Dynamic Modeling in the Ready-Mix Concrete Industry

CEMEX

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AGENDA

CEMEX and Ready-Mix context

Ready-Mix order fulfillment processes and challenges

- Supply chain processes
- Tactical and operative modeling
- Main challenges

SIMUL Model

- Model structure
- Demo

Conclusions

- Why iThink?
- Benefits for CEMEX
- Evolution

CEMEX AND READY MIX CONTEXT

CEMEX is the world's largest ready-mix concrete and construction materials supplier and third largest cement producer

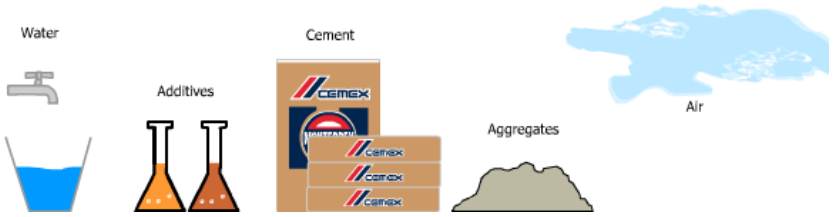
- ~1,800 ready-mix concrete plants worldwide

CEMEX is the major concrete producer in Mexico

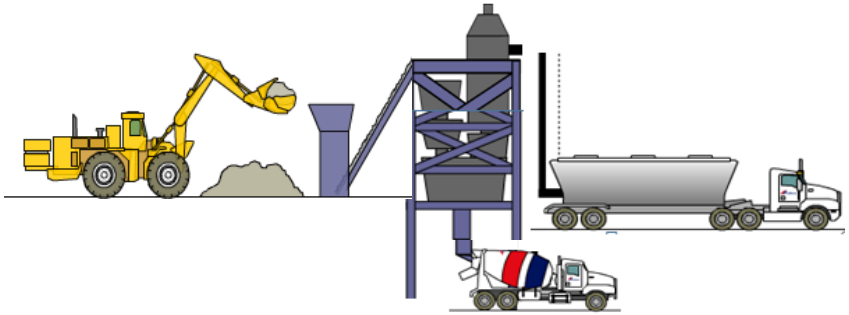
- 300 batching plants
- 4 regional customer service and centralized dispatch offices

Ready-mix is a type of concrete that is specifically manufactured for delivery to the customer's construction site in a freshly mixed and unhardened state

