When Network Design Fails
Where It Goes Wrong and What to Do About It

Ajesh Kapoor
Chief Technology Officer
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Executive Overview

**Distribution Network Design** is a time-tested way to identify opportunities for improving efficiency. The process involves intensive data gathering and complex modeling and simulation of product flows, and leads to a detailed set of recommendations for optimizing network structure. These recommendations touch a variety of strategic concerns, including what suppliers to use, which products to store at which facilities, and where to locate new distribution centers. Despite all of the effort put into these initiatives, however, the results generally fall far short of expectations. This happens because of fundamental organizational and process issues associated with network design that create roadblocks to execution.

Understanding why network design fails requires a close examination of the process that companies follow when conducting one of these initiatives. Limitations inherent in the process and in the supporting technologies influence what operational data is used to create a baseline network model and how that data is used. Inability to include micro-level details in a macro-level network analysis, combined with failure to incorporate the input of front-line personnel, ultimately leads to recommendations that are impracticable. To overcome this scenario, what is needed is a new approach to network design.

**Operations Network Design** (OND) is the process of modeling distribution capabilities at the local level in order to determine how to best meet specific customer service requirements using available resources and operating within known business constraints. Because the scope of operations network design initiatives is narrower than that of traditional network design, data and technology limitations can be overcome. This makes it possible to create network models that are more accurate at the local level, which results in recommendations that can be consistently implemented.

Though not appropriate for every network design scenario, when applied to evaluate the efficiency of transportation-related activities, OND is a compelling alternative to its more strategic cousin. Real world applications include examining the impact of DC consolidation on service commitments, developing resource allocation plans for transportation assets, and making dynamic sourcing decisions.
The Problem with Network Design

Distribution Network Design (a.k.a. Network Modeling, Network Optimization) shouldn’t be pursued half-heartedly. It’s a big project, and if your company is considering a network design initiative, you need to go at it with eyes wide open. These efforts require heavy lifting, and while the payback can be significant, getting good results isn’t easy. There is data to gather, models to build, and scenarios to run. And ultimately, there are recommendations to deliver; recommendations that will require people to make changes, to work differently, to implement new business processes, and to realign resources.

It shouldn’t be a surprise that some people will disagree with the design team’s recommendations, resisting or even blocking change. If the managers and frontline personnel responsible for implementing these recommendations don’t fully embrace them, they may act slowly, or take no action at all. When this happens – and it happens all too frequently – the projected savings that look so good on paper fail to materialize. Falling short of expectations is such a common occurrence, in fact, that even achieving half the projected savings is a successful outcome for many of these projects.

Why should this be the case? Why don’t companies reap more benefits from network design? What can be done to ensure that the design team’s recommendations actually get implemented?

Beyond the purely emotional resistance that some people have to change, there are fundamental organizational and process issues that create roadblocks to execution. It isn’t simply malevolence that causes network design initiatives to falter. Good people find seemingly legitimate reasons not to take action. To understand why this happens, and how to prevent it from derailing future projects, we need to re-examine the entire network design process, beginning with how companies typically approach these initiatives.

How Things Go Wrong

Distribution network design has traditionally belonged in the strategic planning domain because it leads to so many critical decisions, such as whether to open or close facilities, where to locate distribution centers and cross docks, which customers to support from which locations, how to transport goods and materials, and what level of service to guarantee. Network design introduces a formalized, data-driven structure that
leverages technology to test a broad scope of ideas about improving efficiency. So rather than relying exclusively on intuition and judgment, executives have a somewhat rational foundation on which to build strategy. In some ways, formalizing the process is simply a way to reduce risk.

Another way companies attempt to mitigate risk is to bring in large consulting organizations to help manage the initiative and lend operations expertise. Most of these firms tout their own multi-step approach for ensuring network design success. Regardless of how detailed the consultant’s project plan is, however, almost every network design project goes through the same three phases: data gathering, modeling & simulation, and implementation.

And that’s part of the problem.

**Data Gathering**

Since the primary focus of most network design initiatives is improving operating efficiency, the design team has to develop an understanding of where and why the current setup is inefficient. Efficiency is typically defined as some combination of reducing costs, increasing profit margin, and/or reducing time to market. So the team has to know what events have an impact on these goals, including how goods move through the network, where costs are incurred, what transportation modes are used, and a myriad of other details.

Team members begin by gathering data from wherever and whoever they can. They pull it from internal systems; from meetings with stakeholders, department heads, and other knowledgeable personnel. They may also work with industry analysts and consultants. This research produces reams of data on just about everything that is involved in, touches, or happens as a result of moving goods through the distribution network; data related to costs, facilities, assets, customers, products, throughput, processes, etc.,.

