The Challenges of Packaging Innovation

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ABSTRACT

The cosmetics and beauty care industry requires that packaging be innovative and attractive. This requirement places demands on packaging design that can increase cost and cause unexpected problems that may affect quality or delivery. Access Business Group recently launched two successful skin care product lines. Both lines required demanding packaging aesthetics, and each line encountered design challenges trying to achieve these requirements. The packages experienced leakage, compatibility, quality, manufacturing, and delivery issues. Changes were necessary to respond to these problems before and after launch. These case studies show that innovation is not easy. A checklist of potential project stress factors may help an organization assess the likelihood for problems when developing an innovative project.

INTRODUCTION

Open a packaging trade publication from within the past few years and there will likely be an article about packaging innovation. One manufacturer may describe a functional improvement to a package that increases consumer utility. Another may claim a new process that reduces cost and provides new benefits. Many year-end editions showcase the year's most innovative packages, and some trade organizations give awards for the best examples of packaging innovation. These articles and awards help encourage greater innovation.

Reading all the success stories about packaging innovation may give the impression that these projects are easy to implement, while, in fact, the opposite is more likely true. Seldom does the trade press feature stories that share background on a project's problems or failures. But such real-world information and awareness would be beneficial to anyone responsible for a packaging innovation project.

Packaging innovation by its broadest definition is doing something that is new. It can be a new idea, method, or component. Within the organization of a package development group, innovation can mean doing something that may be new to the group, but may not be the first time such an idea was implemented within the packaging profession.[1]

Packaging innovation has played a vital role in the cosmetics and beauty care industry. No other industry can match its diverse use of packaging materials, number of decoration methods, and high expenditures on packaging as a percentage of total product cost. In addition, new product development schedules in the cosmetics and beauty care industry are among the shortest of any industry. Some of the recent innovations in the cosmetics industry include airtight components for volatile formulas, unique glass bottle shapes for personal fragrances, improved decoration techniques to simulate metals, and unit-dose applicators for trial-size use. While there have been functional innovations to cosmetic packaging, by far the greatest innovation effort goes into aesthetic design. Aesthetics, or a package's appearance, is equally as important as functional package requirements in the cosmetics and beauty care industry.

The drive to innovate can be strong enough that fundamental packaging requirements, such as containment, can be diminished in favor of implementing an idea. For example, a closure may be developed to meet a particular size profile and not on the basis of how well it seals to the container. Some materials may be chosen for a package because a designer or marketer prefers that material. In reality, the targeted consumer may have different ideas about which material is preferred. Designs requiring metal bands, hot stamp foil, or exotic plastics may be pursued in the spirit of innovation. While these additions may look attractive, the additional cost may not translate into increased sales compared to a less expensive, alternative design.

Packaging suppliers often present innovative ideas. Considering a new supplier because it has an innovative package may appear to be a good idea at the start of a project. But if quality or delivery problems arise, the new supplier may not be as responsive as a tried and true supplier would be in solving the problem or responding to delivery needs. In this situation the innovative package becomes a problematic one of low quality.

All these descriptions may give the impression that packaging innovation is a bad idea and that the status quo should be maintained. Quite the opposite is true. This paper examines the challenges and pitfalls of packaging innovation and gives some guidance to future innovators. Two case studies will be presented. Both involve aesthetic packaging innovations developed by Access Business Group for Amway/Quixtar's Artistry skin care brand. The Pure White and Time Defiance skin care packages are highly attractive, upscale designs that command a prestige price level. Both won packaging awards for their design. Pure White won an AmeriStar award in 2000, and Time Defiance won a HBA International Design award in 2001. Each required design changes after launch in order to ensure a constant supply of components from its packaging suppliers. These changes did not dampen sales. In fact, sales increased due to an improved ability to meet customer demand.

