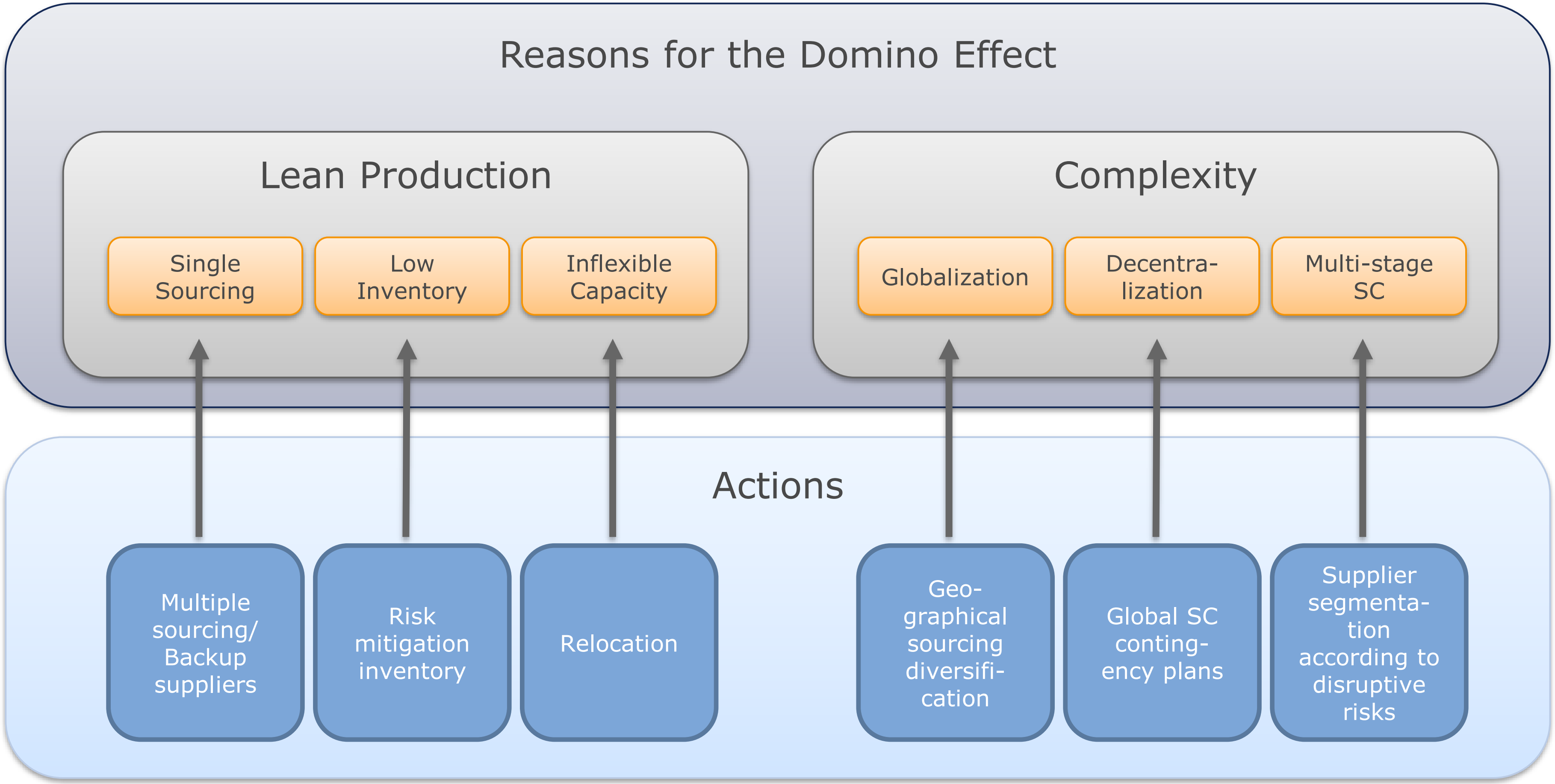
Examples of disruptive risks in recent years

- The earthquake and the following tsunami in Japan in 2011 cost Toyota its top position in sales figures. Other industries were also affected by the resulting bottlenecks.

