SIZE AND TIMING DO MATTER: NPD MODEL GROWTH BETWEEN THE INITIAL SCREEN AND ONE-YEAR POST LAUNCH

JOHN GREEN, JR, Catawba College
VERONICA WONG, Aston University

R&D forecasting models promise up to 88 percent accuracy. Nonetheless, managers have not adopted long-term NPD models such as NewProd, and failure rates keep rising. This paper examines model under-utilization by measuring changes in practitioner retrospection of success variables between the initial screening and one year post launch. The resulting linear regression models become more complex over time, as accurate as NewProd, and exhibit less measurement error. This is important because frequent NPD environmental changes, so obvious and intuitive to managers, would quite naturally discourage use of NewProd and other static, single-stage long-term models.

INTRODUCTION

As early as 1957, Rubenstein observed that managers adopted few published R&D evaluation techniques. Nearly twenty years later, Lilien (1975) was still asking why so many models were built and so few used. He suggested that models are not theories and need not be the most parsimonious solution. Rather, to be useful, models must relate well to user experience and be situationally appropriate, even if modelers must create several less than parsimonious functions to describe users' multifaceted problems. Concurrently, Albala (1975) argued that typical single stage screening models were inadequate in multi-stage new product development (NPD) environments. By 1979, Crawford was pegging the NPD failure rate at 36 percent, just as Cooper was publishing today's most notable single stage model, NewProd (Cooper 1979a, 1979b, 1981). Unfortunately, neither it nor the comparable Stanford model (Maidique and Zirger 1984; Zirger and Maidique 1990) fared much better with practitioners (Cooper 1992). Inexplicably, single stage models are still offered to unconvinced practitioners. And researchers continue to wonder why their efforts go unused and failure rates worsen (Griffin 1997).

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Screening Model Problems

Initial screening models can reduce failure rates if *used*. Although NewProd tracks and predicts outcomes well, it is prescriptive, lacks support for multiple stages, and omits important variables, e.g., entry order and innovativeness. Furthermore, its most appropriate mathematical form has never been determined. And, its considerable initial screening information requirements are inappropriate, subjective, probabilistic, or completely unknowable.

Methodologically, the most recent NewProd respondents make retrospective success/failure judgments concerning only thirty variables, unbenchmarked, somewhere between launch and five years thereafter (Cooper 1992). This produces survivor-biased functions undercounting early failures and kills (Cooper and Kleinschmidt 1990). To improve recall the present study compared NPD managers' short-term perceptions of new product evaluation criteria benchmarked at their initial screen (T_0) and one-year after their product's launch (T_1). Then we constructed linear regression functions reflecting practitioner beliefs about relevant success criteria at each period. We theorized that these more precise short-term decision dates should reduce measurement-timing error, thus improving questionable field construct validity and reliability (Crawford 1979; Mahajan and Wind 1992; Montoya-Weiss and Calantone 1994; Hultink and Robben 1995).

LITERATURE REVIEW

SAPPHO (Rothwell 1972) was the first work to use side-by-side success/failure comparison. Today's better known new product screening models, NewProd and Stanford, are based on six broad variable groups affecting NPD success at the project level: the marketplace, firm resource base, project nature, process proficiency, information acquisition, and commercial entity (Cooper 1979a).

NewProd's linear regression function ranks *product superiority* and *overall project/company resource compatibility* as the keys to success. *Market dynamism* (frequency of introductions), *high relative price, newness to the firm,* and *market competitiveness* increase the probability of failure. The Stanford Innovation Project later found similar dimensions significant in the electronics industry (Table 1).

Our framework is grounded in NewProd's most recent iteration using thirty variables, but adds forty-five new interdisciplinary variables (Wind and Mahajan 1988). We theorize that continuous information evolution, team learning (Shrivastava 1988; Menon, Chowdhury and Lukas 2002), strategic gap diagnosis (Ansoff 1990), and adaptation/reaction (Abell and Hammond 1979; Porter 1991) will affect success model constructs and forecasting accuracy over time (see Figure 1).

Hypotheses

If models are to be accepted by practitioners they should reflect the dynamic nature of the market (Wind and Mahajan 1988). The literature's failure to test temporal instability has limited the validity of previous success/failure conclusions. Our four hypotheses test perceived stability by positing significant environmental and model differences between the initial screen (T_0) and one-year post launch (T_1).

> **H_1:** Variables perceived by practitioners as important to success at the initial screen (T_0) are different from those perceived important one-year after the product's launch (T_1).

Experienced NPD managers recognize in their current project evolving success/failure patterns consistent with previous success/failure history (Thieme, Song and Calantone 2000). Understanding changes in environmental success/failure variables improves the odds of success (Cooper 1992). Models should systematically reflect changing variable environments (Crawford 1986) to guide adaptation (Calantone, Di Benedetto and Haggblom 1995) because success factors, and the way success is measured, may change over time.

