# Product Development and Management Association's 2012 Comparative Performance Assessment Study

**Article** *in* Journal of Product Innovation Management · May 2013

DOI: 10.1111/jpim.12025



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J PROD INNOV MANAG 2016;33(S1):3–19

DOI: 10.1111/jpim.12358

# PDMA Comparative Performance Assessment Study (CPAS): Methods and Future Research Directions

Hyunjung Lee and Stephen K. Markham

*Best practices data are critical for managing and researching new product development. For these purposes the PDMA Research Foundation conducted the 2012 PDMA Comparative Performance Assessment Study (CPAS). This article reports the use of the CPAS data among product development researchers and provides a complete description of the data gathering and cleaning process needed to write additional articles using these data, including other articles in this special issue. This article also reports important results of the CPAS data, makes comparisons between the Best and the Rest firms, and makes comparisons among firms by geography, industry, product/technology/market types, and company size. The results offer insights for academics and practitioners to conduct further research and to find potential new product development best practices.*

## Practitioner Points

- Comparative research in NPD best practices is critical for companies to benchmark the Best firms to result in higher performance.
- Firms are required to adjust their practices based on solid data and their specific environments to increase new product success rather than simply follow commonly held beliefs about product development practices.
- Firms must be careful to interpret and develop practices by linking culture, activities, and performance. Geographical differences among countries are distinct and Asian companies show numerous differences in NPD practices from Western countries.
- Decision-making at the front-end and later development stages in NPD should be approached differently. New product development time in the front-end is increasing while overall cycle time reduction was observed.

## Introduction

Product development success depends on a multitude of factors: global competition, new technologies, partnerships, intellectual property, and social media—just to name a few—all contribute to the seemingly insurmountable task of trying to stay current on all the factors needed for new product success. The amount of time required just to read about all the new topics is challenging. Aggregating the literature and then determining the most important aspects of all the new tools and techniques require a prohibitive amount of time for product development practitioners. Comparative research dedicated to new product development best practices is critical for managers to stay current and for companies to stay competitive.

This special issue of the journal demonstrates how product development scholars can access an extensive data set to formulate research questions that build management methods and test their effectiveness. Best practices studies in new product development (NPD) have been conducted for nearly 50 years, even as business environments continue to change (Table 1). The purpose of comparative performance studies is to enable firms to adjust their practices based on solid data in order to increase new product performance.

The most recognized examples of NPD best practice studies are those sponsored by Booz Allen Hamilton (BAH), the American Productivity and Quality Center (APQC), and the Product Development and Management Association (PDMA). BAH conducted the first best practices study with 50 firms in 1968 and produced ground-breaking results (Booz Allen Hamilton, 1968). BAH conducted the second investigation in 1982 with 150 interviews and 700 U.S. manufacturers (Booz Allen Hamilton, 1982). The primary BAH findings included delineation of a 6- (and then 7-) stage NPD process and development and dissemination of the concepts and outcomes for the "mortality curve" and

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**Table 1. NPD Best Practices Studies**

| Year | Sponsor | Study |
|---|---|---|
| 1968 | Booz Allen Hamilton | BAH Report (1968) |
| 1982 | Booz Allen Hamilton | BAH Report (1982) |
| 1990 | PDMA (1st PDMA Best Practices Study) | Page (1993) |
| 1995 | PDMA (2nd PDMA Best Practices Study) | Griffin (1997a, 1997b) |
| 2004 | APQC | Cooper, Edgett, and Kleinschmidt (2004a, 2004b, 2004c) |
| 2004 | PDMA (3rd PDMA CPAS) | Barczak, Griffin, and Kahn (2009) |
| 2012 | PDMA (4th PDMA CPAS) | Markham and Lee (2013) |

"newness-to-market/newness-to-firm" portfolio management grid. The APQC undertook a qualitative best practices study with five U.S. businesses and a quantitative study with 105 business units (Cooper, Edgett, and Kleinschmidt, 2004a, 2004b, 2004c). The PDMA Best Practices Study first differentiated the practices of the "Best" compared with the "Rest" firms in 1995 (Griffin, 1997b).

The PDMA's efforts have led to a series of NPD best practices studies since 1990 (Barczak, Griffin, and Kahn, 2009; Griffin, 1997b; Markham and Lee, 2013; Page, 1993). Using a variety of NPD metrics that have been stable over time, the PDMA's best practices studies provide a comprehensive view of the NPD environment.

This article provides an in-depth description of the collection and preparation of the data from the 2012 PDMA CPAS. The purpose of this article is to support the use of the CPAS data among product development researchers. The CPAS data are available to PDMA academic researchers who enter into a research agreement that asks them to protect the data and coordinate topics with other researchers. This article is intended to provide a comprehensive description of the data set so that it can be used by other researchers. All of the articles in this special issue draw on this common methods description. While each article must still provide its own measure development section, the basic description of the data is found in this article. A brief description of each article included in this Special Issue follows.

Eling, Griffin, and Langerak, in their study about idea selection at the fuzzy front end, investigate whether a formal process is beneficial for selecting radical and incremental new product ideas. The results show that the highest idea success rate is found when the vast majority of both radical and incremental ideas are selected for advancement through a formal process. The authors confirm that a firm's idea success rate can be maximized when a formal process is consistently used across different new product idea types.

In another study of NPD ideas, Gurtner and Reinhardt argue that ambidexterity plays an important role in the idea generation stage and explore the antecedents that enable firms to actively generate both radical and incremental ideas. The authors found that ambidextrous idea generation influences the success of NPD programs, but it does not affect competitive or financial success. They also indicate that customer orientation and openness play critical roles and expect an inverted U-shaped effect of ambidextrousness on idea generation.

In an article on sustainability, social media, and NPD performance, Du, Yalcinkaya, and Bstieler build a conceptual model to examine how sustainability and social media orientation increase NPD performance. The research findings suggest a positive impact of sustainability orientation on NPD performance. They further show that customer focus plays a partial role as a mediator in the relationship between sustainability orientation and NPD performance, and social media enhances the link between customer focus and NPD performance.

Similarly, Claudy, Peterson, and Pagel investigated the relationship among sustainability, market knowledge competence, and NPD success founded on the

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resource-based view of the firm. They indicate that higher levels of sustainability orientation develop greater knowledge about both customers and competitors that consequently facilitates NPD success.

Next, in an article about global strategy and NPD program success, Dubiel, Durmusoglu, and Gloeckner focus on how firms achieve NPD success in a global competitive environment. Founded on a resource-based view and Kotabe's generic model for market success, the authors state that NPD success is not a direct outcome of a vast international operational presence, but that global discovery management practices are critical factors to enhance a firm's NPD program success.

Carbonell and Rodriguez-Escudero investigate the relationship between a firm's strategy and portfolio management and how they affect NPD success. They particularly focus on the importance of linking NPD portfolio planning to the decentralization of strategy-making, which leads to the success of NPD programs. The authors conclude that the combination of top-down intentions with bottom-up initiatives in strategy-making maximizes the effectiveness of NPD portfolio planning. The findings suggest that national culture, individualism, and power distance have significant moderating effects on the relationship between decentralization in strategy-making and NPD portfolio planning.

Roberts, Piller, and Luttgens build hypotheses concerning the ways social media as a source of external knowledge can contribute to NPD performance. The results indicate that utilizing information about customers and technical solutions from social media channels can lead to better performance. They further found that a formal NPD process has an impact on the link between social media and the performance for incremental and more innovative projects. The authors suggest that firms need to build a clear social media strategy and understand the different platforms for using various types of information at each stage of the NPD process.

The final two articles offer insights into the impact of culture on NPD. First, Obal, Kannan-Narasimhan, and Ko examine the mechanisms whereby internal and external relationship quality affect new product outcomes in different types of innovation. The results indicate that process flexibility through relationship quality is an important driver of project execution success, which increases NPD market success for both radical and incremental innovations; however, they argue that each innovation type should follow different development pathways to achieve market success.