Raw materials used



Just-in-time production process



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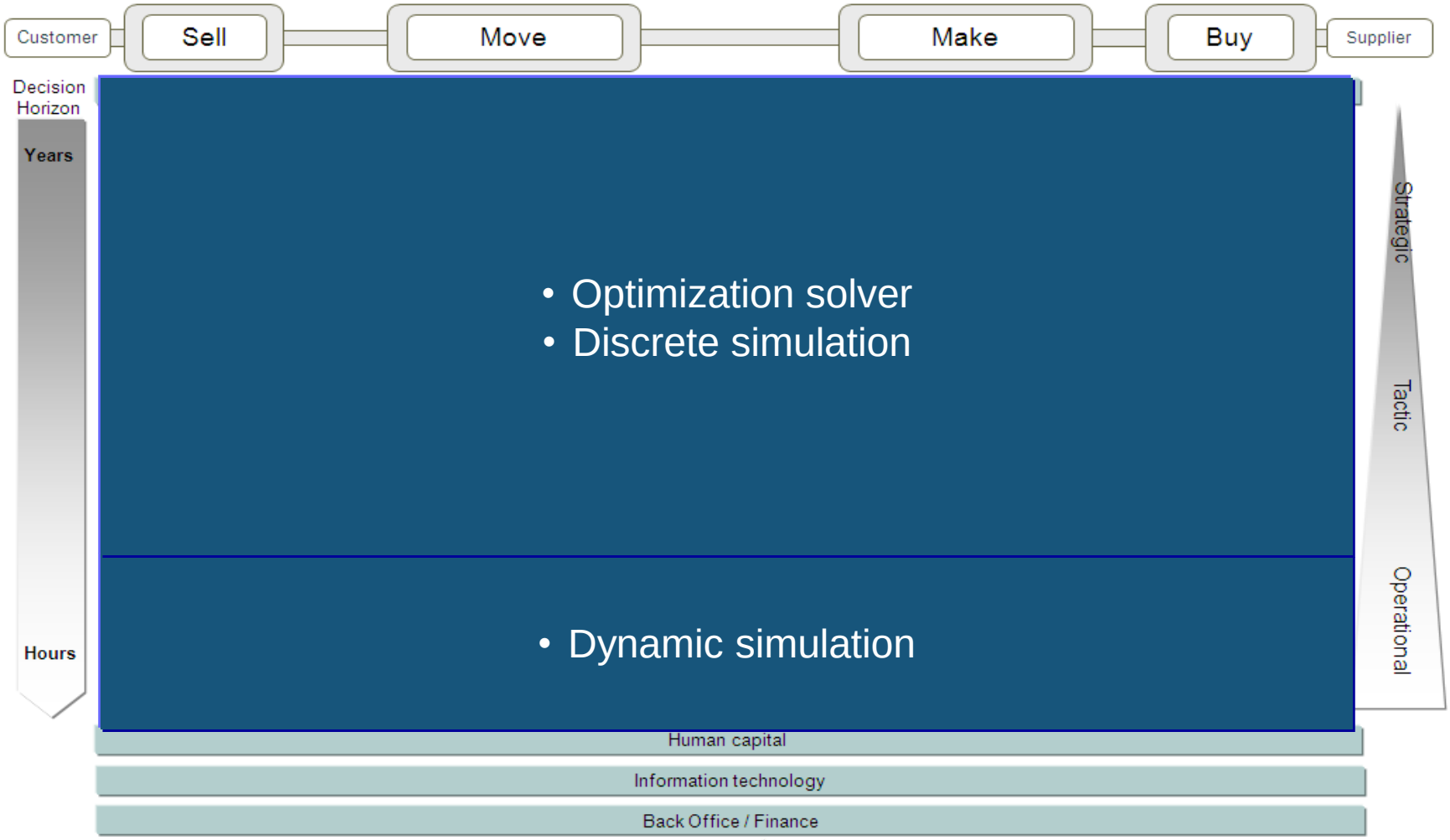
ORDER FULFILLMENT IN THE SUPPLY CHAIN

In CEMEX we have found difficulties in trying to use optimization and discrete tools to model the complexity of the execution in the ready-mix concrete business



READY-MIX ORDER FULFILLMENT

Service and cost are the two main elements that play all the time in the Order Fulfillment processes

Customers → Order taking → Scheduling and dispatch → Production and loading → Delivery

READY-MIX ORDER FULFILLMENT

Main Challenges

The Order Fulfillment process of ready-mix concrete is recognized as one of the most challenging problems in manufacturing and logistics.

- Concrete is a perishable product with a usable time of less than 2 hrs
- The majority of the orders require time-synchronized, staggered deployment of several trucks.
- Concrete must be poured in a continuous fashion

Every 2-5 minutes, dispatchers have to evaluate among many alternatives to decide which individual truck to assign to a delivery and then determining which plant to direct a truck to after delivery completion.

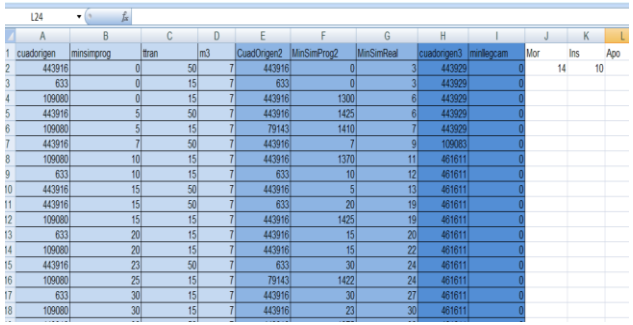
Added to that, changes operative conditions and orders occur all the time:

- Unexpected delays in traffic or at customer sites
- High level of cancellation and modifications subject to weather conditions
- Variable transit times depending on the hours of the day
- Variable order amounts (bonus load)
- Mechanical failures of trucks and plants

The static allocation of trucks and plants can be inefficient in such a dynamic environment like ready-mix concrete

