

CREATING A WINNING R&D CULTURE — I

A new approach to selecting, training and coaching people helped to improve the effectiveness of new business development at Dow Chemical's Polyolefins & Elastomers Business.

Greg A. Stevens and Kurt Swogger

OVERVIEW: *Dow Chemical's Polyolefins and Elastomers (PO&E) business was doing so poorly in 1991 that it was being considered for divestiture. This first of two articles describes how a five-step approach rejuvenated the business through the selection, training and coaching of people to identify profitable new business concepts. This is now part of a philosophy called Speed, which created over \$23 billion in value between 1992 and 2008 for PO&E. The steps for this part of Speed are: 1) measuring and increasing the Creativity Index of the R&D leadership culture, which is genetic to a surprising degree; 2) Increasing the fit of leaders in specific jobs (Starters and Finishers); 3) Identifying, training and coaching creative Rainmakers as Business Opportunity Analysts, who routinely "morph" starting ideas into winners using a non-linear New Business Development (NBD) process; 4) Ensuring enough Finishers are present in the working groups to complete the projects;*

Greg Stevens is president of WinOvationsSM, Inc., Mt. Pleasant, Michigan, founded in 1995 and helping corporations in the early stages of new business development (NBD). Prior to this he worked in The Dow Chemical Company, where he helped launch Insite[®] metallocene polyolefin catalyst technology, and was innovations manager in Corporate Ventures. He received his M.B.A. from Central Michigan University, and B.A. in chemistry and biology from Albion College. He has spoken and published widely on NBD.

gstevens@winovations.com.

Kurt Swogger is a senior consultant with the Cincinnati Consulting Consortium. He retired in 2007 from The Dow Chemical Company as vice president of new business development for Performance Plastics and Chemicals after a 35-year career in a wide range of businesses with roles in manufacturing, research, business, and administration. He is best known for his 15-year role as the R&D leader for Dow's plastics businesses. Swogger graduated from Case Western Reserve University and is a registered Professional Engineer in Texas.

kkswogger@yahoo.com

5) Making sure management implements the positive findings. The five steps also present five new forward-looking R&D metrics that provide a clear and actionable game plan to create a winning R&D culture with 84%–95% success rates vs. the 11% rates that are typical after completing the early stages of NBD.

KEY CONCEPTS: *corporate culture, genetic creativity, new business development, radical innovation, Rainmaker Index.*

If we get the right people in the right job, we've won the game.—Jack Welch (1).

Many studies have shown that in spite of the innumerable changes in New Business Development (NBD) thinking in the last 50 years, and in spite of all of the NBD stage-gate processes that have been put in place, the overall odds of success at the commercial launch stage have remained essentially unchanged (2–4). Only 1 in 125 small projects (typically involving one to three person-years of effort) or issued patents succeeds commercially. When a project reaches the stage of major development, including pilot plants and large R&D and commercialization teams, or advanced venture capital investments of time and money, the odds of success typically remain no greater than 1 in 4. Only 60% of new product launches succeed (4).

Even as the use of stage-gate NBD processes within major corporations has grown to now exceed 75%, the average percentage of products new to the company in the preceding five years has declined from 32% to 28% in the last ten years (5,6). At the very least, traditional linear stage-gate NBD processes are not working well enough. Could the "cure" (standard linear stage-gate NBD processes) be even worse than the disease?

Dow Polyolefins and Elastomers in 1991

In 1991 and before, The Dow Chemical Company's overall odds of success for new product development were only 47% from launch vs. the norm of 60%, where success is defined as yielding economic profit. This was also true for the then-Polyethylene Business, which at the

time was being considered for merger or sale. Profitability was declining, not only because the business was in the trough of the supply-demand cycle, but more ominously because competitors had caught up. There had been no major new polymer developments in over five years. Consultants hired at the time advised top management to sell the business. Even top researchers and R&D management at the time said “patents don’t matter,” and many PO&E business leaders at the time said the business was nothing more than “three yards and a cloud of dust,” implying a low profitability game going forward.

This was the situation that one of the authors, Kurt Swogger, inherited in 1991 when he became the R&D director for the Polyethylene Business. In short, it was *innovate or die*. The time from first invention to *first* sales was typically 7–15 years in Dow. Any new initiatives to save the business had to achieve *significant* sales in less than nine years. The target was set to achieve one billion pounds of new polyolefin product sales in the year 2000, which would be 11 years from the first invention and nine years from the decision to do something, easily more than twice as fast as in the past. (What was actually achieved was 998 million pounds sold in the year 2000.)

The approaches that evolved in the Polyethylene Business (later renamed as the Polyolefins and Elasto-

mers Business, PO&E) were: 1) a technology approach called Insite[®] Technology, which took advantage of inventions in catalysis, process and materials science, and 2) a development philosophy called Speed Based Development, or Speed, that allowed for very rapid product development cycle times (7–9). A key part of Speed involves selecting the right personality types for specific job roles. The thinking behind personnel selection grew out of the authors’ earlier experiences with trying to intuitively match varying personality types with job roles, resulting in both successes as well as some puzzling failures. This raised our interest in understanding more about the genetic nature of personality, a concept just emerging from academia in the early 1990s (7).

Research from the University of Minnesota showed that at least 50% and more likely 80% of a person’s core adult personality is determined by genetics (10). This is true for personality traits measured by virtually all valid psychometric profiling instruments including the Myers-Briggs Type Indicator[®] or MBTI[®] (11). Extroversion and introversion, as well as creativity and innovativeness, are examples of personality traits determined to a large extent by genetics (see “Genetic Nature of Creativity,” below).

In the early 1990s, Dow’s PO&E management was also influenced by the work conducted over an earlier ten-

Genetic Nature of Creativity

Understanding the true genetic nature of creativity has been difficult. Most early studies sought to find familial correlations with creativity, but these were weak at best. Therefore, to this day most people still do not believe that creativity is genetic. Studies now show that creativity is an *emergen* trait involving multiple genes, and although genetic, does not run in families. Creativity emerges only when the right components (genes) are combined in a certain way. When any one gene is absent from the required gene constellation, the configuration is lost and the emergent trait does not appear. In an emergent configuration, every gene is like a keystone element. As genes split in meiosis (leading to sperm or eggs with half the genetic information of each parent) the unique full genetic configurations from neither of the parents’ cells is preserved. This explains why emergent traits do not run in families, even though they are still genetic (12). The only way to clearly distinguish the effects of nature from nurture with emergent traits was from the studies of twins raised apart.

Extensive studies of twins raised apart, carried out over more than 25 years in multiple universities, now indicate that creativity is a personality trait after all, every bit as genetic as extroversion or introversion (13,14). The MBTI[®]-based Creativity Index is one of many excellent and simple ways to measure creativity (15). Approximately 80% of what is measured by the MBTI instrument

is genetic in nature, with two of the four measured scales entirely emergent and one partly emergent (16). A meta-analysis study summarizes the strong genetic nature of personalities (including creativity) across 83 individual studies involving over 13,000 individuals (17).

In spite of the evidence, all the creativity gurus (starting with Osborne in 1948 and continuing today with DeBono *et al.*) still espouse that anyone can be creative if they just release “their inner child.” They regard the genetic nature of creativity as a “myth” (18–21). We suspect that because creativity gurus are highly creative individuals themselves, they feel creativity should come easily to everyone.

In contrast to the belief that creativity can be learned, the most carefully controlled studies show that creativity is largely genetic. We have acted on that basis, with highly profitable results. In more recent years, the general approach of matching genetically based personality strengths to job roles has also become more popular. Matching personalities to job roles is the main theme of several recent best sellers (22–24).

The highly successful Stryker Corporation uses these basic principles to match specific personality types to virtually all job roles in the company, and has consistently achieved over 20% income growth per annum since the late 1970s (25). Companies can no longer afford to ignore these realities. To do so risks their very survival.—
G.S. and K.S.

Creativity and innovativeness are determined to a large extent by genetics.

year period in a different part of Dow by one of the authors (Stevens), which found that certain types of creative personalities involved in the early stages of NBD were able to identify projects that out-earned others. These creative types were referred to by the authors as *Rainmakers* or *Starters*. The individuals in the top third of a *Rainmaker Index*SM identified NBD projects that later went on to out-earn those identified by individuals in the bottom third of the *Index* by a factor of 95 times—a 9,500% improvement (8). *Rainmakers* are excellent at *starting* new product initiatives, while those who were of a more practical mindset were far better at *finishing* projects and getting them to the customer.

These findings were reported by Stevens in the early 1990s to PO&E R&D top management. Later, these results would become a key part of the thinking of many executives within the PO&E group. Starting around 1992, the PO&E R&D leadership actively sought to raise the creativity of the overall R&D leadership culture by bringing in many more *inherently creative* individuals, or mavericks, often from other parts of Dow. They also used reorganizations and downturns in the business as opportunities to move out many of the less creative leaders.

Initially, top PO&E R&D management identified new *creative* leaders through excellent people-watching skills, interviews with the candidates and others who knew them, as well as trial and error in matching peoples' aptitude to the job role. If it appeared that they had the wrong personality for a job, they would make a correction within just 3–6 months. In 2002, PO&E R&D leadership learned how to fit the right personalities with the right job roles even faster by augmenting the earlier methods with personality measuring tools (like the MBTI instrument) (8,9).