In a study of social cohesion on NPD, Shaner, Beeler, and Noble investigate the antecedents and outcomes of within-team, between-team, and between-firm cohesion. The findings show that different levels of social cohesion are influenced differently by organizational culture and leadership. The results also indicate that within-team and between-team social cohesion positively drive NPD performance while between-firm social cohesion is not significantly related to the performance. In addition, the authors explore how three levels of social cohesion have different impacts on the performance across goods- and services-centric firms.

These and more topics can be researched using the CPAS data. The final section of this article describes a model where each of the above articles fit into a larger research agenda. Before presenting and discussing the results, this article briefly reviews the history of PDMA best practices studies, including how the current CPAS survey was developed and how the survey data were prepared. It is hoped that researchers will use these data extensively and that they will rely on the basic description of the data and methods provided by this article as a starting point.

## The History of PDMA Best Practices Study

As the premier global advocate for product development and management, PDMA sponsors new product development best practices research. Table 2 outlines more than 20 years of PDMA best practices studies. The initial PDMA best practices study was conducted in 1990 (Burger, 1989; Page, 1993). Using data from 189 PDMA firms, this study identified norms describing product development practices and found a variety of new techniques with high impact on new product development.

In 1995, the second PDMA Best Practices Study was conducted using a comprehensive survey instrument that was developed after review of multiple sources of best practices information (Griffin, 1997b, 2002; Markham and Griffin, 1998). The survey gathered data from 383 individuals, both PDMA members and nonmembers, who were associated with firms involved in ongoing product development. This study established the practices of the "Best" NPD firms compared with the "Rest" and asked questions about a number of new NPD tools and techniques. The "Best" firms were defined in terms of seven variables that factor analyzed into three dimensions (Griffin, 1997b, 2002). First, new product program success was measured through

**Table 2. PDMA CPAS History and Results**

| | 1st PDMA Best Practices Study | 2nd PDMA Best Practices Study | 3rd PDMA CPAS | 4th PDMA CPAS |
|---|---|---|---|---|
| Year | 1990 | 1995 | 2004 | 2012 |
| Sample | 189 business unit PDMA members North America | 383 business unit PDMA members and non-members North America | 416 business unit PDMA members and non-members North America | 453 business unit PDMA members and non-members 24 countries |
| Framework | • NPD process<br>• Measure of NP performance<br>• Obstacles and performance | • NPD process<br>• Organizing for product development<br>• Product development measurement and expectations<br>• Outcomes | • NPD process<br>• The fuzzy front end and portfolio management<br>• Organizing for product development<br>• Development tools and methodologies<br>• Outcomes<br>• Background<br>• Summary and comments | • Culture<br>• Strategy<br>• Portfolio management<br>• NPD process<br>• The front end of innovation<br>• Development tools<br>• Measure and metrics<br>• Outcomes<br>• Background<br>• Summary and comments |
| New | • NPD techniques and tools | • The Best vs. the Rest | • Radical/More innovative/Incremental<br>• Fuzzy front end<br>• Portfolio management<br>• Hard copy and electronic data collection | • Electronic data collection<br>• Social media<br>• Sustainability<br>• Open innovation<br>• Services<br>• Culture<br>• Global strategy |
| Results | | | | |
| • Success | 58.0% | 59.0% | 59.0% | 61.0% |
| • Success-profits | 55.0% | 54.6% | 54.2% | 56.1% |
| • Sales from new products | 32.6% | 32.4% | 28.0% | 31.1% |
| • Profits from new products | 33.2% | 30.6% | 28.3% | 30.8% |
| • Number of ideas for one success | 11.0 | 6.6 | 7.2 | 8.7 |
| • New product strategy established | 56.4% | 62.7% | 74.0% | 59.6% |
| • Formal NPD process used | 54.5% | 60.0% | 69.0% | 48.9% |
| • Structured portfolio management | N/A | N/A | 55.0% | 70.8% |

two items: (1) our new product program meets the performance objectives set out for it, and (2) overall, our new product program is a success. Second, new product success compared with competitors was measured through one item: (3) please mark the one phrase best describing your business unit's overall new product success as compared with your primary competitors over the past 5 years: the most successful in our industry, in the top third of our industry, in the middle third of our industry, or in the bottom third of our industry. Third, new product market/financial success over the past 5 years was measured through four items: (4) average new product sales as a percent of total sales, (5) average new product profits as a percent of total profits, (6) percent successful of all the new products introduced into the market based upon your business unit's definition, and (7) percent successful in profitability of all the new products introduced into the market based upon your business unit's definition.

The PDMA Research Foundation was established as an independent research arm of PDMA in 2000 and has continued the PDMA Best Practices research, which was re-named the PDMA Comparative Performance Assessment Study (CPAS). In 2003, the third PDMA CPAS was conducted, providing data from 416 respondents in a variety of industries. The questions about new product development tools were significantly broadened and fuzzy front-end and portfolio management sections were added. A main difference from previous studies was that data were collected separately for radical, more innovative, and incremental innovations.

In 2011, the PDMA Foundation assembled an advisory committee to plan, organize, and field the fourth PDMA CPAS. The committee consisted of 24

experienced product development professionals and leading academics. It developed the survey to keep continuity with past studies (especially the outcome variables) and to include numerous new practices. The 2012 PDMA CPAS was a detailed, in-depth, benchmarking survey that was 30 pages in length with 562 different items. The survey was translated into seven languages. For each non-English language, a native speaker translated the survey into that country's language and then a professional translator translated the survey back into English. Both versions of the survey were compared and discrepancies in translation were resolved. This research added numerous new practices to the study including:

1. The use of social media in NPD.
2. Effects of sustainability on new products.
3. The practices of open innovation.
4. Characteristics of services compared with goods.
5. The global nature of product development.
6. The impact of culture on NPD.

The methods and data of the 2012 PDMA CPAS are described in the next section. The following section provides descriptive results based on various contexts.

## 2012 PDMA CPAS Survey Development

The survey was tested multiple times before fielding. First, it was administered to 18 MBA students. A number of questions were reworded to increase their clarity and to simplify instructions. Second, a hard copy of the survey was mailed to 32 NPD practitioners in the United States. Several questions again were modified to improve their clarity. Finally, the survey was transferred to an online format and tested with another set of 30 NPD practitioners (see Supporting Information). Respondents were expected to be in a central position in NPD and have the ability to collect information and to make observations from within their business units. Additional modifications to the survey were made based on the subjects' comments.

An invitation to complete the survey was sent by email to 3391 PDMA members and 21,588 PDMA contacts. The email invitation contained a link to obtain a code that allowed each respondent to access the questionnaire at Global Park's online survey tool. The Global Park tool allowed respondents to return to the survey after logging off without losing any data previously entered. It also provided access to a glossary and industry category definitions by simply clicking a link. Reminders were sent at 2-week intervals. This procedure resulted in 243 usable responses.

An additional 149 responses from Asia and 61 from Europe were obtained. In Asia, PDMA affiliates collected the data with a paper questionnaire from key respondents of each company and their answers were entered into the online version of the survey on Global Park. In Europe, PDMA affiliates also facilitated data gathering; however, the respondents used the online version. In all, surveys were received from 24 countries. A copy of the research results was sent to all the participants who provided a completed survey and webinars reviewing the results were offered to the respondents in 2013.

### *Data Cleaning Process*

A total of 1167 access codes was sent to key respondents with instructions on how to fill out the survey. All the responses were saved on Global Park and then exported to an SPSS file on August 2, 2012, in a document 4420 pages long. Four researchers—Abbie Griffin, Hyunjung Lee, Stephen Markham, and Steve Uban—reviewed the data and, based upon consensus, decided which data were to be kept and which eliminated through a two-month process that included the following decisions:

1. Of the 1167 codes sent to participants, 332 responses were eliminated because participants opened the survey but did not provide any information.
2. Of the remaining 835 responses, the 333 from respondents who did not provide data beyond the "The Front End of Innovation" section were dropped. The Front End of Innovation section begins with question 42 (about halfway through the questionnaire) and includes 18 open items. Due to the complexity of the question, numerous people exited the survey. About 502 responses survived this criterion.
3. Of the 502 remaining responses, 41 were eliminated because they omitted responses to 8 or more items in a row and did not provide performance responses for questions 64 through 67, the critical outcome data. Missing 8 in a row and not providing performance information constituted the threshold of missing data that eliminated a response from the data set.