> **H_2:** Success factors at the initial screen (T_0) are different from those one-year post launch (T_1).

Orthogonal factor analysis is typically used in linear additive success/failure forecasting (Cooper 1979b, 1981; Zirger and Maidique 1990). Hypothesis 2 posits a significant difference between screening and post launch factor analysis results. Rejection would suggest that NPD environments are not dynamic or unique.

> **H_3:** Linear regression success/failure models grow in number of factors and information requirements over time.

Best practices may change over time. Models of best practices, which do not change, would validate NewProd's single stage prescriptive approach, and contradict Porter's assertion that strategic adaptation to changing environments is necessary for success.

TABLE 1
Established Dimensions of Success

NewProd (1979) [a]	NewProd (1981) [b]	Stanford (1990) [c]
1. Product uniqueness and superiority	1. Product superiority, quality, and uniqueness	1. Excellence in R&D organization
2. Market knowledge and marketing proficiency	2. Overall project/Company resource compatibility	2. Superior technical performance
3. Technological resource compatibility	3. Market need, growth and size	3. Product value
4. Market dynamism (frequency of new product introductions) (negative)	4. Economic advantage of product to end user	4. Synergy with existing competencies
5. Market need, growth, and size	5. Newness to the firm (negative)	5. Management support
6. Relative price of product (negative)	6. Technological resource compatibility	6. Competent marketing and manufacturing
7. Marketing and managerial synergy	7. Market competitiveness (negative)	7. Weak competitive environment
8. Market competitiveness (negative)	8. Product scope/specialization	8. Large and growing market
9. Newness to the firm (negative)		
10. Strength of marketing communications and launch effort		
11. Source of idea/investment magnitude		

a. NewProd discriminant analysis model fit statistics. Cooper 1979b. Wilk's Lambda =.51, F=15.95 at .001 with 11df.
b. NewProd linear regression model fit statistics. Cooper 1981. R=.6481, R^2=.420, Adjusted R^2=.395, F=16.83 with 8df, Standard error=2.73.
c. Stanford discriminant analysis model fit statistics. Zirger and Maidique 1990. Wilk's Lambda=.51, Eigenvalue=.978, Canonical Correlation=.7.

H_4: Linear success/failure models become more accurate as the amount and quality of NPD information grows and improves over time.

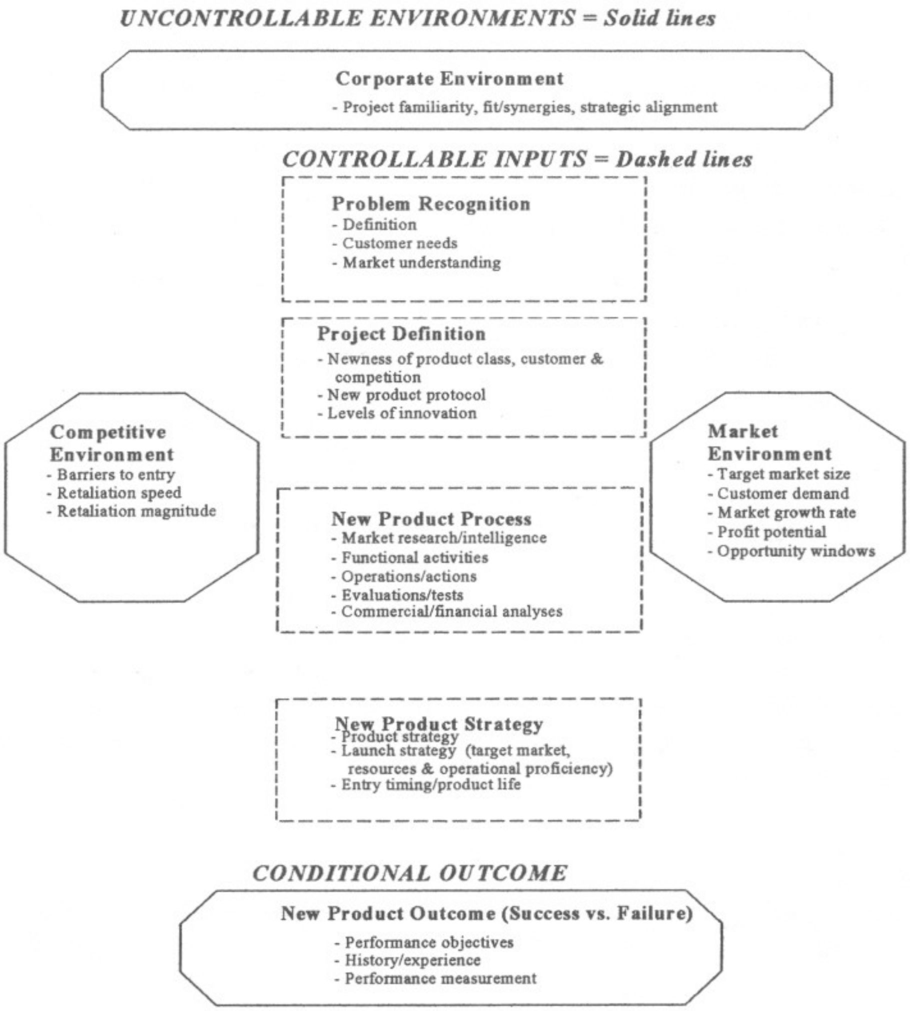
Success/failure forecasting at the initial screen is based on highly speculative or unattainable information. Because screening may be poorly performed if managers believe early data are unreliable, demonstrating increased accuracy would encourage multi-stage model use by NPD managers.