Figure 1 Pure White toner and moisturizer package

Case Study #1

Pure White Skin Care Packages

Pure White is a line of skin care products introduced in 2001 by Amway/Quixtar under its Artistry brand and sold in eight Asian countries. Two of the products in the line are a 150 ml toner and a 100 ml moisturizer. The package for these two products features a round-shouldered, tapered oval bottle with an oval, flat front panel cut on the bias. The closure shape is a short dome atop a silver band. A silver collar covers the neck of the bottle and blends into the flat front panel. The surface of the bottle is textured. **[Fig. 1]**

A package designer hired by the Amway marketer responsible for the Pure White line created the toner and moisturizer package shapes. The first task of the packaging engineer was to determine how the components could be developed to match the aesthetic design. The design also had to be checked to ensure that it matched the desired label claims of 150 ml for the toner and 100 ml for the moisturizer. During this time the marketer stated the preference for glass bottles. Since the Pure White products were to be sold at high price points, the marketer chose glass to communicate an upscale image.

After the initial design review, several key challenges became apparent. First, the bottle shapes needed resizing to accurately reflect the desired fill volumes of 150 ml and 100 ml. Second, the neck diameters of both bottles were too small to be commercially molded in glass. The small neck was not adequate to transfer the relatively large and heavy body of the glass pre-form to the blow mold. Also, the moisturizer was a moderate viscosity lotion, so the neck had to be larger to dispense properly. Third, the shape of the bottle would require using a supplier skilled in molding difficult shapes. The bottle would be unstable moving on a conveyor due to the top-heavy design, and the large flat panel on the front of the bottle would be prone to sagging during the cooling process if it was not molded properly. Fourth, the

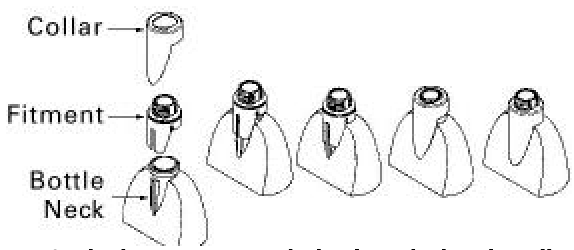

Figure 2 The fitment snaps on the bottle neck, then the collar is placed over the fitment.

partial bottle surface texture, with the clear flat front panel, would be more expensive than fully texturing, because the clear panel would require masking.

With these design challenges in mind, work began to select appropriate packaging suppliers for each component and to determine the engineering design of each component. Two Japanese packaging companies doing business with Access and a French packaging company not doing business with Access at the time were asked to quote on the closure and collar design. Two glass manufacturers, one American and one French, were invited to quote on the bottles. Both glass manufacturers were doing business with Access, although the French company was fairly new to Access compared to the American company.

After the initial proposals were received, the designs were reviewed and evaluated on the basis of whether they matched the proposed shape from the packaging designer. One design element stood out as a challenge after reviewing all design proposals: matching the neck diameter proposed by the designer would be difficult to achieve. Although the neck diameter had to be increased for glass molding reasons, the neck would become even larger when adding the metal collar and the necessary plastic transition piece that secured the collar to the bottle. As the neck became larger, the attractiveness of the design diminished. Another reason for a larger neck was the sealing method. Typically, bottles have either screw or crimp necks. Adding threads to the neck increases the diameter, which in turn increases the collar diameter. A crimp neck was not an option since these packages would need to be opened and closed by means of a threaded or friction-fit closure.

A solution came from the French plastics company. Instead of using a conventional screw thread for the bottle, the French company proposed a plastic fitment that contained the threads and snapped onto the neck. The fitment would be held in place by the metal collar **[Fig. 2]**. Without threads, the neck of the bottle could now be smaller. This proposal also allowed for the closure to be designed to match the original short profile created by the package designer. Aesthetically, the French company's proposal was perfect. However, the design was unconventional in that the sealing of the container would not be made from compressing a liner. Instead, an interference of the fitment diameter and the inside diameter of the glass neck would make the seal. A second seal point would be made between the inside diameter of the fitment and the diameter of the pintle on the closure. This design would be risky because it would rely on the tolerances of the glass neck and the plastic fitment. And the plastic fitment would have tighter tolerances than the glass neck due to the nature of the injection molding process. The inside diameter of the neck is a close-tolerance dimension that is difficult for glass manufacturers to maintain. It is prone to ovality and small nicks called checks, which can cause leakage.