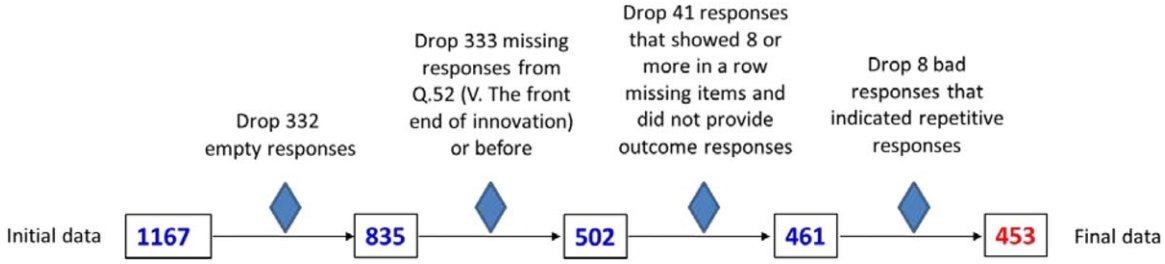


**Figure 1. Data Cleaning Process**

4. Of the remaining 461 responses, 8 were dropped because they showed a repetitive pattern in the answers (e.g., "zig-zagging," "straight-lining").
5. A total of 453 responses were kept in the final data set.

Figure 1 illustrates the entire data cleaning process.

### *Limitations of the Data*

These data have a number of limitations. First, the questionnaire was 30 pages long and included over 500 questions. This could have led to respondent fatigue and resulted in answering questions in a routine or patterned way. Each survey was carefully examined and several were eliminated for this cause.

Second, in most cases the data were provided by a single key respondent from each business unit. Thus, a whole business unit could have been misrepresented by a single person who did not share the view of the rest of the company. Instructions to the key respondents clearly asked them to elicit help from various places in the organization, particularly in areas they were not familiar with. Post-collection interviews indicated that the respondents complied with this instruction, but there is the possibility that they may not have. In 32 cases there were multiple respondents from the same business unit. A difference test was conducted on this subset to test if raters saw their units in the same way. Tests between respondents from the same business unit indicated strong inter-rater reliability.

Third, some of the dependent variable measures could have been supplied by the same people who provided predictor variable data. The same subset of duplicate business unit responses provided a chance to test the bias between independent variables and dependent variables by switching them from one respondent to the other. In no case did any of the relationships change.

Fourth, the data cleaning process could have injected an additional bias into the data. A complete description of the process is provided in this article. While the soundness of the data cleaning process seemed obvious to the aforementioned researchers, everyone is invited to form an independent opinion by obtaining the raw data and conducting a different set of procedures.

Last, many of the variables were measured with a single item. No variables used in the survey were intra-psychic or attitudinal and, therefore, were not amenable to psychometric analysis. Given the objective nature of the phenomenon being measured and the length and comprehensiveness of the survey, not creating multiple item variables was considered a prudent tradeoff. Nevertheless, a number of researchers have created multiple item measures using these data for their particular research questions.

## Descriptions and Results

Previous best practices research has identified multiple categories of results. This article presents the sample demographics and results of 2012 PDMA CPAS in the following areas: (1) demographics; (2) industry; (3) product, technology, and market types; (4) number of products commercialized; (5) product development time; and (6) success.

### *Demographics*

The sample was analyzed in terms of the Best and the Rest firms. There were 88 (24.7%) Best firms and 268 of the Rest (75.3%). Fewer than 451 responses were used in the comparison between the Best and the Rest because of missing data on items needed to make the comparison compatible with previous best practices studies. In this article, two responses were eliminated from the original sample as outliers because they reported an unrealistically high number of new

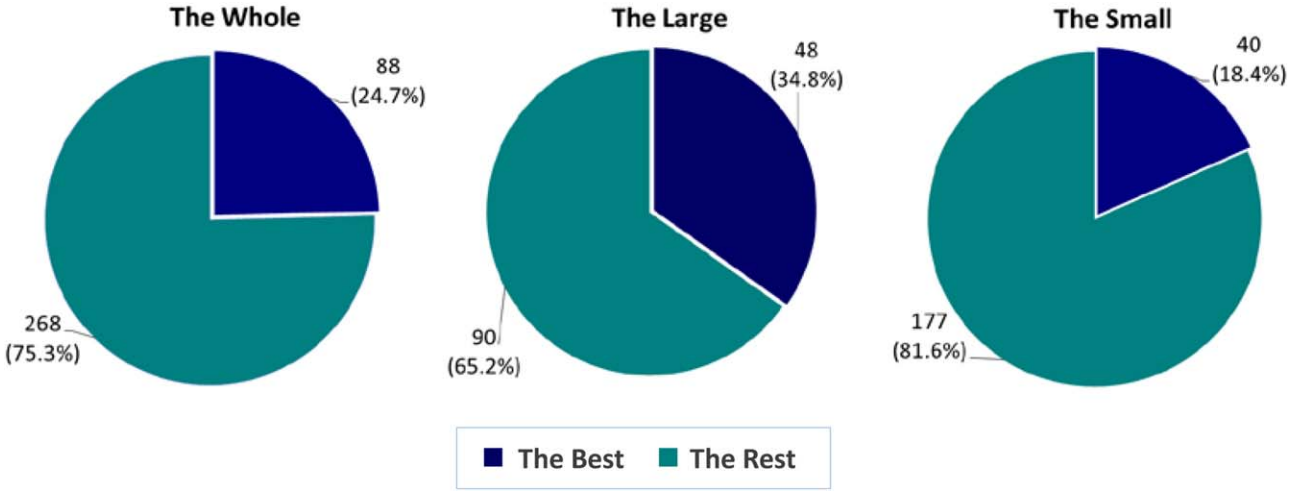


**Figure 2. The Best and the Rest: The Whole, the Large, and the Small Companies**

products commercialized for the past 5 years. These eliminations result in a number of small differences between the results reported here and those in Markham and Lee (2013).

The distribution of the Best and Rest in the large and small firms is distinct. Large firms have revenue equal to or greater than $100 million per year, while the small have less than $100 million in revenue. In the large firms, the Best and Rest are 48 (34.8%) versus 90 (65.2%); in small companies only 18.4% are classified as the Best, while the remaining 81.6% are the Rest (Figure 2). Small companies are often touted as being more innovative, but is that really the case? Further analysis of the CPAS data will allow researchers to explore differences in how product development is conducted in both large and small companies.

Figure 3 shows the geographical distribution of the respondents. Most of the data came from North America (197 surveys), followed by Asia (149), Europe (61), and others (44). The 44 data in the "others" category are not used for geographic comparisons, which means only 407 data points are used for geographic comparisons in this study. The majority of current NPD research is based on North America and Western European countries, albeit current innovation research shows that country effects do exist (Barczak, 2012). Nakata and Sivakumar (1996) indicated that, although national culture and NPD have a close relationship, it has been largely neglected in the literature. Thus, the CPAS data provide researchers with the opportunity to explore geographical differences in NPD.