METHOD

Sample and Data Acquisition

The sample was drawn from *Compact Disclosure*, a 12,000 record CD ROM database of American public businesses with at least 500 shareholders or $5,000,000 in assets. The goal was to examine perceptions in active NPD markets, where product life cycles are shrinking (Menon, Chowdhury and Lukas 2002). Extrapolation to normal populations was not intended. Thus, a non-probability sample

FIGURE 1
Learn/React Conceptual Framework



(n=1300) was constructed limiting commodity-like industries (e.g., stone, clay, and lumber) where manufacturing efficiency is more important than dynamic innovation (Ansoff and Stewart 1967).

Questionnaires were pre-tested in personal interviews with senior managers in the Atlanta Georgia area. Consistent with those suggesting that at least six months are necessary to measure entry strategy characteristics (Green, Barclay and Ryans 1995), managers claimed: (1) the variables were relevant to success; (2) by one year after introduction, initial trends were established signaling the end of the NPD process; and (3) they could reasonably discriminate between, and then quantify, T_0 and T_1 variable states of nature.

Following minor editing the questionnaire and cover letter were sent to either the president, the vice-president of marketing, or the NPD manager/staff member most familiar from start to finish with one clearly successful or failed new project introduced within the last three years. Participants were asked to "... pick one new product that is: (1) new to world; (2) a new product line; (3) an addition to existing product lines; (4) an improvement/revision; (5) a repositioning; or (6) a cost reduction (Booz, Allen and Hamilton 1982)." To increase the response rate, and to permit assessment of early versus late respondent bias, one reminder was sent to those not responding to the original mailing. No significant bias was observed.

Measure Operationalization

There are many ways to measure the dependent variable, NPD success/failure. Consistent with NewProd, success was judged as follows:

1. *Success/failure:* Yes/no categorization based on whether the project had met the company's minimum targets for success.
2. *Degree of success/failure:* +5 to -5 where +5 = highly successful and -5 = highly unsuccessful.
3. *Extent of meeting performance criteria:* +10 to 0 where +10 = far exceeded performance measurement criteria and 0 = far short vis-à-vis:
   a) *Financial* - profits, ROI, and payback period objectives;
   b) *Window of opportunity* - capitalized on new technology, preempted emerging market segment, and/or established foothold in new market; and
   c) *Market impact* - increased market penetration, capitalized on existing markets, and/or combated major competitive entry.

A successful product must have performed well on at least two of the three performance criteria and averaged at least 5.5 for all.

Like NewProd, seventy-two variables measured respondents' agreement with variable statements along an 11-point scale where 0 = *disagree strongly* and 10 = *agree strongly*. Three others, *percent successes, percent failures*, and *percent kills* in the same product market in the last three years combined to measure performance history, a "moving average of long-term project level product market experience." These were obtained from one question: "In the last three years in this product market, we have had (how many?) # Successes, # Failures and # Killed ideas?"

Each respondent was asked to: (1) consider the NPD situation at the initial screening stage and score the variable statement based on information known only at that first benchmark (T_0); and (2) then consider the variable's status based on new information known at one-year post launch (T_1). The final sample of 190 successes and 70 failures represented a 21.7 percent response rate for an adjusted sample size of 1198. This success/failure ratio is consistent with response rates for NewProd and recent industrial studies (Robertson, Eliashberg and Rymon 1995). Principal component analysis with varimax rotation resulted in twenty-two orthogonal factors with Eigenvalues > 1. Applying the typical loading and Chronbach's Alpha cutoffs of .5 reduced the T_0 and T_1 variable sets to seventeen internally consistent factors explaining 61.5 percent and 62.3 percent of the variation. Average T_0 and T_1 loadings were .6943 and .6882, and average

Chronbach's Alphas were .7374 and .7625. Chronbach's Alphas for financial, window, and impact success measures were .5187 at T_0 and .6778 at T_1. All other parameters were consistent with the literature. Thus, we deemed the sample representative of interested, active NPD teams.

