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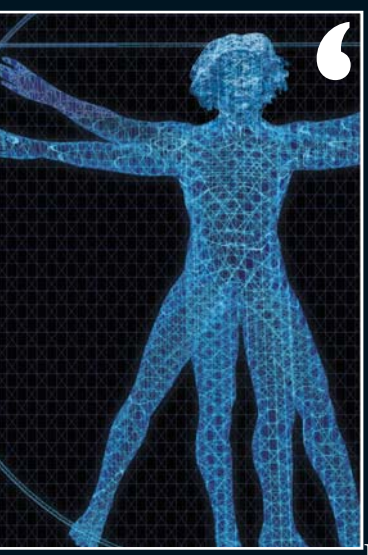
The Future of R&D

A LOOK AT HOW U.S. MANUFACTURERS ARE WINNING IN THE GLOBAL MARKET THANKS TO GOOD OLD-FASHIONED KNOW-HOW

The Future of R&D:

LEVERAGING INNOVATION

> BY JOHN TERESKO



"IN LARGE COMPANIES, of all of the things that are done, innovation tends to be managed with the least discipline of any function." That's how Craig Maxwell, corporate vice president for technology and innovation at Parker Hannifin Corp., a manufacturer of motion and control technologies and systems, explains his company's preparations for the future of research and development (R&D).

"[Consulting firm] Booz Allen Hamilton reports that of all of the core functions of most companies, innovation had the most competitive value, but is managed with the least discipline," Maxwell observes, "and I agree with that. When I looked around the company [Parker Hannifin] and saw what was going on, it wasn't that people weren't innovating; rather, serendipity seemed to rule. Missing was the disciplined rigor of order and metrics common to the rest of our operations, like running a factory. In the manufacturing function we constantly measure our performance."

Maxwell counters the traditional argument that innovation is a random, messy process that can't be measured. "In reality, it is not a messy process, despite the fuzzy project front ends and sparks of imagination that can help fuel the innovation process." Maxwell's approach with the Parker R&D program, called Winovation, puts a lot of things in place to create a corporate environment to enable and facilitate the innovation process. To gain the needed discipline Winovation is based on an

CONTRARY TO CONVENTIONAL THINKING, R&D IS A VERY MANAGEABLE DRIVER OF CORPORATE SUCCESS.

adaptation of the Stage-Gate process. The launching process meant traveling to more than 100 of Parker's global operating divisions and training more than 6,000 people, both engineers and core staffs of each of the divisions, adds Maxwell.

"That resulted, for the first time, in a standardized process by which we would evaluate projects and align them to our strategic growth objectives and track them in real time via the Web." The result: "For the first time Parker Hannifin could see itself. I could see every single project in the entire company and there was a rush of communication and collaboration among the divisions."

Another outcome was the development of metrics that document the product development process. "What we're really measuring is our ability to grow—top line growth and our bottom line profitability. Previously, without this real-time reporting of metrics, the situation was analogous to flying an airplane without gauges."

Maxwell also emphasizes the time savings. "Without a focus on product development metrics, we could be wasting a lot of time on projects of no value." Value is defined through the eyes of the customer, and differentiated value by any definition is innovation. "We're focused on how we can produce increasing levels of value for our customers. Payment for that value translates into margins or earnings for Parker, resulting in a win/win for everyone. Winovation is a screen for value," he emphasizes.

Anyone can enter an idea into Parker's Winovation system. But, says Maxwell, questions are asked—why is this important, why is it significant and how will it make or save money for our customer? The value must be able to be articulated, he explains. "We want to avoid developing the answer to no one's question."

Maxwell refers to the process as a funnel with a lot of

Seven Emerging Trends in R&D Metrics

Seven significant trends in R&D emerged from the 2008 GGI Biennial Product Development Metrics Survey, according to Bradford Goldense, GGI's president. He describes the results as encouraging for senior R&D and product development leaders. "Finally, after 10 years of surveying industry practices on metrics, there is positive change and movement in measurement practices. While the Top 10 metrics and their penetration levels have remained relatively constant for a decade (see page 42), seven distinctly positive trends are evident across the 86 metrics surveyed in 2007-2008." His findings:

1. "The commonality of metrics is rising. More companies are using metrics and defining them in the same way. In the next few years, penetration will likely get to the point that identifying benchmarking partners will become easier in R&D.

2. "The most common measure of tracking new product revenues, 'current-year sales due to products released in the prior x years,' has increased from 48% penetration to 55% penetration. Clearly R&D managers are more focused on business results.

3. "Tracking of profit, while still not a Top 10, has increased significantly. In 1998, tracking of overall profit from R&D was not on the radar. In 2008, analogous to the revenue metric above, 28% of companies now track 'current year profits due to products released in the prior x years.' Companies that have developers focused on the bottom line as well as the top line will generate larger shareholder returns.