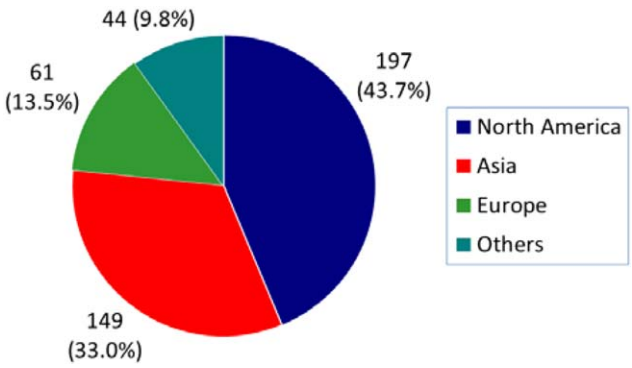


**Figure 3. Country Distribution**

Geographical comparisons between the Best vs. the Rest and between large versus small firms are illustrated in Figure 4. There are 20 (18.7%) Best firms versus the Rest of the 80 firms (81.3%) and 34 (22.8%) large versus 115 (77.2%) small firms in Asia (49 firms did not provide enough data to be calculated into the Best and the Rest). In North America, large and small firms are somewhat similarly distributed (47.7%, 52.3%), but only 29.2% are the Best compared with the 70.8% of companies classified as the Rest. The percentage of the Best companies is still highest in North America, while they constitute only 18.7% of the firms in Asia and 26.4% in Europe. European companies are distributed as 41.0% of large and 59.0% of small companies. Researchers can use the data to further study the interaction between size and geography.

### *Industry*

A total of 31 industry categories were identified in the survey, which were grouped into 11 meta-categories

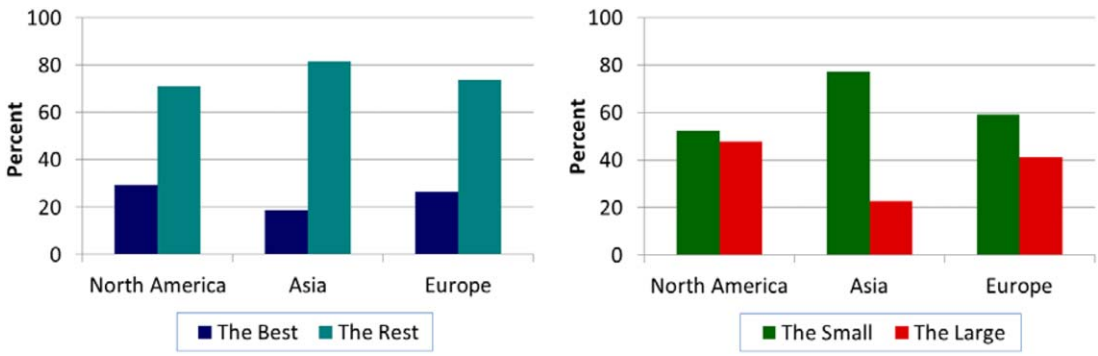


**Figure 4. Geographical Differences: The Best Versus the Rest, the Small Versus the Large**

for the analysis (Table 3). A number of companies reported that they do business in multiple industries. There are numerous references to industry differences in the literature, but there is very little research that demonstrates how those differences are reflected in alternative product development practices. The CPAS data will allow researchers to compare NPD practices both across industry and for cases where firms have single versus multiple lines of business.

Table 4 indicates how the industries are distributed for the Best and the Rest. The highest percentage of the Best firms are in software and services (36.4%)

**Table 3. Industry Distribution**

| Industry | | Number | % |
|---|---|---|---|
| Capital Goods | Capital Goods | | |
| | • Aerospace and Defense | 9 | 1.6 |
| | • Electrical Equipment | 31 | 5.6 |
| | • Other capital goods | 19 | 3.4 |
| | Automobiles and Components | 31 | 5.6 |
| | Consumer Durables and Apparel | 6 | 1.1 |
| Chemicals and Materials | Chemicals | 31 | 5.6 |
| | Construction Materials | 19 | 3.4 |
| | Metals and Mining | 14 | 2.5 |
| | Containers and Packaging | 7 | 1.3 |
| | Paper and Forecast Products | 3 | 0.5 |
| Industrial Services | Industrial Services and Supplies | 27 | 4.9 |
| | Transportation | 20 | 3.6 |
| | Energy | 15 | 2.7 |
| | Utilities | 1 | 0.2 |
| Technology Hardware and Equipment | | 62 | 11.2 |
| Software and Services | | 59 | 10.6 |
| Consumer Services | Telecommunications Services | 25 | 4.5 |
| | Banks | 9 | 1.6 |
| | Media Publishing and Broadcasting | 9 | 1.6 |
| | Diversified Financials | 5 | 0.9 |
| | Insurance | 2 | 0.4 |
| | Hotels, Restaurants, and Leisure | 1 | 0.2 |
| Health Care | Health Care Equipment and Services | 28 | 5.0 |
| | Pharmaceuticals and Biotechnology | 13 | 2.3 |
| Fast-moving Consumer Goods | Food, Beverage, and Tobacco | 14 | 2.5 |
| | Household and Personal Products | 12 | 2.2 |
| Non-for-profit | | 20 | 3.6 |
| Retailing | Food and Drug Retailing | 2 | 0.4 |
| | Retailing (Other than Food and Drug) | 4 | 0.7 |
| Real Estate | | 4 | 0.7 |
| Other | | 54 | 9.7 |
| Total | | 556* | 100% |

*The number of responses is 556 because it includes respondents who indicated multiple industries.

**Table 4. Industry Distribution: The Best and the Rest**

| | The Best | | The Rest | |
|---|---|---|---|---|
| | Number | % | Number | % |
| Capital Goods | 20 | 27.4 | 53 | 72.6 |
| Chemicals and Materials | 10 | 18.5 | 44 | 81.5 |
| Industrial Services | 8 | 18.2 | 36 | 81.8 |
| Technology Hardware | 15 | 30.0 | 35 | 70.0 |
| Software and Services | 16 | 36.4 | 28 | 63.6 |
| Consumer Services | 7 | 18.9 | 30 | 81.1 |
| Health Care | 8 | 23.5 | 26 | 76.5 |
| Fast-Moving Consumer Goods | 6 | 26.1 | 17 | 73.9 |

and in technology hardware (30.0%). The lowest percentage of Best firms is in the industrial services category (18.2%).

Industry distribution in different geographies is shown in Table 5. About one third of the Asian companies are in capital goods (31.2%), and only 3.9% of Asian companies are in the fast-moving consumer goods and health care industries. Firms in North America and Europe are relatively evenly distributed. Again, research opportunities to explain and predict geographical interactions with industry and size are suggested.

### *Product, Technology, and Market Types*

Table 6 shows the sample demographics for product, technology, market types, and company size (see Markham and Lee, 2013, for details). Both the Best and Rest firms have about twice as many goods manufacturers as services firms, and more firms are in the business-to-business market than in primarily consumer or the mixed market of consumer and business-to-business. More than half of the Best firms are from high-tech industries (59.1%), compared with mixed-tech (23.9%) or low-tech industries (17.0%). The Rest are somewhat similarly characterized for high-tech and low-tech firms (40.8% vs. 35.8%). Future research can investigate how best practices can be transferred from one product/technology/market type to another.

All of the North American, Asian, and European samples have a higher percentage of smaller, primarily manufactured goods producers selling in business-to-business markets (Table 7). The Asian sample has more than three times as many high-tech companies as low-tech companies (52.7%, 15.1%). North American firms are undifferentiated in technology base (40.0%, 36.4%).

### *Number of Products Commercialized*

In this study the companies introduced an average of 54.9 new products into the market over the 5 years before the survey, while the median value was only 10 new products (Table 8). Of 379 respondents who answered this question, 199 responses (52.5%) showed that they commercialized 10 or fewer new products. The Best firms commercialized about four times as many new products as the Rest (121.5 vs. 36.1).

There is a stark difference between North America and Asia and between Asia and Europe concerning the number of new products commercialized. While North America averaged 74.3 and Europe averaged 73.6 new products commercialized during the 5 years prior to the study, Asian firms reported 24.5 new products in the same time period, as Table 8 illustrates. In addition, the length of the product life cycle in Asia was significantly shorter than in either North America or Europe.

