

A New Wave of SCM Innovation Must Address Climate Change Concerns

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Companies with significant supply chain operations must be more aware of how their supply chain management (SCM) activities affect the environment, how sustainable the activities are and how emerging SCM technology from the growing awareness of global warming can create sustainable and profitable supply chain practices.

Key Findings

- Most SCM users are not explicitly modeling the effects of their supply chain on their environment.
- Most SCM technology is not yet able to explicitly consider environmental or resource consumption factors that are independent of profitability concerns or model the right business decisions to support this growing need.
- SCM technology is emerging and being adapted to help model environmental implications so that organizations understand their impact on the environment and how to reduce it.

Recommendations

- Users should seek IT solutions that provide views and analysis of where SCM operations do not address environmental concerns and enable them to model the impact on operational profitability that might lead to contrasting decisions made when they were not cognizant of the environmental conditions.
- Users need to look beyond the hype around "carbon footprint" analysis and look to manage the total resource load of supply chain activities on the environment.
- A broader management approach that includes a comprehensive set of new attributes, data, benchmarks, processes and planning models for SCM technology should be adopted to help users identify, monitor and then reduce their supply chain's resource "footprint."
- Users should incorporate complementary multienterprise "green" business intelligence and analytics capabilities in all green supply chain projects. They should do this because users will start to share such data beyond their enterprise activities with their trading partners (perhaps to show a customer they are compliant) and require suppliers to share data with them. The extended supply chain must be optimized to reduce the total resource footprint.

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ANALYSIS

Awareness and hype related to the human contribution to global warming is increasing by the day. A growing number of business leaders recognize that the economy, and more specifically their enterprises, have a detrimental effect on the environment. Good business justification exists to understand this impact and to look for ways to improve business performance before governments mandate it. Some leaders, such as Jeff Immelt at GE, have been very active in the field of "going green" (running the business with an awareness of its impact on the environment to reduce the negative impact), and their success is inspiring other organizations to look for the "green" in going green. If IT organizations only see green activities as corporate social responsibility, then they will miss a significant opportunity to help the business derive business benefit from resource-sensitive activities. Green doesn't mean running a charity: GE sells many products that help reduce an organization's energy and waste products. Rohm and Haas recently announced a change to its product catalog to offer "greener" materials to manufacturers so they can differentiate their products from competitors. Many of The Home Depot suppliers are actively managing their supply chains to be greener so that they can get shelf space under The Home Depot's green supplier initiatives.

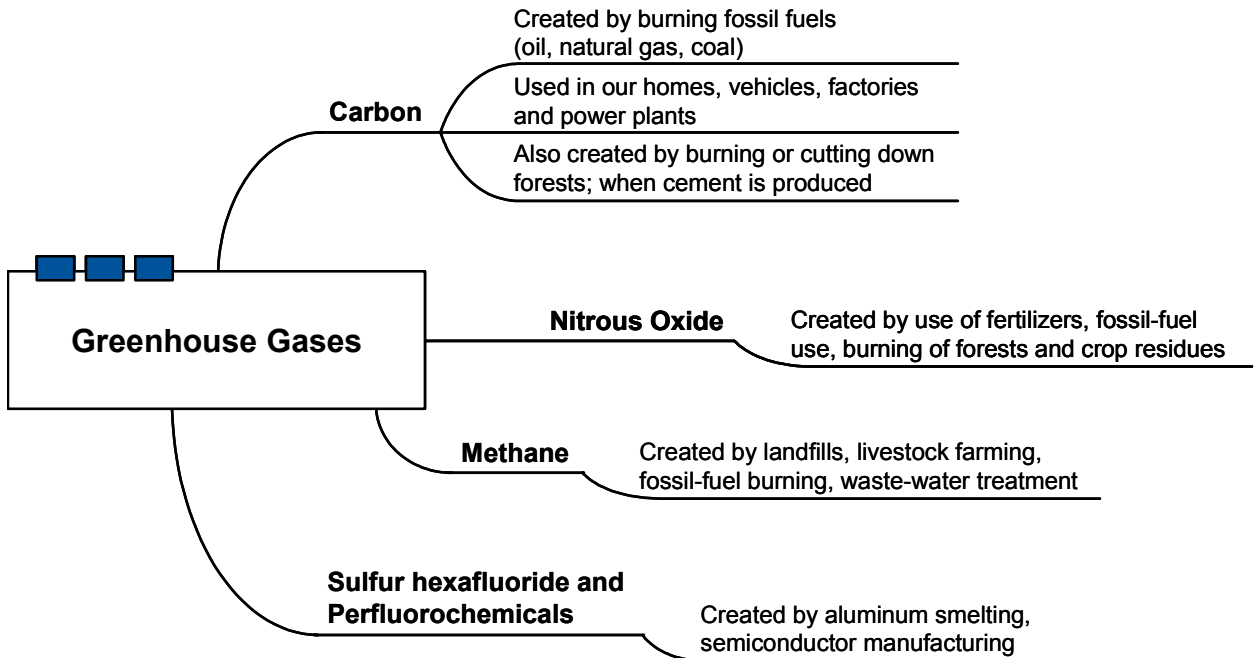
1.0 Manage Resource Sustainability, Not Just the Carbon Footprint

