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“Knowledge of truth is always more than theoretical and intellectual. It is the product of activity as well as its cause. Scholarly reflection therefore must grow out of real problems, and not be the mere invention of professional scholars.”

JOHN DEWEY, UNIVERSITY OF VERMONT

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GIS: The Missing Tool for Supply-Chain Design
Jeff Greer

TOOLS OF THE TRADE FOR SUPPLY CHAIN MANAGEMENT

Today’s supply-chain professionals have well-known tools and processes for planning and executing a supply chain. Examples include statistical forecasting techniques and Sales and Operations Planning (S&OP). Likewise, there are tools for making the supply chain operational, such as materials requirements planning (MRP) and just-in-time (JIT) pull systems. What might be the next big breakthrough for supply-chain management?

One missing tool of vital importance and high potential is software to facilitate supply-chain visualization and design. Traditional means have been limited to tabular report data or network diagrams. But due to globalization, supply chains have increased both in size and geographical scope, stretching beyond the reach of these approaches and creating the need for a new type of tool. Our inability to visualize a supply chain limits our means of designing greater performance into the system.

It is worth noting that nearly every line of work one can think of has a software tool to help with the creative aspects of that particular field. Lawyers use word processing to write contracts, accountants use spreadsheets to generate financial models, marketers use desktop publishing to create promotional efforts, and engineers use computer-aided design to develop new products. Such tools create enormous value for these professionals and the companies they work for. There’s no question that a software tool for designing a top-performing supply chain would be highly valued because of its business potential.

GIS TECHNOLOGY

One obstacle impeding the development of such a design tool has been the lack of an adequate user interface for visualization of such a large-scale supply chain. Fortunately, today there is exciting new technology to help out with this problem: Geographic Information Systems (GIS).

GIS was first developed by the Canadian government in the early 1960s to inventory the country’s natural resources. Since then it has improved, thanks to advances in personal computers, database technology, and

PREVIEW  Jeff Greer, VP of Operations for KVH Industries, supports a global supply chain for satellite communications equipment. In this role, he has developed expertise in enhancing supply-chain performance with Geographic Information System (GIS) technology. KVH has used his pioneering GIS model to facilitate executive thinking about growth strategies and improved supply-chain performance. In this piece, Jeff tells us how any company might benefit from GIS and surveys available GIS solutions – from free downloads to more pricey consulting.
global positioning systems. Early GIS applications focused on mapping for military and scientific use. More recently, businesses have started to adapt this tool for analysis, planning, and decision making.

GIS technology is based on a three-dimensional computer model of the world (picture Google Earth) that provides a comprehensive view of the planet and has the capability to zoom to specific geographic regions. A supply chain can then be projected onto the Earth’s surface by geocoding: assigning a latitude and longitude to supply-chain data such as businesses and transport routes. This data can also represent markets, demand drivers, points of sale, competitors, supply chain, and post-sale services.

**Markets** are a collection of buyers. Every company has sales data for a defined geographic region, which may be as small as an individual person’s sales territory or as large as a state or entire country. Markets with sales data can be projected onto the earth’s surface, where a point can indicate the center of the market or a polygon can define the outer boundaries of the market. Icon type, color, or a balloon window can be used to indicate sales volume.

**Demand Drivers** cause a person, business, or governmental entity to buy products and goods. A classic example in this regard is national census data, which captures ages, incomes, and other data related to its citizens. Because people buy goods and services based on situational need, and their ability to buy is based on their economic conditions, census data that incorporates this kind of information can be projected onto the surface of the earth to help predict where demand will materialize for different types of goods and services.

**Points of Sale** include retail stores, distributors, catalog houses, and Internet resellers. Location of each point of sale relative to where goods or services are purchased, versus being used, is an important business decision relative to maximizing revenue. Each point-of-sale type can be depicted in a GIS model as a different-colored icon. Collectively, multiple points of sale reflect a company’s sales channel.

**Key Points**

- **Companies have not yet tapped the potential of GIS for improving supply-chain design and performance.** This software tool for designing a top-performing supply chain would be highly valued because of its business potential.

- **GIS technology is based on a three-dimensional computer model of the world (picture Google Earth) that provides a comprehensive view of the planet and has the capability to zoom to specific geographic regions.** A supply chain can be projected onto the earth’s surface by geocoding: assigning a latitude and longitude to businesses and transport routes.

- **Census data can then be projected onto the surface of the earth to help predict where demand will materialize for different types of goods and services.** Multiple points of sale can be identified and linked with suppliers of raw materials, conversion points, distribution centers, transportation modalities, and shipping routes.

- **Data Mash-Ups are a unique GIS capability whereby each supply-chain element can be treated as a discrete layer of information to be toggled on or off.** This is an important advance for analyzing relationships between two or more elements such as price sensitivity and location of low-cost suppliers.