RESULTS

Aggregate mean performance was 1.67 (190 successes = 3.351, 70 failures = -2.886). The median project was launched ten months after the initial screen, judged a success or failure twelve months after launch, and reported to us six months thereafter. Thus, the median project was screened, developed, launched, evaluated, and reported to the authors in less than two years and four months. This, we believe, captured previously overlooked early entry failure phenomena and reduced measurement-timing error typical of longer retrospection.

Table 2 (top) provides evidence of the changing relationship among the respondents' simple assessment of project success or failure, and specific financial, window, and impact measures. Understandably, none of the measures is significant at T_0, but all are significant by T_1. Table 2 (middle) provides even stronger evidence of the growing relationship between level of overall success and financial, window, and impact measures over time. At T_0, only potential impact displays an *r* greater than .1. By T_1, all are between .2 and .3. Table 2 (bottom) further demonstrates a dynamic, evolving dependent variable. For successful projects, financial measures grew stronger over time. For failed projects, financial and window measures declined over time (p=.07).

Supporting Hypothesis 1, Tables 3a and 3b illustrate that many variables influencing new product outcomes also change in significance and/or magnitude between T_0 and T_1. In Table 3a, 27 of 75 variables (36 percent) were significant to success/failure at both periods. We consider these absolute because they discriminate between success/failure throughout the entire NPD process. Eleven are conditional (14.6 percent) and become significant only over time. Table 3b illustrates that *financial resources, sales force/distribution resources, new-to-the-world innovativeness,* and *contribution margin* change in degree of importance over time for both successes and failures. The 5 to 1 ratio (-3.29/-0.64) of aggregate failure difference (-1.06 + -.86 + -.83 + -.54 = -3.29) to aggregate success difference (-.35 + -.33 + -.23 + .27 = -.64) suggests that the relative amount of resources, innovation, and contribution margin discriminates early failures from successes.

Hypothesis 2 is supported by the factor analysis results (Table 4). Factor order, Eigenvalues, percent of variance explained per factor, average variable loadings, and Chronbach's Alpha scores differ over time. Furthermore, differences occur in factor construction and variable loading order at each time period, and new factors emerge at T_1.

Table 5 strongly supports Hypotheses 3 and 4. The T_1 function grows in construct validity, information required, and forecasting accuracy, as additional factors join a subset of common T_0 factors, now in different order. At T_0, overcoming one's past *history of failure* is most important to the new project (positive regression coefficient multiplied by negative loading variable). Early *strategic reaction capability*, *competitive awareness*, *overall resource compatibility*, and a potentially *superior product* improve one's chances. *History of kills and success* has mixed impact on one's next success. At T_0, project potential is positively related to past success. The opposite is true with past kills (negative loading on positive coefficient). *New customers, competitors, and products* reduce the probability of success as does being *late to market* (Robinson and Min 2002).

Except for *late entry* and *overall synergy*, the T_0 dimensions are repeated in the T_1 model. *History of failure* and *history of kills and success* have the same but reduced effect at T_1 with the regression coefficients and variable loadings reversed. *Relatively high prices* also decrease the odds for a success. Provocatively, the early positive effect of *overall synergy* separates into *marketing and*

TABLE 2
Performance Measures

Significance by Time Period		
Performance Measure	**Pearson X^2**	**p**
Financial T_0	15.14	.127
Financial T_1	19.88	.03
Window T_0	12.46	.33
Window T_1	25.52	.004
Impact T_0	16.94	.076
Impact T_1	32.22	.000

*Correlation by Time Period**

Performance Measure	Actual Performance	Financial T_0	Financial T_1	Window T_0	Window T_1	Impact T_0
Financial T_0	.0715					
Financial T_1	.2049	.7196				
Window T_0	.0254	.1430	.0803			
Window T_1	.2604	.1579	.3399	.4663		
Impact T_0	.1681	.3262	.1961	.3459	.3788	
Impact T_1	.2942	.1018	.3198	.2261	.5933	.6531

Mean Change Over Time

	Success n=190 (73%)			Failure N=70 (27%)			All n=260 (100%)		
Performance Measure	T_0	T_1	p	T_0	T_1	p	T_0	T_1	p
Financial	6.811	7.121	.052	6.514	5.971	.072	6.731	6.812	.571
Window	6.505	6.563	.707	6.371	4.714	.071	6.469	6.065	.137
Impact	6.716	7.011	.117	5.429	4.971	.159	6.369	6.462	0.571

* = $p < .05$.

management compatibility and *technological compatibility* later on. And simple warnings not to be late evolve into more complex issues involved in being *first in an innovative market.*

DISCUSSION

All four hypotheses were accepted. Clearly, managers perceive significant differences over time in many areas important to NPD success. Both linear regression functions reflecting these perceptions exhibit less measurement error than NewProd, probably due to additional variable integration, shorter retrospection, early failure assessment, variable timing, and strategic adaptation. Differences among the T_0, T_1, and NewProd models reflect perceived changes in best practices over time and help explain practitioner under-utilization of long-term information-hungry models in short-term information-poor situations.