4. "Other measures of revenue and profit are also increasing. Many companies now take the time to average their returns from projects that produce salable products and calculate averages for first year, first two years, first three years, and first five years revenues and profits after products launch.

5. "'Open innovation,' meaning multi-party development or sale or licensing of intellectual property (IP), which has been the talk of industry since about 2004, appears to be becoming a reality. There is a clear rise in tracking metrics like 'percentage revenues and/or profits from technology licensing' and 'percentage revenues and/or profits from technology sales.' There is also a clear increase in the basic tracking of all forms of IP, including patents, trademarks and copyrights. Perhaps this is also a defensive move now that IP is becoming more open.

6. "There is a clear increase in 'true performance metrics.' For years many metrics simply counted how many projects were in queue, or done, or the number of people involved. Half of the Top 10 are still not true performance metrics. More companies are now calculating productivity measures such as 'products released per engineer or developer' and 'revenues and/or profits per engineer or developer.' In general, 'output over input' metrics [classical industrial engineering measurement] along with revenue and profit metrics are rising.

7. "Experimentation is on the rise. Many companies are trying out old and new metrics that they have not used previously. Likely the quest is to find even better measures of performance than have been present in the past. The invention of new measures is also increasing. 'Return On Innovation' (not to be confused with ROI), a metric that is less than a decade old, is now being tried by about 20% of companies.

"The saying goes, 'You get what you measure,' If the current trends continue," Goldense predicts, "North American companies will be ever more competitive in the years ahead."

ideas coming in and then as you proceed through these series of screens, which are known as stages and gates, the projects have to pass increasingly difficult muster. Winovation is a five-stage process. Ideation, the raw idea, is the first stage and the last stage is product launch. Maxwell says the biggest surprise of implementing Winovation was that "almost 50% of the R&D projects that we had been working on were killed when they went to the gate review."

As a public company, Parker's pain threshold for product revenue from R&D is relatively short, says Maxwell. "We like to see revenue in a one- to five-year period. Pre-competitive technology that may require as much as 15 years to become revenue is better left to startups." To tap into that technological white space, Maxwell says Parker's route is to collaborate with startups, including making equity investments.

Instead of funding a central research approach to pre-competitive research, Parker's approach is to fund various research projects at technical universities. "A side benefit is that promising student researchers could become Parker Hannifin employees." In addition Maxwell with his group level counterparts map out technology roadmaps that extend 10 years into the future. Their work determines whether a technology needs university research, a startup collaborator or entry into the Winovation process.

For large product development programs Parker Hannifin requires an alpha customer who actually becomes part of the design team, Maxwell adds. Recent alpha design team members range from the military to Bobcat, the construction equipment manufacturer. "It adds a substantial element of market pull in what has conventionally been a market push process."

The validation of Parker Hannifin's R&D strategy was shown last December at its investor meeting where the first products enabled by the strategy were shown to analysts. Deutsche Bank's Nigel Cole made this assessment: "Parker's systematic drive towards accelerating product innovation is yet another example of the process improvements initiated by CEO Don Washkewicz. Product innovation is clearly the lifeblood of great companies, since it blunts competitive pressures, raises internal growth potential and adds an aura of excellence. The problem is that it is notoriously difficult to analyze and assess the effectiveness of what is essentially R&D."

Continues Cole: "In this sense, Parker is trying to kick start an ambitious process that few companies are doing, or we suspect many are incapable of doing; that is, establishing a rigorous, quantifiable system for identifying market gaps and customer needs at the front-end, developing ideas and product that addresses those needs and then judging the success of these initiatives in the back-end."

Winovation plays into Parker Hannifin's 10% per year growth goal, half via acquisition and the other half via organic growth. (The company also has a record 51 consecutive years of dividend increases. In addition the company anticipates that the fiscal year ending in June will be the fifth year of record earnings.)

PLM's Critical Role

As R&D is taken out of back rooms and given a central business focus, the immediate challenge is to efficiently connect R&D with manufacturing and the rest of the enterprise. Solving that challenge is the primary value that product lifecycle management (PLM) tools bring to R&D, says Dan Staresinic, worldwide director, consumer products and life sciences, Siemens PLM Software. "In providing that connectivity, PLM tools enhance a company's ability to capitalize on its R&D potential."

Lack of connectivity brings risk and diminished business performance. "For example, in a consumer packaged goods (CPG) environment brand value is destroyed any time anybody's work in the innovation chain doesn't—or can't—conform to the requirements of the brand," says Staresinic.

"Even simple R&D coordination issues can be disruptive," he continues. "For example, in CPG product development the design of the package must be ready to receive the contents it will house."

"It's the job of R&D to convert requirements—from consumers, government and others—into specifications."