- The flood in Thailand in 2011 had an immense impact on the high-tech sector. Intel claims to have lost $1 billion in sales revenue as OEMs were unable to produce computers due to supply shortages in hard drive manufacturing.

- Due to the conflict between Volkswagen and the Prevent Group in summer 2016, 6 VW plants had to be temporarily closed.

How can you protect yourself against the domino effect?



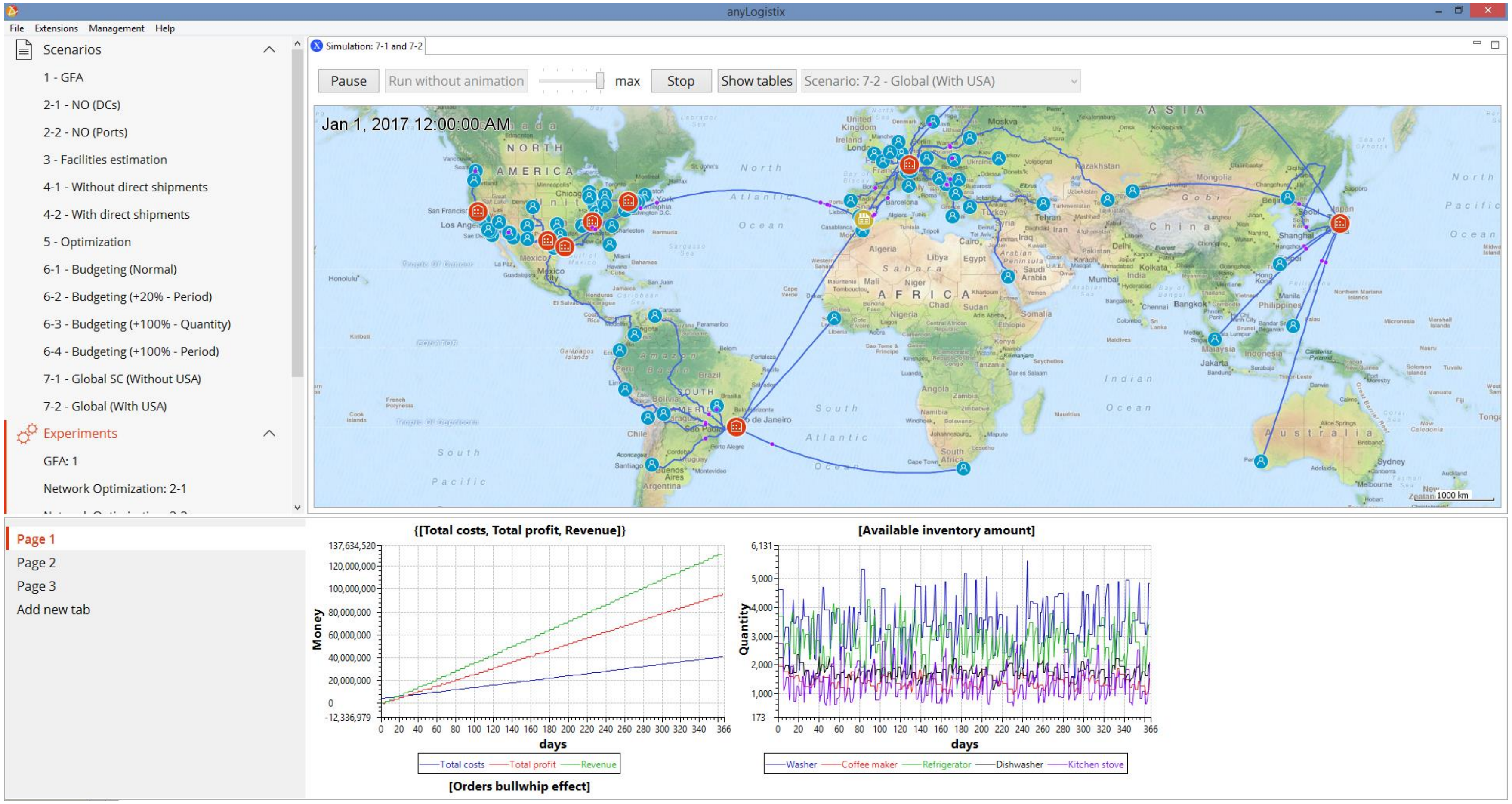
Which issues can be investigated with simulation?