Variable Differences

Managers perceive differences in entry barriers, resources, synergy, protocol, and market assessment. Following the T_0 conditional Go!, successful teams refocus efforts and resources forward to promote and deliver the T_1 outcome, a well-resourced, highly innovative, early entry into a financially lucrative market. Similarly, differences in variable means over time illustrate how successful managers change emphases with changing conditions. For example, between T_0 and T_1, both successes and failures experience reductions in financial and sales/distribution resources. However, the shortfalls

TABLE 3a
Variable significance by time

27 Absolute Variables Significant at T_0 and T_1

Failure percent
Success percent
This product was a repositioning
Brand identity
Expected speed of competitive retaliation
Expected magnitude of competitive retaliation
The product would have done better if marketed by our competitors
Developed clear strategies to deal with deficiencies in barriers to entry
R&D skills and people were more than adequate
Engineering skills and people were more than adequate
Marketing research skills and people were more than adequate
Management skills were more than adequate
Sales force and/or distribution resources and skills were more than adequate
Developed clear strategies to deal with deficiencies in the area of resource requirements
The technical aspects – exactly how the technical problems will be solved were very clear
Product class/type of product was totally new to our company
Never made or sold products to satisfy this type of customer need or use before
Competitors we face in the market were totally new to our company
Product "fit in" with a family of products we already had on the market
Developed clear strategies to deal with deficiencies in the nature of the product
Compared to competitive products (or whatever the customer was using) our product offered a number of unique features, attributes, or benefits to the customer
Product was clearly superior to competing products in terms of meeting customer needs
Developed clear strategies to deal with deficiencies in the final product
Potential customers had a great need for this class or type of product
Market for this product was growing very quickly
Potential customers were very satisfied with the products (competitors' products) they were currently using
Developed clear strategies to deal with difficulties inherent in this market

11 Conditional Variables Significant Only at T_1

Product was new-to-the-world
Developed clear strategies to deal with deficiencies/problems in the area of newness/innovation
Advertising and promotion resources and skills were more than adequate
Product permitted the customer to reduce his/her costs, when compared to what he/she was using
Product permitted the customer to do a job or do something that he/she could not do with what was available on the market
Product was of higher quality - however quality is defined in this market - than competing products
Dollar size of the market (either existing or potential market) for this product was large
We were the first to market this product
We entered the market in its late growth stage
We spent a long time on the market research for this product
Contribution margin was important in the decision to enter this market

37 Variables Insignificant at T_0 and T_1

Product was a new product line
Product was an addition to an existing product line
Product was an improvement in or revision to an existing product
Product was a cost reduction
Cost advantages of incumbents (economies of scale)
Product differentiation (proprietary product differences) of the incumbents
Customer switching costs
Capital requirements
Access to distribution channels
Absolute cost advantages
Government policy
Expected retaliation
Financial resources were more than adequate for this project
Production resources or skills were more than adequate for this project
Product was highly innovative - totally new to the market
Product specifications were very clear
Potential customers for this product were totally new to our company
Product which entered the market was significantly different than that approved at the initial screen
Product was priced considerably higher than competing products
Market was characterized by intense price competition
Many competitors in this market
Strong dominant competitor- with a large market share - in this market
Users' needs changed quickly in this market - a dynamic market situation
Not first to market this product; we followed close behind however
Entered the market somewhere between its maturity and decline
Fast rate of technological change was important in this product market
Competitors introduced new products into this market very quickly
Competitors withdrew products from this market very quickly
R&D in this market produced many advancements in the production process and ensuing products
Production methods in this market changed very quickly
Amount of change (technological leap/boundary distance) was important in this product market
New products introduced into this market were much more technologically sophisticated than those replaced
RandD in this market produced significant advancements in the production process and ensuing products
Product had a long life cycle in its original form (before modifications were necessary)
Market cyclicality was important in the decision to enter this market
Market seasonality was important in the decision to enter this market

The primary market for this product was domestic (over 50 percent in US)

* = p < .05.