Requirements capture and requirements management functions are performed by Siemens' PLM tools, adds Staresinic. "It's the job of R&D to convert requirements—from consumers, government and others—into specifications." One of the areas where PLM is key to the future of R&D, he says, is its ability to take and manage requirements from a multitude of sources and formats. Requirements data management is integral to the Siemens PLM solution. Staresinic says that in Siemens' CPG market the process mantra is "to speed ideas to the shelf."

He says Siemens' enterprise PLM mission is to provide the capability to align the product lifecycle with the production lifecycle on a single technology platform.

"The future of R&D doesn't just lie in R&D," stresses Staresinic. "It lies in R&D being better connected to everything going on outside R&D. Although manufacturing isn't in R&D, an R&D failure occurs every time a product is developed that cannot scale or meet objectives in the manufacturing process. So the future of R&D can be about many things. Examples include being more efficient about scientific research or going outside the organization and bringing new ideas in a secure way." He says the challenge is how to avoid letting an obsolete IT strategy isolate PLM from the rest of the organization.

The Siemens PLM R&D strategy predates the company's acquisition of PLM solution provider UGS, adds Staresinic; Siemens was already implementing its SIMATIC IT R&D Suite. Intended to aid researchers, including formulators and package designers, the solution suite can assist in such things as turning CPG requirements into the specifications of a finished product. In addition, the tool set facilitates the handoff to manufacturing.

DOW's Methane Challenge

Want to sample what may be coming in tomorrow's energy/petroleum feedstock research? Consider chemical giant Dow Chemical Co.'s Methane Challenge, a current R&D program that could be a preview of the large global research project to come.

Chief technology officer Bill Banholzer says the genesis of the Methane Challenge was unprecedented increases in feedstock costs. Last year Dow, a $53 billion company, spent $25 billion for raw materials.

"In the past," says Banholzer, "the raw materials came from oil or natural gas liquids." As a cost saving alternative, Dow has hopes the Methane Challenge will provide a new foundation for the production of chemicals and liquid fuels. "Our challenge," says Banholzer, "is to find new ways to supply the same or even better products at lower cost."

Dow's approach in organizing the Methane Challenge illustrates that when trying to tackle some of the largest

Metrics Matter

The U.S. path to the R&D of the future is emerging from a slowing economy with total funding for R&D expected to increase just 3.3% from the $355 billion funded in 2007 to the $367 billion expected for 2008. Contributing factors start with the globalization of R&D wealth, says the annual Battelle/R&D Magazine study. Other factors include:

- Restructuring of the major corporate R&D approaches in industry,
- Significant growth of the practice of offshore outsourcing of R&D,
- Shift in federal government priorities as a result of world events, and
- Growth of the federal deficit.

"There is little doubt that there are some basic problems facing the U.S. research environment, not the least of which include consideration of energy, environment and the economy," says Battelle's senior researcher and study co-author Jules Duga. "And to a degree not seen in recent years, the average person on the street is calling for long-term relief from high energy costs, improved (but not intrusive) security and resolution of environmental problems."

The researcher's estimate for global R&D spending is expected to reach $1.2 trillion in 2008, 7.6% higher than 2007. Worldwide spending exceeded $1 trillion in 2006, Duga reports.

China is a noteworthy performer with growth of 24% expected for 2008, to total $216.8 billion. That's about 18% of global spending, up from 14% as recently as two years ago, Duga notes.

In the U.S. study industrial performance of R&D in 2008 is expected to reach $258.7 billion in 2008, an increase of 3.4% over 2007 levels of $250.3 billion. Offshore outsourcing has become a game-changer. The study describes the growing practice as a complex weave of relationships, facilities, practices, opportunities and threats.

Increased funding is expected for the following industries: biological and diagnostics, pharmaceutical preps and chemicals and allied products.

Declining support is anticipated for such industries as motor vehicles and car bodies, electronic measurement and testing instruments, other electronics and agricultural chemicals.

Evolving Corporate R&D Metrics

Top 10 R&D Metrics Used by Industry, 1998

1. R&D spending as a percentage of sales	76%
2. New products completed/released	68%
3. Number of approved projects ongoing	61%
4. Total active products supported	54%
5. Total patents filed/pending/awarded	51%
6. Current-year percentage of sales due to new products released in past x years	48%
7. Percentage of resources/investment dedicated	46%
8. Percentage of increase/decrease in R&D head count	43%
9. Percentage of resources/investment dedicated to sustaining products	39%
10. Average development cost per projects/product	39%

Source: Goldense Group Inc.; based on 1998 product development metrics survey

Top 10 R&D Metrics Used by Industry, 2008

1. R&D spending as a percentage of sales	77%
2. Total patents filed/pending/awarded/rejected	61%
3. Total R&D headcount	59%
4. Current-year percentage sales due to new products released in past x years	56%
5. Number of new products released	53%
6. Number of products/projects in active development	47%
7. Percentage resources/investment dedicated to new product development	41%
8. Number of products in defined/planning/estimation stages	35%
9. Average project ROI – return on investment or average projects payback	31%
10. Percentage increase/decrease in R&D headcount	31%

Source: Goldense Group Inc., based on 2008 product development metrics survey

scientific challenges today, thinking outside the box just isn't enough. Sometimes the magnitude of the challenge requires reaching outside the entire company. Dow tapped into the education gene pool and used crowd-sourcing approaches to help discover potential solutions.

