



Cold-chain packaging:

a new, holistic approach to packaging optimization and small-package cost management

How designing cold-chain packaging and shipping solutions within a unified framework of knowledge, design and information flow can provide a practical way to lower supply chain costs and improve customer service and patient healthcare outcomes.

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The legacy supply chain and the new focus on packaging

Healthcare manufacturers have never been under such pressure to deliver more value through improved logistics. Increasing costs and taxes, and the expense of understanding and complying with ever-more-complex regulations constantly raise the cost of doing business and make it challenging to sustain profits.

Healthcare logistics professionals are increasingly looking to their supply chains to realize efficiencies, and retain the confidence of shareholders by growing their businesses.¹ Yet, the supply chain practices of some healthcare companies don't reflect the same logical thought and careful study that characterize the research and development programs that built the company's value in the first place.

Many shipping operations have developed organically over many years, with modifications and adjustments made in response to unique events or imperfect audits. The expensive product that becomes spoiled because of a weather delay, for example, might result in an across-the-board increase to insulating material with little or no consideration of other supply chain elements that could also have been adjusted.

Or, in response to an imperative requirement to contain costs, it may be decided to create savings by trading down from next-day to second-day delivery. The modest transportation cost savings achieved, however, can be more than off-set with the need to re-engineer heavier packaging.

Moreover, if such adjustments reflect more gut judgment than scientific modeling, packaging may become, incrementally and often over many years, significantly over-engineered. And, because over-engineered also means oversized, shipping costs may eventually rise, assessed by dimensional weight, not physical weight and volume.

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Eventually, these “inherited” shipping practices—and their costs—may spiral beyond all reason, the result of well-intended decisions made by business professionals whose service to the company may have ended years before.

Through assisting thousands of its healthcare clients with temperature-controlled supply chain issues UPS has developed a novel approach to cold-chain cost management which can lower overall shipping costs while helping to ensure that healthcare products arrive in the correct place, at the right time, and in an efficacious state.

In this white paper, we will outline a framework for optimizing the supply chain by focusing on packaging. This framework can help logistics executives deliver more value in a rigorous way by creating a methodology for assessment which can be updated and reused. Plus, while the protocol described here focuses on improving an existing system, it could also help inform the design of a new package shipping system.

While the journey from the legacy small-package supply chain to the optimized one is not without the effort required to disembed, assess and reconsider the various components of a temperature-sensitive small package supply chain, UPS clients have found the resulting optimization more than worth the investment of time.

Among the reported returns to the business are reduced incidence of temperature excursions and costly product spoilage, fewer product shortages, the benefits of optimizing the use of packaging materials and, of course, reduced shipping costs.

One UPS customer, a medical device manufacturer, experienced an in-transit spoilage rate of 0.5% to its high-value products. UPS healthcare packaging experts found a better packaging solution and not only did the company reduce product spoilage to virtually zero, but it also saved \$577,000 through a combination of reduced spoilage, reduced inventory requirement, reduced shipping charges in respect of replacement units, and even reduced shipping costs due to a lower dimensional weight. Overall the company found that with similar improvements it could save around \$4.6 million annually across a total of nine product lines.

Customer-perceived benefits are also considerable. These may include greater customer satisfaction through improved service, improved brand image and reputation through perception of greater efforts towards sustainability, and possibly even better patient outcomes.

The approach to packaging and shipping described in this paper will help:

- Decrease product spoilage
- Ensure higher customer satisfaction
- Lower the incidence of product shortages
- Reduce shipping expense
- Improve space and cube utilization
- Optimize utilization of distribution and transportation assets

The key supply chain variables and their owners

At the heart of the UPS approach lies the application of a reproducible method to determine the range of variables that, separately and acting in concert, can be adjusted to produce the most cost-effective supply chain.

No two supply chains are identical and no supply chain is completely without risk. The former means that every supply chain requires a separate assessment, while the latter requires that the assessment's conclusions and implementation of recommendations both will be based upon a determination of an acceptable level of risk to products in the chain.

Accordingly, the information required to conduct a packaging assessment comprises not only the variables within, and the demands of, the supply chain, but also an understanding of how they act upon each other.