TABLE 3b
Mean Change Over Time

15 Success Case Variable Changes	T_1-T_0	26 Failure Case Variable Changes	T_1- T_0
37. Financial resources adequate . . .	-0.35	57. Product superior	-1.60
43. Sales force/distribution resources adequate	-0.33	63. Customers had a great need	-1.34
50. Product class new	-0.26	58. Product reduce customer costs	-1.16
1. New-to-the-world	-0.23	64. Dollar size of market large	-1.13
79. Production methods changed quickly	0.19	*37. Financial resources adequate*	-1.06
87. Contribution margin important	0.27	83. Long life cycle before modifications necessary	-0.94
84. Long time on market research	0.28	56. Unique features/benefits to the customer	-0.93
29. Access to distribution channels	0.34	*43. Sales force/distribution resources adequate*	-0.86
78. R&D produced many advancements	0.35	41. Management skills adequate	-0.84
7. Clear strategies newness/innovation	0.36	*1. New-to-the-world*	-0.83
66. Intense price competition	0.37	46. Our product totally new to the market	-0.73
36. Clear strategies barriers to entry	0.38	44. Advertising resources and skills adequate	-0.73
62. Clear strategies final product	0.41	38. R&D skills and people adequate	-0.69
76. Competition introduced new products quickly	0.46	2. A new line	-0.67
55. Clear strategies nature of the project	0.49	48. The technical aspects clear	-0.66
		39. Engineering skills and people adequate	-0.64
		60. Product higher quality	-0.64
		89. Clear strategies market	-0.64
		42. Production resources or skills adequate	-0.61
		71. First to market	-0.61
		45. Clear strategies resource requirements	-0.57
		40. Marketing research skills and people adequate	-0.54
		87. Contribution margin important	-0.54
		53. Product "fit in"	-0.47
		69. Customers satisfied with competitors' products	0.31
		35. Product done better if marketed by competitors	0.57

NOTE: *italicized* = variables common to both successes and failures. $p < .05$.

TABLE 4
Factor Analyses

T_0 Factors	Eig	% Var	Cum %	Alpha/Mean Loading
1: Dynamic change in fast growing market	8.88	11.8	11.8	.8289/.6397
2: Strategic reaction capability	5.45	7.3	19.1	.8349/.6583
3: Overall project/company resource compatibility	4.94	6.6	25.7	.8209/.6587
4: New to the firm, did not fit in	3.23	4.3	30.0	.8022/.6963
5: First in new, highly innovative market	2.87	3.8	33.8	.7842/.6917
6: Superior unique product meeting needs in large market	2.8	3.7	37.6	.6662/.5707
7: Alertness to threat of competitive retaliation	2.2	2.9	40.5	.8225/.7699
8: Technological resource adequacy	2.0	2.6	43.1	.7878/.7192
9: Satisfied, competitive market	1.9	2.5	45.6	.6291/.5710
10: Exogenous timing variables	1.76	2.4	48.0	.6448/.6603
11: Moderate innovation	1.65	2.2	50.2	.6196/.6576
12: Incremental innovation	1.57	2.1	52.3	.5564/.5947
13: Innovative strategy in highly competitive market	1.52	2.0	54.3	.8351/.8755
14: Late market entry	1.41	1.9	56.2	.6532/.7352
15: Differentiation barriers	1.39	1.9	58.1	.5/.5927
16: Product market history of kills and success	1.28	1.7	59.8	.7492/.8364
17: Product market history of failure	1.25	1.7	61.5	1.0/.8750
T_1 Factors	**Eig**	**% Var**	**Cum %**	**Alpha/Mean Loading**
1: Dynamic change	10.14	13.3	13.3	.8572/.6752
2: Strategic reaction capability	5.17	6.8	20.2	.8577/.6701
3: Superior product in large rapid growth market	5.12	6.7	26.9	.8223/.5839
4: Technological resource compatibility (synergy)	3.39	4.5	31.4	.8220/.6450
5: New to the firm, did not fit in	2.97	3.9	35.3	.7879/.6895
6: First in new, highly innovative market	2.54	3.3	38.6	.7932/.7016
7: Marketing and management resource compatibility (synergy)	2.25	3.0	41.6	.8063/.6631
8: Alertness to threat of competitive retaliation	2.03	2.7	44.3	.8137/.7552
9: Exogenous timing variables	1.98	2.6	46.9	.6577/.6360
10: Intense market competitiveness	1.89	2.5	49.3	.7083/.7501
11: Satisfied customer with dominant competitor	1.64	2.2	51.5	.5397/.5780
12: Moderate level of product innovation	1.59	2.1	53.6	.5777/.6382
13: Financial barriers	1.50	2.0	55.6	.6122/.5634
14: Product market history of kills and success	1.41	1.8	57.4	.7492/.8526
15: Product market history of failure	1.29	1.7	59.1	1.0/.83617
16: Incremental innovation	1.27	1.7	60.8	.5572/.7016
17: Relative high price of product	1.16	1.5	62.3	1.0/.7590

NOTE: Eig = Eigenvalue; % Var = individual factor percentage of variance; Cum % = cumulative percentage of variance.