The numbers of new products commercialized in different industries varied significantly (Table 9). While the technology hardware firms commercialized an average of 86.8 products, the consumer services firms reported only 17.9. Similarly, primarily goods manufacturers, mixed firms of both goods and

**Table 5. Industry Distribution: Geography**

| | North America (NA) | | Asia (A) | | Europe (E) | |
|---|---|---|---|---|---|---|
| | Number | % of NA | Number | % of A | Number | % of E |
| Capital Goods | 28 | 14.4 | 48 | 31.2 | 13 | 20.3 |
| Chemicals and Materials | 33 | 16.9 | 17 | 11.0 | 11 | 17.2 |
| Industrial Services | 27 | 13.8 | 11 | 7.1 | 10 | 15.6 |
| Technology Hardware | 18 | 9.2 | 34 | 22.1 | 6 | 9.4 |
| Software and Services | 26 | 13.3 | 17 | 11.0 | 9 | 14.1 |
| Consumer Services | 24 | 12.3 | 15 | 9.7 | 4 | 6.3 |
| Health Care | 25 | 12.8 | 6 | 3.9 | 6 | 9.4 |
| Fast-Moving Consumer Goods | 14 | 7.2 | 6 | 3.9 | 5 | 7.8 |

**Table 6. Sample Demographics: The Best and the Rest**

| | | The Best (B) | | The Rest (R) | | Total (T)* | |
|---|---|---|---|---|---|---|---|
| | | # | % of B | # | % of R | # | % of T |
| Product Type | Goods | 51 | 58.6 | 136 | 54.8 | 222 | 55.8 |
| | Mix | 9 | 10.3 | 48 | 19.4 | 68 | 17.1 |
| | Services | 27 | 31.0 | 64 | 25.8 | 108 | 27.1 |
| Technology Base | High tech | 52 | 59.1 | 106 | 40.8 | 200 | 45.6 |
| | Mix | 21 | 23.9 | 61 | 23.5 | 112 | 25.5 |
| | Low tech | 15 | 17.0 | 93 | 35.8 | 127 | 28.9 |
| Market | Consumer | 31 | 35.2 | 73 | 28.0 | 130 | 29.7 |
| | Mix | 8 | 9.1 | 42 | 16.1 | 62 | 14.2 |
| | B2B | 49 | 55.7 | 146 | 56.0 | 246 | 56.2 |
| Sales | < $100M | 40 | 45.5 | 177 | 66.3 | 285 | 63.3 |
| | > =$100M | 48 | 54.5 | 90 | 33.7 | 165 | 36.7 |

*Total = the Best (88) + the Rest (268) + Others (95).

services, and primarily services firms show clear differences in the numbers of products commercialized. Mixed firms commercialized only 21.8 new products during the 5 years prior to the study, while goods producers commercialized 70.2 and services firms commercialized 51.6. This may be different than reports of service firms delivering more offerings to the market than goods companies. Goods producers also had a significantly longer product life cycle than mixed firms. Primarily high-tech, mixed-high, and low-tech; and primarily low-tech firms had relatively even numbers of new products commercialized, but low-tech firms had significantly longer product life cycles than either high-tech or mixed-tech firms. Mixed consumer and business-to-business firms, along with small firms, showed significantly shorter product life cycles than other firms. Firms may have different approaches for successful new product commercialization and product life cycle depending on their industry, product, and market types.

**Table 7. Sample Demographics: Geography**

| | | North America (NA) | | Asia (A) | | Europe (E) | |
|---|---|---|---|---|---|---|---|
| | | # | % of NA | # | % of A | # | % of E |
| Product Type | Goods | 101 | 54.3 | 68 | 53.5 | 38 | 67.9 |
| | Mix | 18 | 9.7 | 46 | 36.2 | 4 | 7.1 |
| | Services | 67 | 36.0 | 13 | 10.2 | 14 | 25.0 |
| Technology Base | High tech | 78 | 40.0 | 77 | 52.7 | 28 | 45.9 |
| | Mix | 46 | 23.6 | 47 | 32.2 | 9 | 14.8 |
| | Low tech | 71 | 36.4 | 22 | 15.1 | 24 | 39.3 |
| Market | Consumer | 54 | 27.7 | 46 | 31.7 | 14 | 23.0 |
| | Mix | 14 | 7.2 | 36 | 24.8 | 10 | 16.4 |
| | B2B | 127 | 65.1 | 63 | 43.4 | 37 | 60.7 |
| Sales | <$100M | 103 | 52.3 | 115 | 77.2 | 36 | 59.0 |
| | >=$100M | 94 | 47.7 | 34 | 22.8 | 25 | 41.0 |

**Table 8. Numbers of New Products Commercialized and Product Life Cycle**

| | | Number of NP commercialized (5 year)[a] | Length of product life cycle |
|---|---|---|---|
| 2012 | | 54.9 | 7.0 |
| Performance[1] | The Best | 121.5 | 7.3 |
| | The Rest | 36.1 | 7.3 |
| Geography[2] | North America | 74.3 | 8.9 |
| | Asia | 24.5 | 4.0 |
| | Europe | 73.6 | 8.4 |

NP, new product.
[1a]T-test: $F = 22.9$, $df = 89.7$, $p = 0.035$.
[2a]ANOVA: $F$ (2, 403) = 18.42, $p = 0.000$.

## *Product Development Time*

Responses from the Best firms show longer product development cycle times for all three levels of innovation—radical, more innovative, and incremental—than the Rest (Table 10). At the same time, the Best firms

**Table 9. Numbers of New Products Commercialized and Product Life Cycle**

| | | Number of NP commercialized (5 years)[a] | Length of product life cycle[b] |
|---|---|---|---|
| Industry | Capital Goods | 47.3 | 6.6 |
| | Chemical and Materials | 73.6 | 11.2 |
| | Industrial Services | 35.5 | 9.1 |
| | Tech. Hardware | 86.8 | 4.6 |
| | Software and Services | 79.5 | 4.5 |
| | Consumer Services | 17.9 | 8.8 |
| | Health Care | 35.0 | 9.5 |
| | Fast-Moving Consumer Goods | 75.6 | 8.0 |
| Product Type[1] | Primarily goods | 70.2 | 8.5 |
| | Mix | 21.8 | 5.2 |
| | Primarily services | 51.6 | 7.6 |
| Technology Base[2] | Primarily high tech | 58.9 | 6.5 |
| | Mix | 46.2 | 5.4 |
| | Primarily low tech | 59.6 | 9.9 |
| Market Type[3] | Primarily consumer | 49.4 | 7.8 |
| | Mix | 47.9 | 4.6 |
| | Primarily B2B | 61.1 | 7.5 |
| Size[4] | Small | 32.3 | 5.9 |
| | Large | 92.1 | 9.1 |

NP, new product.
[1b]ANOVA: $F$ (2, 394) = 4.06, $p = 0.018$.
[2b]ANOVA: $F$ (2.435) = 10.86, $p = 0.000$.
[3b]ANOVA: $F$ (2, 434) = 3.68, $p = 0.026$.
[4a]$T$-test: $F = 10.42$, $df = 174$, $p = 0.018$.
[4b]$T$-test: $F = 10.06$, $df = 276$, $p = 0.000$.

**Table 10. New Product Development Time and On-Time Success**

| | | Cycle Time | | | |
|---|---|---|---|---|---|
| | | Radical[a] | More Innovative[b] | Incremental | On-Time Success |
| 2012 | | 82.0 | 57.0 | 33.2 | 48.3% |
| Performance | The Best | 87.7 | 62.6 | 34.7 | 65.8% |
| | The Rest | 77.8 | 51.9 | 32.7 | 41.9% |
| Geography[1] | North America | 97.0 | 66.3 | 35.5 | 52.9% |
| | Asia | 39.7 | 40.9 | 31.9 | 38.9% |
| | Europe | 134.6 | 66.4 | 32.7 | 43.4% |

[1a]ANOVA: $F$ (2, 302) = 31.56, $p = 0.000$.
[1b]ANOVA: $F$ (2, 326) = 7.33, $p = 0.001$.

show significantly higher on-time success rates than the Rest (65.8% vs. 41.9%). On-time success rate with product development time is important for market success since many failures are due to bad ideas or wrong timing (Griffin, 1997b).

