Using Research Metrics Helps Get More Bang for Your R&D Buck

A REVIEW OF SOME PAPERS PRESENTED AT THE ELEVENTH ANNUAL CONFERENCE ON PRODUCT DEVELOPMENT METRICS.

"Technical professionals provide 85% of new product profitability," states consultant Brad Goldense, CEO of the Goldense Group (Needham, MA). Therefore, it is only natural that firms would turn to using metrics to improve their R&D process after applying metrics to other, less complicated business processes. These processes include financial, sales and distribution, and manufacturing to which companies applied metrics in the pre-1970s, 1970s, and 1980s respectively.

Table 1. Most Commonly Used R&D Metrics[a]

Metric	% of Companies Using the Metric
R&D spending as % of sales	68
Total patents filed/pending/awarded	50
Current year % of sales of new products developed last N[b] years	47
Number of new products released	6
% increase/decrease in R&D headcount	3
Number of products/projects in active development	2
% resources/investment devoted to new product developmen	1

[a] Goldense Group "Big Picture: Corporate R&D Metrics Used in Industry – 2002 Survey." This biannual survey has been performed since 1998.
[b] Typically N is 3 or 5

Goldense commented that systematic efforts to develop metrics for R&D began only in the 1990s and continue today. The seven most common predictive metrics used by seventy-six companies are summarized in Table 1. The use of twenty-four other R&D metrics was reported but none were used by as many as 33% of the responding firms.

What separates the best from the rest and why do the top businesses do so exceptionally well?

Goldense observed that the main new metric to rise to general usage in the 1990s was sales due to new products. This metric was invented and popularized by 3M circa 1988 and rose to industry prominence over the next decade. He suggested that one way to measure overall R&D program effectiveness is the equation:

$$\text{ROII} = \frac{\text{(Cumulative N-year Profit from New Products)}}{\text{(Cumulative N-year Expenditure on New Product Development)}}$$

wherein: ROII = return on innovation investment
N = a given number of years after the investment is made

The numerator is sometimes referred to as "profit before tax." By using the net present value for both the numerator and denominator, the time factor can be taken into account. Net present value can be affected by inflation and other increases in the cost of raw materials, salaries, and sale price of the new product.

Consultant Scott Edgett (Product Development Institute, Inc.) offered another key metric, the new product development (NPD) success rate. This is defined as the fraction of NPD projects

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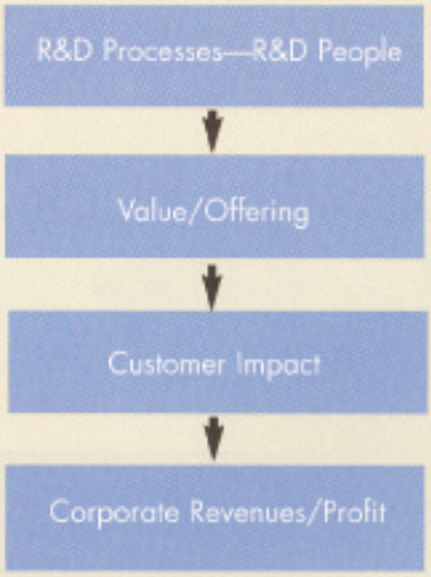

Figure 1. R&D performance metrics must be aligned with strategic objectives of both the parent organization and the customer.

