



AIMMS

# IMPLEMENTING SUPPLY CHAIN NETWORK DESIGN

A step-by-step guide to achieve successful results



# Introduction

Companies want to maximize service levels, but they also want to cut costs. These goals are often at odds with one another. How do you find the optimum balance? That's what Supply Chain Network Design is all about. Traditionally, supply chain network design has been done on a one-off or project basis. Rising volatility and uncertainty have changed that. Companies are now running models on a quarterly basis, and sometimes more frequently, to adjust to changes in their business landscape. This guide offers hands-on advice that will help you use network design to achieve successful results.

## Who is this guide for?

The advice in this guide may seem obvious to experienced network design practitioners but it is useful for:

- Those getting started in the field
- Analysts who are moving from spreadsheets to more advanced modeling tools

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# 1. What is supply chain network design?

Supply chain network design is the practice of building and modeling the supply chain to understand how resources should be located and rationalized, such that the business can meet target service levels at the lowest possible cost. It determines the capacity of the business' facilities, the movement of raw materials, intermediates, and finished goods – from the source to the point of consumption.

Network Design is typically based on a MILP (Mixed Linear Integer Program) solver. This type of mathematical formulation means that the model optimizes flows on lanes for a given period (for example a year), and not individual truck loads. It can approximate average truck loads on a lane, or you can use approximate routes to generate cost functions for multi-drop / milk run type of deliveries. These are all approximations that are good enough for strategic and often tactical decision making, but not detailed enough for operational planning, where a routing and scheduling engine is a better fit.

## What are good use cases for network design?

As mentioned above, network design is a strategic planning activity in most cases. But there are exceptions where network design software can fulfill tactical or even operational needs.

The table below explains typical use cases for network design technology across different planning horizons.

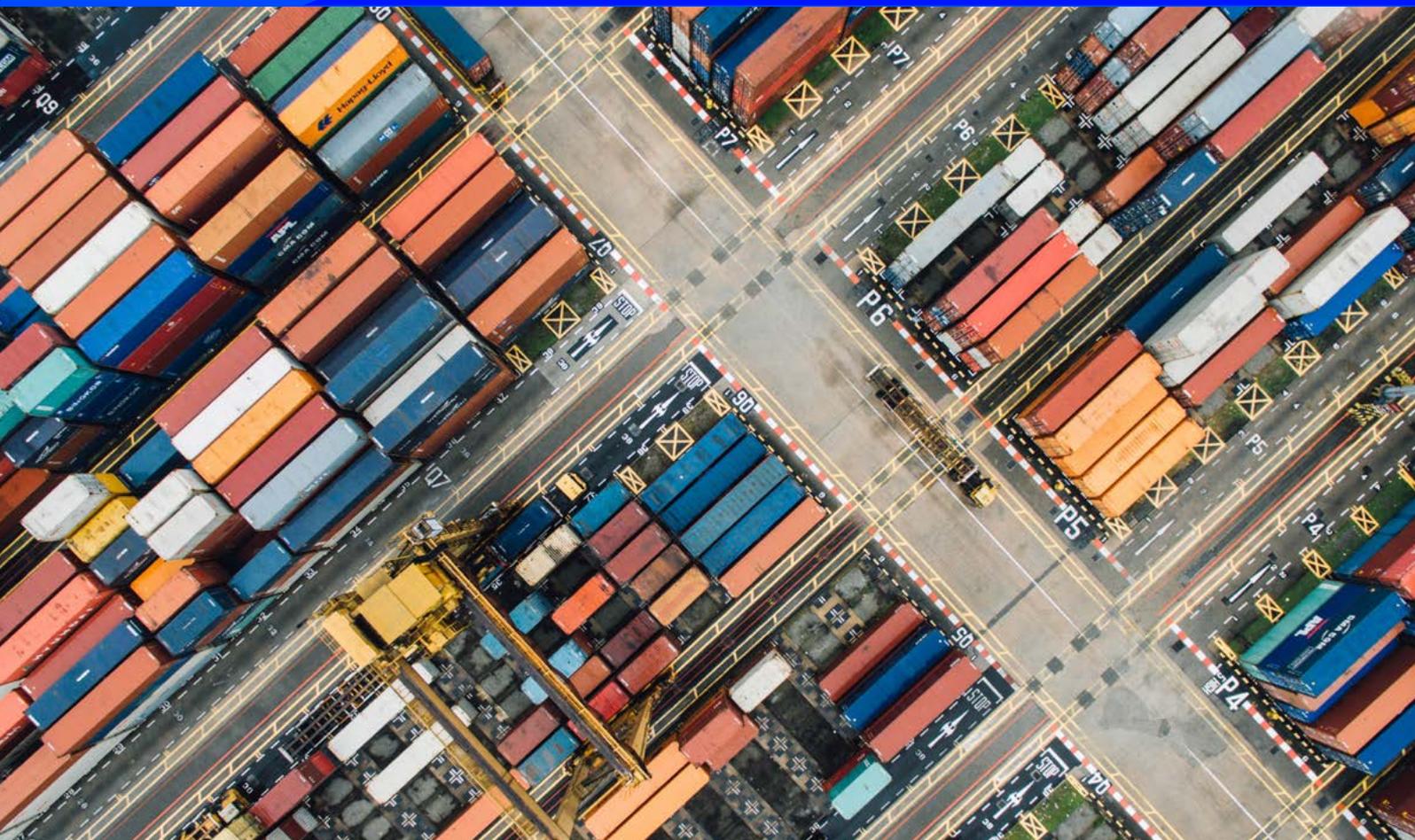
Strategic network design	Tactical planning	Operational planning
 <p>Model in annual or monthly time buckets, and make sure your cost functions are "good enough" so that your answers are still valid at the strategic level. You can afford to make some assumptions and sacrifice some accuracy, because your main goal is to run multiple scenarios and compare them to understand the differences between them, rather than being accurate to the last cent.</p>	 <p>Rough cut-capacity planning on a monthly basis or supporting an S&amp;OP process with a monthly supply/demand balancing solve are also good use cases for network design. Still, the process and collaboration aspects of S&amp;OP may be better handled in a tool specifically designed to manage that process.</p>	 <p>One example where a network design tool can be successfully used for operational planning is the placement of spare parts at forward stock locations in an MRO (maintain, repair, and operate) environment. This can be done at the SKU location level and run weekly, for example <a href="#">AIMMS Network Design</a> comes with a companion app, <a href="#">AIMMS Inventory Planning</a>, that helps you achieve just that.</p>