Five Steps to More Effective NBD

These results helped to create the approach used by PO&E R&D to transform its culture. The five-step people selection part of Speed that emerged from this journey is diagrammed schematically in Figure 1. This is the process that PO&E followed on an intuitive and qualitative basis initially. In 2002, after the authors compared their thinking, PO&E began using a more scientific and rigorous approach both for measuring personalities, and training and coaching its Business Opportunity Analysts (BOAs). A retrospective study using Stevens' techniques *quantified* what had been done *qualitatively* before (with the same underlying concept) and suggested even quicker ways to achieve the same or better results (8,9). Continuing study and research helped refine the approach and will be reported in the second article of this series.

1. Raise leadership group's creativity

The first question involves whether or not R&D leadership is innovative enough. PO&E R&D management

identified two main personality types: *Starters*, later characterized via the MBTI instrument as NTPs (people with MBTI-based preferences for intuition, thinking and perceiving), and *Finishers* characterized as STJs (people with sensory, thinking and judging preferences).

The *Starter* personality types are creative, intuitive, visionary, and curious. They continually challenge the status-quo, and tend to be difficult to manage as well as difficult to follow when in leadership roles. They also tend to be unfocused, bubbling over with ideas. They tend to dislike details, agendas, may be viewed as impractical, and are often procrastinators. They typically score above 122 on the MBTI-based Starter Index, and often have NTP (intuitive, thinking, perceiving) preferences on the MBTI instrument. These people, when properly directed, can open up new markets and create new breakthrough processes. There is a very high correlation between the MBTI-based Creativity Index, and the Starter Index.

In contrast, the *Finisher* personality types are far more pragmatic, better focused, more respectful of authority, and more task-oriented. They like details, agendas, and are far steadier, consistent workers. They typically have scores below 122 on the Starter Index, and often have STJ (sensory, thinking, judging) preferences on the MBTI instrument. They are the people who get the job done. They capture the cash as they exploit the developed opportunity. Both *Starters* and *Finishers* are clearly needed in NBD groups.

Because individual personality is determined to a large extent by genetics, we believe it must follow that organizational cultures are also determined to a large extent by genetics, when organizational culture is defined as the collective mindset of the leadership in that organization.

In the case of PO&E R&D, we measured the personalities of all the top leaders in both managerial and technical positions (at a group leader level and up) with the MBTI instrument to determine the overall organizational culture. In 1991, we found that the PO&E's R&D leadership culture was well below the national norm for creativity (Figure 2). In short, it lacked the will to innovate.

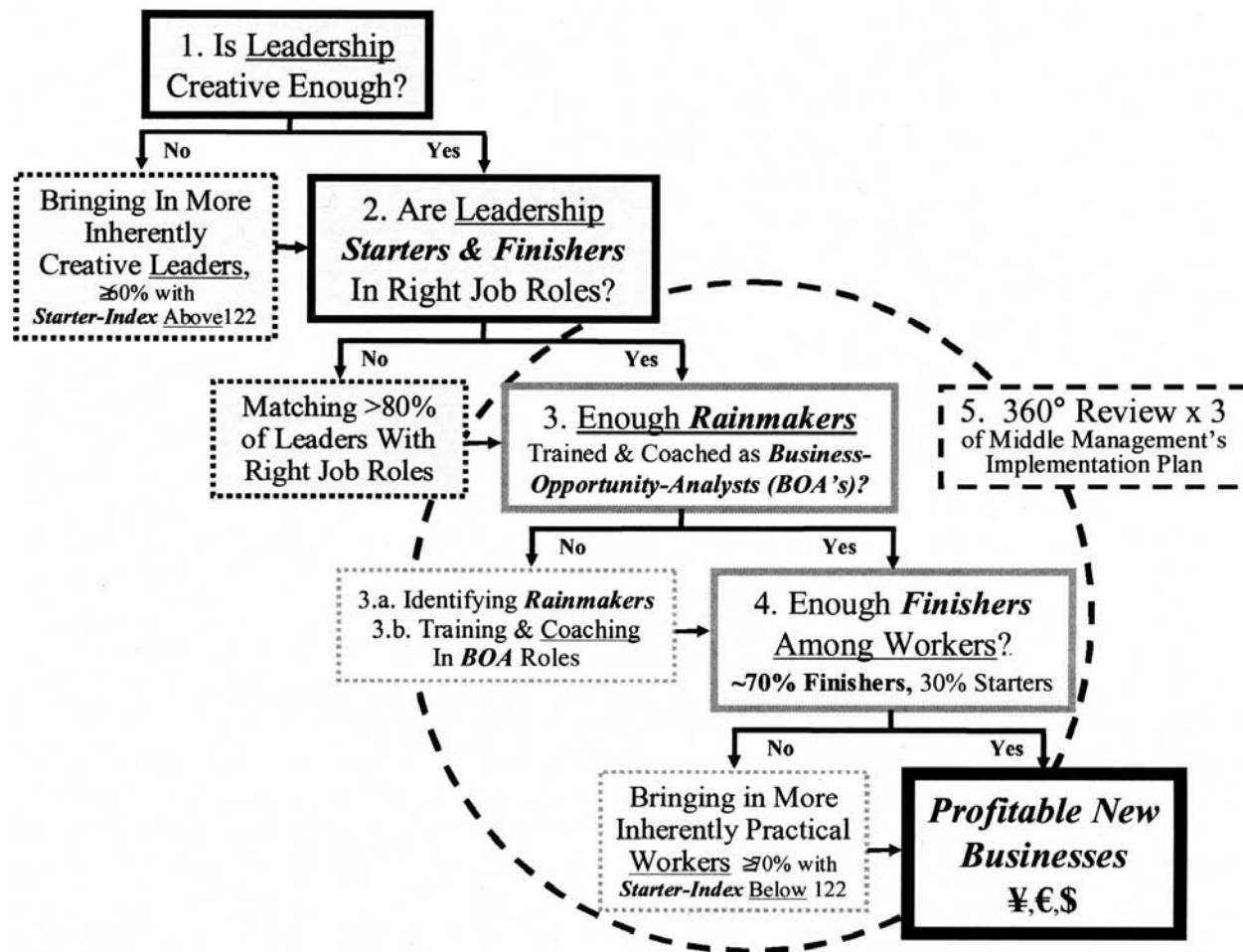


Figure 1.—Each step in this five-step model for increasing R&D group effectiveness contains new forward-looking performance metrics that are highly indicative of future NBD profitability, as demonstrated by a 15-year longitudinal study of actual profits delivered.

Recognizing this, management consciously decided to raise the level of creativity by bringing in more *Starter* types. Between 1991 and 2001, the group averages for both the Creativity Index and Starter Index were significantly increased within PO&E leadership. This is the only instance the authors are aware of in which an organizational culture has been made more creative this quickly in a measurable and lasting manner. The results are shown in Figure 2.

In contrast, traditional creativity-boosting approaches attempt to raise everyone's creativity through group exercises and workshops (without bringing in more inherently creative people). The traditional approach has been in vogue for over 75 years (18–20). Therefore, one would think there should be many studies showing how this approach leads to lasting and measurable increases of a group's creativity. However we have found no such studies—zero.

It is worth noting that while R&D leadership charged with creating new products needs to have approximately 60% *Starter* personality types, the business leadership overall needs far fewer *Starters*, and more *Finishers* (up to 70%) to make sure the job gets done. Unfortunately, we believe the typical business leadership in too many mature companies has fewer than 5% *Starters*. This may explain the lack of innovation in so many mature firms.

2. Match leadership personalities to job roles

People tend to perform best and gain the greatest job satisfaction in roles that enable them to use their natural gifts. Therefore, understanding the genetic nature of personality meant it was also critical to match the personalities of the leaders with appropriate job roles. Otherwise productivity suffers dramatically.

Starter personality types are best suited to job roles involving innovating and developing, requiring them to

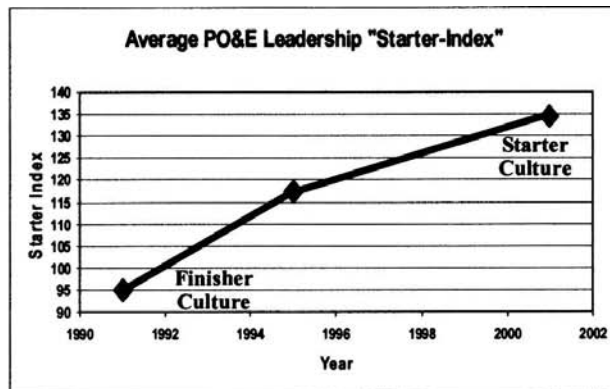
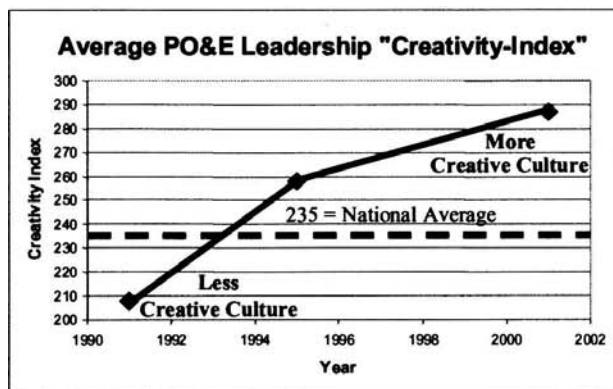


Figure 2.—The organizational culture of the Polyolefins and Elastomers Business (PO&E) was made more creative in three to four years (between 1992–1993 and 1995), and much more so in eight to nine years (9,26).

operate in an area of ambiguity. These job roles include determining what new types of polymers are needed to meet customers' needs, and then creating them.