Table 10 also shows that the cycle time for radical innovation was significantly different between North America and Asia, Asia and Europe, and Europe and North America. On the other hand, the cycle time for incremental innovation does not differ significantly across geographies. Asian firms have a significantly shorter cycle time than North America for more innovative projects (40.9 vs. 66.3), while North America has a significantly higher on-time success rate than Asia (52.9% vs. 38.9%). Currently, there are no explanations for these findings.

**Table 11. New Product Development Time and On-Time Success**

| | | Cycle Time | | | |
|---|---|---|---|---|---|
| | | Radical[a] | More Innovative[b] | Incremental[c] | On-Time Success[d] |
| Industry | Capital Goods | 73.8 | 57.4 | 33.4 | 49.1% |
| | Chemical and Materials | 100.8 | 66.1 | 33.7 | 44.4% |
| | Industrial Services | 80.6 | 55.8 | 27.4 | 42.2% |
| | Tech. Hardware | 63.8 | 42.8 | 25.6 | 43.7% |
| | Software and Services | 51.2 | 36.2 | 20.9 | 52.5% |
| | Consumer Services | 48.2 | 32.6 | 20.1 | 47.8% |
| | Health Care | 170.6 | 113.7 | 67.9 | 46.7% |
| | Fast-Moving Consumer Goods | 104.7 | 65.6 | 32.0 | 44.5% |
| Product Type[1] | Primarily goods | 108.5 | 70.0 | 39.3 | 46.4% |
| | Mix | 35.8 | 32.1 | 26.1 | 37.9% |
| | Primarily services | 59.0 | 26.1 | 26.1 | 56.7% |
| Technology Base[2] | Primarily high tech | 89.7 | 59.9 | 39.2 | 49.8% |
| | Mix | 59.3 | 49.1 | 25.5 | 47.1% |
| | Primarily low tech | 88.6 | 60.0 | 30.5 | 47.0% |
| Market Type[3] | Primarily consumer | 99.8 | 75.2 | 47.4 | 51.2% |
| | Mix | 46.6 | 33.9 | 24.6 | 36.1% |
| | Primarily B2B | 81.9 | 52.9 | 27.5 | 49.7% |
| Size[4] | Small | 65.3 | 48.3 | 29.9 | 46.4% |
| | Large | 106.6 | 70.1 | 38.2 | 51.2% |

[1a]ANOVA: F (2, 312)=24.16, p = 0.000.
[1b]ANOVA: F (2, 339)=15.34, p = 0.000.
[1c]ANOVA: F (2, 355)=4.05, p = 0.018.
[1d]ANOVA: $F$ (2, 279) = 6.69, $p = 0.001$.
[2a]ANOVA: $F$ (2, 323) = 4.03, $p = 0.019$.
[2c]ANOVA: $F$ (2, 369) = 3.31, $p = 0.038$.
[3a]ANOVA: $F$ (2, 324) = 6.82, $p = 0.001$.
[3b]ANOVA: $F$ (2, 353) = 10.78, $p = 0.00$.
[3c]ANOVA: $F$ (2. 370) = 9.23, $p = 0.000$.
[4a]$T$-test: $F = 3.06$, $df = 329$, $p = 0.000$.
[4b]$T$-test: $F = 1.76$, $df = 359$, $p = 0.000$.

**Table 12. Success Rates**

| | | # of Firms | Success[a] | Success-Profits[b] | Sales from NP[c] | Profits from NP[d] | # of Ideas from One Success |
|---|---|---|---|---|---|---|---|
| 2012 | | 451 | 61.0% | 56.1% | 31.1% | 30.8% | 8.7 |
| Performance[1] | The Best | 88 (24.7%) | 82.2% | 78.2% | 47.9% | 48.5% | 4.5 |
| | The Rest | 268 (75.3%) | 52.7% | 47.7% | 25.3% | 24.9% | 11.4 |
| Geography[2] | North America | 197 (43.7%) | 67.6% | 62.6% | 28.1% | 28.3% | 6.4 |
| | Asia | 149 (33.0%) | 48.6% | 44.5% | 38.9% | 36.7% | 14.9 |
| | Europe | 61 (13.5%) | 56.8% | 51.8% | 29.2% | 31.5% | 10.2 |

NP, new product.
[1a]*T*-test: $F = 48.02$, $df = 253$, $p = 0.000$.
[1b]*T*-test: $F = 24.36$, $df = 215$, $p = 0.000$.
[1c]*T*-test: $F = 4.48$, $df = 154$, $p = 0.000$.
[1d]*T*-test: $F = 5.36$, $df = 142$, $p = 0.000$.
[2a]ANOVA: $F\ (2, 266) = 13.23$, $p = 0.000$.
[2b]ANOVA: $F\ (2, 257) = 10.44$, $p = 0.000$.
[2c]ANOVA: $F\ (2, 342) = 5.37$, $p = 0.005$.
[2d]ANOVA: $F\ (2, 331) = 3.58$, $p = 0.029$.

Asian companies reported far fewer products introduced with shorter life cycles. Their success rates and profitability are similarly provocative. The NPD differences in Asia are dramatic and pervasive. There might be an entirely different method and mind-set for innovation in Asia. American and European innovation models may not be applicable in Asia. The CPAS data allows the investigation of a fairly comprehensive set of practices that can generate a myriad of hypotheses to determine which practices are related to reducing cycle time and increasing on-time success in different geographies.

Table 11 shows product development time and on-time success by industry, product/technology/market types, and company size. The product development times vary in different industries. The health care industry has much longer cycle times for radical, more innovative, and incremental innovation than all the other industries. This is not surprising given health care firms operate in a highly regulated environment and require rigorous clinical testing. Goods firms have significantly longer cycle times for radical innovation and more innovative projects than both primarily services and mixed-type firms, but not for incremental innovation. Clearly product and service development differ on multiple dimensions. Mixed-tech firms, with both high-tech and low-tech products, have statistically shorter cycle times than high-tech firms for both radical and incremental innovation. Table 11 also shows that consumer, mixed-consumer and business-to-business, and business-to-business firms have different product development times. Mixed firms have significantly shorter cycle times for radical innovation than either primarily consumer or business-to-business firms. On the other hand, the findings show that primarily consumer firms have significantly longer cycle times for more innovative and incremental innovation than either primarily business-to-business or mixed firms. The small firms indicated statistically shorter cycle times for radical and more innovative projects than larger firms. Identifying the practices that explain the interaction between development time, product and market types, and firm size can help companies optimize their product development efforts.

## *Success*

The 2012 PDMA CPAS found that product success rates have changed between 1990 and 2012 and indicates how they differed between the Best and the Rest as well as among geographies (Table 12).

In this sample, the three industries that showed the highest market success during the 5 years prior to the study were software and services (66.5%), capital goods (61.3%), and consumer services (60.3%), as shown in Table 13. The software and services industry also had the highest percentage of the Best firms (see Table 4). Software and services was the only industry with a success-profit rate exceeding 60%, while all other industries had less than 57%. The success-profit rate for fast-moving consumer goods was under 50%. The industry that showed the highest sales from new products was also software and services (40.7%), but capital goods showed the highest rate of profits from new products (37.3%); in contrast, industrial services firms derived only 23.3% of sales and 21.4% of profits