## Zooming into the strategic level, network design is typically used to:

- ✓ Reduce “hard-coded” costs
- ✓ Optimize service levels
- ✓ Make DC Open / close decisions
- ✓ Optimize customer to DC allocations
- ✓ Optimize transport flows
- ✓ Optimize supplier, production and DC flows
- ✓ Manage capacity constraints
- ✓ Understand cost to serve
- ✓ Perform M&A due diligence
- ✓ Do post M&A rationalization
- ✓ Mitigate risks for disruptions such as disease, weather, trade wars, industrial action, political turmoil, etc
- ✓ Prepare business cases for investment
- ✓ Optimize carbon emissions

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## Getting Started with Supply Chain Network Design

So, you've identified that you've got a (strategic) network design problem. Now, where do you start? While network design does have a 'usual' workflow, every project will have its own nuances and be slightly different. Remember that you are experimenting with a future that doesn't exist yet. This makes the steps you need to follow a little fuzzy and they may vary every time. This is very different to operational and tactical planning, where you repeat certain well-defined tasks over and over.

If you don't know where to start, our best advice would be to avoid this approach: "Let's get some data, push it into the app and see what happens." This can lead to much frustration and inefficiency in all stages of the process because you have no sense of direction and purpose to what you are doing.

Instead, we recommend that you start with the end in mind. Try following these steps:

### 1 Capture the business question(s)

Figure out (together with your business owners) what questions you are trying to answer with network design and write them down. Picture yourself giving a boardroom presentation with the outcomes of the study and think about the slides you will need to present it.

### 2 Design a list of scenarios that you will need to run to answer the business question(s)

This list is preliminary and will inevitably need to be adjusted as you work through the process and learn new things. After you present your first scenarios, new questions and associated scenarios will arise. If you're using a tool like AIMMS Network Design, that's ok, because you can run as many scenarios as you like.

### 3 Figure out what data you will need to run the scenarios

The scenarios you want to run will help you define your data requirements, and also guide you in deciding how to aggregate the data into something that makes sense for a network design exercise.

### 4 Collect the data you need

You now have a focused list of data requirements. So, gather only the data that you really need. Clean and aggregate the data and validate it with the business before capturing it in the model.

### 5 Work through the rest of the network design process

You are now ready to start modeling: import the data into the model, run the scenarios, prepare the boardroom presentation.

In the pages that follow, we will delve into these steps in more detail.



## Key takeaway

Following the process above should help you avoid many pitfalls along the way. Spending some time upfront to design and plan the exercise is well worth the investment. It's also a good strategy to start small and grow fast from there. You don't need to solve every problem you have with your first model. Try to define a manageable scope of work for your first model, so that you can deliver value as soon as possible. You can always expand your scope after that.

## 2. Identifying scenarios

As we explain above, you should start with the business questions: what are you trying to solve?

Once you identify that, you should have a clear list of scenarios that you need to run to answer those questions. There is also an opportunity to run some exploratory scenarios. These may uncover hidden opportunities for optimization that are not always immediately apparent or obvious. You might be able to suggest some optimization opportunities to the business that they had never thought about.