Gartner sees a marked increase in interest from clients asking two very important questions:

- What is the carbon footprint of my supply chain?
- Where and how do I go about decreasing my carbon footprint while maintaining or even enhancing business performance?

A carbon footprint is a focal point and, as such, carbon emissions are thought to be the biggest (close to 80%) single chemical contribution that the global economy is contributing to climate change. Also, transportation is believed to be the single largest activity that contributes to such emissions. Therefore, IT organizations' support for green supply chain projects should start with a focus on carbon footprint and transportation analyses. However, from a climate change perspective, the picture is broader, more-complex and not even solely driven by carbon dioxide (CO₂) emissions (see Figure 1).

Figure 1. Greenhouse Gases and How They Are Released Into the Environment



Source: Gartner (August 2007)

Although today's focus is on CO₂ emissions, on inspection clearly other polluting gases are released into the environment right across the entire supply chain — from manufacturing, distribution, consumption and across multiple industries. Many activities, from raw material sourcing through manufacturing and consumption, release harmful gases and waste. IT organizations should build architectures and applications that can flexibly support monitoring and reducing greenhouse gas emissions and resources used throughout the supply chain, rather than build applications and processes with a single-minded focus on reducing CO₂ emissions.

2.0 Focus on Holistic Supply Chain Effects, Not Local Optimization

Other emissions and resource consumption areas that the IT organization should focus on are:

- **Design** — Product design is increasingly becoming more environmentally friendly through designs that reduce materiality (increasing recyclability) and waste, which reduces the need for landfills (methane). But, there is a need for product design to take more account of manufacturing efficiency and logistics. Some notions of industrial ecology that are taking hold in some countries will obligate manufacturers to be responsible for hazardous materials and resource consumption through the entire life cycle of the product, as opposed to the point at which the customer buys it. Other areas may achieve improvements through better design.
- **Manufacture** — Certain manufacturing processes (see Figure 1) cannot help producing greenhouse gases with the available technology. However, through better reuse or increased optimization of how resources are used, manufacturing should increase yield and improve performance. Lean manufacturing has focused on waste reduction, but that predates the focus on environmental waste. Also, lean manufacturing doesn't address

one of the primary issues associated with going green: market pricing may not reflect resource consumption, externalities or scarcity. This means lean manufacturing may not be green. Manufacturing processes might be inefficient (leading to excess production of CO₂) or unrestrained by waste products (leading to more landfills). Also, energy is used by plant and equipment, and, as such, the efficient and optimal use of plant and equipment is another aspect to look at when it comes to carbon output as a constraint. The geographical aspect to manufacturing is an important factor, even if political arguments are ignored; developing nations have different local public pressure to advance their industries and bypass the same development processes that developed nations followed. Multinationals that span developed and developing nations need to concern themselves with how their supplier's carbon footprint changes as they evaluate different sourcing strategies.