But despite the effort, there will also be important information that was never gathered, simply because it was too difficult to do so. This is the first limitation of traditional network design. Data that has been gathered for the purpose of modeling the current distribution network winds up lacking important detail and context that could impact the company’s ability to implement future recommendations.
Modeling & Simulation

The next step is to translate all of the data that has been gathered into a functioning model of the distribution network. At this point, the design team usually begins to isolate itself from the operational details of the business. The view is that the data gathering exercise, if it is sufficiently thorough, will have given the analysts enough information to form an accurate model. Eventually the flow of information has to be shut off or there will simply be too much to contend with. This points to another limitation of traditional approaches to network design: the difficulty of processing large quantities of data, even with advanced technology.

Despite the fact that processing power has increased exponentially in recent years, it is still not possible to develop network models that include every possible level of detail. Physical resources like drivers, tractors, trailers, dock doors, and warehouse staging area are not modeled explicitly in traditional network design. Customer service related issues and scheduling constraints are not modeled either. Product-specific capacity and manufacturing details may be overlooked as well. This becomes a limitation specifically because there can be great variability in costs, service requirements, and resource constraints from one location to the next.

To cope with these data gathering and data processing challenges, the design team simply aggregates the information they have. For instance, when modeling demand for a given region, the demand value assigned will represent the sum of all demand for every customer in that particular region. The actual demand for each individual customer will not be modeled. Aggregation happens time and again; values used to model a wide range of categories (shipment volume, customer demand, transportation costs, etc.) represent generalized totals that are not accurate at the site level. This approach makes any network cost and customer-level profitability measurements like “Total Landed Cost” meaningless.

This is an important limitation because the initial model or baseline is the test bed on which changes to the network will be simulated. Once the team has created the baseline, and evaluated its accuracy by testing it with real world scenarios, they can begin to make modifications to see if efficiency improves. As with the model itself, the resulting scenarios may suggest that efficiency can be improved, but overlook the fact that real world conditions make implementing these changes impossible.
For instance, the team may want to test the effects of consolidating two distribution centers. “What If” scenarios can be run to compare the impact of this change on network performance, but any simulation will only approximate real world conditions. Without localized detail, the solution may not take into account that the remaining distribution center cannot easily be configured to support the additional delivery volume; or that reassigning customers to a DC located 25 miles farther away will make it impossible to meet narrow delivery time windows.

Because the baseline network model does not incorporate local operational detail, it may not be possible to implement some of the design team’s recommendations without significantly increasing costs or reducing service levels – outcomes that run counter to the efficiency objectives of the project.

**Implementation**

We have already considered several limitations of the traditional approach to network design:

- Despite the effort put into gathering operational data, in almost every case details that might be important aren’t captured.
- In any case, technology limitations mean there are limits to the amount of data that can be incorporated into the design of the network model.
- While it may be possible to develop a network model that is accurate at the macro level, the absence of site level details may lead to recommendations that are impractical to implement.

But there is one more factor that virtually guarantees that some of the design team’s recommendations will be difficult or impossible to implement: the lack of Operations involvement in the modeling and simulation phase of the initiative. Without the involvement, or at a minimum the review, of field-level personnel, it is simply not possible for the network analysts, no matter how experienced, to fully understand the ramifications of changes they propose.

For instance, suppose the network analysis suggests that a group of ten customers should be reassigned from one distribution center to another. In building a direct delivery plan to support these customers, the optimization process may lead to a scenario where
a single vehicle is assigned to handle all ten stops. Because each of these customers has a tight delivery time window, however, it is not possible to meet customer service commitments using only one vehicle. In this instance, the local fleet manager would have to acquire an additional truck to handle the added delivery volume.

**Fixing Network Design**

There is an opportunity to overcome many of the limitations associated with distribution network design and to ensure that recommendations which flow from these initiatives can be implemented more successfully. To improve results, however, companies must be able to bridge the gap between the strategic and operational domains. This means frontline realities must be integrated more fully into the design process. Accomplishing this will require design teams to work more closely with the operations personnel who are responsible for serving customers at the local level.

Operations Network Design (OND) accomplishes this by providing a mechanism for evaluating network alternatives and testing the impact changes will have on local customer service commitments. OND is a complement to the standard approach and is focused on a more limited set of variables. Using currently available technology to model distribution at a finer level of detail, OND makes it possible to simulate network changes at the micro level. These changes can then be analyzed for their feasibility, as well as for their efficiency. This process allows operations personnel to fully vet strategic recommendations and gives them the ability to voice concerns during the design process.