### Here are some ideas for typical scenarios:

#### 1 Base case

You need a validated base case to ensure confidence that your model represents reality. This will also be a reference point from which you can measure optimization benefits.

#### 2 Relax transport constraints

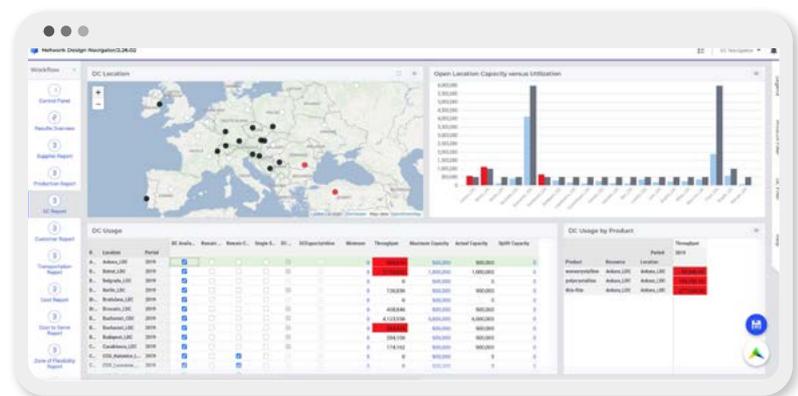
This will show you opportunities for allocating customers to different service locations to optimize costs. These are often “low hanging fruit” as they require little or no investment to execute.

#### 3 Relax DC capacity constraints

Relaxing DC capacity constraints may highlight opportunities to shift volumes between locations to save costs. It will also reveal the quantum of additional capacity required at DCs to make these shifts, and whether it is worth the CAPEX investment to do this compared to the OPEX savings that can be achieved.

#### 4 Relax supplier and production constraints

This will show you shifts in supplier and production volumes that may deliver a cost improvement. In some cases, supplier and production shifts can be done easily without massive investment. In other cases, the opposite is true. But either way, this scenario will highlight the quantum of the shift and the expected OPEX benefits, which can then be weighed up against the CAPEX required.



Constraints in AIMMS Network Design

#### 5 Allow the model to close locations

This is a high-impact decision. This scenario helps you identify the locations that could be considered for closing in order to save costs.

## 6 Explore CoG (Centre of Gravity) candidate locations

A Center of Gravity analysis helps you compare the current network to a hypothetical “blue sky” network. AIMMS Network Design comes with Center of Gravity capabilities that help you identify some candidate locations. You can run these together with the existing network in the app. The optimization will reveal the best mix of existing locations and new “greenfield” locations.



Center of Gravity analysis in AIMMS Network Design

## 7 Add Lead time constraints to the optimization

In AIMMS Network Design, the optimization will give you the “best cost” network but still respect lead time (drive time) constraints. This will result in a balance between cost and service levels that may be a better solution than just optimizing costs.

## 8 Run some demand flex scenarios

Running optimizations against the base case network can reveal many insights. You should also optimize for the future by running some scenarios against projected future demand. These projections may not be accurate, but you could run high growth / low growth / expected growth scenarios to put some confidence bounds around your forecast.

There are many other scenarios that can be run. The list above should provide a good starting point to explore optimization opportunities.

## 3. Modeling the base case to build a digital supply chain twin

Running a base case scenario is often tedious and uninteresting because you have to force the model to replicate what happened in a past period. This typically means forcing min=max constraints on all transport lanes, based on the transactional data in your ERP or system of record. The model does not build or draw stock. So, the material balance constraint at each node in the network means that what is forced in must exactly equal what is forced out. Otherwise, the model will run infeasible.

The transactions from the past will never balance out exactly. Inbound may be more than outbound if there was an inventory build, or it could be less than outbound if there was a stock draw-down. There may be inter-facility movements and abnormal location-to-customer movements in the transactional record, which happened in reality, but are usually the result of some operational issues in past data. You may also need to create additional lanes that are not in the base case to allow the optimization to be as open as possible if you want to relax transport constraints.

**Although it can be work-intensive to prepare a base case, it is necessary for two key reasons:**

### 1 Validating that the model represents reality

Your base case provides the foundation for a strategic, digital supply chain twin. Once this digital representation of your supply chain is in place, it becomes easy to run multiple what-if scenarios. You need to ensure confidence (both for yourself and for the business owners) that your model actually represents reality. Run the base case model and compare it to income statement or other cost data, and independent sources of volume data. You should get to within 5% to 10% of actual costs and volumes. You should also validate the model with business owners, so that they get involved in the process, and share the knowledge of how things actually work in practice with you. As a modeler you don't always know all the practical realities in the field, so this can be very helpful.