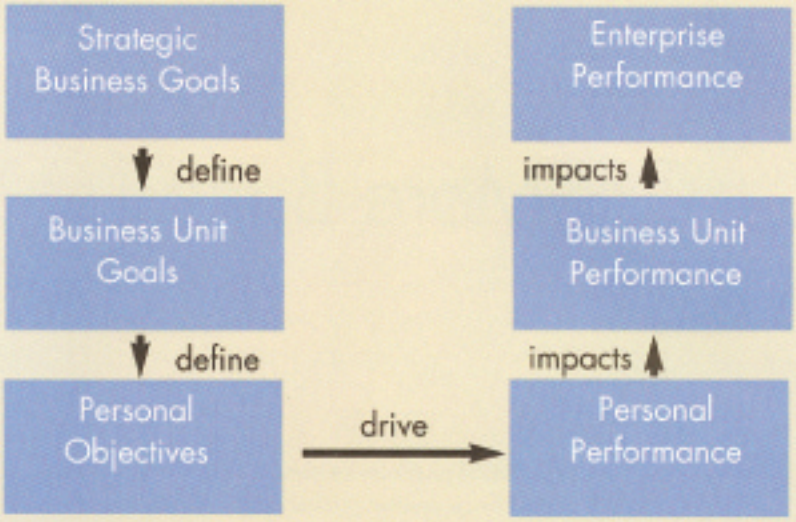

Figure 2. Enterprise strategies and objectives should be communicated to all employees to better align business strategies, tactics, actions, and measures of success.

entering the commercial development stage that become commercial successes that meet or exceed financial objectives. The average for the U.S. industry is 60.2%. But there is a big difference between the top 20% of businesses and the average; the top 20% has an almost 20% higher new product success rate at 79.5% and less than half the failure rate of the average business. These big differences raise the question: what separates the best from the rest and why do the top businesses do so exceptionally well?

One can begin to explore this question by looking at case histories.

CASE HISTORY — ACCESS BUSINESS GROUP

Access Business Group has a 500-person R&D organization with five people working full-time to support the firm's development and utilization of R&D metrics. (Access Business Group is more familiar to many by the name of its largest business unit, Amway.) In 2003, the firm instituted a research metric program under the leadership of Patrice Gausselin, senior research scientist.

She noted that historical measures, such as the percent of total revenue produced by new and improved products less than three years old and staff hour work expenditures, are retrospective metrics providing good indicators of R&D performance outputs (e.g., products and processes). However, they provide little predictive guidance on how to improve R&D effectiveness when designing projects and during the product development process.

To deal with this issue, Gausselin led a team that developed metrics for "real-time" R&D management, particularly of time, personnel, and budget resources. Her goal was to use metrics "to create an aligned, integrated, and performance-driven organization." To do this she held extensive discussions with consultants, utilized expert networks, and studied literature references and various websites.

She determined that R&D performance metrics must:

- Be aligned with strategic objectives of both the parent organization and the customer, in Amway's case, individual consumers. This alignment is depicted in Figure 1.
- The metrics methodology must be communicated to all members of the R&D organization so they have a good understanding of it.
- Connections must be forged between the metrics and the personal objectives of the researchers.

The team used this information to establish external benchmarking to organization leaders in utilizing metrics to improve corporate performance and to review the key deliverables to establish how R&D activity links to strategic objectives and corporate performance. They developed a list of common industry metrics they could use to align R&D activities with corporate performance. These included:

- ratio of R&D spending to total sales (R&D intensity)
- number of new products released and the number of

products in the development pipeline
- sales from new products
- percentage of sales from new products
- percentage of products meeting time and cost commitments
- value of the organization's patent portfolio
- market share of each newly commercialized product
- effectiveness of cost controls

Performance metrics should be measured as value-added contributions at the individual, departmental, business unit, customer, and, ultimately, the enterprise level (e.g., corporate sales and profit margin). The team developed metric variables for R&D and corporate financial performance based upon key R&D activities: conceptual research, business development, and business sustaining activities. They gathered historical data for the following metrics and created x,y scatter plots:

- x variable datasets
  - Total R&D funding
  - R&D funding for developing new and improved products
  - R&D staff hours
  - R&D staff hours spent on developing new and improved products
  - R&D intensity
  - Number of patents
- y variable datasets
  - Total corporate revenue
  - Revenue generated by new and improved products
  - Top market revenue
  - Top new and improved product revenue
  - Percent of revenue generated by new and improved products

In particular, these graphs indicated a strong correlation between the number of new patents and new product sales by the relevant business unit.

