



Green Design

With simulation and analysis, going green offers many benefits.

By Peter A. Bilello, President, CIMdata Inc., Ann Arbor, U.S.A.

Evidence is mounting that the impetus for “going green” and developing environmentally sustainable products is moving away from mere regulatory compliance to the realization that a significant new business opportunity is at hand.

The realization marks a dramatic opinion shift. Many U.S. manufacturers greeted sustainability and greenness as a regulatory burden foisted on them by European bureaucrats. Today, many of these same manufacturers see that developing sustainable products offers a sustainable competitive advantage.

As a result, manufacturers — even those subject to little real oversight until recently — are undergoing a fundamental attitude adjustment. Corporations realize the green opportunity is much bigger than the emerging technologies — wind-powered turbines, solar collectors, biofuels, clean coal, etc. — that dominate media coverage of business.

A survey by the Massachusetts Institute of Technology’s *Sloan Management Review* (winter 2011) and Boston Consulting Group shows that sustainability “pressures” are changing top management’s outlook. Businesses are increasing investment in, and paying more attention to, sustainability; a performance gap is emerging between companies that embrace sustainability and those that do not; and top management is on board more for bottom-line impact than for environmental reasons.

Essentially, the study looks at reactions to a series of stringent regulations aimed at enforcing sustainability. Enacted in the European Union (EU), these include the Restriction of Hazardous Substances (RoHS) and closely related Waste Electrical and Electronic Equipment (WEEE) directives. More detailed is the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) restriction. End of Life Vehicle (ELV) attempts to reduce the amount of waste when vehicles are finally scrapped. China, Japan, South Korea, several other countries, and a number of U.S. states are adopting these regulations or authoring similar ones.

The business implications have *not* been missed in Germany and several other export-oriented economies. Recognizing that green confers sustainable competitive advantage and boosts employment, legislators appropriate hundreds of millions of euros annually in loans, grants and subsidies for major industries. Solar heating panels are one example.

Perhaps the biggest case in point is the automotive industry. Manufacturers of cars, trucks and buses are creating radically new powertrains — engines, transmissions, fuel cells and batteries plus power electronics — for coming generations of electric and hybrid vehicles. Automotive companies worldwide are investing tens of billions of dollars/euros annually.



Simulation and Analysis Meets PLM

Whether in automotive or other large-scale manufacturing, going green brings together two complementary solution sets that, when paired, can significantly enhance an organization's ability to design and deliver green products.

Simulation and analysis (S&A) is often called computer-aided engineering (CAE) or computational modeling. Finite element analysis (FEA) and computational fluid dynamics (CFD) are its two most widely used forms. Given the increasing scope and complexity of green requirements, too much is at stake to rely on analyses that are performed late in development.

For large, complex green systems, S&A is intended to work within the context of an enterprise's overall **product lifecycle management (PLM)** environment.

PLM is the enterprise-level solution for managing new-product development information and all corresponding intellectual property (IP). PLM is a centralized conduit for unified data exchange with product data management and efficient workflow. This approach is as comprehensive as lifecycle sustainability.

Success with these powerful solutions and tools means developing a holistic design approach to building green compliance into a sustainable competitive advantage.

Significant improvements of product performance and reliability can be achieved with CAE techniques such as parametric CAD modeling, FEA, CFD, electromagnetic modeling and multiphysics computer simulations. But for maximum benefit, they must be used within PLM environments applied in a broad sense. This means utilizing a consistent set of business processes and focusing data-creation and data-management tools on the product's greenness.

S&A, Green Design and Manufacturing

From experts and analysts, here are some specifics about using S&A solutions in an overall PLM environment to find green opportunities. Many of these are not new; some are basic, common business sense.

- **Minimize** the use of energy-intensive raw materials by trimming excess weight/mass. Use engineering simulation to rethink rules of thumb and old margins for error. Materials costs could drop by several percentage points. Examples abound: One from outside heavy manufacturing is the plastic bottle. Worldwide, 200 million of them are emptied and discarded every day. Each one weighs an ounce or more (roughly 50 grams). Reducing their weight by 10 percent could save several thousand tons of plastic *per day*, plus the energy used to recycle them.



