

The North America Competitive Product Laundry Initiative – A Case study on thorough understanding and quantitation of Laundry product performance through Statistical Engineering.

Authors: Sol Escobar, Cindy Rodenberg, Alex Varbanov (The Procter & Gamble Company)

0. Introduction

The Procter & Gamble Company (P&G) is one of the top 10 largest consumer packaged goods (CPG) companies and is considered one of the leading companies contributing to growth and innovation in an evolving market (reference BizVibe Top 10 Largest CPG Companies by Revenue in the World 2020 – CPG Industry Factsheet <https://www.bizvibe.com/blog/largest-cpg-companies/>). P&G's mission is to "provide branded products and services of superior quality and value that improve the lives of the world's consumers, now and for generations to come." (<https://www.pg.com>). Throughout its ten-category portfolio of products, P&G leverages deep consumer knowledge and category-changing innovation to identify consumer unmet needs and develop new technologies to address these needs. In order to stay competitive, it is essential for P&G to play at the leading edge of product superiority by providing consumers with high-performing options. This involves not only leading the market on key benefit spaces but also communicating those benefits to consumers around the world.

Case Study – North America Competitive Product Laundry Initiative

Fabric and Home Care (F&HC) is one of P&G's six industry-based Sector Business Units. The Laundry Cleaning and Care business is a highly competitive environment with multiple CPG players such as Henkel, Unilever, and numerous Private Label (store-brand) products. As such the Laundry Research & Development (R&D) division's Senior Leadership was interested in landscaping the product performance of North America (NA) P&G's laundry and fabric care products relative to the other competitive products (the NA Competitive Product Laundry Initiative) across the myriad of consumer benefit spaces: Stain Removal, Odor Removal, Whitening, Color Care, Freshness, Feel, and other attributes.

At first glance this may not seem like a complex problem. However, when we begin to think about the number of laundry and fabric care products, 1000+, and the number of consumer relevant benefit spaces, 10+, the time and cost (let alone the scheduling) for conducting the necessary tests to enable product comparisons, explodes dramatically. Additionally, the competitive laundry environment is very dynamic; including changes of 20 or more new product launches in a year, as well as, the potential for multiple blind formulation changes within pre-existing marketed products. Not only is it essential to

identify statistically appropriate designs and analysis for enabling reliable, unbiased product comparison, additionally, the scope of the initiative needs to be identified, the joint effort of multiple individuals needs to be coordinated, and a system that allows for ongoing updates and communication of results needs to be developed. The initiative meets the criteria of a large, complex, unstructured problem laid out in Hoerl and Snee (2017) that would benefit from the strategies of Statistical Engineering. In this paper, we discuss how each of the elements of Statistical Engineering, 1) Identify the high impact problems, 2) Providing structure, 3) Understanding context, 4) Develop Strategy, 5) Develop and execute tactics, and 6) Identify and deploy a final solution, were leveraged in initiative success. For simplicity, we will discuss each of these in a linear fashion, but as with all complex programs, iteration occurred throughout the program.

1. Identifying the High Impact Problem

As noted by Prof. Geoff Vining (Department of Statistics, Virginia Tech) during a P&G Statistical Engineering workshop (2019), rarely does senior management clearly or completely define the opportunity. Success requires systematic, systems thinking across the organization and therefore relies heavily on the scientists and researchers to scope out the full problem and potential opportunity, as well as, define the solution. As such, a critical first step is identification of the multi-disciplinary team.

P&G is comprised of Organization Units, some housed in the Business Units having deep category-specific knowledge of the business, customers, and/or needed technical capability, while others housed in organizations, such as Corporate Functions, with responsibilities to deliver and scale technical solutions across BUs. The multi-disciplinary team comprised of three individuals in the BU and two in Corporate Functions (identified in Table 1) ensured that the necessary expertise was included and enabled communication with the critical stakeholders.