Among the supply chain variables that can be optimized and harmonized to lower risk to an acceptable level are:

- Packaging including weight, size, R-values, volume for product, and the volume, type and nature of temperature-maintaining materials used
- Shipping speed and modes of transportation
- Shipping lane environment data
- Pack-out requirements
- Type of consignee (home healthcare customer, hospital, etc.)²
- Availability and cost of shipment insurance
- Package intervention and remediation capabilities

Among the determinants of the acceptable level of risk are:

- Nature of product and commercial value
- Product stability data
- Replacement product: cost of manufacturing and re-shipping
- Quantified impact of delays and/or spoilage



To begin the process, it should be ascertained which persons in the organization are responsible for each of these items, and any others that are relevant to a particular product's supply chain, and also what the parameters of control may be.

To optimize the supply chain by right-sizing packaging, it is first necessary to designate a project owner who should identify and form a working group of experts. This group should be led by an expert that can speak knowledgeably to all the variables outlined above. UPS packaging experts, for example, have the experience, the tools and the knowledge to facilitate this type of session in the most productive fashion.

Members of this working group may include product managers, operations personnel, warehouse personnel, logistics planners, logistics partners, packaging suppliers, and even representatives of channel partners such as wholesalers, retailers, and healthcare providers.

Each of these individuals will contribute to the working group, speaking to their functional areas' parts in the supply chain objective—that is, the on-time delivery of each product to the correct package recipient in efficacious condition.

Each expert should be able to express the present parameters of control within their respective areas of expertise, and to be able to project the implications of adjusting those parameters.

For example, a shipping manager should not only fully understand the terms of the shipping services presently utilized, but also to be able to speak to the cost and service implications of moving to a faster, or less urgent, service. Product managers must be able to express the conditions which will cause products to decrease in efficiency and, perhaps along with regulatory compliance managers, determine the deviations in conditions which will cause products to fail regulatory standards.

Only by having these experts in the room can the many interdependent dimensions of temperature-sensitive shipping operations be refined into a fully optimized model.

White-boarding as a means to mapping “the big picture”



It will quickly be seen, as the flow or process map emerges, that product, packaging, and transportation—frequently seen as separate elements—are, in fact, most meaningful in context, as dependencies in an ecosystem.

To begin, the working group, guided by the packaging logistics expert, should document, in “white-boarding” session(s), the forward and return flows of packages and their contents. They should also document, along with package visibility information from the manufacturer’s dock to the consignee, the return journey to the manufacturer, whether a planned and integral element of the operation, or whether reverse logistics come into play only when there has been a service failure.

To help ensure the greatest possible understanding across the group, the participants should be encouraged to request from one another clarification and explanations of elements that are not understood by, or not clearly represented, to all.

It will quickly be seen, as the flow or process map emerges, that product, packaging, and transportation—frequently seen as separate elements—are, in fact, most meaningful in context as dependencies in an ecosystem.

What’s more, each of these elements can be seen to act upon the other. This is the principle, it will be noted, which allows modifications to package engineering to balance other dependent variables to make the supply chain more efficient, and reduce risk to the package contents.

This session(s) may be judged successful when the team:

1

Has documented how products and information flow to and from the organization, and to and from the consignee

2

Identifies areas or supply chain variables where package and transportation changes can be made (faster or less urgent shipping, air or ground, greater or lesser insulation in packaging, more or less dry ice or other phase-change temperature-maintaining material, etc.)

3

Has identified the interdependencies between each element in the supply chain (for example that shipping speed will vary supply chain costs, but that greater shipping speed is unnecessary for shipments of lesser value, when a higher level of risk can be accepted.

Having carried out the mapping exercise, the following elements should be examined in detail. Remember: There may be no good reasons that practices which were instituted long ago should be continued today. Gains can be made in surprising places!

Dimensional weight

Though primary and secondary packaging are typically the largest determinants of package size and weight, *dimensional weight* determines the cost of shipping of light, large packages.