SIMUL MODEL
Inputs and Outputs

Scheduled and dispatched orders



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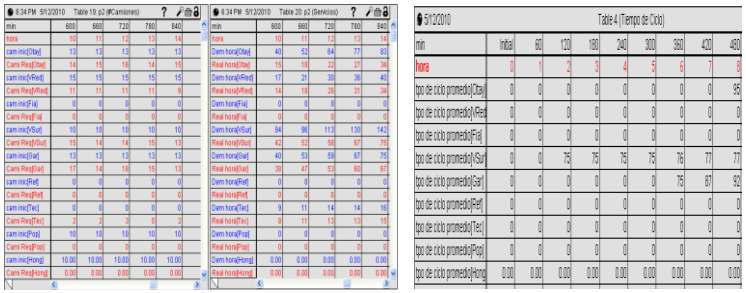
Operative parameters

	Tpo. De carga min.	No. De Camiones	Tpo de descarga en mins
TIC Otay P-167,	6	13	30
TIC Valle Redondo I P-406,	6	15	30
TIC Fiadert P-184,	6	0	30
TIC ValleSur P-161, TIC ValleSur II P-253,	5	10	30
TIC Garcia P-163,	5	13	30
TIC El Refugio P-220,	6		30
TIC Rosarito P-168,	5		30
TIC Popotla Cemex 1 P-340,	8	10	25
Hongo	8	10	31

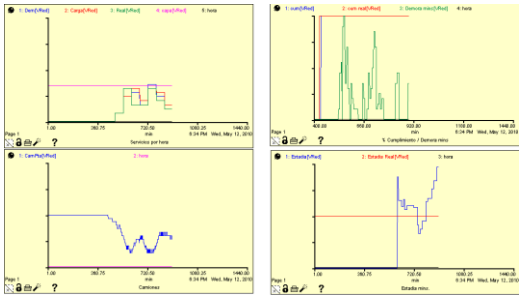
Input data (two excel spreadsheets)

iThink model (model runs in 20 seconds)