Finisher personality types are best suited to growing and enhancing job roles that usually rely on using well established procedures to solve problems. These jobs include commercializing existing products, keeping plants running well, and implementing procedures. Both continuous improvement and incremental advances are hallmarks of *Finisher* job roles.

When *Finishers* are asked to innovate, they typically fail to innovate and are miserable as well. Likewise, when *Starters* are asked to implement established procedures, at best they typically perform at a lackluster level. It is important to emphasize that there are no right or wrong personality types. All are needed, but in the right roles and in the right balance.

Starting in 1991, the match-up between the two main personality types and their proper job roles was low in PO&E leadership, (approximately 29%). By 1995 the match-up was consciously raised to 76% as judged by management's intuition and 79% as later judged by the Starter Index (Figure 3). If someone was put into a role requiring them to innovate or develop a concept, but was not performing well, they were quickly moved into a job role more appropriate for *Finisher* personality types, and vice versa (9,26). Figures 3 and 4 show that the use of psychometric instruments (like the MBTI) is especially needed to quickly improve fit when there are reorganizations or changes within larger groups, as happened in 2000. In 2000, Dow Chemical made a large acquisition (Union Carbide Corporation), and several other plastics groups were added to PO&E, dropping the job match ratio. This later improved over time but it did take time.

3. Train and coach Rainmakers as BOAs

Great care must also be taken to help the organization identify opportunities to focus on with the greatest potential for financial returns. *This is the Achilles heel of most NBD groups.*

The PO&E R&D and business groups identified commercially significant opportunities in two principal ways. The first approach, Business Opportunity Analysis, was used particularly between 1991 and 1995, and to a lesser degree thereafter, to probe NBD concepts. (During the following years conventional marketing and sometimes research were used to fill this function, with less success). The individuals performing the BOA function, the Business Opportunity Analysts, tend to have technical backgrounds and at least 5–10 years of experience in the company. In PO&E, BOAs were most often located in the commercial departments. Their jobs included the following steps:

- *Making sure the new product concepts fit within the business.* This was done through a careful process of determining top management's "Gut Level Screen," ensuring that the opportunities presented to them by the BOAs would truly excite top management from a standpoint of potential size and profitability, timing, geography, technology, and markets.
- *Preparing draft propositions (or hypotheses) to test with potential customers and global experts, related to customer need, cost-performance vs. the competition, value to the customer and to Dow, and sustainable competitive advantage.*
- *Visiting customers or other global experts at their locations and plants, testing the draft propositions, determining the customers' true functional requirements (which they often can not articulate themselves), and analyzing the results.*

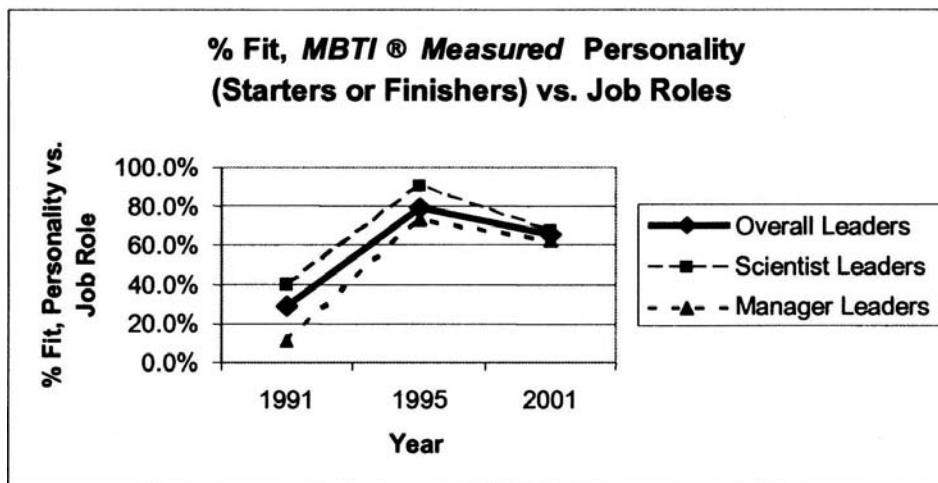
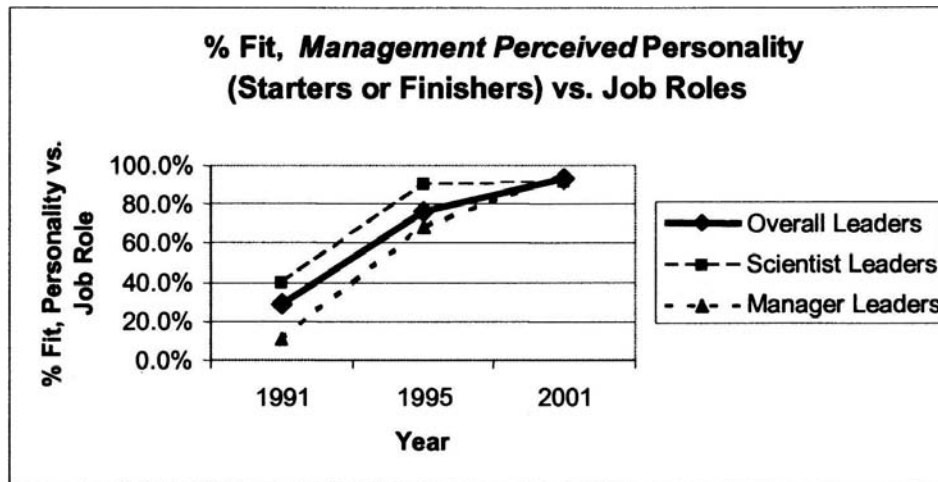


Figure 3.—The match between leadership personalities (either Starters or Finishers) and their job roles was increased substantially between 1991 and 2001 in PO&E R&D. Use of psychometrics (like the MBTI® instrument) is especially needed for improving fit within larger groups as in 2001. (In 2000 there was a large acquisition.)

■ *Building system cost-performance models* of the way customers use products or services (including labor, capital and raw materials), both today and tomorrow—the next generation already on the drawing board. These results then need to be compared with potential new offerings based on both performance and cost.

■ *Morphing the concept* until a winning concept for commercialization is identified, then reporting to top management, while typically staying within the zone of top management’s Gut Level Screen.

When the initial new product ideas are analyzed critically, the shape of the success curve dictates that very few starting point ideas will be commercial (4). Usually, the BOA ends up shelving the initial idea. Perhaps the proposed un-met customer need no longer exists, or the potential new offering is not competitive in overall cost-

performance, or your firm cannot create the means for a sustainable competitive advantage. In short, BOAs are likely to discover why the starting point idea should be shelved (or even killed.) This is a major problem with linear stage-gate NBD processes: statistically they turn into “killing machines.”

We have found that successful BOAs and marketing people, like R&D leadership, need a creative mindset which enables them to morph a starting-point idea (statistically doomed to fail) into a winner. Earlier research by one of the authors (Stevens) has shown that certain *Rainmaker* personality types out-perform others in the BOA role. A *Rainmaker* is closely correlated with the PO&E working definition of a *Starter*.

As with BOAs in the bottom third of the Rainmaker Index, those in the top third of the index also end up

Certain Rainmaker personality types out-perform others in Business Opportunity Analysis.

shelving the vast majority of starting-point ideas. However, in the same process the top third of the BOAs also uncover the real customer's unmet needs (often unspoken) along with the value of meeting those needs. In short, they *morph* the starting-point idea. After a second turn of analysis, the morphed ideas were remarkably positive. In fact, over 95% of the morphed ideas made money after commercialization vs. the normal 11% odds of success from the end of the early stages of the NBD process (8). The 95% success rates were made possible in part because there was virtually no technical uncertainty among these particular BOAs. Clearly, the success rates cannot be higher than the degree of technical uncertainty. The BOA approach essentially removes the *market* uncertainty while also focusing R&D on opportunities that will be highly profitable if technically successful.

Note that the Rainmaker Index is highly correlated with the MBTI-based Creativity Index, meaning that *Rainmakers* are indeed highly creative in a technical sense (8). Their creativity is needed because starting-point ideas are rarely commercial. In short, "It's *the People*—not *the Process* that matters most (7)."

It was critically important that the staged NBD process the BOAs used was among the best such approaches then available (27,28). Even so, the original consultant's approach was significantly modified (and sometimes ignored) internally by Dow to allow starting ideas to morph by making the process far more non-linear than Dow's consultants originally taught. The projects that were initially coached by the consultants in a strictly linear fashion achieved positive outcomes only 11% of the time vs. 49% after a few of the more creative BOAs independently learned to morph their starting-point concepts. By even more routinely morphing starting-point ideas, we now achieve over 80% positive outcomes from the individuals coached.

It is doubtful whether the same results would have been obtained with a similar group of BOAs working a run-of-the-mill linear stage-gate NBD process, because there has been no correlation found between corporate success and the use of such linear structured NBD systems. Traditional linear stage-gate systems seem to work only for incremental improvements and process improvements, not for breakthrough innovations (29). Even Robert Cooper noted that after 25 years of research in NBD stage-gate processes, "... there is little evidence that success rates or research and development productivity have increased much," and "... just having a new product process has absolutely no impact on performance" (30).