**Table 13. Success Rates**

| | | # of Firms | Success[a] | Success-Profits[b] | Sales from NP[c] | Profits from NP[d] | # of Ideas from One Success |
|---|---|---|---|---|---|---|---|
| Industry | Capital goods | 94 (20.9%) | 61.3% | 56.1% | 35.3% | 37.3% | 9.8 |
| | Chemical and materials | 66 (14.7%) | 56.5% | 54.5% | 25.3% | 27.9% | 11.7 |
| | Industrial services | 56 (12.4%) | 53.2% | 52.1% | 23.3% | 21.4% | 9.0 |
| | Tech. hardware | 62 (13.8%) | 54.0% | 52.4% | 37.5% | 36.4% | 9.4 |
| | Software and services | 59 (13.1%) | 66.5% | 64.2% | 40.7% | 35.5% | 7.3 |
| | Consumer services | 48 (10.7%) | 60.3% | 53.3% | 33.1% | 25.9% | 11.8 |
| | Health care | 39 (8.7%) | 59.4% | 56.1% | 25.0% | 27.5% | 7.9 |
| | FMCG | 26 (5.8%) | 52.1% | 48.9% | 25.2% | 26.0% | 6.4 |
| Product Type[1] | Primarily goods | 222 (55.8%) | 59.7% | 55.6% | 28.9% | 31.5% | 8.0 |
| | Mix | 68 (17.1%) | 50.7% | 49.0% | 37.8% | 33.5% | 14.2 |
| | Primarily services | 108 (27.1%) | 68.6% | 60.2% | 34.6% | 30.5% | 7.8 |
| Technology Base[2] | Primarily high tech | 200 (45.6%) | 61.0% | 56.5% | 35.5% | 35.4% | 9.2 |
| | Mix | 112 (25.5%) | 61.1% | 57.5% | 37.6% | 35.1% | 7.8 |
| | Primarily low tech | 127 (28.9%) | 60.8% | 54.7% | 20.7% | 22.0% | 8.6 |
| Market Type[3] | Primarily consumer | 130 (29.7%) | 64.5% | 58.9% | 33.2% | 32.2% | 8.7 |
| | Mix | 62 (14.2%) | 49.9% | 47.4% | 36.4% | 37.7% | 14.6 |
| | Primarily B2B | 246 (56.2%) | 61.8% | 56.9% | 29.2% | 28.8% | 7.7 |
| Size[4] | Small | 285 (63.3%) | 58.1% | 52.9% | 33.3% | 32.0% | 9.9 |
| | Large | 166 (36.7%) | 65.5% | 61.0% | 27.8% | 28.9% | 7.1 |

FMCG, fast-moving consumer goods; B2B, business-to-business.
[1a]ANOVA: $F$ (2, 288) = 6.66, $p = 0.001$.
[2c]ANOVA: $F$ (2, 370) = 12.99, $p = 0.000$.
[2d]ANOVA: $F$ (2. 359) = 10.43, $p = 0.000$.
[3a]ANOVA: $F$ (2, 294) = 4.41, $p = 0.013$.
[4a]$T$-test: $F = 16.03$, $df = 280$, $p = 0.018$.
[4b]$T$-test: $F = 13.68$, $df = 279$, $p = 0.014$.
[4c]$T$-test: $F = 8.22$, $df = 371$, $p = 0.048$.

from new products. To generate one product success, fast-moving consumer goods firms started with only 6.4 ideas, while consumer services firms started with 11.8 ideas and chemical and material firms started with 11.7 ideas to achieve the same effect. Research is needed to assess whether success rates are a function of the general business environment in a given industry (e.g., industry growth) or if best practices are concentrated in those industries.

Respondents from primarily services firms indicated that they achieved a higher percent of both success and success-profit rates than did primarily goods and mixed firms. Service firms had significantly higher success rates than mixed-product firms. In sales and profits from new products, mixed goods and service firms responded with higher success rates than either primarily goods or services firms. Despite this difference, all three groups of respondents were statistically undifferentiated on new product sales and profits. Mixed firms required about twice as many ideas (14.2) for one new product success than firms dealing primarily in services (7.8) or goods (8.0). Research is needed to understand the optimal tradeoff implicit in the fact that, compared with both goods and services firms, mixed-product firms had higher sales and profits from new products but lower overall success and success-profit rates.

Success rates and success-profit rates for primarily high-tech, mixed-tech, and primarily low-tech firms are similarly characterized. Low-tech firms showed significantly lower sales and profits from new products than did both primarily high-tech and mixed-tech firms. The numbers of ideas for one success did not differ, however. The only difference among primarily consumer, mixed-consumer, and primarily business-to-business firms was the success rates. Primarily consumer and business-to-business firms showed significantly better achievement than mixed consumer and business-to-business firms. Primarily consumer and business-to-business firms started fewer than 9 ideas to obtain one product success while mixed firms needed 14.6 ideas. As indicated in Table 13, large firms showed significantly higher success and success-profit rates than small firms, but small firms had higher sales and profits from new products. These results suggest that large and small company development practices may be borrowed from each other to improve NPD in both sizes of firms.

**Table 14. Potential Research Topics from the CPAS Data and the Articles Included in this Special Issue**

| Topics<br>Articles | Success Trends | Shortening Time to Market | Strategy and Leadership | Portfolio Management | Process | Structure and Management | Investment |
|---|---|---|---|---|---|---|---|
| Eling, Langerak, and Griffin | ○ | | | | ○ | | |
| Gurtner and Reinhardt | ○ | | | | ○ | | |
| Du, Yalcinkaya, and Bstieler | ○ | | ○ | | | | |
| Claudy and Peterson | ○ | | ○ | | | | |
| Dubiel, Durmusoglu, and Gloeckner | ○ | | ○ | | | | |
| Carbonell and Rodriguez-Escudero | ○ | | ○ | ○ | | | |
| Piller and Roberts | ○ | | ○ | | | ○ | |
| Obal, Kannan-Narasimhan, and Ko | ○ | | | | ○ | ○ | |
| Shaner, Beeler, and Noble | ○ | | ○ | | | ○ | |

## Future Research Directions

From the results section, previous research and practices, and the articles in this special issue, we identify seven research themes important to the understanding and practice of product development: (1) success trends, (2) shortening time to market, (3) strategy and leadership, (4) portfolio management, (5) process, (6) structure and management, and (7) investment (Table 14). We place the special issue articles in Table 14 as a way to identify where research has begun and areas open to research with the CPAS data.

The CPAS data set contains a wide range of product development practices that can be used to test numerous hypotheses about how to improve product development outcomes. This section introduces potential research questions that need further in-depth investigation. First, we summarize the findings for each of the themes identified in Table 14, and, second, we propose research questions raised by the CPAS findings.

### *Success Trends*

Although product success increased slightly in 2012, the success rate has been stable for almost 50 years: 58% in 1990, 59% in 1995, 59% in 2004, and 61% in 2012 (Castellion and Markham, 2012; Markham and Lee, 2013). Similarly, Booz Allen Hamilton (1982) report, with a predominantly industrial product sample, that 67% of new product commercialized was successful in 1968 and 65% in 1982. Given all the changes in markets and NPD tools, it is hard to understand how the product success rate can be so stable for so long. What are the dynamics and causes of success rate?

NPD success rates among firms in North America, Asia, and Europe show distinct geographical differences. The literature shows that national culture differences exist (Barczak, 2012; Nakata and Sivakumar, 1996); however, these differences have been largely neglected in discussions of how each culture approaches NPD and the consequences of those differences. Asian firms report higher sales and profits from new products and take less time to develop new products, but fail more often, do fewer projects, and have shorter length of product life cycle. Are these results a methodological artifact or are there profound cultural differences, or both?

Industry, product type, market type, and technical background are other critical context-variables that raise questions such as, "Why are mixed consumer and business-to-business firms less successful in the market but more sales and profits come from new products?" Parsing out the data by industry has not been explored to any great length.

Various subjective and objective performance measures are used to assess NPD success, but the association between various practices as they relate to specific performance characteristics has not been established. Impact on performance invokes numerous questions such as: What are the implications of a 50% versus 80% success rate of the Rest versus the Best firms? What must the Rest firms do to achieve the Best results? What impact does the number of ideas moving from one stage to the next mean to performance? How do the Best firms achieve twice the sales and profits from new products?

### *Shortening Time to Market*

Because the relationship between product development time and NPD success is important, a large number of academics have conducted research trying to understand how to shorten product development time to market and what the impact is on product success (Chen, Reilly, and Lynn, 2012; Griffin, 1993, 1997a, 1997b, 2002; Ittner and Larcker, 1997; Kessler and Chakrabarti, 1996; LaBahn, Ali, and Krapfel, 1996;

Langerak, Hultink, and Griffin, 2008). Nevertheless, questions remain about how to decrease cycle time and the cost of NPD. The Best firms show higher on-time success rate but longer product development cycle time than the Rest firms. How is cycle time associated with NPD success?

