Case Study: General Motors

Managing Chemicals of Concern in Products and the Supply Chain

General Motors (GM)[1], founded in 1908, is one of the world's largest automakers, employing approximately 252,000 people. Headquartered in Detroit, Michigan, GM manufactures cars and trucks in 34 countries and sells and services vehicles in 140 countries. GM brands include Buick, Cadillac, Chevrolet, GMC, GM Daewoo, Holden, Hummer, Opel, Pontiac, Saab, Saturn, Vauxhall and Wuling. The largest markets for GM vehicles are the US, China, Brazil, UK, Russia, and Germany.[2]

Automotive manufacturers such as GM have large and complex supply chains that traditionally have been divided into Tiers. Tier 1 suppliers manufacture and supply components directly to the automotive company. Tier 2 suppliers produce parts that are included in the components manufactured by Tier 1. Tiers 3 and 4 primarily supply raw materials. One recent study of the auto industry indicates that a more accurate description of the supply chain is as follows: "systems integrators" (suppliers that design and integrate components, subassemblies and systems that are shipped to assembly plants); "global standardizer-systems manufacturers" (companies that design, develop and manufacture complex systems and may supply directly to auto companies or to systems integrators); component specialists; and, raw materials suppliers.[3]

The End of Life Vehicle (ELV) Directive, initially adopted by the European Commission in 1997 and officially adopted by the European Parliament and Council in 2002, was designed to encourage the manufacture of vehicles that could be dismantled and recycled in an environmentally friendly manner. This legislation set the stage for many of the efforts described below, as it motivated the auto industry to develop systems to track chemicals and materials of concern throughout their supply chains. The ELV Directive banned lead, mercury, cadmium and hexavalent chromium in materials and components of vehicles as of July 1, 2003 with some exceptions, such as lead in batteries and lead used as an alloy and stabilizer, mercury in bulbs, and hexavalent chromium used as a corrosion preventative coating. It also required auto manufacturers to set up systems for recycling automobiles and to increase amounts of recycled materials over time.

IDENTIFYING, PRIORITIZING AND EVALUATING MATERIALS OF CONCERN

Beginning in the 1990's, in response to the ELV Directive, auto manufacturers began to develop lists of chemicals and materials of concern and ask their suppliers to report whether the parts they were providing contained these substances. GM's list, GMW3059, delineates restricted and reportable materials for parts specification. The proliferation of different lists from each auto manufacturer made it difficult for suppliers to comply with reporting requirements.

To address this problem, in 2004, auto manufacturers, parts suppliers, and representatives of the chemical and plastics industries formed the Global Automotive Stakeholders Group, with a goal to "develop a single, globally harmonized list with clear criteria and a transparent process to manage future versions."[4] This became known as the Global Automotive Declarable Substances List (GADSL). The stakeholder group developed a formal review process to add and delete chemicals and meets annually to modify the list.

This list has served as a starting point to harmonize the reporting requirements of auto manufacturers and make it easier for suppliers to comply. The GADSL includes only substances that are likely to be present in the vehicle at the point of sale. Process chemicals are not included. The GADSL criteria allow for including regulated chemicals, "chemicals projected to be regulated", and substances that are tested and found to be "associated with a significant hazard to human health and/or the environment and its presence in a material or part in a vehicle may create a significant risk to human health and/or the environment."[5]

GADSL substances are either "prohibited" (P), "declarable" (D), or in some cases D/P (prohibited in some applications/ declarable in others). Prohibited substances are "either prohibited by regulation for use in certain applications or may not exceed regulated threshold amounts." Declarable

substances must be declared if the amount in the part exceeds the defined threshold limits. The default threshold limit is 0.1% (percent by weight). Each substance on the GADSL list has a "reason code" to explain why it has been included. The "reason codes" are as follows: LR—legally regulated because its use in a vehicle part or material poses a significant risk to health and or the environment; FA—for assessment—a substance projected to be regulated; FI—for information—a substance tracked for information purposes only. The GADSL instructions note that these codes "do not necessarily mean that the substance is prohibited from being used in vehicle parts or is to be de-selected."[6]

Although the GADSL provides a useful common starting point for auto manufacturers to identify, track, and eliminate chemicals of concern, it contains 144 substances, many of which (102) are "declarable' but are not prohibited. Many companies have conducted a further review of the GADSL to prioritize the substances on this list. General Motors has reviewed data on these substances and has categorized them as being of high, medium or low priority for elimination.