- **A GIS model can improve the global management team’s interaction, facilitating higher-quality decision making.** Projection of the GIS supply-chain model on the wall gives a comprehensive presence in the room, replacing the more fragmented visions that stem from different levels of individual knowledge.
Exhibit 1 depicts KVH’s sales partners on the eastern seaboard of the United States, with each sales partner represented by a red push-pin.

**Competitors** influence the success of a point of sale. If a company is marketing a new product or service and consumers need to be educated to its benefits, the presence of a competitor may lend credibility to the concept, thereby facilitating sales. Likewise, a competitor can limit a company’s sales and profits if there is too much capacity chasing a limited amount of demand; then a price war breaks out. Mapping competitors into a GIS model will facilitate optimal location of a new point of sale.

**Supply Chain** spans the point of origination of raw material to the point of material consumption. It is important to identify suppliers of raw materials, conversion points, distribution centers, transportation modalities, and shipping routes when defining a supply chain which will ultimately connect to points of sale or the end consumer. Each business in a supply chain is reflected as a point; a shipping route is a line connecting two points. Again, by using unique icon types and colors, it is possible to highlight characteristics of the supply chain – such as lead times or dollars spent.

In Exhibit 2, each colored square shows the location of a ship in Northern Europe that is logged into KVH’s Internet service network, while Exhibit 3 distinguishes high data-usage areas (hot colors) from low data usage (cool colors).

**Post-Sales Service** is important for maintaining a good brand image. Customers are quick to complain when there are problems with their purchases, and their ire increases exponentially if they do not receive a professional response to those problems. Companies, therefore, are increasingly looking at optimizing the locations of service centers and
reverse logistics for bringing defective units back for service, to give one example. Just as you can project a supply chain onto the surface of the earth, it is an equally effective methodology for facilitating and developing a post-sales service strategy.

Exhibit 4 shows service coverage for KVH service partners. The center of every green circle marks the location of a service partner, while the circle itself demonstrates the travel range for that service partner’s technicians.

**Data Mash-Ups** are a unique GIS capability whereby each of the supply-chain elements defined above can be treated as a discrete layer of information that can be toggled on or off. Turning on multiple layers creates a mash-up of information. This is an important advance for analyzing the relationship between two or more elements, such as the relationship of a market to its supply chain. A market with unpredictable demand will require a supply chain with dynamic response and short lead times. If a market is price sensitive, it might require materials from a region of the world where low-cost suppliers are prevalent.

Now that you have a basic understanding of GIS technology and elements for supply-chain modeling, let’s examine ways we might apply these concepts to a business problem.

**GIS AND TEAM COLLABORATION**

Today, supply chains are developed by teams of cross-functional experts to address a specific business need. Examples include new-market development, the launch of a new product or a merchandising program for an upcoming retail season, cost reduction, quality improvement, or reduction of costs for post-sale services. A GIS model can improve team interaction and facilitate higher-quality decision making.

A typical cross-functional team may consist of representatives from sales, marketing, product management, engineering, purchasing, quality, and finance, each of whom may bring vastly differing degrees of knowledge to the table. Some will have firsthand knowledge—often the best because they have been in the field. Others will have specific awareness based on information they have been provided. Still others will be only topically aware, picking up what they’ve learned through ongoing conversations. This difference in knowledge and understanding within the team can result in poor decision making and suboptimal supply-chain design.

It’s common for cross-functional teams to meet in generic conference rooms booked by the hour, so the challenge is to bring supply-chain facts and understanding into the room so all members are equally well informed. During meetings at KVH, we have used a projector hooked up to a computer to display the GIS supply-chain model on the wall, so that everyone can interact with it. With this approach, the supply chain has a mutually apparent presence in the room, replacing the more fragmented visions that often stem from different levels of individual knowledge. A well-informed team makes higher-quality decisions that drive superior business results.

Some leading-edge companies are starting to create meeting spaces that have been specialized for supply-chain work. These rooms feature a series of monitors to facilitate supply-chain visualization. Status information regarding supply-chain performance is displayed for all to see. It is reasonable to predict
these visual tools will improve over time to include supply-chain design, planning, and execution. Improved cross-functional team performance, along with the superior decision making that results, will justify the investment for a better work environment.

**GIS TOOLS**

GIS tools are readily available from a large number of sources. Please note there are both subtle and significant differences from one tool set to another, and these may influence which one you select for your first project. Some are free; others come with a fee. In addition, you will need to consider whether it is better to learn GIS technology and build your own model or hire a consultant with the necessary expertise to build it for you.