To drive the point home, had BOAs been forced to use a linear stage-gate process at Dow (emphasizing "go-kill" decisions at the review gates, instead of being allowed to morph starting-point ideas into winners), then there would have been far less benefit from the NBD process in its entirety, and most likely no benefit whatsoever. If this had been the case, then of course there would have been little or no difference found between the personality types involved and their effectiveness at identifying

Year	PO&E R&D Leadership Group	# of Leaders in PO&E R&D	% Starters ≥122 Starter-Index	Avg. Starter-Index MBTI-Based	Avg. Creativity-Index MBTI-Based	Avg. Rainmaker-Index MBTI-Based	Overall Culture MBTI-Based	Avg. Job Level "Hay Points"	Avg. Years Professional Service
1991	Combined	14	21.4	95.0	207.7	10.1	STJ	356	19.9
	Scientific Leaders	5	20.0	79.6	172.6	-6.4	ESTJ	329	20.2
	Managerial Leaders	9	22.2	103.6	227.2	19.3	ISTJ	371	19.8
1995	Combined	29	44.8	117.2	258.1	29.4	NTJ	355	21.0
	Scientific Leaders	10	50.0	117.3	246.9	25.2	STJ	347	23.2
	Managerial Leaders	19	42.1	117.2	264.0	31.7	INTJ	359	19.8
2001	Combined	86	57.0	134.4	286.9	34.5	NT	375	20.7
	Scientific Leaders	46	54.3	126.5	269.6	33.2	INTJ	344	20.2
	Managerial Leaders	40	60.0	143.5	306.8	35.9	ENTP	411	21.2

Figure 4.—Leading-indicator metrics show an increase in creativity within the Polyolefins and Elastomers Business R&D leadership between 1991, 1995 and 2001.

profitable NBD opportunities. Creative BOAs require a non-linear NBD process like Speed for there to be significant benefit from their creativity.

To learn the structured NBD approach, BOAs were heavily coached through their first one or two projects over a period of six months to two years. Most typically they worked full-time in the BOA role. Virtually all the BOAs in PO&E were in the top third of the Rainmaker Index, with indices above 40 (8). When marketing was assuming this role after 1995, their success rate was much lower as marketers at that time were mostly ex-sellers who were *Finishers*. It took years as well as a couple of major failures to get this discipline back. The successful innovations were done by the few innovative marketing people as well as some research people who did the marketing. This was changed in 2001 back to the BOA model.

New product applications in PO&E R&D were targeted in three major markets: packaging, durables and automotive, involving replacing five competing materials: EVA, synthetic non-woven fiber, impact modifier, flexible PVC, and conventional polyolefin line extensions (31).

Real breakthrough technology was developed within PO&E R&D in order to pursue these new applications using Insite technology (a metallocene-based, single-site catalyst). The Insite technology enabled producing far more valuable elastomers from existing low-cost polyolefin plants (and feed stocks), with relatively minor modifications (7). BOA was used for the more complex markets and technologies from this effort (another example being high-voltage wire and cable insulation), as well as for the less-well-defined NBD projects.

The second major approach used to target opportunities was generally used for understanding less complicated market opportunities. This was done under the banner of DFSS (Design for Six Sigma). In this approach, PO&E R&D worked together with marketing, taking great care to ensure that they understood key customers' *real* functional requirements. If a new lower-cost polymer could replace a widely used higher-cost polymer, it simply should win in the marketplace. In these cases the more complicated analyses provided by BOA were not required.

Based on the findings of many Business Opportunity Analyses as well as all the other forms of market investigations, the goal of several billion pounds of new polymer sales was established as realistically achievable in less than 10 years. These goals, which have long since been surpassed, were called audacious, even delusional, (these were the printable words) by many within PO&E leadership, who did not fully understand the power of the new set of rules allowed by Insite technology and Speed.

The 2005 sales from new products resulting from these efforts reached \$1.5 billion per year (with over 2 billion

pounds per year of new polymers). Well over \$6 billion in cumulative value was delivered from new products, processes, businesses, joint ventures, and acquisitions alone since 1991 by the efforts of the PO&E R&D and business groups through 2004, as previously published (7,32). Since that time, the value delivered from this approach has increased dramatically. In December 2007, Andrew Liveris, Dow Chemical chairman and CEO, announced a joint venture with Petrochemical Industries Company (PIC), a wholly owned subsidiary of Kuwait Petroleum Corporation for \$19 billion. Dow Chemical was to receive \$9.5 billion in cash while retaining 50% ownership in late 2008 (33). Dow would also retain a profitable 2 billion pounds per year elastomers business.

The total value delivered to date that can be fully attributed to this overall innovation approach in the PO&E business is now well in excess of an estimated \$23 billion. (This counts free cash flow generated by the new technology-based polymers over the past several years, plus the JV equity, plus the value of the retained elastomers business, *minus* the original value of the PO&E business in 1991, when it was on the block for sale) (34).

The value delivered has also helped enable Dow Chemical's purchase of specialty chemical producer Rohm and Haas for \$18.8 billion. The purchase has been approved by both company's boards of directors and was expected to be completed in early 2009 (35).

It is possible to estimate the size of the BOA group needed, depending on the size of the businesses and its growth goals. Through more than 20 years of practical experience we have developed the following rule of thumb: One well coached and experienced *Rainmaker* working full time as a BOA on average identifies new business development opportunities with \$50 million sales potential per year, in large industrial corporations operating in global markets. Of course, there is a large range in the size of opportunities discovered, with some being as small as \$5 million while others exceed \$500 million per year sales potential (as was often the case for Insite metallocene catalyzed polyolefins).

The size of the BOA group can be scaled to the size and growth goals of the business. A \$10 billion sales company with a revenue growth goal of 15% per year (or \$1.5 billion in new sales per year) would need approximately 30 BOAs. A full time BOA typically conducts two major project analyses per year. However, while the great majority of projects are positive after the BOA morphs them, not every project is positive. Some positive findings will also require research which ultimately may not succeed. And while the *Rainmaker* strives to ensure that most projects fit top management's Gut Level Screen, not every positive outcome will be acted upon by the business. Therefore, we are assuming that just half of each BOA's two projects per year ulti-

mately result in \$50 million sales potential. Thus, 30 analysts × \$50 million NBD/year/analyst = \$1.5 billion NBD potential/year.

Analogous to the training within the Six Sigma quality movement, we envision a group of green-belt BOAs, capable of conducting Business Opportunity Analyses semi-independently, with a smaller group of black-belt BOAs who are qualified to coach and manage potential BOAs with high Rainmaker Indices until they are qualified as green-belts. (This analogy is limited, however, because individuals who excel at Six Sigma tend to be *Finishers*, whereas those who excel at the early stages of NBD are *Starters* or *Rainmakers*.)

Having a strong group of coached and trained Rainmakers in BOA roles eliminates one of the most fundamental barriers to NBD success: working to commercialize the wrong things. Having well-conducted Business Opportunity Analyses focuses an R&D organization’s creativity toward opportunities with high potential value to its customers, and therefore to itself. Figure 5 shows how to measure the degree to which the Rainmakers’ activities are well conducted, with regard to both organizing and implementing the approach. This is among the most important of the new forward-looking metrics that are highly predictive of NBD success. We hope that Dow Chemical will adopt this philosophy even further, but that is their decision.

4. Ensure enough *Finishers* among non-leadership professionals

Someone has to grow the opportunity to make money. We hypothesize this requires a higher percentage of *Finisher* personality types within the larger group of

non-leadership professionals (i.e., the workers) than within NBD or R&D *leadership* professionals.

We are in the process of empirically determining what this percentage should be, using the highly effective PO&E R&D group of 2003 as a base. From observation and experience, we hypothesize that the makeup within the rank and file R&D group should be approximately 20–30% *Starters* and 70–80% *Finishers* (vs. 60% *Starters* and 40% *Finishers* within R&D leadership roles). We hope the findings can be reported in the near future. The point is, when R&D leadership is primarily made of *Starters*, and replicates itself among the non-leadership R&D group (by choosing primarily *Starters* instead of primarily *Finishers*), then very little makes it to commercial success. One of PO&E’s R&D leaders picked a team of all *Starters* for a project so “things could get done in a hurry.” Several months later he came back to ask one of the authors (Swogger) for some *Finishers* because while lots of things got *started*, nothing got *finished*!

Figure 6 shows that the leadership human resource portfolio needs to be continually rebalanced with the businesses portfolio and product life-cycle. (The non-leadership groups among both should be primarily *Finishers*.) Figure 7 describes the major job roles in greater detail.