Key indicators



Detail per plant



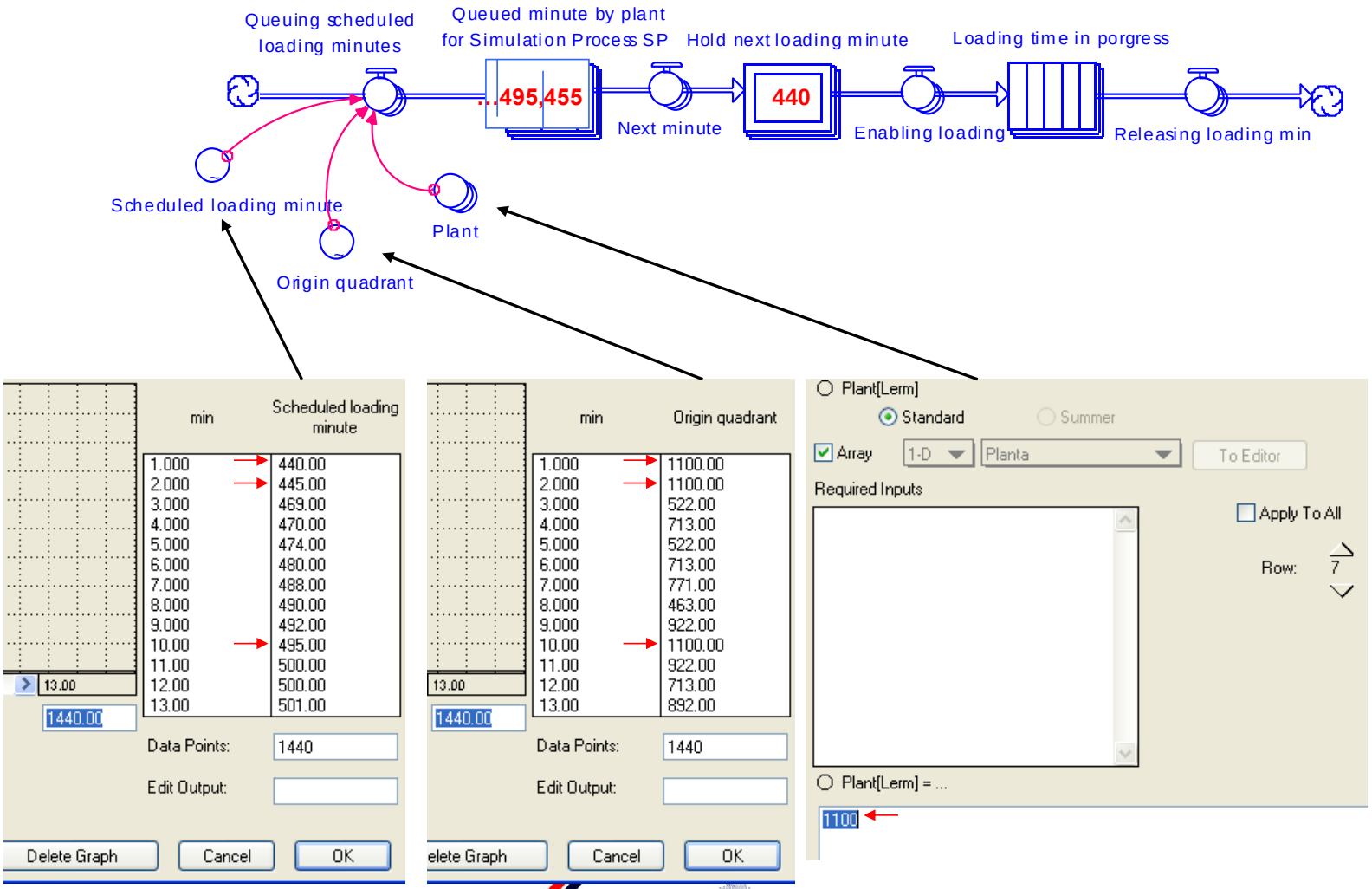
Model's output

This simulation is helping dispatchers to anticipate potential issues and delays attributed to the lack of trucks or an over-demand in the plants

SIMUL MODEL

Model Structure – Data loading

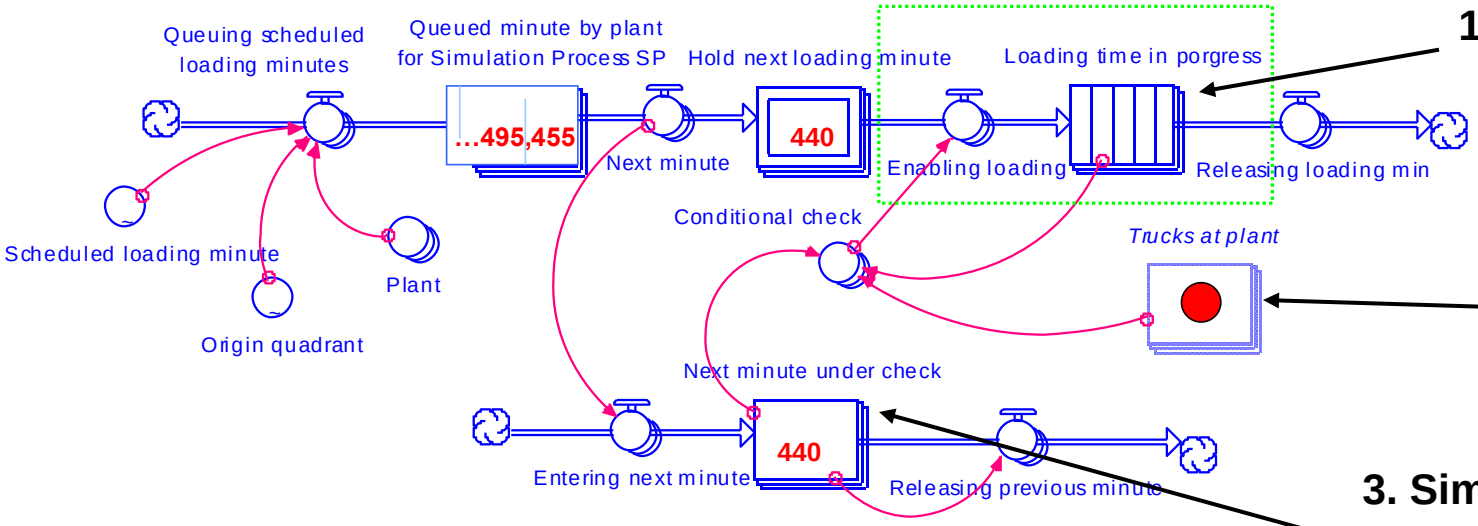
Each load and its scheduled loading time is allocated to its corresponding plant