- What impact will a disruption have on the performance of the supply chain?
- How long does it take for a supply network to recover after a disruption?
- How long can a supply chain compensate for such disruption?
- What role does the extent and timing play in the spread of disruptions?
- What network strategies are most efficient in compensating for disruptions at different levels of severity?
- What are the most critical scenarios regarding the spread of the disruption?

"Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case" by Dmitry Ivanov

https://www.sciencedirect.com/science/article/pii/S1366554520304300

SCM Simulation in Risk Management



References

SCM Simulation

SIMPLAN

Distribution Network ZF Trading

Problem

- Five distribution centres in Europe
- Several production sites
- Customers are currently permanently assigned to warehouses

Objectives and challenges

- Establishment of a virtual warehouse
- Distribution of the more than 50,000 articles via five European warehouse locations

Orders (1 year)

- 305.000 Orders with 900.000 order lines
- 3.363.000 Pieces

Results

- Significant reduction of (capital commitment) costs by successively reducing the number of article allocations
- Simulation model as basis for continuous (re-)allocation of articles

zentrale Tabelle mit allen Kunden-aufträgen

tägliche Kunden-bestellungen

virtuelles Lager

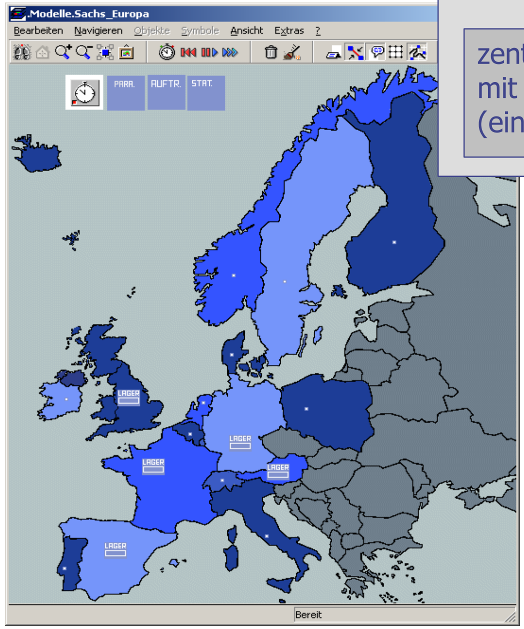
zentrale Bestellabwicklung: Für jeden Auftrag erfolgt die Auswahl eines Lagers bzw. mehrerer Läger (Splitting)

zentrale Tabelle mit allen Artikeldaten (einschl. Allokation)