5. Review middle management’s implementation plan

The BOAs’ final step is capturing the information in a clear presentation to the business management, describing why it fits top management’s Gut Level Screen and why it will win. But then what? Sometimes middle management does the right thing and takes action to commer-

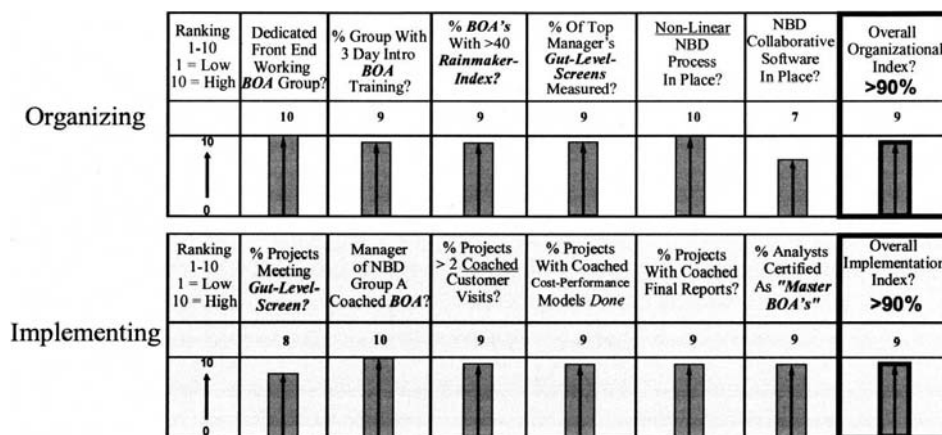


Figure 5.—No other forward-looking metrics are more important than these, and especially so for the metrics related to implementing NBD. Managers in innovating companies should push for over-90% grades here. This requires work and dedication from both management and the Business Opportunity Analysts.

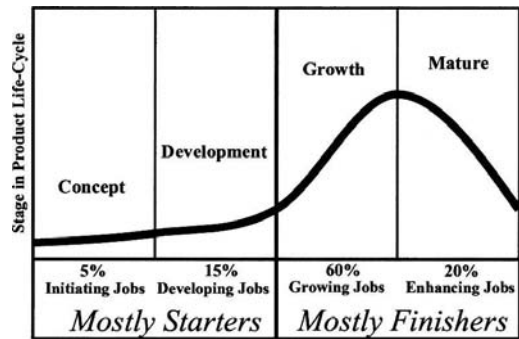


Figure 6.—More Finisher personality types than Starters are needed in the overall leadership of a long-established business, particularly in non-R&D functions. However, more Starters are needed in the leadership of new businesses, as well as those parts of long-established businesses charged with NBD, including R&D and Marketing.

cialize the new business opportunity. Sometimes they legitimately ask for more information.

However, far too often (approximately half to two-thirds of the time) middle management fails to take the right actions. After a BOA presentation with a recommended course of action, a manager should either agree with the information and take appropriate action, or disagree with the information, refuting it with better information, and take a different course.

There are two major categories of management failure related to NBD findings from a BOA:

1. *Management fails to shut down the work which the BOA proved cannot succeed.* In all of the cases where BOAs clearly showed why the starting ideas were doomed, and management tried to commercialize them anyway, failures occurred, often ending with massive write-offs involving hundreds of millions of dollars.

2. *Management fails to commercialize the positive morphed ideas from the analyses.* The opportunity costs of missing out on new commercial products and services can run into the billions of dollars. In both cases the financial impact of improving middle management's actions is high.

Naturally there are managers who do considerably better, batting nearly 100% in their implementation plans, and those that do far worse. We predict that finding ways for improving management decision making regarding NBD initiatives will become one of the next exciting frontiers for improving NBD productivity because management failure is one of the remaining major bottlenecks limiting NBD success.

Reasons for failed decisions include:

- Management is too busy and quite literally over-worked. NBD initiatives are easy to neglect, and the opportunity drifts away. We have seen management ignore opportunities that should have led to multi-billion-dollar businesses.

- Projects take on a life of their own, and gain powerful political constituencies forcing them forward. This is by far the biggest issue leading to NBD management failure. These political constituencies are difficult for managers to take on, all the more so if the organization is heavily matrixed. In matrix management organizations managers can get “zapped” by important yet displeased people from many different departments and functions whose project the BOA is often recommending be shelved. In short, it takes guts and political savvy to stand up and find an acceptable way to say “no,” precisely because it is professionally risky for a manager. Saying “no” can easily save large corporations hundreds of millions of dollars per project.

- The BOA findings typically require business management to deal with not just *one* but *two* surprises. First, the starting idea is rarely commercial. This can be a big disappointment, particularly so when managers themselves are already emotionally and financially invested in it. Secondly, the managers are not yet emotionally invested in the *new* idea. Management also too often fancies themselves to be experts at NBD, when all they may have done before is help run parts of an existing business. NBD is a more brutal and unforgiving game. Consequently, managers often reject the deep insight being provided by the BOA. Most of these factors leading to management failure relate to excessive pride and ego, natural human emotions.

However, the resulting failures can no longer be tolerated in an increasingly competitive global marketplace. In the recent past this was less crucial because the information that managers were acting on relative to NBD was usually wrong to begin with (4)! In this case, having a middle manager ignoring the unintentionally bad information could be in the company's best interests. However, when the other bottlenecks in the NBD process are eliminated, and the information on how to succeed becomes of remarkably high quality, management judgment is exposed as the next weak link.

How can we help management become more effective with NBD initiatives? Another step is needed. Upper management needs to instill practices to closely review and monitor middle management's actions related to the NBD findings. Three reviews are usually needed after the initial presentation from the BOA, with the BOA, upper management and middle management present at all three. In these reviews (each spaced apart two weeks or so), middle management indicates what they propose

Personalities →	Starters		Finishers	
Job Roles →	Initiating Roles	Developing Roles	Growing Roles	Enhancing Roles
Functional Capability	Able to define scope and initiate project. Continuously looks for opportunities.	Defines technical hurdles and value of opportunity. Able to synthesize capabilities.	Able to focus and implement while controlling cost.	Continuously improves process and reduces cost through incremental advances.
Personality Attributes	Visionary risk taker who anticipates and is willing to continuously learn. >122 Starter-Index.	Driver who is a good organizer, wants to learn and is a good communicator and team builder. >122 Starter-Index.	Detail-minded driver who enjoys reducing challenges to practice. <122 Starter-Index.	Patient. Comfortable with boundaries and rules. Likes to deal with details. <122 Starter-Index
Network Capability	Links ideas & technology across industry. May also be more of a loner.	Broad within organization.	Focused internally/externally. More team-oriented.	Focused on function and business, teams.
Skill Set	Very broad and multi-disciplinary. Uses history so not to repeat past mistakes. Broad experience.	Broad skill set with the ability to exploit with historical practice.	Able to focus on task-at-hand and apply specific skill sets. Adds to historical knowledge. Depth of knowledge in an area.	Detailed by nature and a specialist in a specified area. Leverages specific historical perspective.
Experience	Must understand and continuously learn from “the system.” Sees the big picture. Able to synthesize from experience and present (articulate).	High experience requirements. Focuses and develops the new and applies it.	Medium breadth and moderate depth of experience requirements. Generates and captures information which adds to history.	More depth than breadth of experience. Must know the specific “use history.” Works within the system.
Organizational Requirements	Requires support from key individuals. “High maintenance.”	Requires individual and organizational support. Can be “High maintenance.”	Uses organization for support with some individual assistance.	Uses the organization for support.

Figure 7.—Job descriptions for Starter personality types (Initiating and Developing job roles) and Finisher personality types (Growing and Enhancing job roles) apply to leaders as well as workers.

to do after they have considered the BOA’s final report. The BOA indicates whether or not they think this will optimize the business potential of their findings. It needs to be discussed and debated openly and factually. Upper management can count on the first plan from middle management usually containing far too much of the status quo. Knowing that will likely be the case, upper management should expect to disagree with middle management after the first implementation planning meeting.

This process is repeated with the BOA present until agreement is reached. Only then does top management sign off and agree to provide the resources needed. Middle management is then committed to a course of action. After a month, in the third implementation meeting, top management reviews the real actions being taken, again with the BOA present to challenge, with corrective action taken as needed. Typically taking the correct actions requires both *stopping* an ongoing initiative, and *starting* others that should result in significant new business opportunities. Both are a challenge to

accomplish, and require great political skill and finesse on the part of both middle and upper management.

As common sense as this sounds, we have rarely seen 360-degree pre-implementation reviews conducted outside of PO&E R&D. Instead, we more often hear words after BOA reports to the effect that “you can’t say that politically,” or “it’s a done deal,” even regarding projects that the BOA has just determined have a 100% chance of failure.

If middle managers refuse to take the right actions based on the BOA’s findings, (or do not refute those findings with better information), then they should be reassigned. This requires fast and strong action from *top* management. Far too much is at stake financially. Another way to say this is that NBD managers who make bad decisions usually go on to make many more bad decisions if allowed to do so. Nothing is more damaging to the future success of an organization than poor decision making by NBD management.

Of all the NBD success factor studies conducted by academics, far too few consider the roles of top and middle management, even though this is undoubtedly one of the most important success factors of all. The Polyolefins and Elastomers R&D and business top leadership was remarkably consistent and strong in this regard for 15 years, in part by holding semi-annual week-long reviews of all the projects. This was not (and still is not) true for The Dow Chemical Company as a whole. The crucial role of top PO&E management has been acknowledged by the Product Development and Management Association (PDMA) in 2003 via the award of *Outstanding Corporate Innovator*, the first time this award was ever made to an individual business within a larger corporation (36).

Five New Forward-Looking Performance Metrics

Between 1991 and 2001, PO&E R&D leadership was intentionally made more creative by bringing in more inherently creative individuals, and the leaders were much better matched with their job roles. Additionally, a much better job was done in the early stages of NBD, both through *Rainmakers* formally conducting Business Opportunity Analyses as well as less formally by PO&E R&D and the business groups, while still ensuring a deep understanding of key customers' functional needs and the cost-performance of competing approaches.