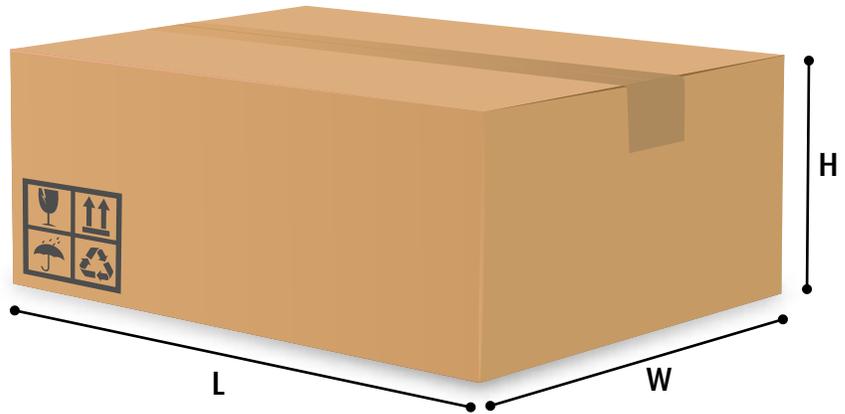
Determining Dimensional Weight

Domestic Shipments

$$\text{Dimensional Weight (lbs)} = \frac{L \times W \times H}{166}$$

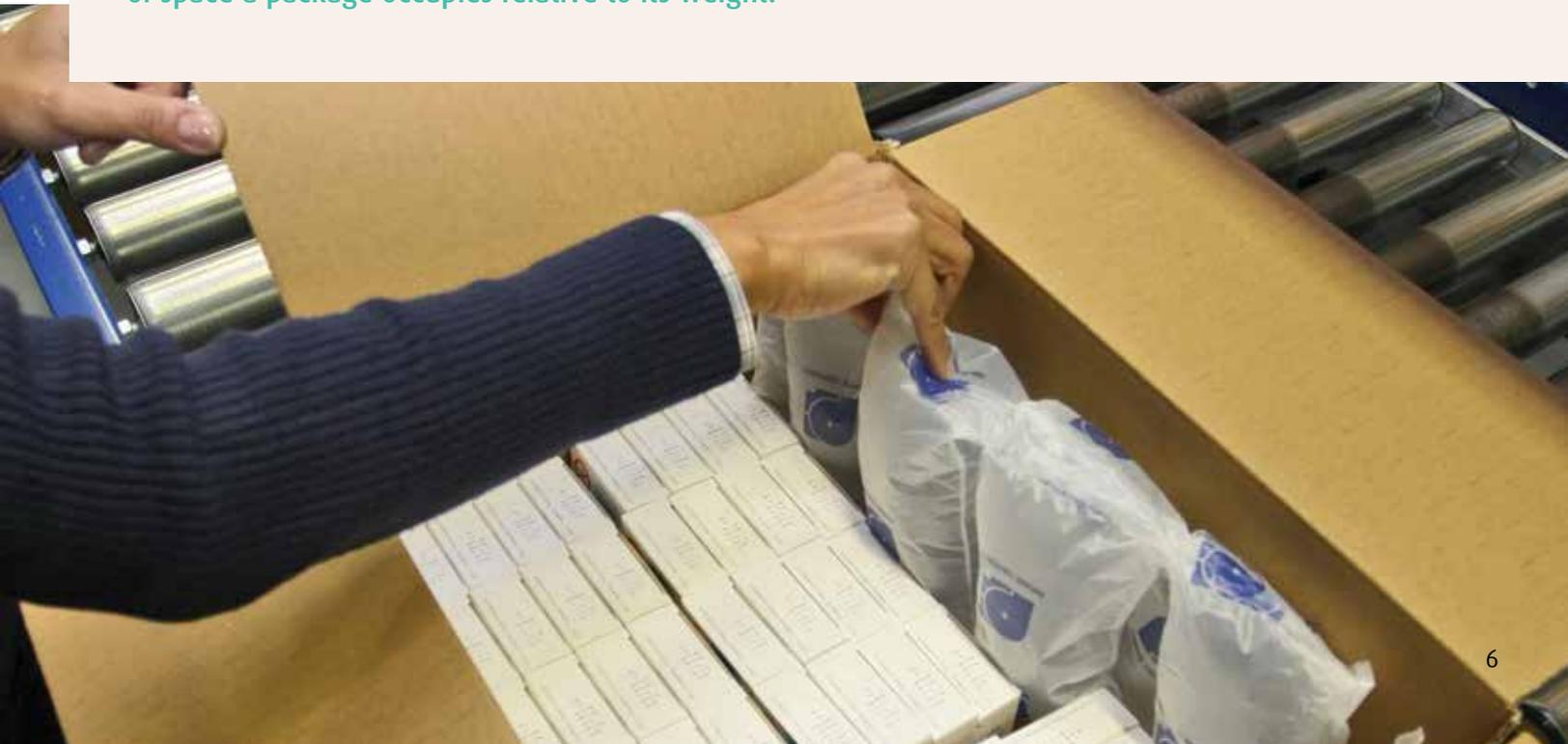
International Shipments

$$\text{Dimensional Weight (lbs)} = \frac{L \times W \times H}{139}$$

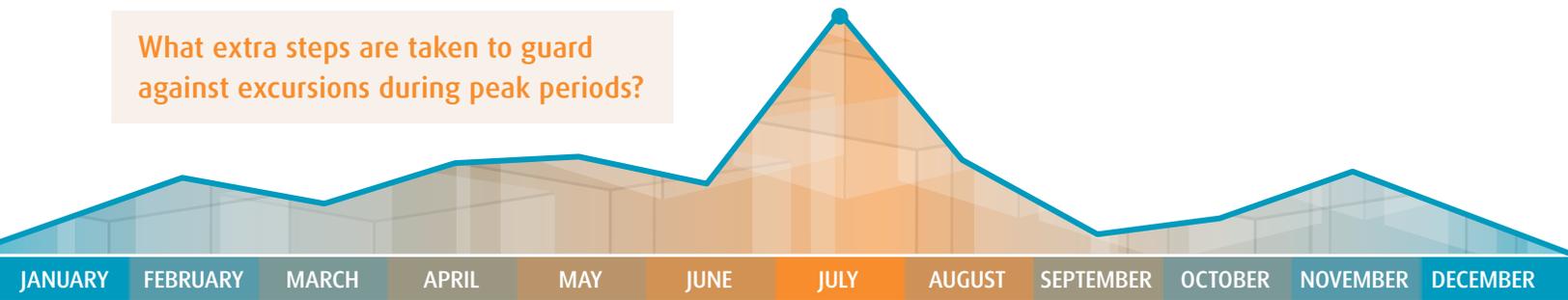


“Dim weight” rules are common to all major shipping companies, and ensuring that packages fall beneath the dim weight threshold is desirable from a cost perspective. The packaging analysis area of the white-boarding session should therefore begin by examining the size ratio between the product and its packaging.

Dimensional weight reflects package density, which is the amount of space a package occupies relative to its weight.



What extra steps are taken to guard against excursions during peak periods?



Product ordering, and compliant storage and handling

A product's specified storage temperature range, and the permitted excursions beyond that range are the foundation of product protection and the starting point for packaging decisions. This is important, however, for even non-"cold chain" products because ambient shipping temperatures may be harsher than commonly anticipated or imagined.

Aim to uncover order volume and shipping and handling patterns and processes. Look for seasonal spikes of product shipments particularly in the coldest and hottest periods of the year to prompt discussion of extra steps taken to guard against temperature extremes when large volumes of product are moving. If there is a relatively high percentage of low-volume orders (that reduce payload ratio to shipping-container size), then consider whether adjusting minimum order levels could compensate without hurting businesses. Alternatively, consider what changes could be made to the choice of shipping cartons.

Assess product ordering patterns to ascertain where the majority of units are being sent and at what patterns during the year, being specific about:

- Number of units per order
- Seasonality in order patterns
- Shifting demand between shipping locations
- Increasing and decreasing demand in geographical locations

Outer shipping containers and packaging failure information

Improving the ratio of product payload to shipping case size will reduce the overall transportation cost of total units shipped. It will also improve pallet cube utilization, lowering total cost of shipping per unit.

If payload and shipping cases show a higher-than-anticipated rate of failure in transit and/or the dimensional weight can be reduced, discuss laboratory testing to seek solutions.

Pay particular attention to how end-user feedback on product damage is being relayed back to package design and operations. Only pertinent information that reaches the right people can result in improvements. Where there is concern about package failure information "going to waste," the creation of a new, shared information channel for product failures might be a solution.

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Special considerations of the cold chain

Almost every pharmaceutical product, including over-the-counter medicines, must be temperature controlled to a greater or lesser extent. A discussion at the whiteboard about general temperature control or actual cold chain packaging should start with an examination of the typical failures most often found at the end of the supply chain.

These can include the visible failures, including:

- Contamination
- Crystallization
- Freezing
- Denaturing
- Bacterial growth
- Closure violations

Failures can also be invisible, or consequential to a product recall:

- Ineffectiveness
- Infection/patient safety
- Cost of product recall
- Sales loss
- Regulatory implications
- Brand damage



...are responsible for
80% of failures

Pareto 80/20 Rule

20% of manageable issues...