### 2 Providing a reference point to measure optimization opportunities

If you only present the optimized model to business owners, the immediate response will be: how much OPEX am I saving to justify the CAPEX required? Is it \$10 per year or \$10 million per year? If the savings are small, they probably won't justify the effort and investment to re-design your network. If the savings are large, they can be used in the business case and NPV (net present value) calculations.



### Key takeaway

Without a base case, you have no way of providing the estimated benefits. Your base case should get to within 5% to 10% of actual costs and volumes.

**So, preparing a base case model is really important.**

**Here are some tips to make it easier:**

- ✔ Try forcing the outbound lanes to match final demand. Create business rules to allow the optimization to pull inbound volumes so that they match the outbound volumes, but still follow normal, "as-is," flows. This will prevent infeasibilities created by node balance constraints.
- ✔ Don't sweat the small stuff. You could remove the "noise" from the base case data (for instance, very small or abnormal volumes). If you get to within 5% to 10% accuracy that is usually good enough. You don't have to match to the last cent exactly.
- ✔ Use the source data set to pivot or query your demand volumes, and to generate your transport forcing constraints. This way, forced volumes on lanes will always match demand data.
- ✔ Validate your base case with the business. They will help you decide what is important and what is not, what happens in "real life" and what does not. At the same time, this creates buy-in for your modeling exercise.
- ✔ Use specific from/to lanes to force the base case but create "blanket" lanes using location groupings to provide as much room to optimize when transport constraints are relaxed.



## 4. Preparing the data for your model

Preparing data to feed into the model is one of the biggest tasks in network design. It is worth investing time in thinking about how you will prepare your data before importing it. If your model data is well-designed, your life will be a lot easier.

### Follow these tips and tricks for network design data preparation:

#### 1 Keep it simple

Remember that this is strategic modeling. Your data doesn't have to be detailed and accurate to the Nth degree. You can afford to take some shortcuts, use aggregated instead of detailed data, and make some assumptions. The simpler your data is, the easier it will be to collect, validate, clean and enter it into any template. Your results will also be easier to interpret, and there will be runtime advantages as well.

#### 2 Remove the noise

ERP data often contains information that is necessary for ERP purposes but creates an unnecessary distraction in network design modeling.

Consider removing data around:

- Credit notes
- Samples
- Returns
- Transfers between virtual locations
- Tiny volume products
- Retired products

Extract transactions that represent physical flows and filter out transactions that represent virtual flows.



### Quick start route

[AIMMS Network Design](#) makes it straightforward to capture data in Excel templates.

It's also possible to integrate directly with the application's MySQL database but importing data from Excel using our configuration wizard and Data Navigator is the recommended best practice.

[LEARN MORE](#)



### Key takeaway

Keep your data as simple as possible, without compromising the quality of the answers you produce.

### 3 Aggregate your products

Unless your business only has a few SKUs, or you need SKU-level results, modeling at the SKU level rarely makes sense for network design. Create the minimum number of aggregate “model” products that capture the complexity you need. These can be, but do not necessarily have to be, the same product groups or product families that you have in your ERP system. As a rule of thumb, the number of model products in the 10s are ok; products in the 100s are too many.

#### Consider these aspects when creating model products and product groups

- Supplier / production capability: the model needs to understand that some products can only be produced or procured from certain production facilities or suppliers. For example, if factory A can only make widget A, and factory B can only make widget B, then you need 2 products: widget A and widget B. However, if both factories can make both widgets, you only need one product: widgets.
- DC capability: if your storage facilities can only handle certain products, your model products need to reflect this. For example, you may need to distinguish between products that use pallet storage, bin storage, bulk storage, outdoor storage, double deep racking, etc.
- Transport types: if different products carry different transport rates, you should have model products that reflect this. For example, if parceled products can travel via 3PL or air freight, but palletized products can only be road hauled, your model products need to be separated to reflect this.
- Linking demand to supply: your model products need to flow from supply through to demand. So, there must be a link between the product demand that you specify for a customer, and where that product can be sourced from.
- Common segmentation: your business might be used to talking about certain products differently, and these can be useful model products. For example, slow movers vs fast movers. You may model one product “slow movers” to aggregate all the slow movers, and split fast movers into a few distinct categories. High value goods vs low value goods may also be a useful distinction.
- Packaging types: different packaging types may require different model products. For example, you could model bulk cement and packed cement as separate products because they are manufactured, transported and stored in a very different way. You don’t need to model every type of packaging as a separate product though. This will make the number of products explode. For instance, beer in bottles and beer in cans may be a good enough segmentation for network design.

### 4 Aggregate your demand nodes

You may be tempted to model every customer at the street address level as a separate demand node. But this is often unnecessary for network design. Using aggregated demand may give you the same answers and insights, with less hassle. Aggregated demand has big advantages in terms of data capture, result interpretation, model runtime, and clarity on the map. A good rule of thumb: 1,000 demand nodes is good, more than 5,000 starts to cause problems.