It was important to measure R&D effectiveness over this same time period. There are two broad categories of performance metrics to consider. The first category includes the traditional backward-looking metrics, primarily of a financial nature, but also related to speed to market and patents granted. Because backward-looking performance metrics measure what has already happened, many years must pass before learning the answers. In contrast, forward-looking or leading-indicator metrics are predictive of future R&D effectiveness. Not only have we collected a large number of backward-looking R&D performance metrics for PO&E R&D spanning more than ten years, but we also believe that this experience provides the basis for a new and unique set of forward-looking metrics or leading indicators that are indicative of *future* R&D group effectiveness (see Figure 8).

From the standpoint of backward-looking performance metrics, Dow's PO&E has achieved best-in-class for time to market, and added over \$23 billion in cumulative value through 2008 (Figures 8 and 9) (7,9,34).

"In terms of the normative value of predictions, scholarly work would have greater implications for practice if it could produce *ex ante* predictions rather than *ex post* predictions (37)." In other words, while anyone can predict the past, more useful forward-looking metrics are needed to predict future profits (which are usually years away) from today's NBD efforts. The five forward-looking performance metrics (or leading indicators) that we have

found to predict future NBD commercial success are listed in Figure 8 and described below.

1. *More visionary leaders*

It is important to ensure that the organization's leadership culture is in line with the function of their group. In the case of PO&E R&D, there was an imperative to create new technology for new polymeric products. Therefore, it was important to raise the level of creativity within the combined leadership group, including both managerial and scientific leaders. For groups that need to be creative, the leadership should be approximately 60% *Starters* personality types. This is easy to measure with any valid psychological instrument including the MBTI-based Starter Index. As demonstrated, the leadership culture can be quickly changed; if more creative leadership is needed (as was the case in PO&E in 1991), then more creative leaders must be brought in, because creativity is largely genetic in nature. 60% *Starters* are needed within the leadership groups to dominate the culture with creative thinking.

Over the course of ten years, more than 85% of the leadership was changed in PO&E R&D, with many more inherently creative leaders being added than were present at the start (Figure 2). However, 100% *Starters* in the leadership group would also be a disaster, as too few NBD projects would get completed. It works well to pair leaders with their opposite type: *Starter* scientists with *Finisher* managers, and vice versa. These are far from natural pairings, and doing so often requires firm upper management.

2. *Better fit of leaders' personalities with job roles*

The degree to which the personalities of leaders (*Starters* or *Finishers*, in both technical and managerial leadership roles) are matched with job roles can be measured and quickly changed either by moving people around within the same group, or moving people in and out of the group. This is particularly important for leadership roles, where the fit between personalities and job roles should be approximately 80–90%. There needs to be room for some exceptions, particularly for the *Finisher* types of leaders who understand the importance of having *Starters* involved when innovation is needed. Still, exceptions should be exceptional and not the rule. Achieving excellent fit between personalities and job roles is critical for all the business functions and leaders, not just within R&D.

3. *High Rainmaker Indices and Quality Analyses*

Having BOAs almost entirely with Rainmaker Indices over 40 helps ensure that they will have a much higher probability of morphing starting-point projects into winners. Now and then, there may be a manager with a lower Rainmaker Index who needs to go through the coaching procedure in order to know how to better

Five New Forward-Looking Performance Metrics

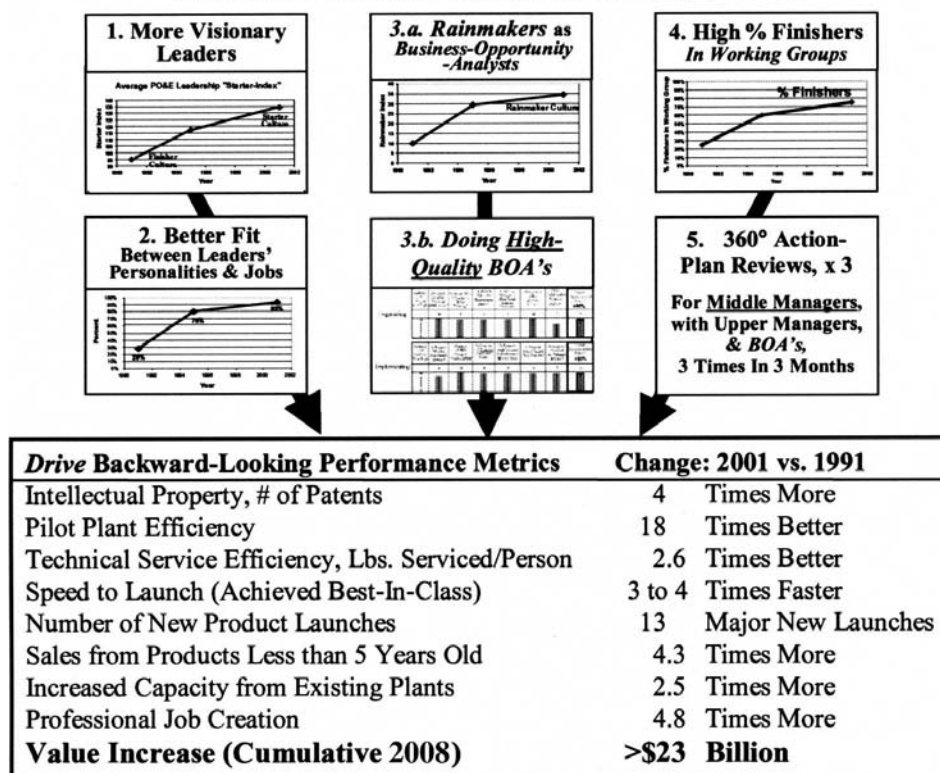


Figure 8.—These forward-looking (leading-indicator) metrics related to human resources and training are highly predictive of more traditional backward-looking R&D performance metrics (like profitability). The five new forward-looking metrics can be easily measured and quickly raised, providing an action plan for greater future NBD profitability.

manage *Rainmakers*. In this case, they should still have a higher-than-average Rainmaker Index.

However, just getting creative types into these roles is not sufficient. If that is all that is done, it would be far better not to select these personalities for these roles. While *Rainmakers* are inherently creative, they are also not very disciplined in challenging their ideas related to customer needs, competitive cost-performance, value and sustainable competitive advantage. Potential *Rainmakers* need a significant degree of training and coaching before becoming actualized *Rainmakers*. Even after their initial coaching and training they need a high degree of ongoing management attention as they work through the process time and again.

Metrics need to be in place to ensure high quality of Business Opportunity Analyses, because *Rainmakers* will inherently try to short circuit almost any process. The following metrics will help middle management ensure ongoing excellence of the BOA function itself. Without these metrics, most *Rainmakers* will almost always say they are fully using the process when they are

using only 15% of it. Key factors for success include the following:

- *100% of potential Rainmakers need to be coached by a certified BOA.*—No one, in over 40 years of cumulative experience in this particular function, has ever learned it without extensive one-on-one coaching. (That would be like trying to learn to play PGA-level championship golf without a coach, and without lifting a club.) Experiential learning is key. The coaching is typified by 40–50 meetings between the coach and the BOA, often lasting several hours each. They need to be coached on their first one or two projects through all five steps of the NBD process mentioned earlier. The organizing and implementing aspects of NBD are each in turn made up of sub-categories of activities, all of which can be easily measured. Management should strive to achieve scores of at least 90% for these metrics (Figure 5) for every BOA conducted in their group.

- *100% of BOAs Certified.*—The BOAs who are expected to repeat the approach independently need to be certified by a qualified BOA coach. When preselecting

BOAs with Rainmaker Indices above 40 points (as well as through personal interviews) the success rates from coaching are approximately 80%. This is about four times higher than without using the Rainmaker Index. Even so, one in five BOAs won't make it. If their coach finds that they are unlikely to perform the function largely on their own, even after being coached through two projects (as is typical, with less coaching on their second project), then the potential BOAs should not be allowed to continue in these roles. Too much is at stake.

■ *Continuing management for BOAs.*—Once certified, the BOAs still need to be monitored by management, and encouraged to perform the five major steps of the process as described earlier. It is not enough to know what to do. You actually have to do it, on every NBD project! Experience shows that without these metrics to help management maintain discipline, the system usually degrades within 18–24 months to business as usual, i.e. 11% success instead of 84% to 95% successes from the end of the early stages of analysis.

■ *High-Quality Business Opportunity Analysis.*—Of all of the leading-indicator metrics, those related to organizing and especially implementing Business Opportunity Analyses in a high-quality manner are the most important of all. This is because *not* doing the work involved in Business Opportunity Analysis is the largest barrier to commercial success. It will take three to six months to coach the first group of BOAs, assuming they are fully dedicated to this role. Because of the relative scarcity of these kinds of people, and the effort required from them, the BOAs must be given projects which are both significant and challenging, plus the time needed to morph them into winners. Smaller or incremental projects should be done by more traditional approaches augmented by tools such as provided by Six Sigma.