SIMUL MODEL

Model Structure – Data reading and synchronization

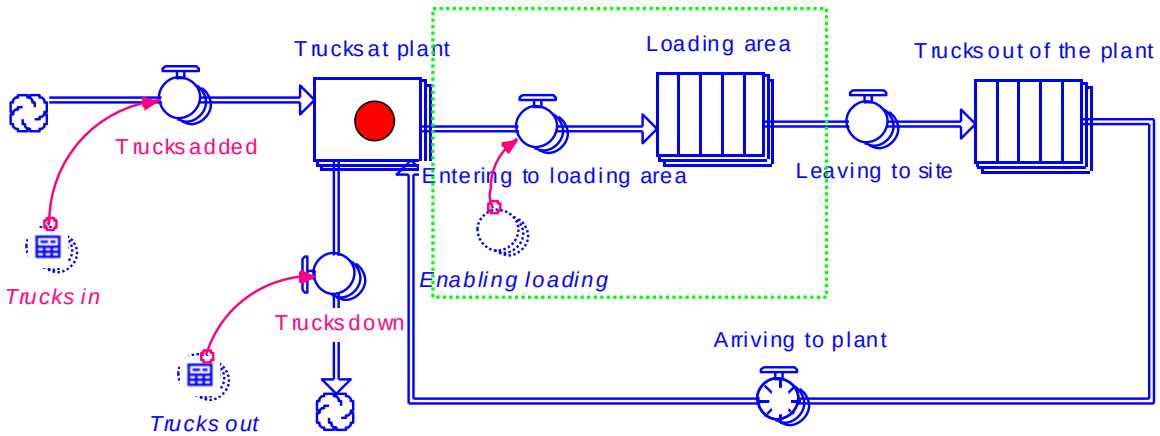
When these 3 conditions met, then a loading minute is moved to the loading stock, and at the same time, a truck is moved to the loading area.



1. Loading point is free

2. Truck is available at the plat

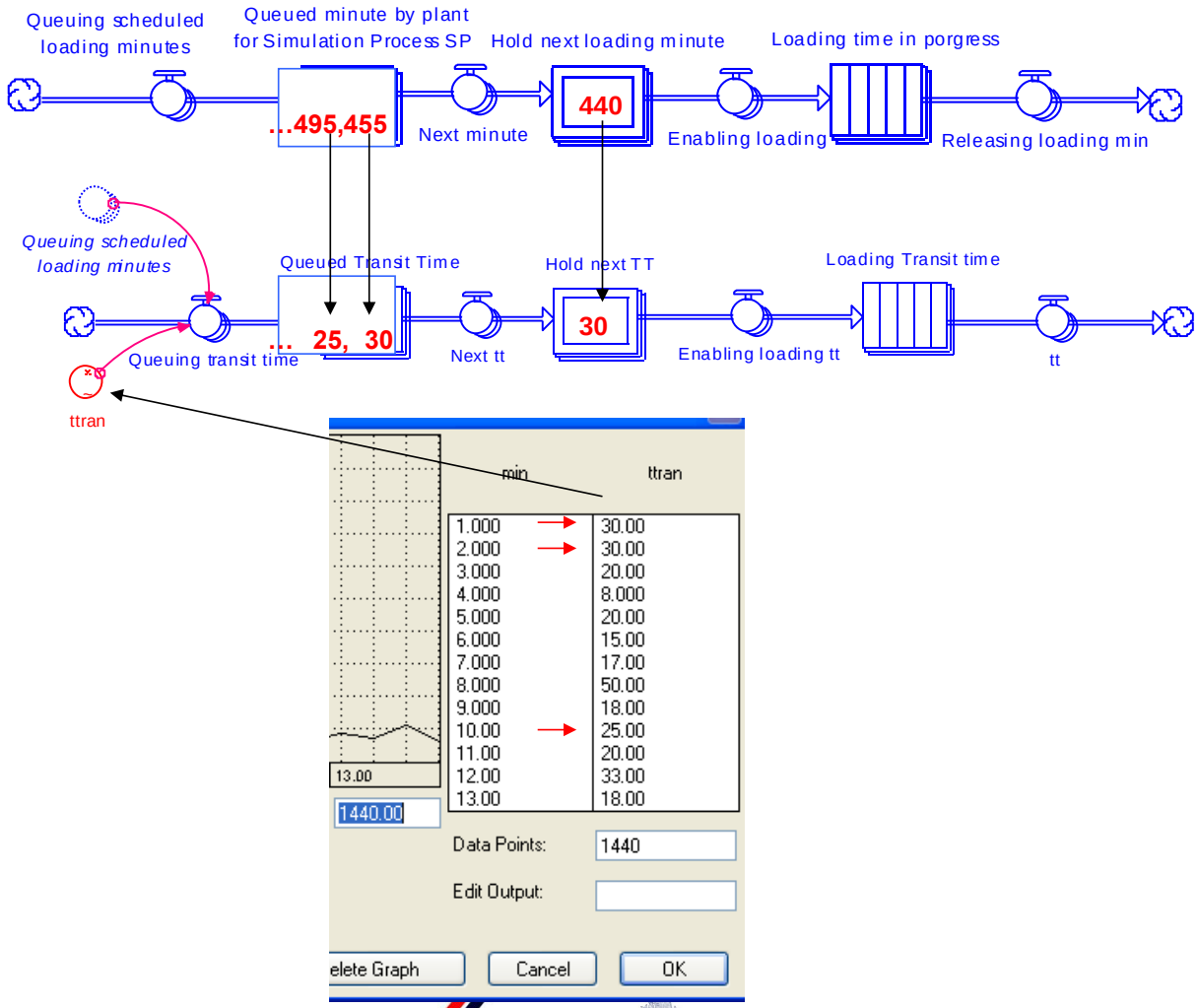
3. Simulation minute equal or greater than the loading minute