**Google Earth** is worth considering if you are looking for an inexpensive GIS solution: [http://www.google.com/earth/index.html](http://www.google.com/earth/index.html). In return for free use, Google asks that you honor its licensing agreement, which mandates that you display the Google Earth brand and that its application cannot be resold for commercial gain.

The key to using Google Earth is a scripting language called Keyhole Markup Language (KML). There is an excellent reference book from Josie Wernecke that will teach you everything required to build the most basic to advanced GIS models; it's entitled *KML Handbook: Geographic Visualization for the Web* (2008) and is less than a half-inch thick and an easy read.

You will also need to get a text editor. One of my favorites is NotePad++, which can be downloaded for free use at [http://notepad-plus-plus.org/](http://notepad-plus-plus.org/). With the text editor, enter your first KML script as described in the handbook and save it with a .kml file extension. Once it's saved, double-click on it and your script and data will appear in Google Earth.

With KML, you have total flexibility to create a supply-chain model that meets your operational needs.

**ESRI**, an industry leader in GIS located in Redlands, California ([http://www.esri.com/](http://www.esri.com/)), has GIS tools that spare you the challenge of writing KML scripts to create a GIS model. With ESRI solutions, you can work with spreadsheets or databases; all scripting work is automatically done in the background. Ease of use, however, comes at a price, as these are commercial GIS tools that must be purchased. When you open ESRI’s main Web page, click on the “Industries” tab, then “Business,” then “Retail.” There you will find examples of companies using ESRI’s tools for market analysis, retail-store location, and supply-chain design. This will illustrate how companies are moving forward to improve their competitive positions.

**Training Options**, as with all new technology, are helpful. A number of seminars, college courses, and certificate and degree programs are offered in a traditional classroom setting or through distance learning. A quick Internet search will identify numerous learning opportunities.

Currently, these learning opportunities are focused primarily on the basics of GIS technology and its applications to a number of different problems. Because the field is so new, there is not a mature body of knowledge on how to apply these methods specifically to supply-chain design and performance optimization, so you will need to apply your own supply-chain knowledge when developing a GIS model.

If you have an urgent project and do not have the time to personally learn GIS technology, I recommend using a knowledgeable consulting firm.
**Consultants** are another, more pricey option. We’ve noted that using GIS technology for supply-chain design and optimization is relatively new. As with any search for a business consultant, the key is finding the best one to help with your particular business needs. ESRI, mentioned earlier, offers consulting services, and I recently came across Llamasoft, located in Ann Arbor, Michigan ([http://llamasoft.com/](http://llamasoft.com/)). Both companies specialize in supply-chain management using GIS technology. Of course, consultants aren’t cheap— but they do provide extensive knowledge and expertise that can be used to solve a business problem quickly.

I have no affiliation whatsoever with any of the companies mentioned. I am simply a supply-chain practitioner, looking to enhance the competitive position of my company and help make you aware of available options.

**USING GIS TO ADDRESS A REAL BUSINESS NEED**

I joined KVH Industries as Vice President of Operations for their satellite communications division in 1994, a time when KVH was focused on products for the leisure marine market, primarily in North America, Europe, and Australia. Order fulfillment was accomplished with a North American supply base and sales offices in the U.S. and Denmark.

Over the next several years, KVH’s business fundamentals changed dramatically. To reduce product cost, we restructured our supply chain to include more global parts content. Longer supply chains drove the need for an improved sales and operations planning process. We then launched a new line of satellite communication terminals and a broadband service for delivering high-speed Internet capabilities to commercial ships around the world.

To help with these global business initiatives, I developed a supply-chain model using GIS technology to facilitate executive thinking regarding sales, customers, service delivery, hardware manufacturing, and customer care.

Today, KVH is the fastest-growing maritime mobile Internet service provider in the world, an achievement accomplished with new GIS technology. To address global customer demand, KVH has opened offices in Singapore, Brazil, and Japan, in addition to our established offices in the U.S. and Denmark. Current customers include sovereign navies, deepwater merchant vessels, work boats, and luxury yachts. Lower-cost data is driving new IP-based applications that improve ship operations as well as crew morale and welfare.

While reliability is extremely important in a maritime environment, even the best companies have a 1% failure rate. Consequently, KVH is working to expand its field-service network to cover select ports around the world. Sales growth over the last several years has been steady in spite of a tough economy and a downturn in the global shipping industry.

Our use of GIS technology and supply-chain mapping has been instrumental to the company’s success, and our efforts will continue to evolve. If you hope to pursue development of a similar capability, my advice is to start small and bring your first project to completion quickly. Early success will build support for subsequent initiatives, and you can then scale your efforts over time.

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**foresight:** *n.*

1: an act or the power of foreseeing: prescience  
2: provident care: prudence  
   <had the foresight to invest his money wisely>  
3: an act of looking forward; also: a view forward

– *Merriam-Webster Dictionary*

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