Lager: Abwicklung des (Teil-)Auftrags

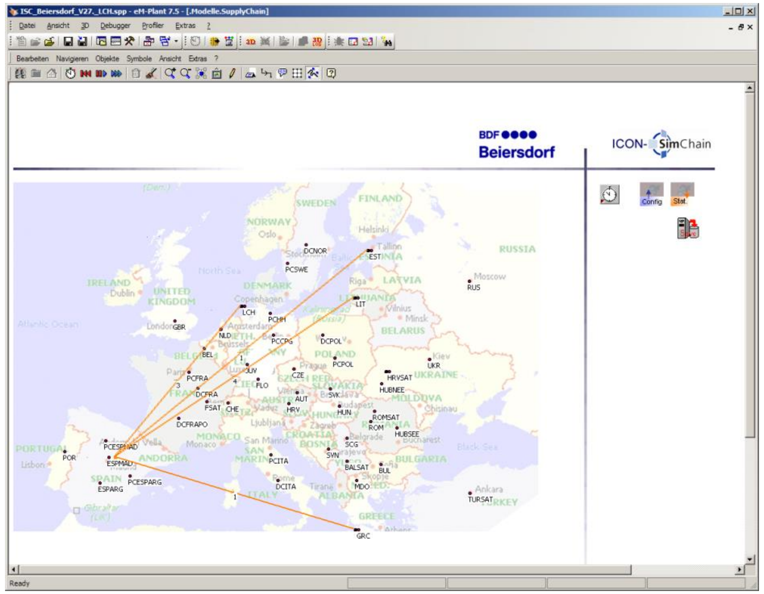
Ergebnisgrößen (Kosten):

1. Transportkosten
2. variable Handlingskosten
3. Kapitalkosten



Beiersdorf Network Design

- Object of investigation
  - ➔ Currently about 50 locations (production and warehouses)
  - ➔ 12,000 articles (35,000 article allocations)
  - ➔ Different types of articles (production articles, 3rds, sun, promotions, designed once or during the year)
- Objectives of the overall project
  - ➔ Evaluation of different optimization measures regarding potential for reducing the stock (until 2010)
  - ➔ Design of (future) warehouses

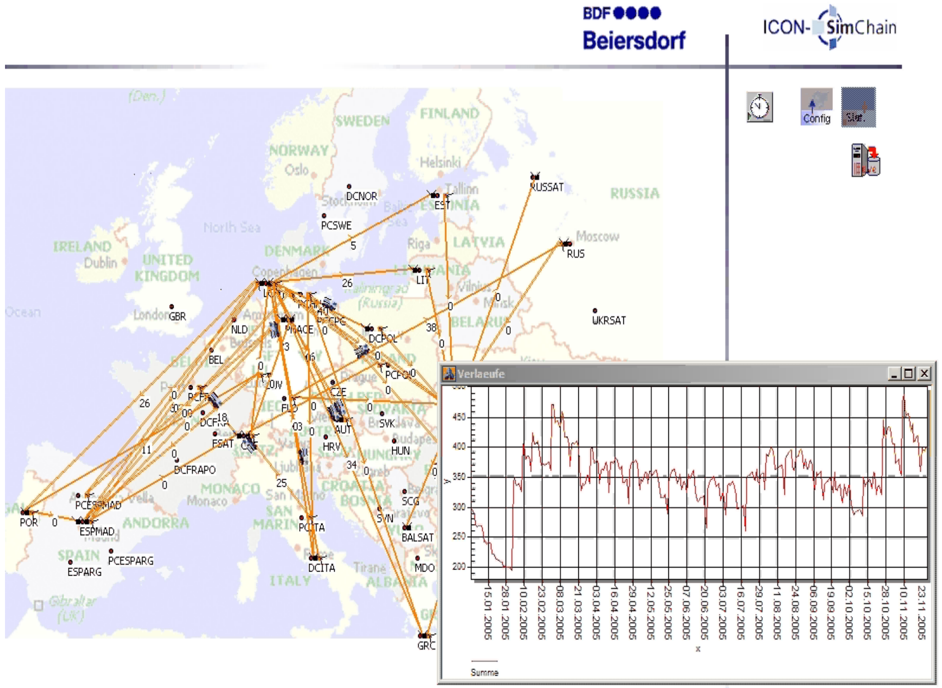


Beiersdorf Network Design

- Examined optimization measures
  - Concentration on fewer locations
  - Change in the delivery process
  - Introduction of multi-lingual articles and product range streamlining
  - Production flexibilization
  - Improvement of the forecast quality
- Data Basis
  - Article master data
  - Sales figures of the year 2005 (article level)
  - Forecasts on sales development (item level)
  - Information on transport relations
  - Calendar for the relocation of production articles
  - Calendar for relocation of delivery locations
  - Development of forecast quality (global)