SIMUL MODEL

Model Structure – Data reading and synchronization

The attributes of every delivery (i.e. scheduling loading time, transit time and m3) move simultaneously through the model



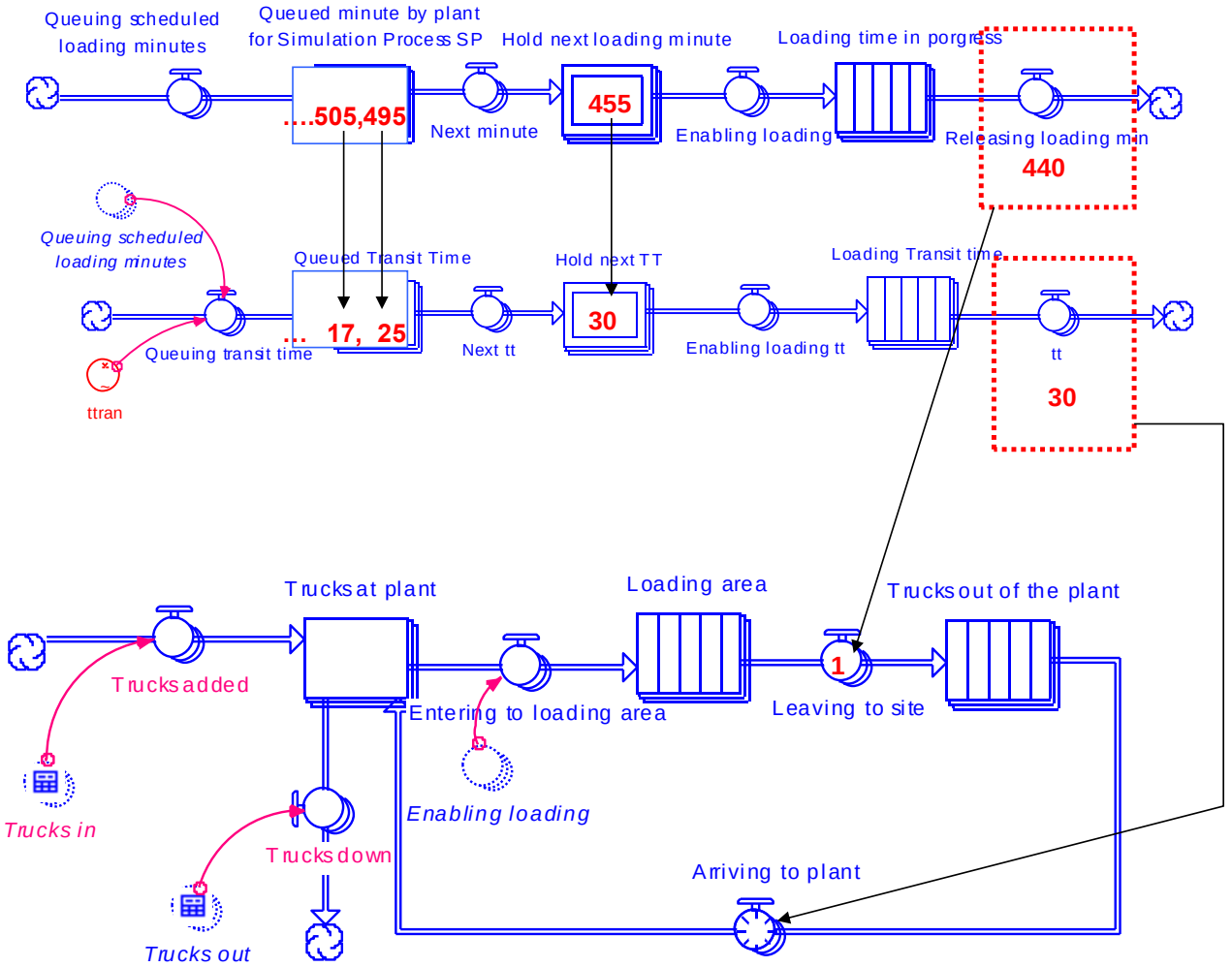
SIMUL MODEL

Model Structure – Data reading and synchronization

In this example, the delivery to be loaded at minute 440 is synchronized with its