This area is, of course, business-critical. As in most areas, the Pareto 80/20 rule is a good place to start an analysis. Begin assessing where the majority of failures are occurring and determine the patterns of failure types. Identify the 20 percent of issues that generate 80 percent of deviations. Then prioritize them and address them by order of importance. Analysis may find, for example, that 80 percent of potency problems are associated with 20 percent of customers. It is then possible to work backwards and identify the problem.

It's clear that a whiteboard session is not equipped to immediately solve problems that may require weeks or even months of study. The session can, however, identify and prioritize avenues of investigation.



Packaging types and testing, and sustainability

Any assessment of cold chain packaging has to include discussion of pre-qualified, and custom tertiary packaging. Off-the-shelf solutions are the least expensive and the easiest (and fastest) packaging to acquire. Custom-designed solutions on the other hand can, in some cases, take more than a year to design, test and validate (best practice dictates revalidation every two years).

Healthcare companies seeking a one-stop solution for their packaging needs may do well to scrutinize very carefully proposed off-the-shelf solutions. It should be expected that packaging consultants (including third-party logistics providers) maintain a database of elements that can be combined to create solutions but every product requires an optimum packaging solution, not simply packaging in inventory waiting to be sold.

Regardless of the type chosen, however, all packaging should be assessed against the following checklist of considerations:



Shipment needs:

- Payload dimensions
- Compatibility for multi-package shipments
- Single consignment



Product needs:

- Environmental requirements
- Tolerance levels
- Financial risk associated with spoiled products



Transit Needs:

- Origin and destination
- Time in transit
- Transport mode



Custom solutions have these additional assessment needs:

- Temperature criteria and allowable excursions
- Duration of anticipated time in transit (plus a contingency)
- Design constraints: size, weight, number of components, etc.
- Ambient temperature shipping lane profile
- Payload space
- Regulations



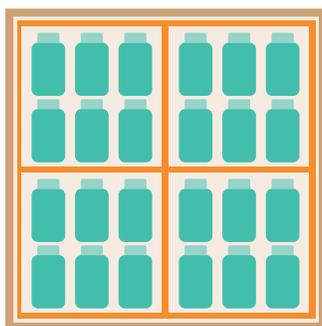
Because a full evaluation cannot be staged on demand within an actual transportation network, UPS recommends laboratory testing to help model packaging performance.

The UPS Package Lab typically helps healthcare customers gain important information through:

- Compression tests
- Shock tests
- Vibration test
- Environmental tests
- Drop tests

Testing may have been done when a new product or package entered the system but problems can arise if conditions change. Perhaps there is new primary and secondary packaging or the products formulation has changed, or new export regions have opened up. UPS has found in its own lab that reevaluating an already-tested solution may be worthwhile. The findings of the lab and pilot tests may uncover a new solution—one that was not available earlier.

A note about sustainability: Increased packaging efficiency delivers sustainability returns through less material being required to ship each unit of product. Sustainability considerations extend also to the choice of materials: new versus recycled, for example. Not only is sustainability a serious consideration from the viewpoint of environmental responsibility, it may also influence customer preference for your products.