Consider aggregating demand nodes at the city or zip code level. You could also think about combinations depending on volume of demand.

For example:

- Big US cities at the zip code level
- Small US cities at the city level
- Rest of the world at the country level

## **5 Remove virtual locations**

Your ERP might make a distinction between several virtual locations, which are actually at the same physical location. There are good reasons to do this in the ERP. Namely, to manage the transactional flows in the business. In network design, however, your goal is to model physical flows and associated costs. So, combine all virtual locations into single physical locations if possible. This is especially true for DC locations, where the separate virtual codes in the ERP can be combined into one physical DC location for network modeling purposes.

## **6 Choose your Units of Measure with care**

Ideally, you should use one unit of measure (UoM) throughout the model. For example, if you can model “tons” or “cases” throughout the network, and are able to capture demand volumes, supply volumes, DC throughput, DC costs and transport costs for one UoM, then normalize your model to this single UoM.

However, this doesn’t always make sense. If you do need multiple UoMs to capture different volumes and costs at different points in the supply chain, try to keep these to a minimum. For example, there might be many different case sizes in the business. Using one “average” case to specify volumes and then one weight measure, such as kg, to specify transport costing, may be sufficient. Consider removing UoMs from the model for very small volumes. For example, if only 0.5% of your volumes are measured in pallets, and 99.5% are measured in boxes, consider making an assumption and standardize on boxes. There is some overlap between model products and UoMs, so it is worth spending some time upfront designing how this will work in your model. Keeping it simple is the goal.

## **7 Use capacity constraint assumptions**

Capacity constraints at production facilities, suppliers and DCs are not always easy numbers to obtain. Asking your production or DC manager for a max throughput capacity can sometimes trigger a large exercise in understanding nameplate capacity and how these changes depend on product mix, etc.

Consider using the throughput from your base case data as an initial proxy for capacity. The actual production/throughput from last year’s data is often an easy number to get. When you run the model, you can relax these proxy “constraints” and see how much the model does over or under the number from last year. The discussion with your production or DC manager will go more smoothly in this case. Instead of asking “how much can your DC handle,” you can ask: “can your DC handle 15% more throughput?” This is often an easier question to answer. It provides the same insights, and can reveal exactly where you need to sharpen the pencil on capacity numbers, rather than trying to establish them across the board from the beginning.

## 8 Calculate transport rates

Transport rates are often the most difficult piece of data to obtain. Transport rate structures can be very detailed and complex. The goal for network design is to simplify this to the right level of detail for network design. You don't need to capture the costing of every single load; look for ways to average out transport cost data so that it is directionally correct, and comprehends the different geographical differentials between freight rates.

Often, primary distribution is lane-based, fairly well-defined, and can be used as is. You could consider using actual lane rates for existing lanes. With this data, you could then create distance vs \$/ton regression type formulae per geography to approximate lane rates for lanes that are not currently in use.

Secondary distribution involves many more lanes, is often less well-defined and may require some simplification for network design purposes. For example, you can consider using the following steps to calculate starting freight rates:

1. From the base case dataset, calculate the following for each DC:
  - a. Total volume delivered
  - b. Average stem distance from the DC (weighted on demand)
2. You can also use the base case model with forced volumes to help generate these numbers
3. Get the following for each DC from the income statement, finance department or logistics department:
  - a. Total cost incurred for secondary distribution
4. Calculate the average cost/volume/stem distance for each DC (for example, each DC would have an associated \$/case/stem mile or €/ton/stem km number)
5. Use these numbers to capture secondary costs in the data template.

**Note:** the approximations above assume distance-based costing separated per geography, and ignore fixed + variable cost components, backhaul costing structures, drop-size impacts, multi-drop implications and other complexities inherent in transport costing. However, they can provide a very good starting point for your model. In some cases, they are good enough to continue using. In other cases, they will provide enough data to do initial scenario runs. These initial runs may then identify areas where freight rates need to be sharpened up. For example, a few critical transport lanes may emerge. The focus could then turn to improving the rates on these lanes only.

## 9 Avoid multi-periods models, unless you need the complexity

Single-period models are easier to populate, run and interpret than multi-period models. So, if you can avoid creating multi-period models you should. For example:

- If you are worried about seasonality, consider running a peak month and an average month as 2 separate single period datasets, instead of running a multi-period model with 12 months. The answers you are looking for may be more apparent this way, without the additional overhead of all the months in between.
- If you are designing for 5 years out, you could model an initial year and an "end state" year, instead of a 5-year, multi-period model.

There are some good reasons to create multi-period models. For example:

- If you want to model how capacity requirements for DC throughput and transport service providers change on a month-to-month basis in a seasonal supply chain.