4. 70–80% Finishers among non-leadership workers

While a more exact number is being defined, we believe it will take approximately 70% *Finishers* among the

Leadership of groups that need to be creative should be 60% Starters personality types.

much larger group of non-leadership R&D professionals to make sure projects get delivered in a timely fashion. This metric also can be quickly measured (in a matter of weeks) and adjusted by management in a matter of months, by moving people around as needed. However, there is no perfect mix of *Starters* and *Finishers*. The mix within the working group (as well as in leadership roles) must be varied tactically by upper and middle management as the mix of projects continually shifts. When the NBD pipeline is too empty, management needs to quickly bring in more *Starters*. When the NBD pipeline is too full, management needs to add more *Finishers* to complete the projects and make money. The concept of *Starters* and *Finishers* is already starting to gain traction in both academia and the popular press (38).

5. 360° action-planning meetings

It is important to hold pre-implementation action-planning meetings for middle management, with top management and the BOA present. It is simple to measure whether or not the pre-implementation planning review meetings are taking place, as described earlier. It is also possible for top management to take fast and appropriate action based on the results from these meetings.

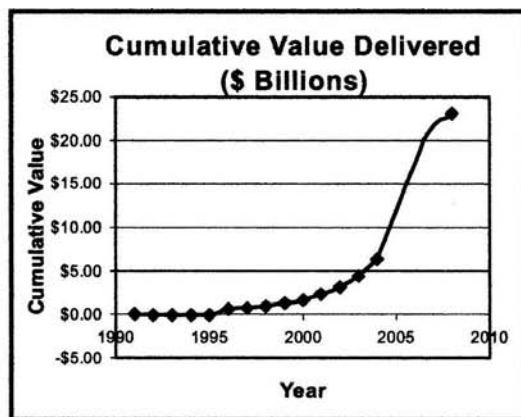
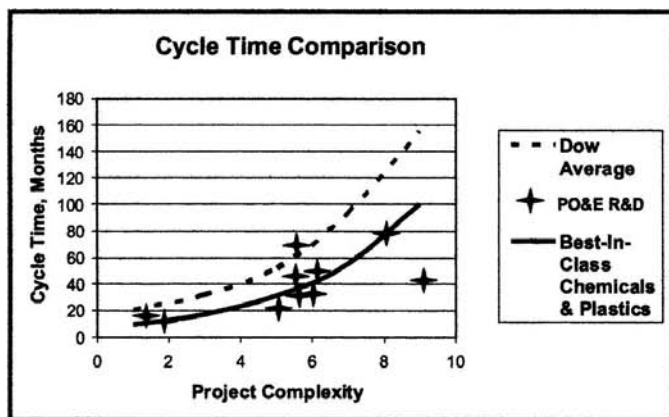


Figure 9.—PO&E now has best-in class time to market from inception to launch, and delivered over \$6 billion in cumulative value between 1991–2004, and \$23 billion through 2008.

Roadmap for Management

The five new forward-looking R&D metrics described here constitute a roadmap for management actions to improve NBD effectiveness. Improvements (as measured by these metrics) have led to a steady stream of NBD winners, including many breakthrough products and services. For example, within PO&E R&D, these activities resulted in more than 16 successful major new breakthrough product innovations spanning more than ten years for PO&E R&D. Examples include Engage™ Polyolefin Elastomers, Dow XLA™ Elastic Fibers, Affinity™ Adhesives, Thermoplastic TPOs, and Polyolefin Dispersions.

Success rates from the end of the early stages of NBD in PO&E were 84% (16 of 19 launches succeeded), vs. the industrial norm of 11% (4,32), (or 60% from launch) with more blockbusters continually coming on-stream. An earlier longitudinal study of this approach spanning ten years found success rates of 95%, involving about twice as many NBD projects, so these findings are repeatable (8). With *differentiated* businesses led by *Starters* and *low-cost* businesses led by *Finishers*, the overall PO&E business was able to become both innovative and low-cost.

The total value delivered by the PO&E business through 2008 using these approaches has been well in excess of an estimated \$23 billion. This drives home the commercial importance of considering this approach, based on the genetic perspective of creativity, plus taught business discipline. Had this approach not been followed, virtually none of this value would have been created. The cost of lost opportunities from not utilizing this approach in other parts of Dow, as well as in other companies, is staggering. The good news here is that remarkable growth from NBD is achievable in a planned manner.

Growth from innovation is one of the fundamental business strategies. To succeed, there must be a corresponding innovation mindset across the business as well as in R&D. Abdication of growth to R&D *without* support and involvement from the business (including marketing and production support) means the growth initiatives would simply fail.

Low-Cost Plus Differentiated Simultaneously

Michael Porter describes two main strategies: 1) *low-cost* products and services, and 2) *highly innovative* (i.e. differentiated) products and services (39). Few if any companies perform both strategies well. Porter teaches that a company can do one *or* the other strategy well, but not both. We believe that the genetic nature of personality and creativity explains why it has been virtually impossible for the same organization to operate both a low-cost strategy and a differentiated strategy at the same time.

The low-cost approach requires and rewards a culture *primarily* of superb *Finishers* (with a few *Starters* for new ideas), while the innovative strategy requires and rewards a culture *primarily* of *Starters* (but with approximately 40% *Finishers* in leadership roles to get the job done). Both organizational cultures are largely genetic in their makeup. Therefore, an organizational culture, or tribe, made up almost entirely of *Finishers*, that is inherently good at the low-cost strategy will be inherently bad at the innovative strategy, which requires more *Starters*, and vice versa.

Further, the two personality types and cultures usually do not get along, so one tribe almost always forces the other out over time, creating a very distinct culture of *either Finishers* (most typically) *or Starters*. Neither a pure *Starter* culture nor a pure *Finisher* culture would be optimal. They both need some diversity of thought, but in different proportions.

Firms are typically begun by innovative *Starters* (which may also be why most new firms do not survive the chaos of the start-up phase!) For those that do survive, there is far more work requiring *Finisher* skills (production, selling, accounting, safety, quality, shipping and logistics) than *Starter* skills (innovating in R&D, marketing, advertising). Therefore, the leadership of most firms typically shifts over a period of 20–30 years toward becoming a culture of *Finishers*—operationally excellent, but no longer able to innovate at world-class levels. The end result is usually a sudden turn-over catastrophe, from which only one in three firms typically recovers. This is very likely one of the major reasons that the average life of *Fortune* 500 companies is only about 40 years (40,41). Most firms appear to literally have a biological lifetime based on their natural aging process as they gradually shift from a genetic *Starter* culture to a genetic *Finisher* culture.

In the future, understanding the largely genetic nature of personality should allow organizations to have subgroups of creative leadership composed of more *Starters*, even within a larger organization that needs to be more heavily staffed with *Finishers*. This should allow organizations to routinely capture the holy grail of strategy, by being *both* low cost and highly innovative *at the same time*, as was achieved in the Dow PO&E business. Such organizations will have a remarkable people-based sustainable competitive advantage (being *both* differentiated by utilizing predominantly *Starter* tribes, *and* low cost by utilizing predominantly *Finisher* tribes) making them nearly unstoppable.

In sum, managers should not ask, “Can we afford to do this?” but rather, “Can we afford *not* to?” As it has been written, “If you bring forth what is within you, what you bring forth will save you. If you do not bring forth what is within you, what you do not bring forth will destroy you” (42).

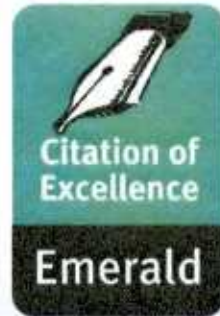
Part II of this article will show how this same approach was later implemented in just one to two years. ☺