TABLE 5
Regression Models

T_0 Factors	Reg Coef	F
Product market history of failure	1.1146	48.01
Strategic reaction capability	.7004	18.96
New to the firm, did not fit in	-. 6449	16.08
Product market history of kills and success	.5861	13.27
Alertness to threat of competitive retaliation	.4375	7.40
Late market entry	-. 4101	6.50
Overall project/company resource compatibility	.3268	4.13
Superior unique product meeting needs in large rapid growth market	.3175	3.90
(Constant)	1.6718	
T_1 Factors	**Reg Coef**	**F**
Strategic reaction capability	1.0968	59.78
Product market history of failure	1.0507	54.86
Superior product in large rapid growth market	.8007	31.87
New to the firm, didn't fit in	-.7176	25.59
Relative high price of product	-.5577	15.46
Product market history of kills and success	-.5420	14.60
Marketing and management resource compatibility (synergy)	.3992	7.92
Alertness to threat of competitive retaliation	.3728	6.91
Technological resource compatibility (synergy)	.3026	4.55
First in new, highly innovative market	.2922	4.24
(Constant)	1.6719	

NOTE: Reg Coef = Linear regression coefficients.
a. T_0 initial screening model fit statistics: R=.5659, R^2= .3202, Adjusted R^2=.2986, F =14.7807 at .0000, d.f.=8, Standard error = 2.5887, Accuracy = 81.1538%.
b. T_1 one-year post launch model fit statistics: R=.6896, R^2=.4756, Adjusted R^2=.4545, F =22.5794 at .0000, d.f.=10, Standard error = 2.2829, Accuracy = 83.8462%.

are far worse for entry failures. Similarly, the decrease in innovation levels for failed projects is 3.6 times that for successes (-.83/-.23). This pattern is repeated by successful team emphases on R&D and distribution activities and failed team de-emphases of market research, engineering, and production activities. Obviously, failures enter later into financially less attractive markets with less innovative products. Then they compound their initial error by not reacting well to changing market conditions while their successful counterparts do.

Model Differences

The regression functions changed structurally over time, suggesting that we captured phenomena missing in single-stage work. Model validity improved from F=14.8 at T_0 to F=22.6 at T_1, as standard error improved from 2.58 to 2.28 (Table 5). The average F score of 18.7 and error of 2.43 is modestly better than NewProd's 16.83 and 2.73. This improvement, and a better T_1 Adjusted R^2 of .454 (versus NewProd's .395), probably resulted from reduced measurement error.

T_0 dimensions are logical, resemble the early stages of the Booz, Allen framework, and recommend early, honest appraisal of past product market experience and adaptation thereafter. Fewer initial screening factors require less expensive early information and are more appropriate early on than NewProd. By contrast, the T_1 model grows to look more like NewProd because of its later benchmark. Except for *late market entry*, which evolves into *first in*, all T_0 factors are repeated in different order in the T_1 model. T_0 deterministic *history* becomes less so over time. The stochastic *strategic reaction* becomes the key to success at T_1. Understandably, the negatives associated with *newness* and *competitive threat* decline in importance as better information is revealed. *Superior product*, in last place at T_0, rises to third place by T_1. This suggests that product superiority is an evolving construct co-varying with other evolving constructs, e.g., with entry order, innovativeness, and cross-functional integration. *Overall resource compatibility* at T_0 splits into two more precise functions at T_1- *marketing/management synergy* and *technological synergy*. Unmistakably, successful teams adjust R&D, manufacturing, collaboration, and marketing effort to changing competitive and technical conditions.

MANAGERIAL IMPLICATIONS

NPD activity evolution supports new research into dynamic modeling techniques. However, managers can improve their success rates immediately by applying three simple lessons from this research:

1. Those who do not benchmark past variable histories are condemned to repeat them.

To overcome a history of failure and/or to build on past success, teams must honestly assess the impact of variables associated with past efforts. Managers should build simple longitudinal databases using the variables outlined in Tables 3a and 3b. This will provide them with real time NPD statistical process control and an early failure warning system to reduce resource waste.

2. Apply gap diagnosis to benchmarked variables

Managers should heed Crawford's advice to:

> Accept today's evaluations for what they are: estimates of what we will be able to do, later, in a changing environment, with the advantage then of information yet to surface, and with the option to change much of what we currently plan to do. (1986, p. 54)

Figure 2 illustrates how successful managers instinctively apply Ansoff's concept of strategic diagnosis to develop clear strategies for counteracting project deficiencies. The positive impact of continuous learning and appropriate reaction cannot be overestimated.