- If you want to model the transition between your base case year and your future state year to support decisions around which locations to open/close.

If you need this level of complexity, the model in AIMMS Network Design is perfectly capable of catering for this.

## 10 Model Bill of Materials (BOMs) only when necessary

Similar to multi-period models, models with BOMs and bill of resource add complexity in terms of data collection, populating your model, and interpreting results. So, you should be sure you need this complexity in order to achieve the results you are trying to get. If not, consider modeling without BOMs. Most outbound studies, and projects where you have no ability to influence the location of manufacturing facilities and volumes, often do not require modeling with BOMs.

Having said this, the model in AIMMS Network Design is perfectly capable of modeling the complexities of BOMs if you need this level of complexity to achieve your results. Modeling with BOMs is useful when you need to:

- Capture the costs and flows of raw material and intermediate products, as well as final products.
- Decide where to build your next factory
- Understand the potential of moving manufacturing equipment from one site to another.
- Decide where to perform value-adding activities at storage locations (for example, packaging or de-stuffing containers at a DC, or blending components at a tank farm).
- Evaluate where to process intermediate products like chemical components or parts assembly.

The rule of thumb is (as always) keep it as simple as possible. You don't need to model every BOM in your ERP that is required for operational activities. Try to create BOMs for your model product groups and not for every SKU.

## 11 Use model groups

Model groups can be a great way to simplify data capture. For example, if you have 20 products, 10 DCs and 1,000 customers, this requires a transport rate for 200,000 (20x10x1000) lanes. Instead of capturing 200,000 rows of data, you could create:

- a product grouping called "all products,"
- a DC grouping called "all DCs,"
- and a customer grouping called "all customers."

You can then use these groupings to capture one line of distance-based cost data for "all products" from "all DC's" to "all customers." If you're using AIMMS Network Design, the model will then explore all the possible combinations for you and create a distance-based costing matrix for all 200,000 possible combinations.

You can also create period groupings in multi-period models in order to specify DC and transport costing for "all periods" instead of individual lines of data for each period.



### Key takeaway

Using model groupings creatively can help you simplify data capture in a big way.

## 12 Mind the business rules

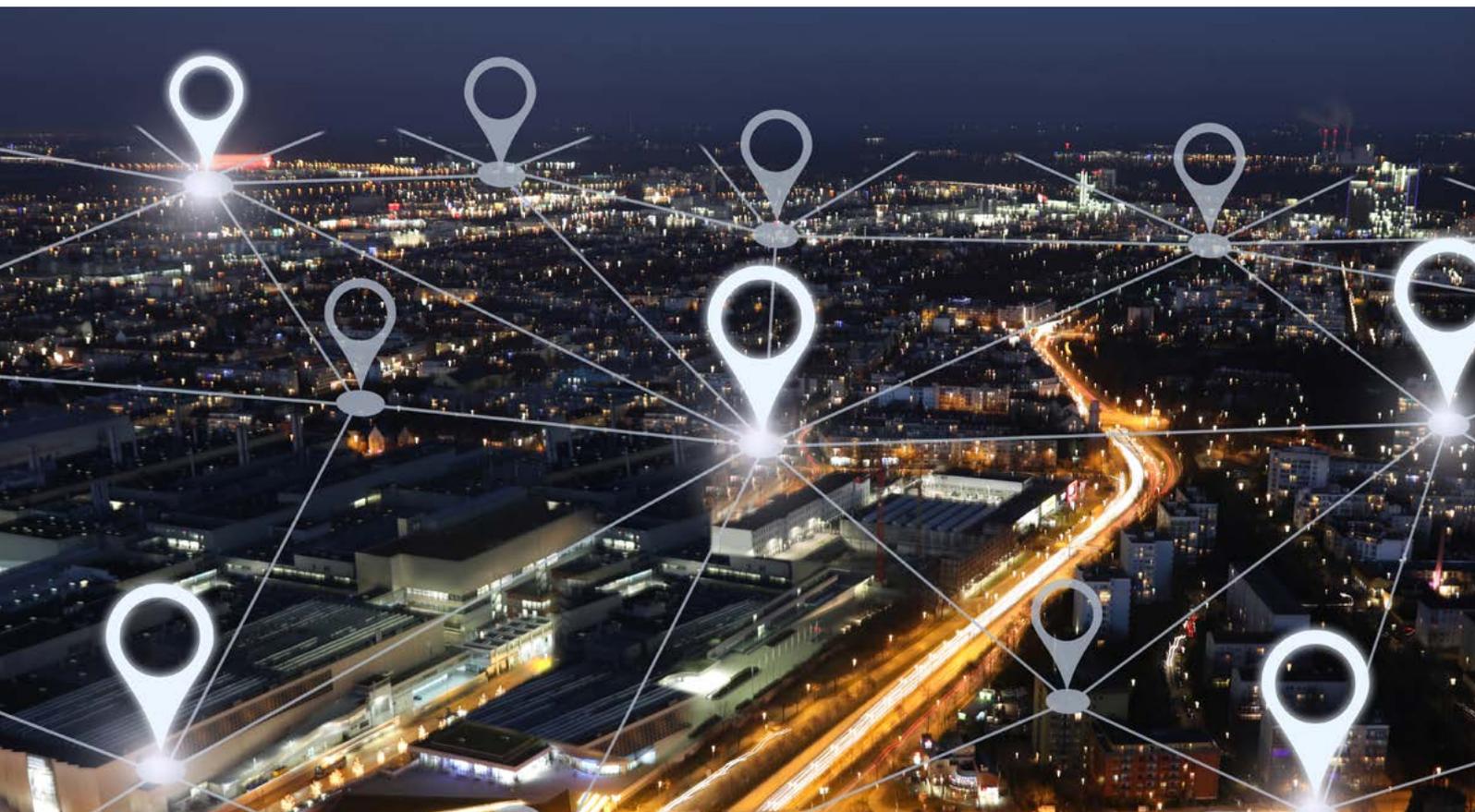
When compiling your first data set, your first focus is often (and should be) the base case data. However, you should also keep an eye on future scenarios that you want to run. There are many business rules that are inherently captured in base case flows. For example, if you can't send product from Supplier A to Distribution Center B because of certain business rules, the base case data will reflect that. However, when you want to run optimization scenarios, the algorithm will optimize costs by all means possible, and may ignore these inherent business rules unless you build them into the model as constraints.