corresponding transit time (30 minutes). All of this happens for all 13 plants at the same time

Scheduled loading minutes

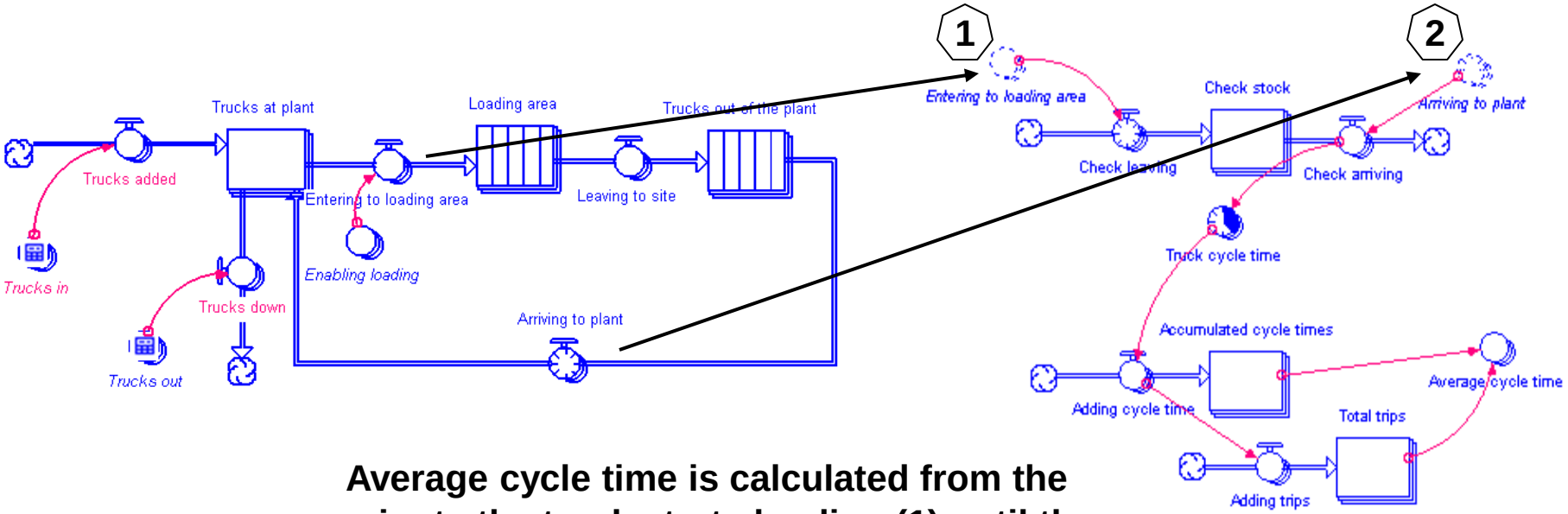
Trucks



SIMUL MODEL

Model Structure – Data processing and outputs

Cycle time calculation



Average cycle time is calculated from the minute the truck starts loading (1) until the same truck gets back to the plant (2):