With the closure and collar design set, the French glass company was chosen over the American company for two reasons. First, the French company had a strong reputation for molding uniquely shaped glass bottles. They had recently molded a bottle similar to Access' bottle. Second, the French company had the ability to sandblast bottles to create textured effects on glass. The American company had only the capability to acid etch. Since the front panel was to be clear, acid etching would be difficult because the entire bottle would be submerged in an acid bath. A partial etching would be too costly. Sandblasting makes use of a fixture that can mask or void an area on the bottle so as not to receive the abrasive sand.

There was some concern by Access' Procurement department about selecting two new companies for this challenging project. Historically, European suppliers had not been responsive to Access' quality and delivery needs for packaging components. However, both French companies offered innovative solutions for achieving the proposed aesthetic design, and they had experience producing components for well-known companies in the cosmetics and beauty care industry.

After the suppliers were chosen, unit cavity tooling construction began. Once parts were received, package testing focused on the following anticipated problem areas:

1. Potential leakage with the closure and fitment design
2. Bottle dimensions and flatness of the front panel
3. Packaging line assembly method of components

The initial parts produced from the unit tools did indeed leak under vacuum testing. The outside diameter of the valve seal on the fitment was subsequently increased to create more of an interference fit between the bottle and the fitment. A few hundred packages using the modified fitments were re-tested under vacuum and passed. The glass manufacturer needed three separate sample runs using the unit tool in order to achieve the proper glass distribution in the bottle and to eliminate any front panel sagging. Now that unit parts were available, Access' manufacturing plant engineers could review them. There was concern at the start of the project that the Pure White package design would be difficult to assemble. Very little automation could be used to apply the fitment, collar, and closure to the bottle. This application would need to be done semi-automatically and would require much more labor than was typically used for similar products.

About two months before production orders for the packaging components were placed, unexpected problems occurred. Samples from the weight-loss and compatibility tests showed environmental stress cracking on the plastic fitment on the moisturizer packages. Cracks were appearing at the base of the threads and causing product leakage around the neck and behind the metal collar. Inspection of the toner packages revealed similar cracking, but less severe than the moisturizer packages.

Testing began to reproduce the cracking using control samples to determine when and why the fitments were cracking. The French supplier was notified of the discovery, and discussions took place to decide on a remedy. The vast distance between the two companies caused some uncertainty within Access in knowing whether the supplier understood the problem and was indeed working on a solution. Further testing showed that several factors were causing the stress cracking. First, a sharp corner on the fitment below the threads was a source of molded-in stress on the part. Second, the pintle on the closure created high hoop stress around the area below the threads. Third, an emulsifier in the moisturizer acted as a catalyst under these conditions and partially dissolved the high-density polyethylene (HDPE) fitment. The cracking in the toner packages was less severe than the moisturizer packages because the pintle diameter was smaller and did not create high hoop stress. Also, the toner contained a low-level surfactant system, so it did not cause as much damage to the fitment.

To solve the stress-cracking problem, the French supplier increased the radius on the fitment below the threads and changed the material from HDPE to polypropylene. Polypropylene has much better stress-cracking resistance properties than HDPE, but it is a stiffer resin, so there was concern about its ability to form a seal around the neck opening.[2] Also, there was fear that the polypropylene fitments would require a higher insertion force than the HDPE fitments, which concerned the manufacturing engineers. Fortunately, the polypropylene fitments were not difficult to assemble to the bottle, and they did not leak under vacuum and temperature cycle testing.

Another problem area continued to be with the assembly process on the packaging line. Although this was a concern from the start, the impact was not seen until a plant trial was conducted. The initial process of assembling the fitment and the collar to the bottle proved to be inadequate. It was labor intensive, and misaligned collars created excessive scrap. Misaligned collars looked bad, but they also exposed a cut metal edge, which could harm a consumer. To remedy this situation, the French company made a spring-loaded alignment tool that was used on the packaging line to align and press fit the collar over the fitment. After this plant trial run, the front panel design of the bottle was revised to help cover the metal edges of the collar. Although these were not perfect solutions, the manufacturing plant engineers felt they could refine the assembly process and be ready for the scheduled production start up in five months.