These business rules are typically restrictions for certain product flows in certain locations, and may be due to:

- Practical implications: for instance, you can't flow bulk product through a packed product warehouse.
- Regulatory requirements: for example, you can't service pharma customers from a DC outside of the state.
- Political and trade rules, etc.

You can model all of these business rules as constraints, so that when the model optimizes, it doesn't do things that immediately prompt the business to say "but that's not possible."

You should also explore whether your business rules are really hard and fast constraints, or whether they are built-in assumptions. They might be there just because "they have always been there." This, in turn, may hide optimization opportunities. To find out if you can ignore certain rules, you can run a scenario with the business rule in place, and then another scenario where the business rule is relaxed. This will quantify the cost impact of respecting a certain business rule, and may trigger some interesting discussions about whether it makes sense to change it.



## 5. Data collection tips: where can you find it?

Collecting data for your model might seem like a daunting task. In this section, you will find the main types of data you will need, and some suggestions on where to find it.



### Key takeaway

Remember that the scope of your initial model and the scenarios you need to run will determine the data you will need. Collect only the data you need. You can always expand the data at a later modeling stage.

#### 1 Base case data

As we explained above, you need a base case dataset to populate your initial model. This is typically obtained from an ERP system with the help of your IT department. Select a representative period (typically one year of history) without any major deviations from the norm. Use the guidelines in the check list below:

- ✓ The data should allow you to aggregate flows summarized by location, to location, mode of transport and product group – depending on what you will use in your model.
- ✓ Try to obtain flows for primary, secondary and inter-resource transport.
- ✓ Try to obtain a dataset at a lower level of detail that you can aggregate upwards, rather than pre-aggregated data. This will allow you to re-visit your data aggregation assumptions if necessary. You can always aggregate upwards from a detailed dataset, but aggregating downwards will usually require a different dataset.

#### 2 Geographic data

Your model will need geocodes (latitude and longitude) for each node, including demand points, DC locations, supplier locations, etc. This data may be held as master data in your ERP or routing and scheduling system. If not, you should obtain address data (country/state/city/zip code/street address). If you're using AIMMS Network Design, you can use the integrated geo-coder in Data Navigator to generate geo-codes from address data.

If you are aggregating demand for your model, you may create nodes that don't exist in your ERP or routing and scheduling system (for example, zip code, city or country groupings). You can also use the integrated geo-coder in Data Navigator to create geo-codes for these.

#### 3 Capacity constraints

Capacity constraint data is not readily available in transactional or ERP systems. Typically, this information will have to be supplied by:

- ✓ Your production department (production constraints)
- ✓ warehouse manager (DC constraints)
- ✓ Logistics department (logistics constraints)

Consider using actual volumes from the base case data as a "proxy" for constraints, rather than nameplate numbers, if these numbers are difficult to come by.

## 4 Demand Forecasts

Your base case data reflects what happened last year, but in network design you should take a forward view to design for the future and not the past. So, you should run some scenarios with demand adjusted for the anticipated future. The horizon will depend on what you are trying to achieve:

- You may look forward a few months to model short-term risk scenarios
- 2-5 years for DC capacity questions
- 10 to 20 years for heavy industry with major CAPEX investments.