The company instituted a comprehensive resource management process and a 3-5 year resource utilization plan that would support Access Business Group's 5-year business plan. Specific actions included adding thirteen researchers and then holding the staff level constant. The number of people in different technology areas was adjusted to better support corpo-

rate goals. The number of staff hours devoted to new product R&D was increased. To support this increase, ideation and planning activities were developed to augment the number of products in the R&D development pipeline.

Enterprise strategies and objectives were communicated to all employees to better align business unit and division strategies, tactics, actions, and measures of success. This alignment is depicted in Figure 2.

CASE HISTORY – CARGILL, INC.

Two case histories from Cargill, Inc. were presented by Business Development Manager Larry Micek. Cargill has 140,000 employees and annual revenues of $70 billion. It is a complex organization with 90 business units. Micek estimates that his business development team commercializes one new product for every 250 R&D project ideas they evaluate.

Micek uses what he calls qualitative metrics to determine Cargill's organizational fit for both successfully undertaking a research project and successfully commercializing a new product. The key qualitative metric to consider when determining organization fit is whether the technology to be developed by the project is disruptive or sustaining. These classifications aid in deciding whether to deploy a project as a separate business entity (disruptive technology) or keep a project within an existing business unit (sustaining technology).

Disruptive technologies offer greater potential for penetrating new markets. However, disruptive technology-based businesses are often killed due to the associated overhead and resistance to change by existing businesses — both those within the company that produces the disruptive technology product and customers whose utilization of the disruptive technology would require major changes in the way they operate. Adoption of a disruptive technology is often facilitated by customers comparing a disruptive technology, not to a current technology, but to having nothing at all to solve their problem.

Cargill's SafeLane™ Polymer Overlay, a new Cargill product, is an example of a disruptive technology. This is a patented polymer overlay treatment for bridges to prevent ice formation in winter weather. Cargill licensed the product from Michigan Technological University. The polymer is based on starch. Micek considers it a disruptive technology because until it was introduced, customers, mainly local and state departments of transportation (DOTs), lacked environmentally acceptable, cost-effective solutions that would prevent bridge pavement from icing. The primary alternative is spraying brine or salt on bridge surfaces. Particularly in southern states, DOTs will compare using the product to using nothing at all, which is what many do now. The product opens up a new market in southern states without any anti-icing capability.

Because these customers are not served by existing Cargill businesses, SafeLane Polymer Overlay was introduced through Cargill's Emerging Business Accelerator, a unit that concentrates on businesses that do not have a "natural home" within existing Cargill business units.

Micek provided a list of product benefits to customers. These include: decreased accidents, increased vehicle traction, prolonged bridge life, reduced pavement maintenance, reduced usage of bridge maintenance chemicals, and reduced environmental impact compared to spraying of salt or brine.

SafeLane Polymer Overlay customers can quantify these benefits and use them as project metrics to measure success in using the product.

Micek went on to discuss a product, C*Film™ Film paper coating solutions process, as an example of sustaining technology. It utilizes Cargill's current competitive advantage in starch technology and provides improved performance compared to current paper coating technology — performance customers are willing to pay for. Customers can use current coating equipment when using the product. The product was commercialized through existing Cargill's Industrial Starch business unit by personnel familiar with the value drivers for coatings customers. In selling a new product to a customer and evaluating its benefits, Micek noted that the process begins with providing customers with a list of product/process benefits and applying these benefits to the customer's needs. Then the customer and the supplier need to agree on project goals and metrics to use in measuring achievement of these goals. Achievement of target metrics becomes the standard for evaluating project success.

WRAP-UP

Three general themes emerged from these and other papers presented at the conference. First, simple metrics are useful even if they don't measure all of the project activities. Second, one should be careful of having too many metrics and turning metrics into an overly bureaucratic exercise. Finally, timely updates of metrics are essential if the metrics are to drive project planning and progress.

The Eleventh Annual Conference on Product Development Metrics was held November 6–8, 2006 in Chicago, IL. The conference sponsor, Management Roundtable, is a knowledge and networking resource for individuals involved in new product and product technology development.

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