SUSTAINABILITY

ASME's third annual survey finds that engineers are still trying to understand how sustainability fits into their workflow.

By Alan S. Brown

Engineers have been working overtime to figure out where sustainability fits into their profession. In fact, many believe that "sustainability" is just another word for "engineering."

In a recent survey by *Mechanical Engineering*, one respondent put it this way: "Sustainability is just good stewardship and something that most engineers have practiced for years." Another added, "The point of the design is that it is sustainable. Otherwise it is not marketable."

Prevailing attitudes among engineers are that they see the value of sustainability, show skepticism about the hype, and are searching for a better way to quantify what they are doing.

This is the third year *Mechanical Engineering* has surveyed ASME members about their attitudes and practices regarding sustainability.

Alan S. Brown is associate editor.

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This year's survey drew responses from nearly 2,100 mechanical engineers and 800 mechanical engineering students. Most of the professional respondents had 20 years or more of experience. Four out of ten worked in large organizations with more than 1,000 people. They represented a broad range of job descriptions, with energy, professional services, manufacturing, defense, and aerospace leading the list.

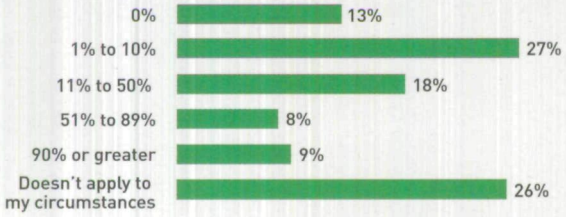
The survey deliberately left the definition of "sustainability" and "green technology" open. While this created some confusion, it also provided an expanded view of what mechanical engineers consider sustainable. This ranged from reducing energy use and waste to employing recycling and lowering emissions—and a belief among many that sustainable engineering is a trendy name for what used to be called good engineering.

Not everyone is a booster. Some dismiss sustainability as "the flavor of the week." Often, they equate it with fighting climate change and say that there is no reason to change anything. Others argue that organizations launch programs strictly for their public relations value.

Many mechanical engineers surveyed are equally adamant in their support. "ALL sustainable design practices are ultimately cost-saving, hence always considered, always recommended," one wrote.

The vast majority of respondents work for organizations that believe sustainability is important. Two-thirds of respondents reported that their organizations are "extremely" or "somewhat" involved in such efforts. Only one in five said an organization showed little or no interest. About six out of 10 respondents had worked on at least one sustainability project this past year.

Over the past year, approximately what portion of all of your projects included specifications that were based on sustainable and/or green design principles beyond those mandated by regulations?



Because sustainability has so many different facets, it should not come as a surprise that even some who are skeptical about climate change are on board. "We do not subscribe to the politics behind the green/sustainable movement," one engineer wrote. "We believe in using sound engineering judgment to deliver the most cost-effective means to lower our customer's energy consumption to save them money. The CO_2 savings, a meaningless metric, is simply a function of lower energy consumption."

The reason for such widespread acceptance is simple economics. Rapidly industrializing nations are competing with developed countries for a limited amount of resources, thus driving up costs. Between 1999 and 2011, for example, prices have risen six-fold to $85 for a barrel for oil, doubled to $4 per million cubic feet for natural gas, and rose five-fold to $4 per pound for copper. Some critical materials, such as rare earth metals, are increasingly hard to get.

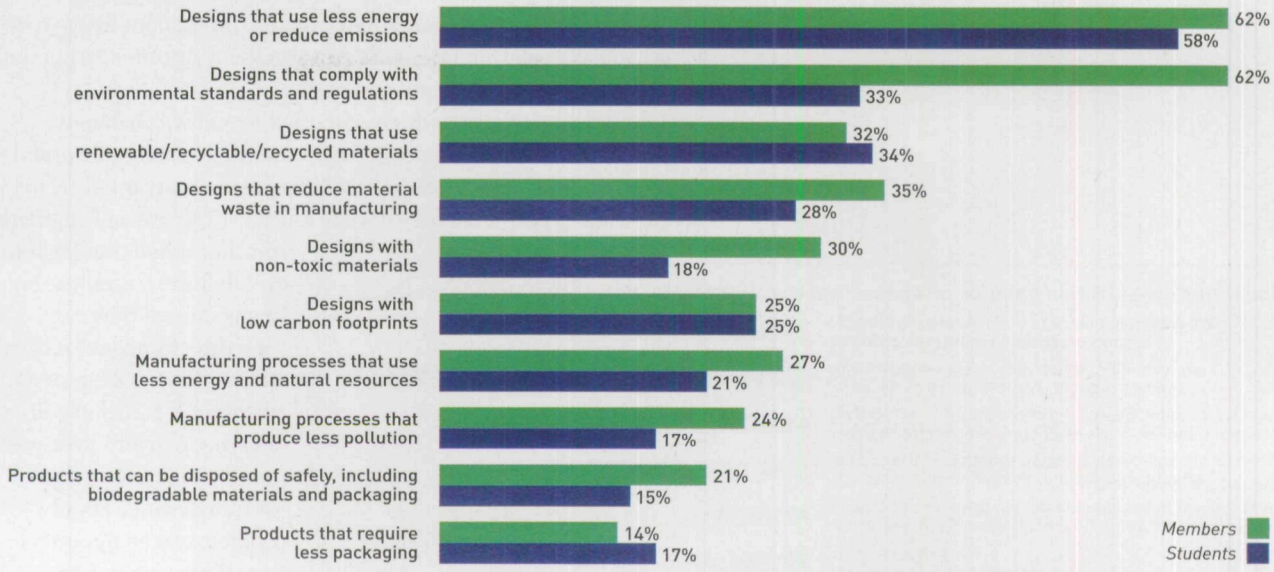
The results are changing the economics of design and production throughout the world. Engineers are the ones tasked with responding to rising costs. And what could be more sustainable than improving efficiency and eliminating waste to lower the cost of new products and manufacturing processes?

