THE R&D DAILY PM

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Do You Know Your Research Quotient For R&D Spending?

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How does your company determine how much to spend each year on R&D? Likely, a group of senior executives get together and offer their thoughts on what the figure should be for the next year. After a back and forth discussion focusing on the right amount for R&D, other corporate financial considerations are then put on the table that compete for monies that might go to R&D.

Now, with everything on table, the group decides what it will spend for R&D. So, one question is answered. What will we spend next year? But, the more important question is not answered. What is the right amount to spend on R&D? Each year management answers the "how much" question, but for decades management has never known if it is the "right amount" to spend.

Numerous R&D Spending Gauges Exist

Competitive Alignment: Some of the figures that are put on the table every year are the amounts that key competitors are spending; and there is always a range of spending across those key competitors. Discussions about the range often

include comments such as "Competitor A is inefficient so they are not a good comparison." Or, "Competitor B is playing catch-up so they are spending too much." Or, "Competitor C is riding their brand value and has been cheating spending for years."

At the time these comments are made, they are mostly conjecture as it is impossible to know if they are accurate until years later. Regardless, it is always good practice to know what competitors are spending. But, those figures do not answer the question about what your company should spend.

Desired Vitality Index: Since 3M created the Vitality index in 1988 to measure 3M's ability to produce new revenues from investments in R&D, the Vitality Index has steadily been adopted by corporations around the world. Today, this metric is the number one performance metric for R&D in most companies. Also known as "new product sales as a percent of total sales," this metric is effective at getting at one of the tangible outputs of investments in R&D—new revenues. However, vitality is not perfect indicator as it does not address the profitability of new products, the capital investments that were required, and a host of other operational and financial considerations. If revenues were all that counted—assuming a consistently performing R&D organization—executives could simply modulate R&D spending to produce their desired Vitality Index each year.

Baseline Spending: If it is not broken, don't fix it. This mindset leads executives to always start the discussion about the next year with percentages from the prior years. If Wall Street rewarded the company in the past year, or was at least neutral because annual corporate performance is not just about R&D, then nothing was broken and keeping the same figure for the next year can't be penalized.

In fact, it might even be risky to change it as it gives analysts something else to inquire about. Other considerations then enter. Are we doing any big stretch projects? Do we need to replace a platform we currently sell? Are we discontinuing products or product lines that consumed large amounts of prior year spending? Depending on the answers to these questions, management might then modulate R&D spending for the next year up or down. With the baseline approach, if analysts or anyone else inquires about the changed amount, the answer is strongly declarative and the specific reasons are easily communicated. Again though, the question about what will be spent remains different from the question about the right amount to spend.

Zero-Base Budgeting: Some companies start with a clean sheet of paper each year. Every investment and project in development, approved projects not yet started, and new proposed projects must be re-justified from scratch each year. When the justification process is completed, the R&D budget is determined. However, many companies that try this approach subsequently move away from it, as they find that projects in development slow down when the team members aren't sure of management's commitment to the project. It is probably good to periodically put everything on the table, but as an annual process it has many drawbacks. The biggest drawback is that it is almost exclusively based on projects that have been proposed and is far removed from "what should be."

Patent Growth: Patent inventory and growth rates are prime inputs to many of today's global innovation rankings. Many companies also peg their R&D spending to produce their desired patent output. In some industries, this is the name of

the game. For other industries, it does not apply. Where it does apply, it is still fraught with imperfection. Consciously, some competitors don't play the patent game. They may have some patent output, but they primarily rely on 'trade secrets.' Other competitors prefer to fast follow the patent generators by licensing the technology or capability. They focus on creating products with more total value versus spending R&D monies on the patents themselves. There are so many business models around the registration of intellectual property that it makes it hard to use as a gauge for R&D spending. The reason patents are core elements of so many global ranking methodologies is that patents are published and the data is equally available to all.