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- **Maximize** the use of eco-friendly materials. Design in recycled materials whenever possible in place of energy-intensive raw materials.
- **Identify and optimize** promising new design alternatives with S&A and PLM to avoid physically building and testing multiple prototypes. Eliminating a single prototype can cut weeks from a product launch schedule.
- **Reduce manufacturing learning curves** faster with numerical analysis for likely causes of late-stage engineering changes, errors and rework. Profits can be generated sooner.
- **Resolve bottlenecks** as they appear in production with S&A and the information in PLM repositories. As work-arounds eliminate potential showstoppers, output per unit of energy goes up again, and production costs fall.
- **Use electronic distribution** for all factory floor documents — work/assembly instructions, for example. The amount of paper (and factory floor trash) can be slashed by thousands of pages a week in a medium-size plant, and many times that in a large one.
- **Focus S&A on shipping and packaging** products and supplier materials. Consider moving final assembly, run-off tests and painting close to the customer. For most companies, shipping still offers many ways to reduce fuel costs and get greener. Most packaging can become more eco-friendly.

- **Address service and support early** in the design phase. Simulation is a proven tool for simplifying field-service access to components based on needs for service. Quicker, easier maintenance reduces the customer's lifecycle costs and is easily demonstrated with S&A.
- **The end of the product lifecycle** brings engineering modeling back to RoHS, WEEE, REACH, ELV, etc. Obsolescence and foreseeable recycling difficulties are best dealt with at conception by analyzing what can happen in the scrap yard.

Most of these green practices have much in common with already-established manufacturing initiatives. These include lean (minimizing inventories), re-engineering (optimizing factory work flows) and sensible risk management. Going green adds to incentives and payoffs; it can leave less astute competitors floundering.

The Green Consumer and Noncompliance

Simulation and analysis within an overall PLM context offers significant opportunities to win new customers. Consumers have already shown they are willing to pay a premium for well-engineered green products, beginning with hybrid-powered and electric cars. As industry shifts to sustainable goods, today's price differences can be expected to reverse.

Failing to comply with sustainability-related regulations can be extremely costly in fines, penalties and recalls. Regulators set very low thresholds for certain metals and chemicals; they have low tolerance for even small violations. In some countries, noncompliant products may be banned from sale if a hazardous material threshold is exceeded on a single part.

Delays in demonstrating compliance can slow or halt a product launch, potentially leaving products stacked in warehouses while forms are retrieved, material levels are verified, and approvals are sought. S&A in an end-to-end

PLM environment allows businesses to compile, correlate, analyze, support and report against today's and the future's even-tougher green regulations and requirements.



Green is Here to Stay

As a critical part of an overall product lifecycle management environment, engineering simulation provides the data creation and optimization capabilities needed to truly optimize greenness of a new product in all aspects. Industrial companies, regardless of size or line of business, can and will have to utilize PLM to integrate green concepts into every phase of product development.

Manufacturers can speed up and smooth out new design processes and production launches. Alternatives to improve green designs can be quickly and thoroughly evaluated with S&A. Engineers can comply with more-demanding governmental requirements, meet changing market needs, boost the value of green products to end users and even optimize conflicting consumer demands.

The value of these solutions is that through a simulation-driven product development process, companies can take a proactive approach to gain significant competitive advantage for years to come. They will be able to get green products to market quickly and efficiently. Disruptive last-minute changes can be avoided along with the oppressive costs of noncompliance. New leaders in concerns for environmental issues are already emerging.

An overall green approach to product lifecycle management not only enables a company to design, produce and deliver greener products to the market, it also can help the company increase a product's perceived value to the consumer — decreasing lifecycle costs for consumer and company.

PLM is truly a green enabler, but a company's PLM strategy needs the appropriate S&A tools to turn green and sustainability into sustainable competitive advantage. ■

CIMdata is a non-biased, independent, global management consulting firm that has established itself as a world-leading source of information and guidance to both industrial organizations and suppliers of PLM technologies and services.

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