- **Transportation** — Logistics and transportation are obvious parts of the supply chain that are most scrutinized because it is through movement that fuel gets used and CO₂ is released into the atmosphere. Most transportation departments are not measured or remunerated on their carbon footprint reduction; yet they may still be focused on fleet use. Awareness of each transportation's likely impact on carbon output might change transportation modes and use. The current focus on transportation cost containment and reduction is also indirectly making companies look at ways to reduce their fuel bills and become more efficient and thereby emit less carbon. However, these projects should have been done without a green initiative anyway. Green projects will focus on reduction of carbon footprint or resource use in the presence of a divergence between market prices and resource consumption. Also, green projects will likely lower the bar for scrutiny of capital budgeting for investments in plant and equipment that reduce resource consumption, such as engine modifications that reduce fuel consumption, but may not independently meet capital budgeting criteria.
- **Service** — Products, parts and assets that are serviced are also a major consideration, because resources continue to be used, consumed, stored and moved. Resource considerations may change assumptions about the relative value of engineering longer-lived products vs. building replaceable and serviceable products. For example, with an assumption of low-cost resources and fuel, a company might have chosen to invest in equipment that was less durable and chosen to replace it more frequently. However, with resource considerations as a factor in decision making, the enterprise may opt for longer-lived equipment to reduce transportation of repair and replacement parts. Conversely, a company may decide to invest more in repair capabilities than replacing entire pieces of equipment. Decisions such as these could have effects on transportation patterns and the overall size of the repair fleet. The service supply chain should be part of the overall green effort (see "IT Organizations Will Need Eight Technologies to Provide 'Greener' Services").
- **Storage** — Large quantities of product sitting idle in a warehouse might seem minimally polluting, but warehouses often take up valuable land and consume resources, even in a static state. They are large building footprints absorbing and reflecting heat, and facilities that consume large amounts of energy to operate and control climate. Also, warehouses can be sources of other pollutants because they often handle hazardous materials, and there is a trade-off between the marginal release of pollutants and the output handling of hazardous materials. Improving throughput, reducing the amount of idle inventory taking up space and more-efficient use space can have a significant impact on environmental issues associated with storage, although idling inventory and resources may actually be greener.

- Consumption — Finally, the product is consumed, and everything around the consumption is wasted. Most typically, this is the packaging around the consumer good or the set of materials and ancillary services supporting a commercial transaction between two enterprises. Many things just happen in making a deal or transaction — there might be a lot more packaging than just what you throw away by the time you use a product. In a way, we are back to design again, because design for reuse should include packing — all parts of the packaging process through the entire value chain. For assets that are returned as faulty, for repair or for reuse, there is a growing recognition that reverse logistics should be part of the overall analysis of a carbon footprint.

3.0 Extend Traditional Supply Chain Methodologies to Incorporate Green Concerns

In many places, the supply chain affects and can be supportive of a program to reduce emissions that contribute to climate change. Initially, some traditional SCM technologies help create more-efficient processes that reduce waste and can thus be the initial targets for green initiatives. These traditional programs include lean/lean manufacturing (efficient supply response to a known and stable demand), total quality control and Six Sigma (improved yield and stability of processes), transportation planning/optimization (reduce empty truck miles, reduce fuel consumption), and added and demand-centered SCM (synchronized demand and supply). The processes and domains explained above are not explicitly ecological because it could be possible to implement lean programs at organizations that are unfriendly to the environment. However, by targeting obvious waste, for example, there can be environmental benefits to doing something that makes good business sense. Where market prices do not reflect resource use and environmental impact, additional steps will be required to comply with green mandates. Each of the holistic supply chain affects can be supported and managed more affectively by SCM technology if it was extended to model the necessary constraints and optimization routines. This is where new IT investments must take place.