Total Factor Productivity: For around five decades economists and academic professionals have been using Total Factor Productivity (TFP) as a way to compare the outputs of a country, or regional block of countries, against other countries or regions. TFP is derived from the production function equation that is based on a weighting of labor and capital inputs, which is then contrasted to the output. Entities that have a larger amount of output for any comparative amount of input are considered more productive. This "excess" amount is often referred to as "innovativeness" or the "degree of innovativeness." Some companies have used TFP to examine their own company in contrast to their competitors, and it is valid. An issue arises though when trying to tie TFP excesses to R&D, it is simply not the case. A TFP surplus, or excess, emanates from tens of factors within a corporation including R&D. An accepted method for isolating the TFP that accrues from R&D, so as to use it in determining R&D spending, has not existed. While some corporations use TFP for comparative analysis, it is not generally employed in discussions regarding R&D spending.

The TFP-Based Research Quotient

Every company seeks to maximize its return from monies it spends on R&D. The only difference is the timeframe considered for maximization of the return. For example, basic materials companies spend knowing the maximum return will not be until years later. Most companies spend with the expectation that their return will occur within three to five years. Regardless, every corporate business model seeks to maximize its return on investment.

The methods for estimating R&D spending are mostly "hope and pray" in nature. Spending amounts are determined using a variety of semi-scientific methods, described in the preceding sections, and best efforts are then made to maximize the return in subsequent years. So much time passes between the spend activity and the realization of results, that it has been impractical to put in the work to get at the optimal spending amount. As technology changes so fast, most managers would argue that an analysis this year of spend that occurred five years ago has no bearing on what should be spent today. In addition, there has never been a mathematical model that isolates results from R&D that could be deployed across the length of time that occurs between spending and results. That is until now.

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Around ten years ago, a former employee of the highly inventive Hughes Aircraft Corporation became incensed when Hughes was acquired by General Motors and immediately put return on investment criteria on near every dollar Hughes spent. Many of the things Hughes invested in wouldn't see the light of day for a decade, yet the criteria had to be met.

After leaving the company and becoming a member of the faculty at The Wharton School at the University of Pennsylvania, and subsequently at Washington University in St. Louis, Anne Marie Knott, PhD began working on an equation that would effectively tie R&D spending and results together. With the help of two National Science Foundation grants, and permitted access to the Compustat database to test her hypotheses, Knott mathematically ironed-out the ambiguity of the TFP equation so as to be able to isolate the excess TFP that was specifically due to R&D. In 2012, Harvard Business Review published the "Trillion-Dollar R&D Fix," an article which highlighted the key findings of Knott's research.

Slow Adoption

In the five years that have passed since this seemingly breakthrough finding, industry has been slow to react. A surprisingly small number of companies have seriously considered the new approach to determining spending, and even fewer have adopted it. When Knott published her book on research quotient (RQ) in 2017, "How Innovation Really Works", a few more companies became interested, but it could hardly be described as a wave.

Are executives really content to continue with the semi-scientific methods that do not tie cause and effect together? There may be several other things going on, such as executives might become more accountable if RQ becomes widespread.

Knott's findings indicate that most companies are overspending relative to their input. Due to that, those lower down in the organization who are aware of RQ might not want to raise it up to the CXO-level because it might result in budget-cutting actions. It could also just be that new innovations are also often slow to be adopted.

Whatever the reason, RQ hasn't caught on. The good news is that it likely gives early adopters a competitive advantage as they gain familiarity with this new approach to the management science of investing in R&D, as compared to the rest of the pack.

Knott's book documents her thought process to modify the basic TFP equation to isolate R&D in a manner that all can understand. In short, to isolate the excess output that comes directly from R&D, additional variables were introduced: R&D cash expenditures, R&D labor costs, product margins (which infer gross profit), technology transfer rates, and advertising investments.

All of the variables except the transfer rates and advertising are required reporting under GAAP (Generally Accepted Accounting Principles) by public companies and the data has resided in the Compustat database since it began in 1962. As such, every company can be compared on an equal footing. Assumptions for technology transfer rates were designed to be comparative and consistent. Advertising is the only outlier. Many companies do report advertising in their footnotes to financial statements, but it is not consistent. Knott's assumption was that advertising (versus marketing) directly contributes to the sales and therefore the return on products and belongs in the investment part of the equation.