**Operations Network Design: A Definition**

Operations Network Design is the process of modeling distribution capabilities at the local level in order to determine how to best meet specific customer service requirements using available resources and operating within known business constraints.

The difficulty of gathering and processing location-specific data at the macro level has already been discussed. Due to the broad scope of most network design initiatives, details that greatly affect day-to-day operations are simply not evaluated. Physical resources like drivers, tractors, trailers, dock doors, and warehouse staging area are not modeled explicitly in traditional network design. Customer service related issues and
scheduling constraints are not modeled; neither are product-specific capacity and manufacturing details. This is one of the major differences between standard approaches and OND.

The scope of an operations network design initiative is much narrower than that of traditional network design. While traditional network design looks for efficiencies across a wide range of variables, OND focuses primarily on the relationship between network structure, customer service requirements, and the physical movement of goods. A narrowed focus encompasses fewer variables and makes it possible to evaluate these variables at a more granular level, meaning transportation requirements and capabilities can be modeled in greater detail. Thus it is possible to replicate real world operating conditions more accurately.

Existing technologies, such as fleet and transportation management systems, are a key element in this process because they contain production and historical information that is only available at the local level. The more advanced of these applications also make it possible to explore a virtually unlimited number of service options for each customer. For instance, some OND tools can be used to evaluate individual customer delivery requirements in order to determine whether a planned DC consolidation will impact service level commitments. Closing distribution centers is the kind of recommendation that frequently results from a strategic network design initiative. OND allows operations personnel to clearly demonstrate that a given action is or is not feasible.

Another important difference between OND and traditional network design initiatives is that it is a plan-focused activity. The output of an OND initiative is a set of plans that can be executed with little or no modification. Output from a typical design project is generally limited to a set of recommended changes, with limited guidance concerning the implementation of these changes. In other words, strategic network design tells an organization what should be done, but says nothing about how to do it. Operations Network Design indicates what can be done, given existing customer requirements, and provides a plan of action.

**Practical Example: DC Consolidation**

Many industries today are experiencing unprecedented levels of consolidation. Companies that compete aggressively against each other one day may be merged the next. When this happens, it naturally creates certain difficulties. If two retailers, for
instance, target the same customer group within the same market, they are likely to have overlapping distribution centers and outlets in close proximity to one another. To achieve synergies of scale, they will have to close some locations and potentially expand others. Similarly, if two food distributors merge, they will also be faced with questions about consolidation, including which customers to serve from which DCs.

Developing a consolidation strategy is often handled by strategic planners working at headquarters. In reality, however, local personnel may be better equipped to respond to customer concerns during a transition. Operations Network Design can be used to rationalize local distribution. For instance, if the newly combined entity has four distribution centers in a region, and management believes that only three are necessary, a local team can determine which DC to eliminate by testing multiple open/close and customer assignment scenarios. This would ensure that service level requirements were factored into the decision.

**Practical Example: Transportation Resources**

Today, the world is in a constant state of flux: Business cycles are moving faster and faster. Market demographics are being transformed. And consumer tastes seem to change overnight. With shorter product lifecycles and customers that are demanding greater flexibility, accelerating time to market has become a focal point for many logistics executives.

These dynamics put pressure on transportation, particularly for companies that operate a private fleet. At the local level, the impact is felt by the need to reposition transportation resources more frequently. Making decisions that are both cost effective and satisfy customer commitments is difficult, time consuming, and prone to miscalculation. Operations Network Design can facilitate making these changes, giving decision makers the ability to evaluate transportation plans within the scope of real world operating conditions.

For example, if fleet assignments need to change in response to seasonal demand fluctuations, managers can begin by developing a model that assumes every vehicle is available at every location. Working backwards, the fleet can be repositioned until resources are properly aligned. Because this is an automated process, numerous simulations can be run quickly, allowing the organization to make changes as they are
needed. This capability is particularly useful when unforeseen events, such as a natural
disaster, make it impossible to move goods in or out of some distribution centers.

Operational Network Design projects can also be used to evaluate the effects of different
loading and unloading scenarios, like sending vehicles out in waves rather than all at
once, or extending loading and unloading hours. These sorts of analysis are possible
with OND because the process uses actual customer data, such as service
requirements, equipment needs, and operating hours and appointment times, when
evaluating different scenarios to identify optimal resource allocation.

