READ ME - How to use the modelling method “Logistics”

1. I want to create an economic map of a national area and simulate several scenarios upon the model

MODELING (model type 1)

Create a new model of type “Logistic strategy planner”.

Within the modelling environment create 1-n producers, 0-n borders, 0-n distribution hubs and 1-n reseller.

Connect those entities using the relation “FlowOfGood” in the following fashion: producer => (border) => distribution hub => (border) => reseller

(Hint: any other order of connections is restricted, the product flow always originates at a producer and ends at a reseller, if not necessary you won’t have to model distribution hubs).

You can specify (or leave your model generic) if a producer or reseller is of type “food”, “medicine” or “care product” to approximate the model to reality, by double-clicking on an entity and flagging the corresponding radio box.

After the basic economic overview of an area (e.g. a state, a district) is created, you can now detail the supply and demand parameters of the object’s producer, distribution hub and reseller.

In order to make the simulation work every entity should be enriched by those parameters.

Short explanation to the parameters:

<u>Non special parameters for any economic entity</u>
Current capacity: represents the current stock of goods at t=0 at a specified economic party e.g., producer of type food has a current capacity of 5, this means the producers stock is filled with 5 units of the product “food”.

Maximum capacity: this parameter represents the maximum amount of goods an economic party can store at any time; it is not possible to store more than the maximum capacity. You can imagine this parameter as the size of the warehouse/stock of an entity.

<u>Special parameter only for producer</u>

Supply: this parameter describes the number of goods that are manufactured by the producer within one time unit (time units will be described later on, as they are important for the simulation phase).

Special parameter only for reseller
Demand: this parameter describes the number of goods that are bought by the customers of the reseller within one time unit.

Now that every economic party is fairly well parameterised, we can cluster producers and resellers by creating aggregations, so called “areas” which arrange groups of producers/resellers more granular.

If an area overlays the producer or reseller sent it to the background by right-clicking and choosing “Layer” and then “To background”.

Borders along the route between producers, distribution hubs and resellers can either be open or closed.

Last but not least create a “duration tracker” by using the model object “TIME” and place it anywhere you like (we suggest the left upper corner as convention).

Do not forget to give producers, distribution hubs, resellers and areas names so that the viewer of the model instantly will understand what the model is about.

SIMULATION

It is time to do some simulations on top of the created economic model.

Open the simulation module of ADOxx and click on “Economy Simulation” and “Update supply and demand”.

The upcoming dialog box will ask you how many days you’d like to simulate
After filling in the desired amount of time units (=days) you can click on “OK” and the simulation will start.

By looking at the time object we can see while the simulation runs through at which point in time, we currently are.

Every second the time objects jump to the next day until the specified duration is completed.

What we see is that the colour of the areas (aggregations) will change according to the current capacity situation.

What do the colours mean?
Colours indicate how critical the capacity situation at a given area is, green indicates that everything is alright, yellow shows that the capacity situation is fairly well, but not ideal. Starting for orange the capacity situation is indicating that there might be problems within the supply chain. If an area is coloured red there is a severe problem with stock replenishment, immediate actions are needed.

Mathematics behind the colour code:

Green: 100% - 80% as the result of the calculation: Current capacity / Maximum capacity at a particular time
Yellow: 80% -50% as the result of the calculation: Current capacity / Maximum capacity at a particular time
Orange: 50% - 20” as the result of the calculation: Current capacity / Maximum capacity at a particular time
Red: 20% - 0% as the result of the calculation: Current capacity / Maximum capacity at a particular time

If all areas stay green this might indicate the normal stage of affairs.

But how does the modelled adapt if e.g. a pandemic crisis occurs?

RESTRICTIONS

We enriched our modelling method by pandemic related concepts that can be applied to the model to see how the market dynamics change, if certain events occur.

We cluster the restrictions into the following effect-groups:

Demand restrictions
Panic buying: By inserting this model object into the model the modeller can simulate how demand sided effects could worsen the situation. This object comes with one parameter, namely “Magnitude of Panic” which requires a percentage value of how severe the effects of the panic buying increase the demand. The demand value of all resellers will be increased by the defined percentage.