Table 1: Team Members and Roles

Organization Unit	Role	Responsibility	Link to Critical Stakeholders
Fabric Care: Franchise	Product Researcher	Identifying: competitive product landscape, test methods for comparing product benefits	Senior Leadership to ensure that critical questions addressed and raise awareness of opportunity
Fabric Care: Franchise	Lab Researcher	Expert in test method execution and management of testing labs	Report to Product Research Leader for lab testing execution

Corporate Functions: Data & Modeling Sciences (D&MS)	Statistician	Experimental Study Design, Method Validation, Data Processing, Database Creation and Maintenance, Statistical Analysis, Results Interpretation	Senior D&MS Leadership for work accountability, work priority decisions, and availability of statistical resources
Corporate Functions: D&MS	Informaticist	Develop tools to access database of results	Project Statistician to ensure tools meet user requirements
Fabric Care/D&MS	Director Management	Communicate work/effort; Provide additional resources and funding as needed	Senior Leadership to ensure priority of initiative

Leveraging a small team of individuals with the necessary, unique domain expertise and a knowledgeable project leader, enabled efficient decision making and effective collaboration. Additionally, regular and direct communication between team members and with Senior Leadership ensured the work was going smoothly and in the direction of achieving the team objectives.

Additionally, to ensure the developed system met the needs of Senior Leadership, it was essential to understand the questions that were important to be addressed by this work. The project leader worked closely with Senior Management and the team, throughout the program, to identify the relevant questions, as well as, always keeping in consideration what was possible. Examples included:

- Status Quo
 - Where does my current product stand relative to competition and benefit spaces?
 - As the environment changes, is my product maintaining superiority or is the gap closing?
- Investment
 - How have other products changed and can they extract consumer and monetary value from it?
 - When is the optimal time to re-invest in my product formulation or innovate on new formulation?
- Consumer
 - How can I leverage my superiority gap to communicate the benefit I provide to consumers?

- How can I confidently state my performance value in business-building claims for TV and Media advertisement?
- Expansion
 - Where can I launch a new product (performance whitespace) and what currently exists there?
 - What product performance trends exist and what is my product's potential in them?

Besides having the right team in place and defining the questions of interest, implementing the project strategy relied on other critical tactical decisions such as i) determining the scope, ii) establishing common product annotation hierarchy with unique codes, iii) using validated technical methods for data generations, iv) performing studies using statistical designs to get robust and reproducible data, v) leveraging Network Meta-Analysis (NMA) as the statistical tool to integrate information across studies, and vi) developing an online tool for easy access to results by different P&G users.

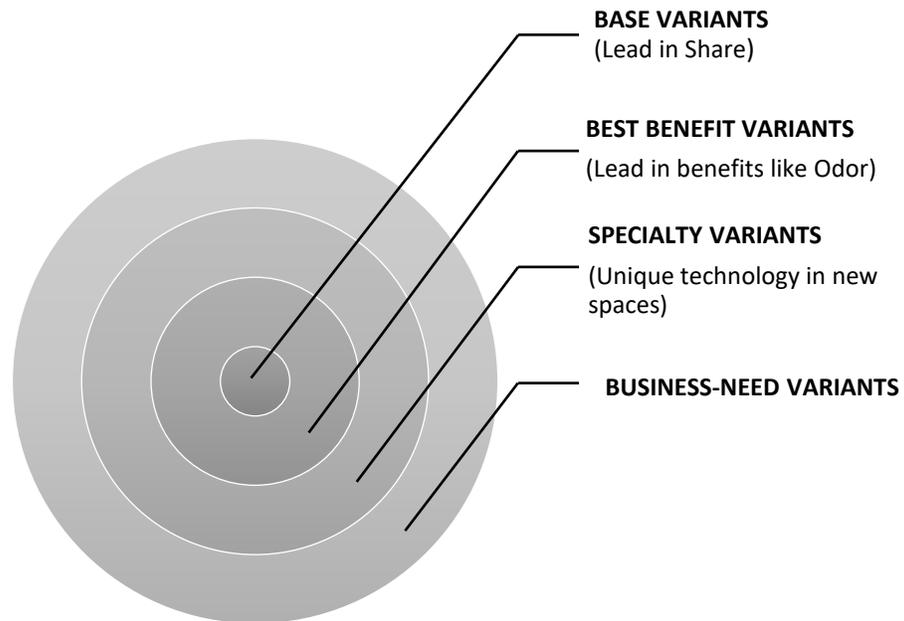
2. Provide Structure

Defining the scope and availability of actionable and robust data are two key areas necessary for determining the design strategy as well ensuring project success.