Production began remarkably well considering the major component and assembly issues that took place just months before. Manufacturing struggled with each trial run attempting to place the metal collar over the fitment accurately. Standards were set on what was acceptable, and scrap had to be discarded since the collars were too difficult to remove and reposition once in place. Product launches began about three months after the first production run. Promotion and excitement of the Pure White line began to increase, which caused the forecast to increase substantially from the initial first-year quantities. Order quantities were increased for the closures and glass bottles to meet the rising demand for Pure White products. Unfortunately, the French packaging suppliers were unable to meet the demand. Leadtime for glass from the French supplier increased from the original 16 weeks to 22 weeks. The additional sandblasting process limited the output of finished glass.

During this time, several lots of fitments from the other French supplier were rejected by quality control because of grease contamination. This meant fewer fitments were available for production until the supplier sorted them. Access did not have much purchasing leverage with the French suppliers because it was a new relationship. In addition, the inability to receive components to meet market demand created pressure to seek an alternate supplier for the long-leadtime glass bottles.

Access decided to build glass tooling at the American glass manufacturer that had originally quoted on the Pure White project. Doing so, however, meant making a compromise to the original design. Because the American company could not sandblast, the Pure White bottle had to be fully acid etched. The clear front panel, which was part of the innovative design, was now frosted like the rest of the bottle. Qualifying a new supplier, especially under the market pressure of needing bottles right away, proved to be a challenge. Duplicating the design was difficult because the new tooling had to produce a bottle that was virtually identical to the French company's bottle. The neck dimensions were critical to maintain the seal of the fitment and position of the collar. The capacity had to be the same, and the front panel had to be flat and not concave.

Several sample trial runs were made over the course of three months at the glass manufacturer. A plant trial run was conducted on Access' packaging line using the American company's bottles. Only minor problems were noted and no leakage was found using the new bottles. Unfortunately, the first production bottles from the American glass manufacturer *did* leak, and this caused further delay in meeting market demand. The American company's bottles had variances in neck dimensions compared to the French company's bottles. The variances were enough to cause leakage with the fitment. Although neck dimensions were a critical focus when development started, additional, subtle dimensions in the neck proved to be important for sealing. These new dimensions were neither apparent nor an an issue during the original development with the French company. The American company corrected their process and put more focus on these critical dimensions. In addition, the valve seal on the fitment was lengthened to increase the sealing area and prevent leakage.

The original design of Pure White was attractive and innovative, and this design contributed to the initial success of the products. The modified design, however, remains attractive, and Access has not lost sales due to this change. It could be argued that sales have increased now that there is a more reliable supply of packaging components that can be procured by Access.

Case Study #2

Time Defiance Skin Care Packages

The Artistry Time Defiance skin care line was launched in 2000 by Amway/Quixtar, and is sold in more than 50 countries. It consists of a daytime cream, a nighttime cream, and a nighttime renewal lotion. The daytime cream is classified as a drug in many markets due to the sunscreen active ingredients that it claims. The cream is

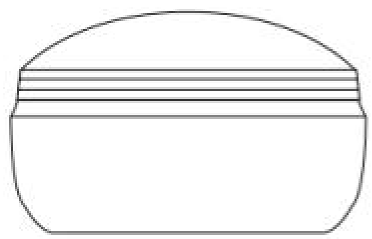

Figure 3 The Time Defiance cream package

packaged in a short 50 g jar with a low-domed, full-diameter closure **[Fig. 3].** The lotion is packaged in a tall, slim, cylindrical bottle with a threaded pump. Both containers are white with a matte finish and gold decoration. The metal portions of the closures are two-tone gold and gray. The products are positioned as premium and command a high price point. Access' in-house package design group, in collaboration with Marketing, created the design for the line. Numerous package shapes were proposed and evaluated by global marketing affiliates before the final shape was selected. Many prestige jar packages were in the marketplace with either flat-topped closures with square corners or closures with tall domes. To differentiate the package, Marketing felt that having a very flat dome was crucial and this drove the overall package design. Package materials were selected to enhance the prestige positioning of the products. Glass was selected for the containers and metal for the closures. Texture, both visual and tactile, played an important role in the design. As the package design began, the product formulation work also started. It became immediately apparent that the product would need to be in an opaque container because several of the key ingredients providing the anti-aging benefits would cause the product to develop a brownish cast over time, which needed to be masked. This shifted the container material of choice from clear to opal, or white, glass. This also limited the number of suppliers that could provide the containers and led the Access team to select a supplier in France with which Access had limited experience. Suppliers that Access had considerable development and supply experience were selected for the closure and pump.