References and Notes

1. Welch, John (Jack) H. 1993. Jack Welch on the Art of Thinking Small. *Business Week/Enterprise*, p. 215.
2. Albala, Americo. 1975. Stage approach for the evaluation and Selection of R&D Projects. *IEEE Transactions on Engineering Management*, EM22(4), pp. 153–163.
3. Booz-Allen & Hamilton Inc., Jones, Ralph W. 1958. Management of New Products. *The Journal of Industrial Engineering IX* (5), pp. 429–435.
4. Stevens, Gregory A. and James Burley. 1997. 3000 Raw Ideas = 1 Commercial Success! *Research-Technology Management* 40(3), pp. 16–27.
5. Cooper, Robert G. 2007. The thought column with Bob Cooper, Creator of the Stage-Gate Idea-to-Launch Process. *The Innovators, Conversations On The Cutting Edge*. www.stage-gate.com.
6. Cooper, Robert G. 2005. Your NPD portfolio may be harmful to your business health. *PDMA Visions XXIX*, No. 2
7. Swogger, Kurt W. 2006. Picking the Right People—Essential to Innovation. *Pacificchem 2005 Conference*, Area 4, Symposium 258, on the Pacific Basin Chemical Community: Chemical Business and Economics. Session 2; January, Hawaii
8. Stevens, Greg and James Burley. 2003. Piloting the Rocket of Radical Innovation, *Research Technology Management* 46(2), pp. 16–25. (Chosen by *Emerald Management Reviews* as one of the “Top 50” juried management articles out of more than 15,000 reviewed in 2003.)
9. Stevens, Greg, James Burley and Kurt Swogger. 2003. Dow Chemical Achieves Major Transformation of PO&E R&D Group: Personality-Oriented Approach Improves NPD Results. *PDMA Visions XXVII*, No. 3, pp. 6–10.
10. Bouchard, Thomas J., et al. 1990. Sources of Human Psychological Development. *Science*, Oct. 12, pp. 223–229.
11. Bouchard, Thomas. 1993. Twins and Type. *Association for Psychological Type, Tenth Biennial International Conference*, July 6–11, Long Beach, CA. (Audio tape transcription).
12. Li, C. C. 1987. A General Model For Emergenesis. *American Journal of Human Genetics* 41, pp. 517–523.
13. Bouchard, Thomas J., et al. 1993. Creativity, Heritability, Familiarity: Which Word Does Not Belong? *Psychological Inquiry* 4, pp. 235–237.
14. Gough, Harrison and David T. Lykken. 1995. Genetic and environmental influences on correlates of creativity. (May also be misnamed as: Life achievement in a sample of twins reared apart: estimating the role genetic and environmental influences). *Proceedings from the 1995 Henry B. and Jocelyn Wallace National Research Symposium on Talent Development*. Scottsdale, AZ, Gifted Psychology Press.
15. Gough, Harrison. 1981. Studies of the Myers-Briggs Type Indicator® In A Personality Assessment Research Institute. Presentation at the *Fourth National Conference on The Myers-Briggs Type Indicator*, July, Stanford University, CA.
16. Bouchard, Thomas J., Jr., and Yoon-Mi Hur. 1998. Genetic and Environmental Influences on the Continuous Scales of the Myers-Briggs Type Indicator®: An Analysis Based On Twins Reared Apart. *Journal of Personality* 66:2. April, pp. 135–149.
17. Feist, Gregory J. 1998. A Meta-Analysis of Personality in Scientific and Artistic Creativity. *Personality and Social Psychology Review*, Vol. 2, No. 4, pp. 290–309.
18. DeBono, Edward. 1985. *Six Thinking Hats: An Essential Approach to Business Management from the Creator of Lateral Thinking*. Little, Brown and Co.
19. Von Oech, Roger. 1983, 1990. *A Whack on the Side of the Head: How You Can Be More Creative*. Warner Books.
20. Osborn, Alex F. 1948. *Your Creative Power*. Charles Scribner’s Sons, NY & London.
21. Breen, Bill. 2004. The Six Myths of Creativity. *Fast Company*, Dec., p. 75.
22. Buckingham, Marcus and Donald O. Clifton. 2001. *Now, Discover Your Strengths*. The Free Press, Division of Simon and Schuster Inc., NY, NY.
23. Buckingham, Marcus and Curt Coffman. 1999. *First, Break All the Rules*. Simon and Schuster, Inc., NY, NY.
24. Buckingham, Marcus and Donald O. Clifton. 2007. *Strengths Finder 2.0*. Gallup Press, NY, NY.
25. Folkert, Nate. 2003. Twenty Percent Forever: Stryker Corporation. *Raising your ROI, Return on Innovation*, Proceedings, Great Lakes Chapter of the Product Development and Management Association. April 23, Troy, Michigan
26. Stevens, Greg, James Burley and Kurt Swogger. 2003. Creating an Effective Culture: How Dow Chemical’s Polyolefins and Elastomer R&D Group Transformed Its Culture in Under Four Years, Leading to Even Greater Business Success. *IIR-PDMA (Product Development and Management Association) Portfolio Management Conference*. Feb. 28, Clearwater Beach, FL
27. Bacon, Frank R., Jr. and Thomas W. Butler, Jr. 1981. *Planned Innovation: A Dynamic Approach to Strategic Planning and the Successful Development of New Products*. Ann Arbor, Michigan. Industrial Development Division, Institute of Science and Technology, The University of Michigan.
28. Bacon, Jr., Frank R. and Thomas W. Butler, Jr. 1997. *Achieving Planned Innovation: A Proven System for Success with New Products*, The Free Press, NY, NY.
29. Whitley, Roger L., Alden S. Bean and M. Jean Russo. 1998. IRI/CIMS R&D Database Study. *Research-Technology Management* 41(4), pp. 15–16
30. Cooper, Robert G. 1999. From Experience: The Invisible Success Factors in Product Innovation. *Journal of Product Innovation Management* 16, pp. 115–133.
31. Stevens, Greg. 1995. Early Stage Commercialization Activity for Insite® Polyolefin Technology: Creating the Vision for Customer Success. *PDMA Michigan Chapter Conference, “Customer Driven Innovation,”* Jan. 19, Southfield, MI.
32. Stevens, Greg A. and Kurt Swogger. 2006. Creating More Effective R&D Cultures for Innovation. *IIR-PDMA Conference: Team NPD*. July 19, Keystone, Colorado.
33. Press Release, Dow Chemical, Dec. 13, 2007. “The Dow Chemical Company and Petrochemical Industries Company of Kuwait Announce Global Petrochemicals Joint Venture.”
34. Swogger, Kurt. 2008. It’s the People Not the Process, To Do New Business Development. (Describes how \$30 billion in value was created in Dow Chemical through 2008 from this approach.) *IIR-PDMA Front End of Innovation*, May 21, Boston.
35. Press Release, Dow Chemical, July 10, 2008. “Dow acquires Rohm and Haas, Creating World’s Leading Specialty Chemicals and Advanced Materials Company: \$18.8 Billion Transaction Marks Pivotal Point in Dow’s Transformation.”
36. Swogger, Kurt. 2004. Speed Philosophy Helps Dow Win OCI Award. *Visions (PDMA Journal) XXVIII*, No. 1., pp. 11, 14.
37. Danneels, Erwin. 2006. Worcester Polytechnic Institute. From the Guest Editor: Dialogue on the Effects of Disruptive Technology on Firms and Industries. *Journal of Product Innovation Management* Vol. 23, No. 1. pp. 2–4.
38. Hindo, Brian. 2008. Rewiring Westinghouse—how a risk averse builder of nuclear plants is getting its engineers to think differently. *Business Week*, May 19, pp. 48–49.
39. Porter, Michael E. 1980. *Competitive Strategy. Techniques for Analyzing Industries and Competitors*. The Free Press, pp. 34–41.
40. De Geus, Arie. 2002. *The Living Company: Habits for Survival in a Turbulent Business Environment*. Harvard Business School Press, Boston, MA.
41. Kirton, Michael. Editor. 1989. *Adaptors and Innovators: Styles of Creativity and Problem Solving*. Routledge, London.
42. Gospel of Thomas 70, in Nag Hammadi Library 126. (transl. by Elaine Pagels in *Beyond Belief: The Secret Gospel of Thomas*. New York: Random House, 2003, at p. 32.)

Note

Insite™, Engage™, and XLA™ are registered trademarks of The Dow Chemical Co. WinOvations™, Rainmaker Index™ and Starter Index™ are service marks of WinOvations, Inc. MBTI® and the Myers-Briggs Type Indicator® are registered trademarks of the Consulting Psychologists Press, Palo Alto, CA.



Citation *of* Excellence

This is to certify that

Greg A. Stevens and Kurt Swogger

Have been recognized by the Emerald Management Reviews Independent Review Board as the authors of one of the top 50 management articles of 2009 for the paper:

***"Creating a Winning R&D Culture - I",
Research Technology Management, Vol. 52 No. 1, 2009***

EMR extends its congratulations and international recognition of this outstanding contribution to the literature and body of knowledge.

A handwritten signature in black ink that reads "David Pollitt".

David Pollitt
Editor
Emerald Management Reviews

A handwritten signature in black ink that reads "Deborah Spurgeon".

Deborah Spurgeon
Executive Editor
Emerald Management Reviews

www.emeraldinsight.com/reviews



Greg Stevens
WinOvations, Inc. (Suite 1200)
4850 Rivers Edge Drive
Mt. Pleasant
MI 48858
USA



Dear Mr Stevens,

I am writing to inform you that your article "Creating a Winning R&D Culture - I", published in *Research Technology Management*, Volume 52, Issue 1, has been selected as one of the top fifty articles in Emerald Management Reviews for 2009.

Emerald Management Reviews (formerly Anbar) was established in 1961 and was the first management 'abstracting' database in the UK. Today Emerald Management Reviews features the world's top 400 management publications and is still the only service of its kind to include independent reviews of articles, written by subject experts.

All the 400 titles which feature on our Accredited Journal List have already been independently judged to be the best by an esteemed panel of some of the world's top names in management (e.g. Professor Philip Kotler, Professor Cary Cooper and Joseph B. Pine II).

Each year, however, just 50 of the 15,000 papers assessed are singled out by the independent review team for a special Citation of Excellence Award.

Each of the independent reviewers in the Emerald Management Reviews team has a portfolio of journals carefully matched to his or her area of expertise. Articles from the publications on the coverage list are reviewed and compared by the reviewers for a whole calendar year.

Inclusion in the Emerald Management Reviews database is, in itself, an accolade for authors, whilst a Citation of Excellence is the highest tribute we bestow. More information about the Citations of Excellence, including the complete list of winners from 2009, can be found at: <http://info.emeraldinsight.com/products/reviews/awards.htm>

Included with this letter is your Citation of Excellence certificate. You are also entitled to download the Citation of Excellence logo from our website and use it on other documents or personal homepages. Please feel free to contact me if you need further advice on this or have any other questions, such as how to link back to your online review.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'DB' with a flourish.

Devon Blake
External Relations Executive
dBlake@emeraldinsight.com



Research you can use

Howard House, Wagon Lane, Bingley BD16 1WA, UK. T +44 (0) 1274 777700 F +44 (0) 1274 785201 www.emeraldinsight.com