Scope of initiative: Products in the laundry space span large brand name products as well as small, niche category products. Identifying the scope of products and benefit spaces was essential. First, we started by ensuring we included the Market Share leaders (i.e. the highest selling variants) for each of the Market Core Brands which usually happen to be the Base or Basic variants for each (i.e. Base Tide, Base Arm & Hammer, Base Purex, etc.). This set the core baseline both from a sales and a consumer perspective, so we knew we were working with in a Relevant set. Second, we expanded the product line to the 5 Core Benefits in the Category (Stain Removal, Whiteness, Odor Removal, Color, Freshness). In doing so, we identified the best performing variants in each of the Core market laundry brands and assessed them for overall clean (stain removal) but also their respective benefit measure (i.e. Odor removal testing). At this point we were able to understand not only the 'cleaning core' of each Leading Base product, but also the cleaning and specific-benefit performance of the different portfolio variants from each of the core North American Laundry Brands. Third, we included Specialty Variants within the national leading brands – these included those small/niche spaces with potential to grow in the market (e.g. Wellness/Natural variants, Softening variants) but that might not be dominant leaders in the market

yet. Lastly, as needed by the Business, we included disruptors to the Category which includes anything from up-and-coming Private Label (Store Brand) products, to new forms to deliver detergency (e.g. Detergent sheets). Prioritizing our product inclusion criteria (Figure 1) enabled us to not only align R&D testing to the priorities of the overall Business, but it also enabled us to understand the relevant consumer market and to allow us to understand Competitive portfolio formulation and differentiation strategies.

Figure 1: Product Inclusion Criteria



Annotation Hierarchy: The team understood early on that without having a common annotation system across more than 150 products being tested across multiple types of laundry tests every year (stain, whiteness, color, etc.), there was no way to efficiently process the information. Linking the same product across all the different studies it was tested under was critical for the analysis. This was even more important to have for comparing Laundry products undergoing changes within the same year – often blind to consumers – where it was critical for P&G to understand and compare the different versions of that same marketed product. As a result, the team established a 6-layer hierarchy to annotate products. It included the Company, Brand, Form, Product Variant, Scent Variant, and Year for each individual product and/or product evolution and was cataloged in a Centralized Library. Figure 2, illustrates the annotation hierarchy and how corresponding products may differ across the fields.

Figure 2: 6-layer Annotation Hierarchy



With a unique code assigned to each product, it could then be traced across studies under a single identifier, and therefore allow for proper merging of the information across benefits in the deployment stage.

Validated Technical Methods: P&G relies strongly on using validated technical methods for assessing product performance. That requires understanding the major sources of data noise, as well as establishing reproducibility of results across different studies. Strict guidelines exist for a test method to be considered valid and reliable and usable for external credentialing. All the data collected by the Competitive Team followed that tactical rule, allowing the Company and the legal team to be confident in making product superiority claims, or in understanding how to improve current products. Additionally, having reproducible test methods was a cornerstone of the program enabling comparison of products run in separate tests.

3. Understand Context

Being part of a large organization like the P&G North America Fabric Care Business can sometimes bring some challenges to enabling a big undertaking and breakthrough initiative like this one. Some of these challenges include (1) working in highly focused (on current initiatives) organizations, (2) uncertainty in committing to future value initiatives that involve high initial activation energy/cost investment, and (3) pressure for delivering large and growing business needs while utilizing even less resources and time.

Due to growing priorities and threats in the market for such a large Business, an organization like North America Fabric Care can work more efficiently by having focused functions and projects (e.g. more focus on projects that deliver in the present, each function delivers according to their expertise/craft).

However, P&G has identified that there is also a large opportunity for innovation in having employees think beyond the bounds of a Function or Craft and looking past what the Business can see in the near term. This growing shift was a huge enabler for this Laundry Initiative. Allowing R&D and Corporate Functions create something that can bolster the Sales, Marketing, Finance and External Relations functions – versus only focusing these functions’ capacities to their respective crafts (i.e. product making, models for product design) is a great example.

Second, undertaking the large task of measuring, categorizing, assessing, and modeling a category of more than 1000 products, which has a high-activation cost, time, and resource investment upfront but that could bring new value and capability to the Business is not an easy task – especially when the output and benefits have never been seen before. On top of this, trying to continue to drive more efficiency with less resources and time, would make it seem like an initiative like this one would carry more Risk than Reward to the Business. But this is where the innovative power of Statistics, R&D, and Core Business understanding helped.