Productive Material Review Process: GM has developed a protocol known as the Productive Material Review Process to evaluate all new chemicals and materials that are introduced into the production process. This process is initiated by engineers who describe the projected use of the material in the production process. A team of toxicologists, environmental engineers and industrial hygienists evaluate potential health effects, conduct a worker safety evaluation to determine if engineering controls or personal protective equipment are needed, and assess environmental impacts including waste generation and management and end of life issues such as recycling. Some of these analyses, for example, a review of new paints, may be fairly routine. However, when new technologies and materials are introduced, this process is introduced early on to identify any hazards of concern. With this approach, GM is working to phase out problematic chemicals early in the design/production process.

Chemical Management Services: GM has been a leader in the development of what has become known as Chemical Management Services (CMS) to improve the management of indirect or process chemicals. Using CMS, GM has contracted out the management of its process chemicals to a chemical supplier. This contractor purchases and delivers chemicals, maintains inventory, tracks MSDS and may advise on chemical use and substitution. The CMS model improves chemical management as it aligns the incentives of the chemical supplier and manufacturer. In the traditional model, the chemical supplier profits based on the amount of chemical sold. In the CMS model, the supplier is compensated for more efficient use of chemicals through performance-based metrics and fees. GM began to implement CMS almost 20 years ago and now has this system operating in all North American manufacturing sites and all new manufacturing sites globally. With CMS, GM has reduced process chemical use by 30% with an associated 30% reduction in costs of purchasing and managing these chemicals.[7]

The automotive industry has adopted Chemical Management Services more widely than any other industry. In 2004, the adoption rate was 75–80%. The use of CMS in the aerospace industry is growing (approximately 25–30% in 2004). To date, CMS providers are primarily "product-based", that is, they are large chemical producers who target industries (in particular automotive, semi-conductor and metal-working) that use their products in large volumes. Another type of CMS provider is "service-based", meaning they are not chemical producers, but instead provide a service of providing chemicals to customers who use a range of specialized chemicals, but may be lower volume users. These providers have targeted the aerospace, electronics (except semiconductors) and airline maintenance industries.[8]

TRACKING MATERIALS OF CONCERN

The auto industry has developed a database called the International Material Data System (IMDS) for reporting on materials of concern.[9] German auto makers in 1997 began the groundwork to develop this system as they recognized the need for a standardized means of gathering information on materials across the supply chain. The IMDS was developed by Audi, BMW, Daimler, Ford, GM (Opel), Porsche, VW and Volvo and is now used by 22 major car manufacturers, including 45 brands. This database, designed and maintained by EDS, a global technology service provider, was created to be accessible to the entire supply chain of the auto industry. This is a web-based, secure, high speed system. The first version, created in 2000, was developed to meet the requirements of the ELV Directive. By 2001, IMDS began to be used by US automakers and in 2002 Japanese and Korean automakers began to use this system. The GADSL is the default list of chemicals/materials that must be entered into this data base.

The data base has a four layer architecture. The first layer is "thin-client" for presentation and data input. The second and third layers are "application layers", based on web servers and Enterprise Java Bean servers. The fourth layer is a database server running an Oracle database.[10] From 2000–2006, more than 150,000 users registered with IMDS in over 60,000 companies.[11] EDS has set up service centers in Europe, North America, Japan, and Korea to assist suppliers in entering data into the IMDS system.

The IMDS has proven to be a useful tool for tracking information on chemicals and materials of concern in vehicles.

GM asks its parts suppliers for 100% disclosure on chemicals and materials of concern. In their sourcing package, suppliers receive an environmental statement of requirements. The purchasing department also has a set of requirements. Parts are approved only after data has been properly entered into IMDS system. GM has created a global assistance center in India to review all IMDS submittals by suppliers. Employees at this center review the paperwork submitted by suppliers to ensure that all requirements are met and that sufficient information is provided so that reports can be generated to meet the ELV Directive. GM does not test parts; rather the company relies on data submitted by suppliers. Parts are generally approved or rejected within a three day timeframe.