In fact, 62 percent of survey respondents said their organizations were interested in designs that use less energy, 35 percent in designs that reduce material waste in manufacturing, and 27 percent in more energy- and resource-efficient manufacturing.

When asked to pick what segments of sustainability they felt were most important, respondents overwhelmingly chose ways to reduce energy in designs or manufacturing.

According to one respondent, sustainability is just another word to

In which of the following areas of sustainability is your organization currently involved?
What kinds of projects are you involved in using sustainability or sustainable technologies?



"describe engineering and social practices which, through the majority of the world, are practiced automatically due to the chronic impoverishment that exists everywhere but in countries like the U.S.A."

The engineer continued: "The problem will sort itself out as the global table is leveled, as is being done today, and we all are forced to make do with an equitable proportion of available resources. In other words, the market will eventually prevail as the U.S.A., among others, becomes less affluent."

Not every comment was as fatalistic. But scores of respondents affirmed their belief that sustainable engineering is good engineering by another name. They see themselves as doing what engineers have always done: making a product more efficient or reducing waste in manufacturing to conserve energy, resources, and raw materials in ways that bolster the bottom line.

"I don't know any company that has not been designing products in the most efficient and long-lasting way that is cost-effective," one respondent wrote. "That is sustainability. The big difference today is that the rising cost of resources has changed where we set the bar in terms of cost-effectiveness."

Perhaps that is why two-thirds of the poll's respondents believe that the people they work with are increasingly interested in using sustainable or green design principles in mechanical systems. And the same number believes that incorporating green and sustainable designs results in greater product innovation.

But there is a downside as well. Six out of ten respondents believe that incorporating sustainable and green design practices is too complex for their own company. Moreover, two-thirds of the respondents believe that creating green and sustainable products and processes raises design costs.

Costs are always an issue, but regulations are important too. When asked to list the top three reasons their organization invested in green design practices, 40 percent made regulatory requirements their top pick. Rising energy costs and client demand were distant second at just under 20 percent each. Yet costs and client demand easily garnered the most second and third-place votes.

Most organizations expect sustainability to pay. One-third of respon-

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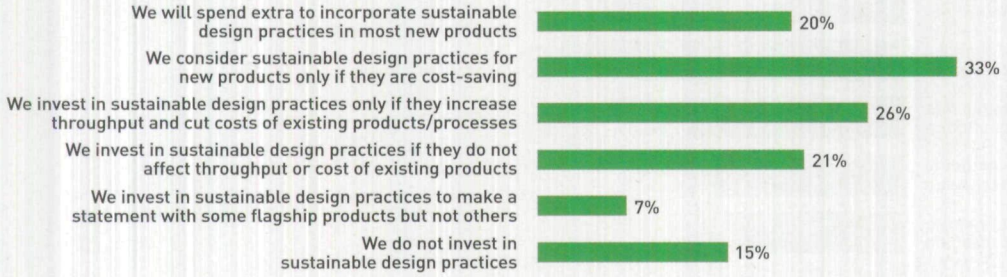
dents said they considered sustainable design practices for new products only when they lower unit costs. One in four said they did it to boost throughput or reduce production costs.

Yet 21 percent of respondents said their organizations spent extra to incorporate sustainable design into most new products. Another 20 percent said they did it as long as it does not add cost.

Cost is clearly the fulcrum on which sustainable practices balance. When asked about the impediments to implementing sustainable practices, mechanical engineers mentioned cost far more than any other factor.

"Everyone loves 'green' until they have to pay for it," wrote one engineer. Another noted that customers "definitely aren't going to pay more if they can't see a direct impact." A third stated, "Higher cost for a sustainable solution will not win out over lower-cost non-sustainable options."