Beiersdorf Network Design

- Modelling approach
  - ➔ All structural changes are reflected in the model over time
  - ➔ Modelling of rules for relocation
  - ➔ Stock-buildup to bridge resource shortfalls
  - ➔ Handling of residual quantities
  - ➔ Rules for the reduction of coverage when merging locations or multi-lingual articles



Beiersdorf Network Design

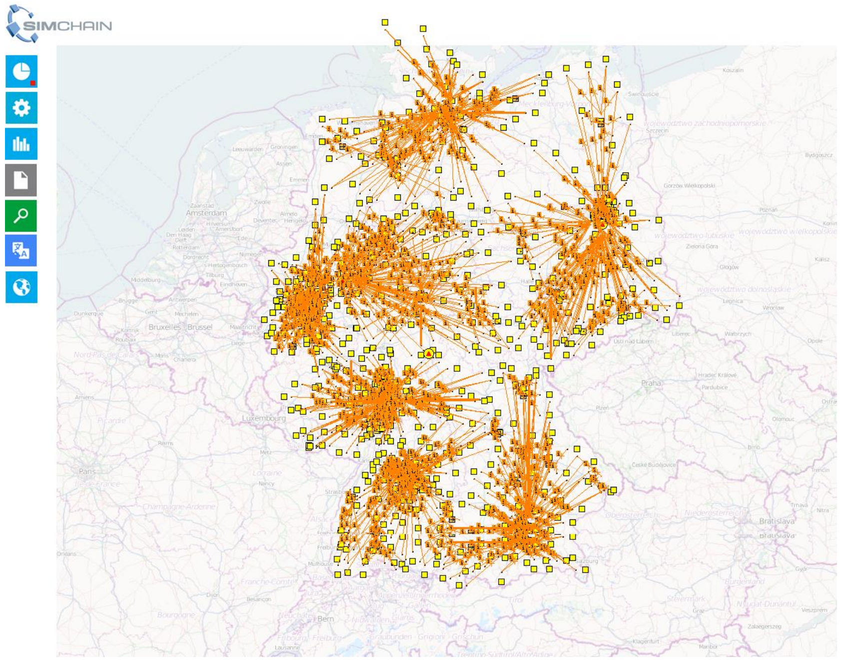
- Experiments
  - Model validation based on real data for 2005
  - Comparison of inventory trends and delivery service levels for (individual) locations / articles
  - “Base Line": evaluation of the inventory development, unless optimization measures (besides relocation) are carried out
  - Evaluation of the individual effects independently of each other
  - Evaluation of the combination of individual or all optimization measures

Beiersdorf Network Design

- Results
  - → Significant reduction of inventories is possible
  - → The introduction of multi-lingual articles as well as production flexibilization offer the greatest potential for optimization

Volkswagen Tyre Distribution

- Simplifications required due to the volume of data
- Clustering: determine substitutes for all classes and simulate them
  - ➔ Example: Distribution network with over 200,000 articles
  - ➔ Formation of few clusters for the articles
  - ➔ **But**: modeling of all 1346 customer locations and 10 warehouse locations
- Goals
- Evaluate scenarios for possible central warehouse locations (no optimization)
- Determination of the respective transport costs
- Evaluate different ranges for the articles



Q&A


Q
&
A

SERVICE SOLUTIONS SOFTWARE SUPPORT

Thank you for your attention!

Dr. Till Fechteler

SimPlan AG
Hanau, **Braunschweig**, Dresden,
Holzgerlingen, München, Regensburg

Adolfstr. 21
38102 Braunschweig, GERMANY

Phone +49 531 70095-10
Fax +49 531 70095-19
Email Till.Fechteler@SimPlan.de
Web www.SimPlan.de