4.0 New IT Investments Will Be Required

Some aspects of SCM technology, specifically the planning engines that are embedded in supply chain planning (SCP) (including demand planning, supply planning and network design), model constraints and, in some cases, byproducts and co-products. As such, this is a fertile place to leverage technology across design, manufacture, transportation, storage and consumption. The planning models used to determine what to make, where and when, and where to move and locate products and materials, are focused on profit or revenue maximization, but can be extended to include carbon emissions. This means that business decisions can be made knowing the possible impact on the environment from those decisions. Also, other business applications across sourcing (supplier input) will be adapted to explicitly model constraints, describing the suppliers' (negative) contribution to the environment.

Transportation management systems are especially adept at targeting carbon footprints because they target efficiency improvements in an area noted as the chief source of CO₂ pollution: vehicle emissions. However, they will need modifications to address additional objectives embodied in green supply chains. If a company can reduce miles driven by a small percentage, they can have a significant environmental impact. These technologies will be adapted to help users make smarter, more-informed business decisions related to:

- Visibility — Greater information is needed to make smarter decisions. Users need greater visibility into the data describing carbon contributions, asset use, equipment use, inventory availability and basically any aspect of the supply chain that affects its

performance. Sharing the data will also become important — especially as organizations move from local optimization to global (and partner) optimization.

- Optimization — There is, by far, an ever-greater need to apply optimization technology across many aspects of the supply chain, from plant scheduling, to inventory flow, to logistics routes and to asset use. This is not SCP as it is today — which is mostly focused on the process automation side of SCM; it is another evolution of SCP that takes into account the constraints representing environmental factors, such as gas emission, waste and byproduct output.
- Multienterprise — So much of SCM focuses on the enterprise, yet the supply chain is about a chain or connected network of stakeholders servicing each partner's requirements to meet an end consumer. Visibility and optimization can be applied at the enterprise level, and also at the multienterprise level, to determine the overall impact on the environment. Therefore, technology that services the needs of multienterprise modeling (specifically in the third-party logistics market) will see only a trivial increase in demand.

The shift from modeling and optimizing the carbon footprint to include all resources that negatively affect the environment could be called a "resource intensity planning" focus — and this focus will cause the technology vendors to expand their library of constraints modeled from carbon output per unit of work (truck, plant and process) to include the range of resources that affect the environment overall. It might be acceptable to optimize freight around reducing the carbon footprint (you might even need to do this to be compliant with future legal requirements), but strategically, organizations need to begin planning to take into account all the major environmentally unfriendly constraints in their supply chain. Figure 1 shows the link between greenhouse gases that affect the climate and activity that leads to longer-term and related environmental issues. For example, waste products are already modeled in manufacturing planning and scheduling products for the chemicals industry and can be optimized to limit the amount of waste product.

5.0 Some Applications Vendors Are Focusing on Green Supply Chain Concerns

Many vendors and technologies are evolving in this direction. Most vendors are only just beginning to talk about this, but a few have been active for a while. Some of the active vendors and classes of technology that should be evaluated include:

- SCP — SCP technology is capable of modeling the data necessary to determine environmental impacts from supply chain activity; however, such modeling requires a lot of additional data.
- Integrated Business Planning — The business will need to align business strategies with operational activities, and this will be achieved through integration programs such as sales and operations planning (S&OP) as well as corporate performance management.
- S&OP — These business planning programs will also evolve to take account of environmental requirements, and it will be through S&OP that organizations will execute compliance programs to meet green targets as they emerge.
- Supply Chain Execution — There is a focus among supply chain execution vendors to monitor and optimize resource consumption within execution environments.