3. Model size and timing matter

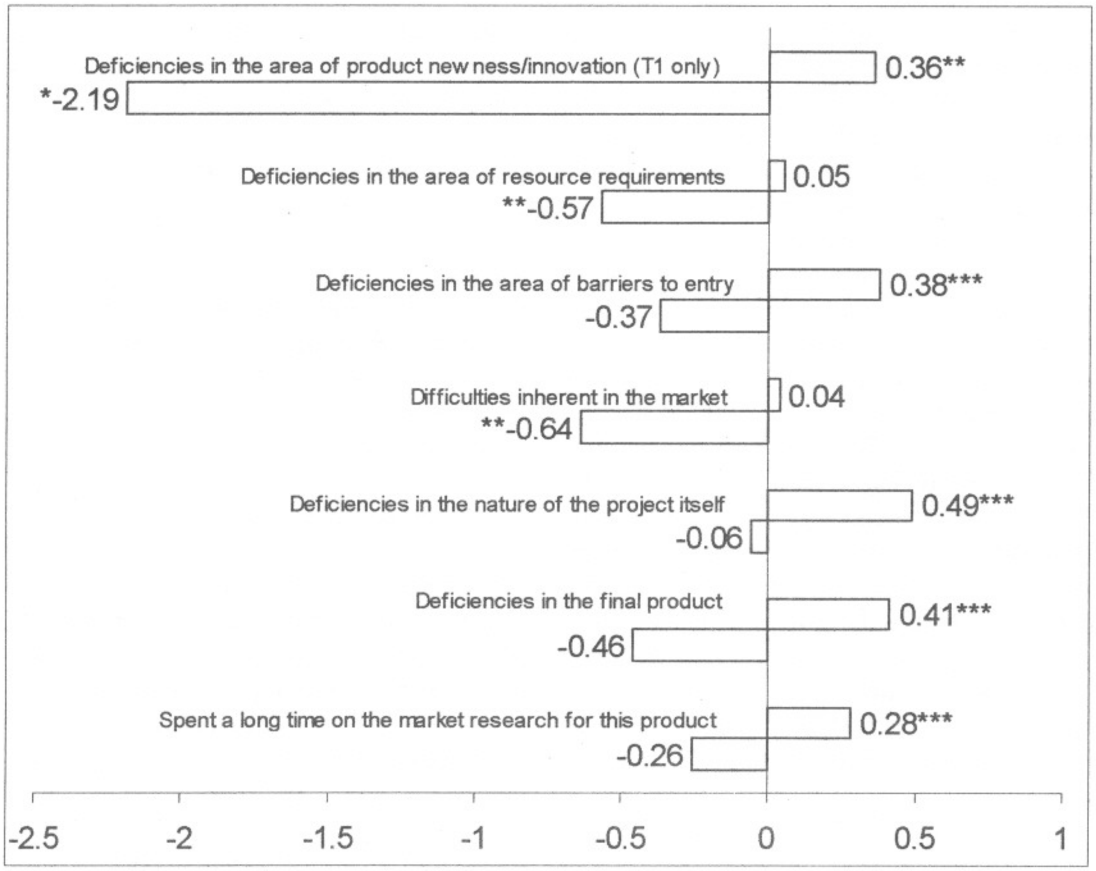
An NPD model's size, its informational requirements, and when it is employed really matter. Who can blame frustrated managers for not using "one size fits all" models prescribing screening, entry, and long-term NPD activity? They undercount key early NPD phenomena and underestimate *entry order*, *innovativeness*, and *competition,* ingredients intuitively obvious to successful managers. Contrarily, smaller short-term models either overlook, or incorrectly emphasize, dimensions critical to long-term success. Managers should choose smaller models early on when information is uncertain or unknown and larger, information-hungry models later on when data are more available and less expensive. Indeed:

> As the project progresses from stage to stage, changes occur in accordance with certain specific trends (increase in the scope of work, content, cost and time; decrease in risk and uncertainty). (Albala 1975, p. 159)

LIMITATIONS AND FUTURE RESEARCH

Accounting for short-term failure phenomena allowed demonstration of two success/failure models exhibiting less measurement-timing error than

Figure 2
Strategic Reaction
Developed Clear Strategy to Deal With:



NOTE:
Difference in mean values over time (T_1 - T_0); *** p=.001; **; p=.05; * p=.1.

NewProd. However, the method presented here fails to account for projects judged differently later in the process. Also, duplicating NewProd's orthogonal linear additive method overlooks environmental covariance (Song and Parry 1997), thus isolating only independent direct factor effects. Future research should apply correlational oblique methods to new one-to five-year post launch benchmarks.

Structural equation modeling to measure direct, indirect, and total success/failure effects is also recommended. This would extend the work of Song and Parry, Calantone and Di Benedetto (1990), and Song, Souder and Dyer (1997), and will be more beneficial than simply re-confirming obvious long-term direct independent success factors. Certainly, more of the same will not advance the debate, encourage practitioner utilization, or reduce the failure rate.

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