Supply restrictions
Shortened shift: This concept is interesting after the big panic has settled down. Demand for non-essential goods decrease massively and there is no need for producers to bring out that many goods. Shorten shifts are introduced to understand how much work hour reduction is bearable before supply scarcity kicks in. Similar to panic buying the modeller is equipped with the parameter “WorkHoursReduction” in which s/he can define on a perceptual basis how much the shift duration will be reduced.

Transportation restrictions
No more Schengen: As the crisis escalates nations do anything for damage control. They close down borders so that the virus can’t be brought into the nation for the outland. The modelling object “NoMoreSchengen” closes down all borders, disabling all foreign product flows into the nation. By deleting the object all borders will be opened again.

General pandemic restrictions

Social distancing: Due to the way the virus is transferred from person to person the nation obligates its citizens to keep a minimum distance to each other, while shopping, while working at a production site. This effects the demand, as well as the supply, because there is a limited number of people allowed in a building. By activating the modelling object “SocialDistancing” every resellers demand and every producers supply is decreased by 20%.

2. I want to visualise the route between two economic parties (one producer, one reseller)

MODEL TRANSFORMATION

Within the modelling environment of the “Logistic strategy planner” there is the “Model transformation” function.

You have to choose two objects by holding the strg-button on your keyboard and clicking on them to make them eligible for model transformation.

(Hint: The only implemented allowed pair of objects within the “Logistic strategy planner - perfect setup” is the producer “Ottakringer” and the reseller “HOFER Favoritenstr.” - This is a mock-up because there is no standard functionality for our use case)

After having both objects selected you can click on “Model transformation” and furthermore “Create logistic route planner”. After doing this a new model of type “Logistic route planner” is created. This model is using a web service call to get possible routes between these objects.

As you can see the objects of the created model are somehow glued together, easily distribute the objects so that they look nicely placed.

3. I want to calculate the shortest path and visualise it on the model

ANALYSIS

For this task we decided to implement the Dijkstra shortest path algorithm to our modelling method. You can use the newly transformed model to perform this analysis or any self-made model. (we will discuss how to create a “Logistic route planner”-model later on).

In order to analyse the shortest path, you have to change to the analysis environment within ADOxx and click on “Route Optimizer” and then decide if you want to visualize the optimal route “Visualize Optimal Route” or if you’d like to calculate the shortest path “Calculate Shortest Path”.

By choosing the “Visualize Optimal Route” option the relation objects of the model, the corresponding nodes, as well as the producer and reseller, will be manipulated in the following fashion:

- All relations (might it be road or rail) that are part of the shortest path change their colour and are painted green
- All node objects along the optimal route (=shortest path), such as crossings and train stations, are enriched with a green quadrangle surrounding those objects

By using the “Calculate Shortest Path” function the user of the model will be presented with an INFOBOX, displaying the following information:

- An enumerated list beginning at the producer, ending at the reseller, of nodes which are chronically sorted, that have to be passed in order to reach the destination (the reseller) by taking the optimal route into account
- The result of the Dijkstra algorithm returning the total length of the optimal route

MODELING (model type 2)

Create a new model of type “Logistic route planner”

Within the modelling environment create 1 producer and 1 reseller. Create 0-n intersections and 0-2*n train stations (you always have to create train stations pairwise).

There are two different relation types, namely road and rail, embedded, the following constellation of connection is allowed (any other constellation will be denied):

- **Road**
    - Producer to intersection
    - Reseller to intersection
    - Intersection to intersection
    - Intersection to train station
    - Intersection to producer
    - Intersection to reseller
    - Train station to intersection
    - Train station to producer
    - Train station to reseller
- **Rail**
    - Train station to train station
    - Producer to train station

Now connect your node objects, these are producer, reseller, intersection and train station according to the map you’d like to model.

After these connections are established you have to specify the cost of a connection (we call it “Cost” because it can be interpreted in regards to several attributes, cost

might be distance, speed-limit, etc.). The default cost-value for a road is 2 and 1 for a rail.

If you are satisfied with your model you can go back to the ANALYSIS chapter of this instruction and perform the shortest path analysis.