Practical Example: Dynamic Sourcing

Operations Network Design can also be used as a method of making product sourcing
decisions. In some industries vehicles must be reloaded and/or emptied multiple times
throughout the day. Examples include waste collection, where trucks are required to stop
at processing facilities several times a day, and petroleum distributors, who must refill
their tanks frequently. In such instances, there is usually more than one landfill or
loading depot to choose from. Which location is appropriate may be based on product
availability, cost, or the types of materials that are accepted at a particular facility.

This is a highly dynamic environment that is quite different from traditional network
design scenarios. The fixed costs associated with stopping at one facility versus another
are not considered relevant. Rather, the decision takes into account the sequence and
schedule of every stop assigned to a given driver, as well as other variables, and inserts
the appropriate unload/reload point based on where a driver will be at a given time
during the day.

The Real World: NAPA Auto Parts

NAPA Auto Parts is a recognized quality leader in the auto parts and repair business.
Founded in 1925 with the goal of meeting the growing need for a world-class auto parts
distribution system, the company has grown to an $8.5 billion organization with over
6,000 retail stores, 69 distribution centers, and approximately 200,000 parts in inventory
every day.

NAPA re-supplies stores five days a week using private and dedicated transportation
resources. The fleet makes deliveries along 525 routes, driving over 185,000 miles each
night. The route structure is static, meaning it seldom changes. With so many vehicles on the road, being as efficient as possible is paramount to success. As a highly distributed organization, however, customer relationships are strongest at the local level. Any changes in the distribution strategy that might impact service levels need to be analyzed carefully, and buy-in from front-line personnel is critical.

Issues like route design, store assignment, and equipment requirements had historically been worked out manually. Decisions were based entirely on intuition and experience because decision support tools were unavailable. As a result, while the network was perceived to be inefficient, knowing how to make improvements was difficult. To address these challenges, the company initiated an Operations Network Design project leveraging route optimization and fleet management solutions from GEOCOMtms.

With so many stores to support, and so many distribution centers, balancing store assignments was difficult. Many stores were located between two DCs and usually wound up being supported by whichever one was closest. By plotting store and DC locations, NAPA was able to simulate different routing scenarios and identify which store assignments were efficient and which needed to be changed. Decision factors included total drive time, actual mileage driven, and constraints such as minimum and maximum stops along a route and route distance. The company even looked at different vehicle combinations to determine whether a straight truck or tractor-trailer would be most efficient.

Results to date for this initiative include:
- 7.5% reduction in overall delivery costs
- 5% reduction in assets and mileage
- $1.3M in annual savings

**In Conclusion**

Historically, companies have viewed distribution network design as a strategic initiative requiring specialized planning and analysis tools. Due to the way these projects have been managed, and inherent limitations associated with the process, network design recommendations have not always been adopted at the operational level. Though not a panacea, in certain situations, Operations Network Design can increase the likelihood that network design recommendations will be embraced by field-level personnel.
About the Author

Ajesh Kapoor – Chief Technology Officer

Ajesh Kapoor is a technology industry veteran with over 15 years of experience and an advanced understanding of transportation and logistics business processes. He is responsible for guiding the company’s product and technology strategy, overseeing every aspect of research and development, and ensuring that GEOCOMtms continues to deliver the most comprehensive fleet optimization and territory design solutions available.

Prior to joining GEOCOMtms in 2000, Ajesh served as Director of Business Development for Baan Supply Chain Solutions (formerly CAPS Logistics). He holds an M.S. in Operations Research from the Georgia Institute of Technology, an M.B.A. in Business Development from Panjab University, and a B.E. in Mechanical Engineering from the Indian Institute of Technology.

About GEOCOMtms

GEOCOMtms gets things moving with fleet management solutions that make local pickup and delivery operations run smoothly. Everyday, leading organizations choose the company’s A.MAZE™ suite to direct thousands of vehicles from hundreds of depots and distribution centers. With tools for territory design, route planning, dispatch, mobile communications, and fleet tracking, A.MAZE is the first fully integrated solution developed specifically for local P&D. Busy logistics executives depend on A.MAZE because it delivers enterprise visibility and complete control over fleet operations. And that translates into greater asset productivity, improved cash flow, and increased return on capital. By partnering with GEOCOMtms, customers like McPherson Oil Products, NAPA Auto Parts, Purolator Courier, and Velocity Express have reduced operating costs while raising the level of customer service they provide. For additional information, please visit www.GEOCOMtms.com.

Canadian Headquarters
575, St-Joseph Est
Quebec Canada G1K 3B7
P: 866-300-1876

U.S. Headquarters
2839 Paces Ferry Road, Suite 250
Atlanta, GA 30339
P: 770-803-0295