Balancing (1) the knowledge of threats to the Business and their negative impact (i.e. how many competitors challenge P&G on a daily basis on advertisement and retail, the number of publishers and Ranking organizations that misinterpret the power of P&G products, etc.), (2) the limitations of R&D driven by resource constraints (i.e. not being able to deliver ‘#1’ or Superiority claims for our products due to our inability to test 130+ products while also delivering other breakthrough innovation, lack of testing methodologies for new benefits like Odor Removal), and (3) identifying how the proposed initiative will deliver on a win-win scenario for the Business is key. This is where the partnership between R&D and Quantitative sciences to not only create new testing methods that deliver higher overall efficiency from the start, but to also identify innovative ways to reduce the amount of testing via powerful statistical methods was key. The compliment to this, which was perhaps even more critical in overcoming the unknown Risk of the investment, was demonstrating how it would directly answer to several of the significant threats the Business faced while creating a capability that – by default – also allowed several commercial areas to do their work more efficiently (i.e. new data-driven Sales content, new claims & communication vehicles for Marketing, new External Relations content for Influencers, and new models for Financial forecasting).

4. Develop Solution Strategy

Many of the components necessary for ensuring a successful solution strategy have been discussed. For example, the standardization of product annotation across all data sources (discussed in

Section 2) was an important strategic decision. In this section we lay out the statistical solution that was leveraged to efficiently integrate information across studies and enable all pairwise product comparisons.

Network Meta-Analysis (NMA): Once the team established validated technical methods to be included in the Competitive program, each study used a corresponding statistical design to account for potential variability sources. It relied on statistical concepts such as randomization, blocking, replications, and treatment balancing. In addition, controls were used in each test to establish critical connectivity between studies to be able to apply NMA.

NMA (Jones et al., 2011) was the main statistical tool to integrate the information across studies for a given laundry benefit (e.g., stain removal). It allowed us not only to compare products that were not placed in the same test, but also to be conservative in our treatment assessment by accounting for variability between tests. As such, many products were able to be compared directly every year, even if two products were never included in the same experiment or evaluation. Even more impressive, NMA enabled products to be compared across years, and therefore allowing us to historically track Laundry product performance evolution over time. As a result, the NMA approach gave the opportunity to establish an overall understanding of the laundry category for each measured benefit and became the basis for designing TV and Digital advertisement claims about Tide being the “#1 stain remover” and “#1 odor remover.” That is only legally possible when Tide is assessed against a substantial majority of the share of marketed laundry products for that Laundry benefit. NMA therefore allowed the business team to be efficient in determining which claims to pursue.

5. Execution of Tactics

The team had to make many tactical decisions to execute the strategy of this complex NA Competitive Product Laundry Initiative. Discussing all of them is beyond the scope of this case study. We focus here only on the main four ones that have most significant contribution for the project success: i) use validated technical methods, ii) apply statistical experimental design principles, iii) use SAS software for all data processing, analysis, and activation, and iv) provide access to product results using an Online Access Tool. The first three are discussed briefly next while the last one is covered in Section 6.

Good business decisions rely on good product performance data. Making sure that the technical methods used to generate such data are validated is key to ensure good data reproducibility and sensitivity. Each method that we use in the NA Competitive Laundry Product Initiative goes thru a formal method validation study to understand different variability source and quantify data reproducibility across days and operators. After that, the follow up studies used for product ranking data are based on statistical

experimental design and using principles such randomization, blocking, replication to ensure robustness of statistical results and hence business decisions. We use controls in each study to be able to not only monitor quality control over time but also allow connectivity between studies for NMA.