- Truck starts loading at minute 440
- Journey time from plant to job: +30 min
- Unloading time at the customer: +15 min
- Journey time back to the plant: +30 min

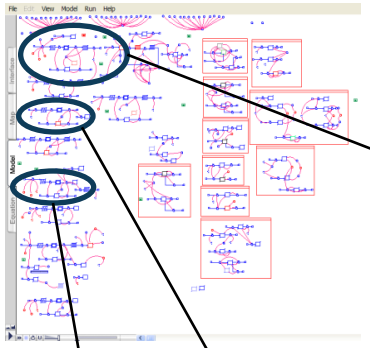
- Truck is back to the plant at minute 515

For this load, the cycle time is 75 min

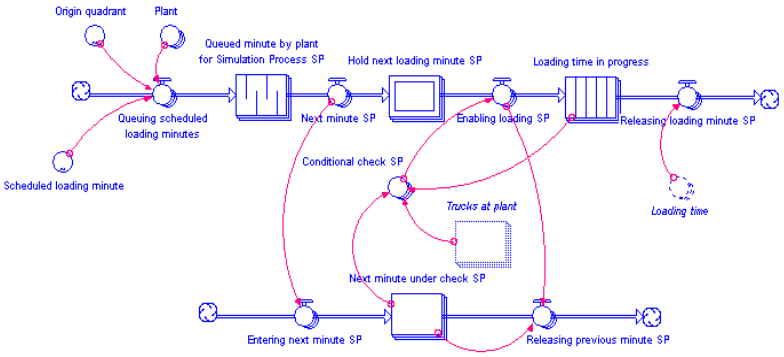
SIMUL MODEL

Model Structure – Simulation vs. Actual

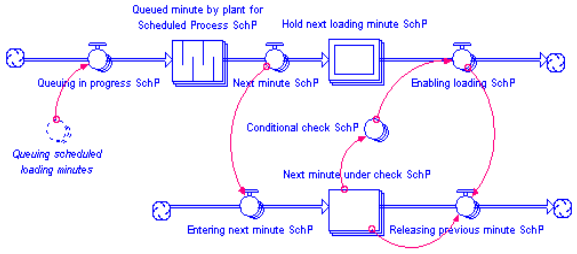
The model runs 3 different scenarios at the same time



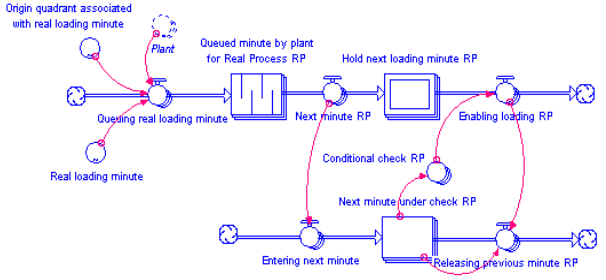
Simulated loading minute (considers operative restrictions)



Scheduled loading minutes



Real loading minutes



SIMUL demo

WHY iThink?

iThnik allows to model the operative complexity in a friendly way using arrays, queue + ovens, etc.

Easy interaction with excel spreadsheets to upload the data into the model

Eliminates the “black box” approach creating trust and allowing users to make their decisions based on the information provided by the model

BENEFITS

Significant benefits have been obtained:

- Cost savings reduction in operative costs
- Increased on-time deliveries from 75% to 90%
- Improve fleet efficiency in 8-10% maintaining service levels

FUTURE DEVELOPMENTS OF SIMUL MODEL

SIMUL V.2©

- **Optimal shipping plant based on cost**
- **Pump allocation**
- **Dynamic synchronization with other business lines (e.g. cement replenishment to ready-mix plants**
- **Use on other transportation modes, such as rail and ship operation**
- **Simulation environments for new dispatchers or other stakeholders for training purposes**

THANK YOU

For further information please contact:

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