The remainder of the case study will focus on the problematic cream package. The initial design work began with the closure. To create the low dome with the other design element, a three-ring band that skirted the dome, the supplier proposed a three-piece design. The dome and rings would be metal and the inner piece would be molded in plastic with a foam liner. Access packaging engineers worked with both closure and jar suppliers to optimize the design. Using the minimum neck height to achieve proper thread engagement and the highest dome still viewed as low, the diameter of the jar opening was determined **[Fig. 4]**. It was considerably smaller than the diameter of the jar, which left a shoulder on the jar that was wider than typical. After confirming dimensional tolerances and the interaction between the glass and plastic components, the design was finalized. Tooling for the jar and closure began simultaneously.

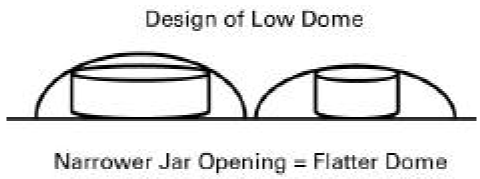

Figure 4 As the dome becomes flatter, the neck diameter becomes smaller

When building glass tooling, it is routine to sample and make corrections to the molds several times to dial in the specifications. Time was built into the schedule to accommodate this. The first sampling of the jar occurred in clear glass, as there was no opal in the furnace when the mold was complete. Analysis showed the neck height to be over specifications and corrections were made to the mold to lower the height. The second sampling, this time in opal, showed that the height was corrected, but that the neck was cocked, resulting in an obvious and unacceptable tilting of the cap on the jar. At this point the supplier began to express concern with its ability to meet the original height tolerance specifications and additionally could not assure that even the difference in height from side to side would be within the original range. They felt that there was a combination of two factors that led to the problem: the wide shoulders and the opal glass. The shoulder was difficult to support as the glass transferred from pre-form to blow cavity in the mold. The opal reacted softer in the molding process, exacerbating the problem. They proposed increasing the slope of the shoulder to try to make it stronger.

At this point, Access became concerned that the supplier would not be able to deliver on the proposed design and sought another European supplier of opal glass. This supplier had never done business with Access. After extensive design and manufacturing discussions with the second supplier, the Access team felt more confident in their manufacturing capabilities, but felt that the risk of changing to a new supplier was too great to proceed.

Access team members met with the closure supplier and two months later visited with the jar supplier for pre-startup qualification. The first stop was at the decoration plant. This facility was a subcontractor for the supplier. The team was shown the acid etching process on a different opal jar and the silk screening process. They next visited the glass factory where the supplier was struggling to produce the jar. After a day of attempting changes in production, it was determined that more changes would be needed at the mold shop. The team left the supplier without approving the process.

As the launch date approached, the supplier continued to try to improve the process. At production startup, they felt that they were producing parts that were within the original tolerance, but with a high level of scrap. A gauge was developed to measure the neck height, but the supplier was inspecting the quality into the parts. This was a losing proposition for both Access and the supplier. Their production costs were high, and when the parts arrived, inspection showed that they were not successful in sorting the out-of-specifications parts from the good. Access began production with parts that, while functional, did not meet their aesthetic quality requirements.

At this point, the supplier was running out of ideas for improvement. Then a second major setback occurred. During the first major post-launch production, quality control detected orange spots in the cream. One of the active ingredients, Avobenzone, turns orange when it contacts iron. Access performed an intensive review of the manufacturing process and could find no step that could be contaminating the product. Initial audits of the jars showed some black spot contamination, but analytical investigation showed that they were not ferric, nor the cause of the reaction. It was only after using dental mirrors to look at the inside of the jar shoulder that the contamination was discovered. Analytical examination showed the contamination was crystallized acid etching solution.