Cycle time for radical innovation in Asia is less than half the time of firms in North America and less than one third of European firms (Markham and Lee, 2013). There is no explanation of how geographical differences impact NPD time, nor are there findings about how firm size, industry, or other demographic differences are related to product development cycle time.

Furthermore, product development time for activities showed a different pattern in the front-end and later development stages (Eling, Langerak, and Griffin, 2013; Markham and Lee, 2013). A drop in development time in all phases except the front-end was observed. How are the time-to-market decisions and planning in the front-end different from later development stages and how do they differentially shorten overall cycle times? Since small firms develop new products in significantly less time than large firms, what decisions at what stage in development differ?

### *Strategy and Leadership*

The contrast between the NPD strategy of the Best firms and the Rest is distinct. Markham and Lee (2013) found that the Best firms are almost twice as likely as the Rest to follow a first-to-market innovation strategy (47.7% vs. 24.8%). In the study, 41% of North American firms are classified as Best, while only 36% of European firms and 23% of Asian firms are considered Best. Nevertheless, North American firms use a first-to-market strategy the least (26%), while such strategies are used by 56% of European firms and 31% of Asian firms. What accounts for these seemingly opposing results? There is a need to examine what we know about strategy, geography, and NPD success; how they are related to one another; and whether the same principles work effectively in different cultures. Similarly, research needs to address how multiple lines of business, in various industries, are managed.

Leadership is another critical role in NPD strategy. Senior managers in the Best firms support innovation significantly more than the Rest; however, the percent of senior managers involved in new product strategy development is less in the Best firms than in the Rest (8% vs. 10%). A dearth of research exists with regard to NPD leadership and strategy in contrasting environments. A primary question to understanding performance is, how do senior managers in the Best firms effectively support new product strategy development with less involvement than senior manager in the Rest firms?

### *Portfolio Management*

Effective portfolio management in NPD can save resources from being wasted on the wrong projects, which is a key element in NPD success (Kester, Griffin, Hultink, and Lauche, 2011). Nevertheless, portfolio management reviews substantially decreased in 2012 compared with 2004 (Barczak et al., 2009; Markham and Lee, 2013). This finding is surprising since the Best firms still review portfolio projects more than the Rest. The Best firms also use numerous portfolio tools and methods significantly more than the Rest (e.g., payback period, checklists, discounted cash flow, scoring models, options pricing, and bubble diagrams). Even more surprising is that more radical projects are reviewed less than incremental projects (Markham and Lee, 2013). At the same time why is the number of radical projects going down? This poses a central question as to the role of project reviews on performance.

Cooper (2011) found that focusing on financial measures results in poorer performance but Markham and Lee (2013) found that financial methods are used to a high degree. The proper use of financial analysis in NPD is a critically under-researched question.

The Best firms use portfolio management strategies significantly more than the Rest firms, but there is no geographical difference in using portfolio management strategies although NPD success rate is significantly different between geographies. How can we understand the relationship between portfolio management strategy and geography?

### *Process*

Although formally documented process has been a norm in NPD, there was a significant retreat from formalized management processes in 2012 (2004: 69%, 2012: 49%) even though there is a trend toward using more formal processes at the front-end and a more structured portfolio management (Barczak et al., 2009; Markham and Lee, 2013). What accounts for using formal processes less and how does that affect NPD?

Continuous redesign of the NPD process is an important differentiator to be considered one of the Best firms: 48% of the Best firms redesign the NPD process on an ongoing basis compared with 29% of the Rest. What are the reasons, methods for, and effect of continuous process redesign?

Geographical differences in NPD processes also need further exploration. For example, North American firms show the most successful NPD; however, only 28% of North American firms use an NPD process on an ongoing basis, compared with 45% in Asia and 33% in Europe. Indeed, 21% of North American firms have not redesigned their process at all. What are the interactions between geography and formal NPD processes?

### *Structure and Management*

There was a shift from functional to specialized NPD structures from 2004 to 2012. The Best firms use more specialized structures, such as new product committees or project management, while functional structures, such as marketing, R&D, engineering, or production, are decreasing in NPD (Markham and Lee, 2013). Functional and specialized structures in NPD are used the least in North America as opposed to Europe and Asia. Notwithstanding the common notion that innovation needs flexibility, its effect on NPD performance remains an open question. Moreover, Asian firms are the most flexible in overlapping gates, even though they show the lowest success rate. What cultural issues drive specialized structures? The interaction between structure and flexibility in different cultures appears to be complex.

In addition, reward systems show clearly different patterns in various NPD contexts. Asian firms use financial reward systems significantly more often than firms in North America and Europe. Although there appears to be a trend toward using financial rewards in NPD more often, we do not understand the consequences of doing this.

### *Investment*

Firms are spending more on new product development than ever (Prendeville, 2015). Markham and Lee (2013) found that spending on NPD in 2012 increased to 12.4% of sales compared with 5.2% in Cooper, Edgett, and Kleinschmidt's NPD best practices study sponsored by AAPQC in 2004. Compared with many companies in a variety of industries, 12% of sales seems like a large amount. The amount spent on NPD is about twice in the Best firms than in the Rest firms (Markham and Lee, 2013). Geographical differences among North America, Asia, and Europe show interesting results. North American firms spend the lowest percentage of total revenue on NPD investment (9.8%) compared with Asia (16.2%) and Europe (14.2%), although they have the highest percent of Best firms (North America: 29.2%, Asia: 19.7%, Europe: 26.4%). This difference would be associated with the sales and profits from new products that are the highest (38.9%, 36.7%) in Asia compared with in North America (28.0%, 28.2%) and Europe (29.2%, 31.5%), although Asian firms have lower success and profitability rates (48.6%, 44.5%) than North America (67.5%, 62.5%) and Europe (56.8%, 51.8%). Asian firms show the highest allocation of NPD investment on radical innovation (29.8%), compared with Europe (28.9%) and North America (20.6%). On the other hand, North American firms show the highest percentage in the NPD investment for incremental innovation (45.7%) compared with Europe (37.6%) and Asia (37.1%). The relationship between the cultural differences and NPD investment raise questions about future NPD success and best practices such as: Why do North American firms invest in incremental projects the most but in radical innovation the least? How are these investment decisions related to performance? Why do the Asian firms have the lowest percent of NP profits relative to NPD investment? Why and how do the Best firms invest more in radical and more innovative projects than the Rest firms?

While spending on NPD is critical in product development, returns on investment (ROI) show controversial results. Markham and Lee (2013) found that the Best firms achieve significantly higher NP profits relative to NPD investment than the Rest firms, whereas Accenture research and analysis indicated that ROI are not strong as expected (Prendeville, 2015). Given all of the other cultural differences, it is surprising that there is no significant differences in sales and profits between North America, Asia, and Europe (Markham and Lee, 2013).

How can we disentangle the effects of NPD investment from other effects such as production and distribution costs and sales force effectiveness? Companies need to understand whether there is an optimal investment level given market need and competitive pressures. New NPD metrics that link investment to market performance are needed. Are there repeatable methods to improve short- and long-term return on

investment? Finally, we have little evidence on how investment differs among various industries.

As can be seen in Table 14, research in this special issue is centered around success trends, strategy, leadership, and a variety of other topics. Notice that while the data do address important issues in shortening time to market and NPD investment, there are no articles on these subjects in this special issue. The table and the discussion above reveal many portfolio management, process and structure, and management research questions.

Although the above questions and the articles in this special issue raise many research and practical questions, they do not represent the universe of NPD issues. Rather, these research articles and questions revolve around topics that can be researched utilizing the CPAS data. We encourage NPD researchers to make use of these freely available data.

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## Supporting Information

Additional Supporting Information may be found in the online version of this paper:

2012 PDMA CPAS Survey