This data is typically sourced from the business or from long-term planning initiatives, and is not typically held in the ERP.

## 5 Costs

Your model will require cost estimates at the appropriate level for network design. This data is typically sourced from your finance department. You should ask them to help you compile sensible cost numbers for:

- ✓ Supply and production costs
- ✓ DC fixed and variable costs
- ✓ Transport costs (primary, inter-resource and secondary)

In network design, you want to represent physical costs in supply chain buckets. However, these costs are not always neatly segregated into the same buckets in the company's financial reporting system. For example, primary transport costs may be reported in the financial system under "product costs." This will require you to work with the finance department to translate costs contained in the financial system into network design model costs, which should add up to the same amount.

Logistics managers could also be another source of information. Often, they have done the translation already, and have cost numbers at hand that can be used for validation against the numbers coming from finance.

Transport costs can be particularly difficult to define, as they can be very detailed and complex. You'll need to aggregate and simplify them for network design purposes. Transport costs can be obtained in a creative way from a mix of the following sources:

- The finance department
- Logistics managers
- Your routing and scheduling tool
- Your 3PL provider
- External data sources like [SMC3](#)
- A secondary costing application

## 6. Designing for a sustainable future: how to model carbon costs in network design

Traditionally, network design focused on optimizing costs and service levels. More recently, designing for resilience and agility has become more prominent. Going forward, another dimension will require more attention: designing for sustainability and responsible business. Modeling carbon costs can be a helpful starting point to understand how climate change targets will impact your supply chain. If your model data is well-designed, your life will be a lot easier.

At AIMMS, we are enabling this type of modeling. While we will release more functionality to support this in the future, custom costs in our app already allow companies to start modeling environmental impact. Here's a quick tutorial for introducing carbon costs into your network model.

1. If you're using AIMMS Network Design, you can create a custom cost called "Carbon Costs" in Data Navigator and indicate at which points in the supply chain carbon emissions occur.
2. Use publicly available data on emission factors to calculate the carbon tons emitted by the activities in your supply chain. For instance, you can use data from:
  - a. The [Environmental Protection Agency \(EPA\) in the U.S.](#)
  - b. [The Intergovernmental Panel on Climate Change \(IPCC\) emission factor's database](#)
  - c. The [UK Government's conversion factors](#) for company reporting on greenhouse gas emissions.
  - d. The [European Environment Agency's Air Pollutant Emission Inventory Guidebook](#)
3. Use a publicly available source of carbon pricing to convert the carbon tons to carbon costs. [This article by McKinsey](#) can be helpful to understand how other companies are doing this.
4. Convert the carbon costs into cost coefficients per unit of activity, and capture these in your model.

You can now run some scenarios to start exploring the impact of carbon costs:

- a. Optimize for physical costs only
- b. Optimize for carbon costs only
- c. Optimize for physical and carbon costs
- d. Compare the scenarios to see how much additional physical costs you will incur if you optimize carbon costs, and how much additional carbon costs you will incur if you optimize for physical costs.

These types of scenarios provide some interesting insights and a concrete way to start modeling improvements on your environmental footprint.

Now that we've covered the best practices, let's explore tips and tricks for technology selection.

## 7. Choosing the right technology

If you're looking to optimize your supply chain network, you're likely going to evaluate the different tools available as well. Your consideration set may include spreadsheets, open-source development tools, or vendors like AIMMS. Besides functionality, we advise supply chain professionals to consider the following when choosing a vendor:

- ✔ Don't use a tick box RFP approach, take time to define your needs and the capabilities required to support these and then ask vendors to describe how their solution enables those capabilities.
- ✔ Identify and share your pain points and opportunity areas.
- ✔ Choose what is right for you...is your team prepared to run the model, do you need occasional support, or do you prefer a solution to be implemented entirely by 3rd parties? [Take our capability fit quiz](#) to find out which implementation option is right for you.
- ✔ Research available suppliers via analyst recommendations, reports, etc.
- ✔ Get demos and pricing structure.
- ✔ Sign an NDA and share selective data with your preferred candidate(s). They should be prepared to use this to build a POC model, the output from which can be used to support your business case.
- ✔ Work closely with your leading candidate to truly understand the onboarding plan, and the training and support you will receive.



### About AIMMS Network Design

AIMMS Network Design is fueled by powerful mathematical optimization in the back end, and intuitive scenario analysis capabilities in the front, empowering you to create flexible designs and expose hidden risks in your network. With it, you can model your base case network, and bill of materials, evaluate changes in the business environment and adapt quickly, quantify optimization opportunities and back up investment decisions with data.

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## Wrapping up

We hope the best practices in this Guide help you implement network design successfully in your business. If you're looking for an easy-to-use solution built for supply chain professionals, contact us to learn more about AIMMS Network Design.

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