COMMUNICATION WITH THE SUPPLY CHAIN ABOUT MATERIALS OF CONCERN

GM's main method of communication to its Tier 1 suppliers is its Supply Power website, where all information about requirements for restricted and reportable chemicals is shared. In addition, organizations such as the Society for Automotive Engineers (SAE) develop engineering standards and provide information on methods to eliminate materials of concern. The Automotive Industry Action Group (AIAG) has created an IMDS-GADSL advisory group to clarify reporting requirements and reduce confusion among parts suppliers.

One of GM's most powerful means of communicating with suppliers about environmental concerns is the Suppliers Partnership for the Environment (SP), initiated in 2003 by GM, automotive suppliers and the USEPA.[12] The SP is a partnership between auto manufacturers, suppliers and the US Environmental Protection Agency. It is a non-profit (501 c 6) trade association that is funded by contributions from its members. Its mission is to share best practices that will result in environmental improvements and cost savings. Members of the SP recognize that sharing information about environmental issues with others in their industry sector, even if they are competitors, is a way to improve environmental management industry-wide. These companies understand that opportunities for competitive advantage will be found in the techniques and methods they employ to implement programs for environmental improvement.

Ford and Chrysler have joined GM in the SP. Including suppliers, there are a total of forty member companies. Most of the suppliers that have joined the SP are small suppliers who find it beneficial to have direct contact with GM to solve technical issues. The SP meets quarterly, with its work groups meeting more frequently. There are currently four work groups of the SP, including Chemicals Issues, Energy, Materials Efficiency and Technology and Networking.

Dr. Pat Beattie of GM chairs the Chemicals Issues Team. This work group's first initiative is to develop a common screening process for assessing health and environmental impacts of chemicals in automotive parts. The goal of this effort is to create a standard process that can be used by suppliers to identify and assess chemicals of concern in their parts and eliminate them as necessary, before they enter into the reporting process. The work group hopes to create a methodology and an automated tool that is user friendly and straightforward enough that it can be used in supplier companies that are not likely to have toxicologists on staff to evaluate chemicals.

Dr. Beattie is working with a consulting firm called Science Strategies to develop this screening protocol, called the Materials Assessment Strategy, and is testing it for materials used the interior of a vehicle. The first step of the protocol is a hazard evaluation, including carcinogenicity, mutagenicity, reproductive toxicity, developmental toxicity, sensory irritation, dermal sensitization, pulmonary sensitization, endocrine disruption, and aquatic toxicity. The next steps include exposure assessment and risk characterization, for the chemicals that are identified as hazardous. The exposure assessment includes three tiers, including a "worst case" scenario, mathematical modeling, and, if needed, actual analytic determination of airborne and surface levels. If exposure levels are found to be unacceptable, chemical substitution is explored.

Another project of the SP is the creation of a process to link new technologies with interested users. The goal of this effort is to develop a credible approach to test and validate new technologies and approaches in areas such as green chemistry and engineering. GM hopes that this information sharing process will attract additional members to the SP.

MANAGEMENT STRATEGIES TO IMPROVE ACCOUNTABILITY FOR MANAGING MATERIALS OF CONCERN

Approximately five years ago, GM restructured as a global functional organization, where it was formerly a network organization. Dr. Beattie is now the global process owner for chemicals risk management and Jerry King is the global process owner for materials engineering. This restructuring means that individuals throughout GM's global organization report to Dr. Beattie on chemical risk management. For example, industrial hygienists in Brazil and Australia who have regional responsibilities, take direction from Dr. Beattie. Design engineers throughout GM report to Jerry King on green design issues such as vehicle recycling and elimination of substances of concern. This reorganization has provided an opportunity to drive a common process for chemical risk management throughout the entire organization.

GM employees are accountable for meeting goals that are specified in the Performance Management Process. These goals are reviewed in employee performance evaluations.