Dow targeted the research facilities at leading universities around the globe, challenging prospective research teams to develop a procedure for converting methane, the natural component of natural gas, into usable feedstocks.

In the end, out of more than 100 proposals, the teams from Cardiff University in the U.K. and Northwestern University in the U.S. developed the winning research proposals. For their efforts, Dow is providing nearly $6.5 million in funding to fulfill the world-changing research objectives.

Banholzer says the Methane Challenge is a component of Dow's Alternate Feedstock Program and is an example of the company's long-term, innovative discovery research. Other parts of the program address more immediate feedstock issues, such as Dow's recently announced sugarcane-to-polyethylene project in Brazil. "In China, we're looking at doing it from coal," adds Banholzer.

In terms of business strategy Mauro Gregorio, Hydrocarbon & Energy Alternate Feedstock global business director, stresses that "the Alternative Feedstock Program is all about innovation and creating possibilities for growth and differentiation. Methane activation holds the promise of bringing an advantaged feedstock position to Dow by reducing capital intensity, allowing growth in multiple geographies and improving Dow's cost position."

The Right Metrics

How will you measure and report progress as you move into the R&D of the future? "The key is for companies to identify those R&D measures that correlate with business results, says Bradford Goldense, founder and CEO of Goldense Group Inc., a technology consulting firm and publisher of a biennial survey of corporate R&D metrics (see sidebar, "Evolving Corporate R&D Metrics"). "Identifying those metrics will truly propel R&D to the next level of competitiveness."

Dow Chemical's Banholzer agrees, but notes a variety of problems associated with the current practice of metric selection: "The historical measurements for R&D are spending (usually expressed as a percentage of sales), or new product introductions (NPI) (sales from products introduced in the last five years), and the number of new patents."

Banholzer says more refinement in the selection process is needed. "Historically, there was an assumption that spending correlated perfectly with innovation, but that is no longer correct—look at Bell Labs." Banholzer stresses that "great science is not enough to assure business success. If the business does not succeed you can't continue to do science.

"Also, R&D budgets don't have to go up to increase capability," he continues, "especially if you're working globally. It's not R&D spending that matters—it's R&D effectiveness." His measure: "New product sales divided by your R&D spend. McKinsey & Co. evaluates the ratio of new product sales over R&D spending. If that ratio is over 7, you're among the top companies in the world. We're around 13. I don't want to spend the most, but I want to make sure my company gets the best return."

Banholzer also identifies flaws in simply documenting new product sales or new product introductions. "If maximizing new product sales is your measure of success, then that leads to product churn—it's easier to tweak products for existing customers and call them 'new' than to invent truly new ones."

If you only want to increase new product sales, he adds, "the best way to accomplish that is to slightly improve your current product for your current customers. But that doesn't ensure that you really grow your business. I once took over R&D for a half billion-dollar business that had 55% new product sales (sales from products introduced in the last five years divided by total sales). Most people equate 30% NPI as world class, so 55% is off the chart, but that business had flat total sales and more important, declining margins for five ears. Obviously, NPI sales do not ensure business success."

"R&D budgets don't have to go up to increase capability."

New-product margins are the best way to measure R&D, says Banholzer. "If we are going to put R&D resources against a new product, we'd better deliver something that expands the company's margin—the shareholders need to see margins going up. That is what they pay for. Increasing earnings is what really matters. There are a lot of new products out there, but many of them make less money than current products. That is not sustainable," he avers.

Patents don't escape Banholzer's scrutiny either. "The last traditional measurement used for R&D is the number of patents. Having a lot of patents does not mean you are necessarily creating a barrier to protect the high margin you worked so hard to create. You can generate a lot of patents, but if they don't protect where you make money, they add little value."

Banholzer looks at the percentage of Dow's sales that are patent-advantaged. "A patent is only valuable if it's applied to products that you are actually selling or are going to sell. My whole definition of R&D success is aligned with 'what's going to be successful for the company?' Justifiable cynicism comes from companies where you see lots of patents, but the earnings aren't going up. Over time this has to change. You had better come up with the next new proprietary thing which creates value that customers will pay for and then protect them with patents." IW