Vendors already active in the green supply chain market include:

- Supply Chain Consulting (SCC) U.K. (www.supplychain-consulting.com) is doing three things:
 - Maintaining a database of carbon data points (acquired from third parties) for doing carbon product and process footprints.
 - Providing a supply chain visibility layer (for example, Viewlocity) for carbon data with the ability to initiate action, and alert and report against objectives.
 - Network-wide supply chain and carbon reduction optimization. SCC is working with one customer in this emerging area by using data to model the supply chain's impact on the environment, making that data and cost visible and then helping users look at the reduction possibilities.
- Barloworld is modeling aspects of carbon output for network design consultations via its CAST product (<http://www.barloworldoptimus.com/solutions/carbon-emissions-modelling.aspx>).
- Infor, a large enterprise applications vendor, is completing a pilot with a major global shipping/logistics customer that targets the reduction of the social costs (negative impact on the environment) of CO2 emissions. The project uses Infor's strategic network design solution (Infor acquired this solution via the acquisition of Baan, which had acquired CAPS Logistics) to first measure and model CO2 emissions from manufacturing and transportation activities and then determine the optimum logistics strategy to reduce the associated costs (<http://www.infor.com/solutions/scm/strategicnetworkdesign/>).
- Lawson Software, a large-enterprise application vendor, is developing a strategy for how it can leverage its business intelligence platform to give a company a carbon dashboard so that it can have visibility into aspects of its environmental impact (<http://phx.corporate-ir.net/phoenix.zhtml?c=129966&p=irol-newsArticle&ID=969973&highlight=>).

Although users initially will be able to focus on enterprise-level resource optimization, eventually they will likely be forced into considering supply chain-wide implications. It would be entirely possible for one organization to claim "green practice" with highly optimal logistics and elimination of storage, only for the overall supply chain performance to be harmed by the next customer in the chain that lets inventory rest in the warehouse and consuming much more energy than needed. Therefore, a two-tiered approach is necessary: one centered on how your organization can reduce waste and become more efficient, the other to seek like-minded partners in your value chain to move from local optima to global optima. This possibility that a focus on local optimization could result in suboptimal global conditions was an initial impetus for SCM thinking, so it is important to incorporate it in any plans for major changes such as these. The more we look forward to climate change issues in the supply chain, the more we look back to goals that were set 30 years ago.

6.0 Recommendations

6.1 Planning and Awareness

- Build a holistic plan for going green, made up of incremental steps. It is hard enough for many organizations to optimize their supply chains for "lowest cost," so running off to model a "carbon footprint" will just make things more complex in the short term. Start with a vision of how your business will become aware of the environment and how it relates to it. Take into account legal and regulatory requirements, and be aware of marketing positives that can be taken from being seen, to being green.

- Identify aspects of your supply chain that contribute most significantly or are affected most by green conditions; put in place a plan to gather the necessary data to model your environmental considerations in your planning systems. Publish your modeling objectives, such as establishing CO2 contributions, and trade-off with profit or revenue objectives.
- Develop a plan to deepen your analytical skills and database with this data to enrich your optimization capability. Put in place a plan to get operational data and new benchmarking data to support green optimization strategies. Build an analytics and business intelligence strategy that enables the enterprise to capture information about green initiatives and support customer reporting requirements.

6.2 Execution and Negotiation

- Engage with your vendor (SCP, transportation management, third-party logistics, strategic network design) or IT organization to determine if you are applying optimization to the level of granularity needed to model environmental factors, such as carbon contribution. Evaluate bills of material for waste or returned items, packaging and so on that can be modeled to determine their overall impact on the environment for waste and recyclability.
- Develop a road map and engage with partners for multienterprise planning, execution and coordination so that joint supply chain decisions about resource consumption can be built across trading partner boundaries

RECOMMENDED READING

"IT Organizations Will Need Eight Technologies to Provide 'Greener' Services"

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