In addition, GM has created an Energy and Environmental Strategy Board composed of executives at the vice president level. The purpose of this high level board is to coordinate environmental initiatives across the company. Strategy teams led by managers such as Dr. Beattie and Jerry King support the work of this board. These management changes have raised the profile of environmental management issues at GM and helped to make environmental programs more consistent globally.

Dr. Beattie advises that the most useful thing a company can do to improve chemical risk management is to partner across its industry sector to share information and develop tools that can be used consistently and easily by suppliers. This approach spreads the costs of developing these programs among participants. This sharing of information and development of standard approaches helps to level the playing field in an industry sector. Opportunities for competitive advantage can be found in the programs each company develops to effectively implement environmental improvements.

LESSONS LEARNED

- **A globally harmonized list for suppliers is a valuable tool for collecting supply chain information on chemicals of concern.** This list, GADSL, which GM played a major role in developing, includes chemicals that are in a vehicle at the point of sale.
- **It is valuable to have a process in place to evaluate new chemicals and materials.** GM's Productive Material Review Process, used to evaluate all new chemicals and materials that are introduced into the production process, can identify problematic chemicals early on. This process includes an industrial hygiene, environmental, and end of life review.
- **Chemical Management Services are very useful in reducing process chemical use.** GM's use of Chemical Management Services (CMS) for process chemicals has reduced process chemical use by 30% with an associated 30% reduction in costs of purchasing and managing these chemicals.
- **Service centers can help suppliers to meet reporting requirements.** Suppliers have learned to use the International Material Data System (IMDS) to report on GADSL substances. The global assistance center based in India has assisted suppliers in meeting requirements.
- **Collaborative supply chain efforts can be very valuable.** The Suppliers Partnership for the Environment, initiated by GM, suppliers and US EPA is a powerful opportunity for sharing information about environmental concerns and solutions.
- **Organizational structure can impact success in global chemicals management.** GM's recent restructuring as a global functional organization, rather than a network organization has improved accountability for chemical risk management.

ENDNOTES

1 For this research, we interviewed Dr. Pat Beattie, Director, Chemical Risk Management, Environmental Services and Jerry King, Engineering Group Manager, Design for the Environment, Materials Engineering.

2 *http://www.gm.com/corporate/about/company.jsp accessed 2/27/09.*

3 Veloso, F., and Kumar, R. (2002, January). The Automotive Supply Chain: Global Trends and Asian Perspectives. Asian Development Bank. Accessed on February 27, 2009 at *http://www.adb.org/Documents/ERD/Working_Papers/WP003.pdf*

4 See *http://www.gadsl.org*

5 Global automotive Declarable Substance List, 2009 GADSL Version 1.0, pg. 3.

6 Global automotive Declarable Substance List, 2009 GADSL Version 1.0, pg. 4.

7 Chemical Strategies Partnership Case Study. (2008, April). Chemical Management Services open the door to process efficiency improvements and cost savings in metal fabrication. Accessed on February 27, 2009 at *http://www.chemicalstrategies.org/pdf/case_studies/GM_Quaker_PEICaseStudy_Apr08.pdf*

8 Chemical Management Services Industry Report 2004. Creating Value through Service. Accessed on March 3, 2009 at *http://www.chemicalstrategies.org/cgi-bin/soupermail.pl*

9 See *http://www.mdsystem.com*

10 See *http://www.mdsystem.com/html/data/imds.pdf*

11 See *http://www.eds.com/services/imds/*

12 See *http://www.supplierspartnership.org/*

This document is one in a series of five case studies prepared as part of a project assessing strategies for improving management of materials of concern for United Technologies Corporation. For more information or to download the other case studies, visit *www.chemicalspolicy.org.*

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The Lowell Center for Sustainable Production at the University of Massachusetts Lowell fosters innovative solutions toward a more sustainable world by developing, studying, and promoting environmentally sound systems of production, healthy work environments, and economically viable work organizations. The Chemicals Policy and Science Initiative (CPSI) at the Lowell Center is one of the most prominent academic chemicals policy efforts in the US. Through research, conferences and trainings, CPSI engages diverse constituencies in the discussion of chemicals management issues to encourage more sustainable chemicals policies.