How does your organization balance priorities that may impact the use of sustainable methods?



A fourth spoke about problems faced by contractors: "Owner/operators stand to benefit the most. But they have lost so much expertise and still demand low-initial-cost designs from consulting and construction companies. Consulting and construction companies have no incentive to reduce energy because they do not benefit because they do not own the designs."

Several respondents asserted that the only way to justify such sustainable investments is to evaluate life-cycle costs. After all, the capital cost of a pump, a fan, or an entire process is almost always a small fraction of its operating cost. A solid sustainable solution can pay itself back with energy savings over several years.

Unfortunately, life-cycle accounting has always been a tough sell. In many organizations, capital and operating budgets are separate. The group that buys equipment is often judged on its ability to keep capital costs down. It may have no incentive to invest in more expensive technologies that reduce operating costs beyond a certain point.

On the facilities side, sustainability initiatives often have longer payback time frames than other capital projects. "Most companies in the U.S. have used a two-to-three-year simple payback window as the longest acceptable payback period for green capital projects," one respondent wrote. "There are a few projects at most sites that meet this payback period, but most solid projects are in the three-to-six-year simple payback window. Businesses are going to have to be willing to invest in longer-term projects to really see significant gains in sustainable/green practices."

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Others argue that government regulations are the only way to ensure sustainable practices. Several respondents argue that waste, suboptimal energy usage, carbon emissions, and decommissioning issues are all costs that society must pay. Government regulations would ensure those costs are carried by producers.

One engineer noted that if the government demanded sustainable products, industry would have to manufacture them in large enough amounts to drive costs down. Another favored government regulation, as long as it was applied equally to imports from other countries. "It's far too easy for manufacturers to produce overseas where there may be fewer regulations," the respondent noted.

Not surprisingly, other engineers argued that with less regulation, they would have a freer hand to recycle or reuse materials.

While engineers may debate about the need for more regulation, many seek greater guidance, especially from their professional societies. "Industry organizations such as ASME and ISPE can encourage and develop technical practices that the industry can leverage to meet regulatory requirements as well as improve the sustainability of assets," wrote one engineer.

"Adopt industry standards to be cited in customer contracts," added another.

A third respondent argued that the very word "sustainable" has been so overused that it is nearly meaningless. "It is a qualitative concept without meaningful and standard metrics," the engineer wrote. "The difficulty in comparing the values like energy efficiency, toxicity, recyclability, and reliability with concepts of manufacturing wastage, energy consumption, and pollution are extremely difficult to weigh against one another."

Yet some engineers do want to make those comparisons. One who held that view wrote: "Engineers must translate sustainability into terms that mean something to business and the general population by using familiar concepts like risk management, optimization, efficiency, productivity, and robustness. Engineers must help business leaders and elected officials also understand that business models, products, and manufacturing processes all have sustainability characteristics that can be measured, managed, and optimized."

So how does that get done? One respondent stated that he had worked on an ASTM committee that developed a standard that uses simple calculations to quantify the sustainability value of the product. "Much judgment is still needed to run the calculations," the engineer explained. "This is the first such standard in our industry, but we had to gather a lot of data about sustainability of raw materials and components. Similar quantifiable methods are needed for each level in the stream of commerce, so sustainability can be measured."

Our survey shows that students' attitudes generally mirror those of more experienced engineers.

For example, 56 percent of students report being "extremely" or "somewhat" involved in sustainability, somewhat less than the two-thirds of professional engineers who report similar involvement. Another 25 percent are "somewhat" or "not at all" involved, compared with 20 percent for professional engineers.

Yet students believe overwhelmingly (75 percent) that sustainable and green designs yield greater product innovation. A similar number believe fellow students are increasingly interested in sustainability. Yet just like professional engineers, six out of ten students believe that sustainable design practices cost more. They also see cost as the single most important impediment to more sustainable technologies.

They will graduate well-versed in the field. Sustainability is part of the core curriculum for 27 percent of the students and an elective for another 61 percent. Fifty-seven percent say their schools offer extracurricular projects and competitions, and 39 percent special assignments on sustainable engineering.

Like the professionals, the students struggle with how to make sustainability part of their ordinary duties. But they are optimistic. "It is fairly easy to incorporate sustainability in new designs," one student wrote. "The primary challenge is justifying the time and costs involved with redesigning products, systems, and facilities that are already in place."

Perhaps one day it will be as easy as that. Until then, though, the profession will have to struggle past the hype to find the value in sustainable technologies. ■

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Which one is most likely to influence your organization's use of green design practices and procedures?

First Choice Responses

1	Regulatory requirements	710
2	Rising energy costs	334
3	Client demand	309
4	Personal sense of environmental responsibility	126
5	Ability to gain a market advantage	103
6	Long-term return on investment	74
7	Government/industry incentives	46