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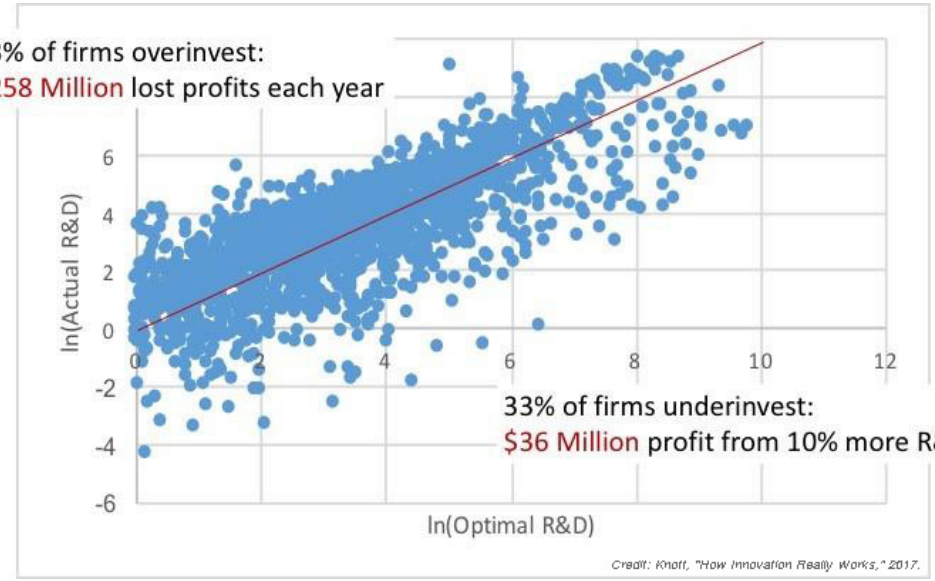
The Benefits Of Knowing Your RQ

The RQ equation offers a never before available mathematically-based alternative to consider when setting R&D budgets. Lastly, each RQ calculation incorporates spending and results over an eight-year period. Eight years is a realistic time period, beginning with spending and then capping the results, for most companies.

There are a number of head-turning findings that resulted from Knott's application of the RQ equation to a statistically valid sample of companies in the Compustat database for the period 1965 to 2011.

First, R&D productivity has declined 65 percent over three decades and continues to decline at an average of about 1.4 percent per year. This finding was correlated with the decline in GDP growth over the same period and is statistically valid.

Second, 63 percent of companies are currently overspending and 33 percent of companies are underspending. This means only 4 percent of companies, using the methods available to them today, have made decisions that puts them in the zone of "right spending."



Third, the RQ average result for each individual industry falls within a narrow range across all industries. Like the correlation to GDP, this is highly validating for the model as a whole.

Fourth, best practice companies in each industry have an RQ score that is four times higher than the average for that industry. That finding is also consistent within a narrow range across all industries.

Fifth, RQ provides an industry-specific benchmark for any company competing in the industry starting in 1965 and continuing into the future. While the validation of RQ capped at 2011, corporate financial results continue to propagate the Compustat database each year and that will continue.

Sixth, RQ cannot be gamed. Every company reports using GAAP. If your RQ score is good, it means your company's R&D productivity is good and is accurate versus your competitors.

Existing approaches to determine annual R&D budgets are based on semi-scientific methods that have never enabled companies to determine if they actually spent the right amount. Existing approaches have no fullcircle feedback nor data to enable executives to become better R&D investors. RQ offers a new alternative to consider, along with existing alternatives, when it is time to set the R&D budget each year. While RQ has its imperfections, overall it is a beneficial tool.

RQ is the beginning of a new management science for R&D—the science of R&D spending. Companies that adopt early will have a leg up on all other companies as this new management science progresses and matures. If you're not convinced yet to check it out, Knott also found that RQ is the single most significant predictor of monthly stock returns over the past 47 years when compared to the current set of measures that companies must to report to Wall Street. Do you really want to wait?

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