Through discussion, Access learned that the supplier had moved production from the original decoration facility to a different subcontractor. This subcontractor etched the jars using the same process as the first, but added a step by submerging the jars in a water bath after etching, which allowed water to enter the jar. The jars were inverted to dry, allowing the water that had become dilute etching solution, to pool on the inside of the shoulder. This formed the crystals that contaminated the product. As the supplier began to go into production, their decoration plants went on strike. Because they could neither estimate the duration of the strike, nor guarantee that Access would have priority after it was over, the team had to look for alternate solutions. Access found a refurbishing house in the U.S. and qualified a process that could clean the jars from inventory and those decorated at the supplier's warehouse. Access also sent unetched jars to a U.S. decorator and filled product into shiny jars, again compromising the aesthetics of the package.

It was at this time that the team had to come to a decision. They could try to continue working with the existing glass supplier or change both the jar and bottle material to thick-wall polyethylene-terephthalate (PET) with a matte spray finish. The team felt that the supply and quality problems plaguing the project dictated that they switch to plastic. Marketing agreed that the aesthetic differences between the materials did not warrant staying with glass.

Package Engineering and Procurement quickly began discussions with a U.S. supplier of thick-wall PET. They were also somewhat unknown. Access had only purchased components from them in the past. However, the packaging engineer was very familiar with plastic molding, and there was nothing complicated or unique for the supplier to mold the jar or bottle shape in plastic. Tooling and qualification proceeded quickly without problems. The changes to PET, while not within the original aesthetic profile, improved the company's ability to meet the consumer's overall expectation for function, aesthetics, supply, and price. The overall reaction to the change from the marketplace was minimal. Some consumers prefer the plastic because, unlike glass, it is unbreakable. Several markets have commented that the change lowered the aesthetic quality, but it has not affected the sales volume.

Key Learning

The Pure White and Time Defiance studies show that aesthetic packaging innovation is not an easy process. Unexpected problems arise and the options for dealing with these problems can be limited. Of course, unexpected problems occur in routine package development projects. However, with routine projects there are more frames of reference available for dealing with the problem. Packaging engineers and suppliers will have some experience to guide their problem solving. Routine projects by definition are low risk projects. Innovative packaging projects, on the other hand, are riskier because they have not been done before, so success is less certain.

With aesthetic innovation projects, it is important to determine what aspects are vital to the project and what are excesses. Making a decision about a design for design's sake can increase cost unnecessarily or cause supply problems due to bottlenecks at the supplier or on the packaging line. A innovator should ask what the consumer wants or needs versus what the package designer or marketer desires. This can be difficult to assess without time, consumer research, and money. But several common factors emerged from the Pure White and Time Defiance studies that can help with this evaluation. These case studies revealed some stress factors, which had negative effects on the projects.

Table 1 lists potential project stress factors. When stress factors are identified up front in an innovative project, more attention can be made to these areas and action plans for addressing these factors can be developed. The issue to decide is whether most of the design impact can be achieved with fewer stress factors, such as selecting acid etching over sandblasting to alleviate a supply bottleneck. By eliminating some stress factors early, the more likely that the project will be on time, meet consumer needs, and be made at the lowest cost.

This project stress factor checklist can guide other organizations when developing innovative packaging projects.

Project Stress Factors

1. Shortened development schedule (e.g., less time than normal)
2. New package process (e.g., molding, decoration, assembly)
3. Unconventional technical design (e.g., sealing method, dispensing method)
4. New relationship with supplier (commitment not strong)
5. Distant supplier (slower response time, reduced on site visits)
6. Rate-limiting factors or bottlenecks at supplier or packaging line
7. Unproven method on packaging line

Table 1

1. Alan Pearson and Jorge Gomes, "Creating the Right Environment for Innovation," *IFSCC Magazine*, vol. 5, no. 1, 37 (2002)
2. R. J. Hernandez, S. E. M. Selke and J. D. Culter, *Plastics Packaging*, Hanser, Munich, Germany (2000)