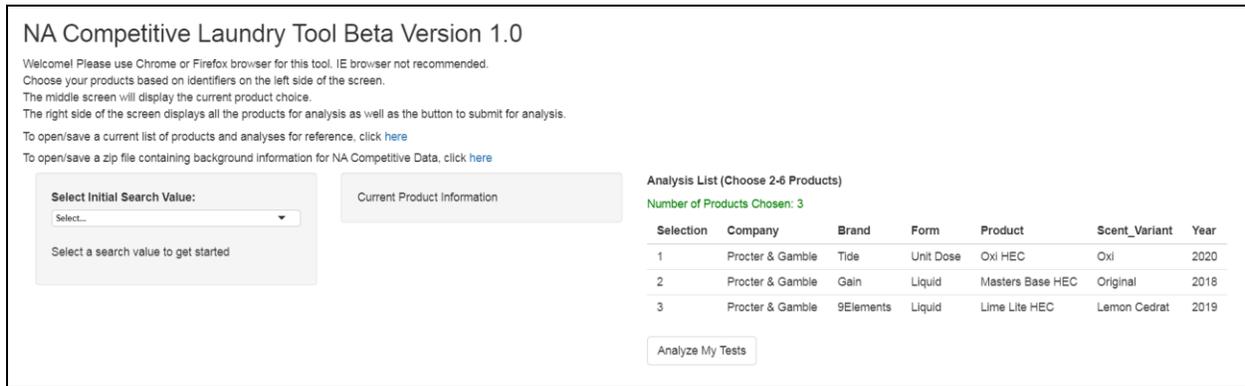
The generation of the product ranking for a given benefit requires a significant amount of data processing and using mixed effect models for statistical analysis. We decided to use SAS software for these tasks because of its ability to handle both. Alternative software (e.g. R) was considered as well in the beginning but SAS was better tool fit given the personnel resources supporting this project. In addition, it was easy to set an online access tool to the results following a successful route to that given by other tool examples.

6. Deployment of Final Solution

Online Access Tool: The last (but not least) critical tactical implementation step was to develop an online tool for easy access of the NMA results across benefits. To create it, the team engaged in a collaboration with the Informatics group, focusing on building a user-friendly interface with easy access to results. By enabling the user to easily specify the product(s) in question (Figure 3), the tool would output all corresponding performance data available across all benefits tested in a consistent structured format. The Tool element therefore became key as unexpected and urgent business questions requiring immediate comparative performance assessments could now be answered within seconds. In addition, even users with low expertise or familiarity with the Laundry category or competitive portfolio structures could access the multi-benefit data and apply the respective learnings to their business cases – which further elevated the level of expertise and capability across the Research & Development organization.

Because constant performance testing and data generation is an on-going process and the team desired minimal-to-no disruption to the business and users, the data tables used by the online tool were updated in the background by the statistician allowing for continuity to operations. In addition, given the team's desire to continuously improve, the deployed solution will be routinely assessed for upgrades such as adding product images and improving user interface.

Figure 3: Online Webtool Interface



7. Conclusion

The NA Competitive Product Laundry Initiative is complex covering multiple benefits, studies, and products. There are other everyday tactical decisions that the team makes to make sure objectives are met and information feeds other teams for best business decisions. However, the elements discussed above were *the most influential ones for the program success*. The final solution of the P&G Competitive Program is the ability to make informed data-driven business decisions about how to make superior products and/or allow for cost savings without sacrificing product performance. That was enabled by the tactical steps outlined in the previous section including the development of an online tool for easy access.

However, it also includes continuous communication between the project leader and P&G sales and other product research and development teams. This is critical for outlining correct use of the results and summarizing the multidimensional information in easy to comprehend way. It also covers the need to address follow up questions quickly and efficiently. As discussed above, the information is consistently updated each year as new products enter the laundry market and there is a need to understand their performance. The P&G Competitive program continues to evolve, enabling coverage of new benefits (e.g., measure scent liking of laundry touchpoints) and laundry categories (e.g., Liquid Fabric Enhancers).

The success of the NA Competitive Product Laundry Initiative - an integrative, fast-responding, business-building system of Laundry performance data would not be possible without use of comprehensive decisions to enable rapid testing, data collection, and analysis as well as deployment of information for driving business decisions. This case study illustrates the importance of utilizing all elements of Statistical Engineering when faced with a large, unstructured, complex problem. The work was done by a small efficient team with diverse complementary skills. It provided structure in solving the problem by defining the right scope of the initiative and product annotation hierarchy. Critical strategic

decisions (e.g., using validated technical methods or NMA) ensured success in the Statistical Engineering process. Using an online access tool helped with the deployment of the final solution. This initiative created significant business value for the company which made it a successful example for Statistical Engineering case study.

References

Hoerl, R.W. and Snee, R.D. (2017), "Statistical Engineering: An Idea Whose Time Has Come?" *The American Statistician*, 71(3), 209-219.

Jones, B., Roger, J., Lane, P.W., Lawton, A., Fletcher, C., Cappelleri, J.C., Tate, H. and Moneuse, P. (2011). "Statistical Approaches for Conducting Network Meta-Analysis in Drug Development", *Pharmaceutical Statistics*, 10, 523-531.