Tertiary



Secondary



Primary



Product

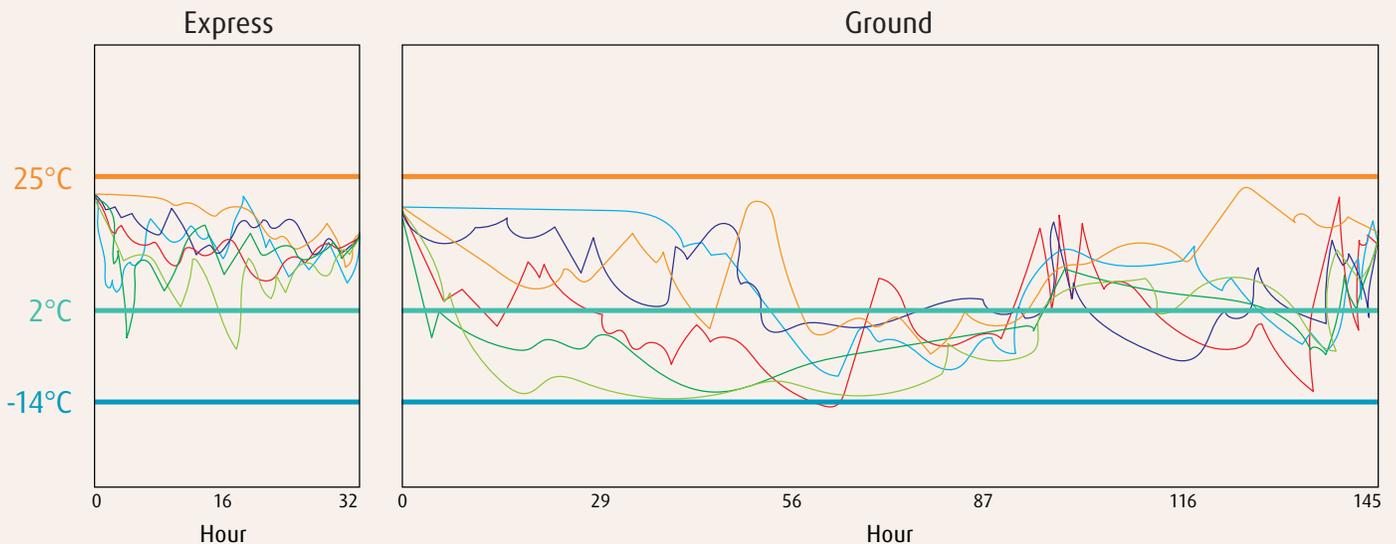
Assessing package performance against real-life conditions

Ambient temperature, service level, and pack patterns are three areas to be assessed closely. These can be viewed against a reliable picture of environmental conditions likely to be found along the transportation legs of each package's journey, both domestic and in key overseas shipping lanes as needed, and at the extremes of annual temperature in the summer and winter periods.

Ambient temperature along the route of the package can have a direct impact on temperature stability within the package. Desert heat or arctic blasts can spoil a controlled room temperature product shipment if the proper packing patterns and transit times have not been followed. Hence the importance of route and seasonal shipping frequency information.

Many transportation companies, including UPS, worked closely with the International Safe Transit Association (ISTA) on the development of the 7E series of "real world" temperature profiles for shipment planning or for testing purposes. Building on ISTA's work, UPS developed a series of highly detailed ambient temperature profiles for key transportation lanes, both domestically and in many European countries. The data that emerged from this extensive network study, carried out to provide the deepest possible understanding of the UPS transportation environment, has proved to be (because it gives greater accuracy to pack patterns) vital to achieving lowest cost of packaging, shipping, and transportation.

Temperature Profiles: UPS air compared with UPS Ground What is the impact of packaging solution when facing a different mode of transportation?



Consideration of pack-out & refrigerants

Information about the transit route, including routing through transportation hubs, hand-offs and the amount and condition of refrigerants to be used in pack-out (that is, the specified pattern and mix within the shipping container of product, refrigerant or phase-change material, and insulation) can be determined with high accuracy.

In fact, shippers may choose to design seasonal pack-outs where, for example, a lower-cost, lighter-weight pack-out for spring and fall may be selected on some routes during warmer weather instead of a heavy-duty, universal packout that protects products throughout the year.

Shipping service level and time in transit

The longer a cold chain package is in transit, the lower its possible payload because of the greater mass of refrigerant or phase-change material needed. Longer transit time increases the per-unit cost of shipping a cold chain product and may increase the complexity of pack-out. It also increases risk because of longer environmental exposure. The attractiveness of longer transit times is lower transit costs; one-or-two day shipping, of course is considerably more expensive than three-to-five day.

Another way to manage longer transit times is to increase the insulation, or R-value, of the packaging. And though higher R-value insulation materials tend to be more costly, they can help create a package with longer duration and a smaller footprint. The key to optimizing this element is to find the right balance.

Conversely, decreasing transit time may preserve payload size, but incrementally increases the transit cost. An analysis that identifies the optimum transit time window per unit, per package, per route, and per time of year will provide a packaging blueprint for each of these shipping challenges.

It is clear that the universal default to a lower service level and longer transit times may, in fact, achieve the opposite of its intended goal. Every hour the package remains in transit is an hour that it is exposed to risk, and it is often the case that a package shipped by a faster service with less packaging, insulation and refrigerant is a better option to help prevent product spoilage—and it may be a less costly option.



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Sometimes the outcome of an assessment is the opposite of what conventional wisdom might dictate.

In summary

Without a proper assessment, it is impossible to know whether packaging is optimized to best perform its function at lowest possible cost. And sometimes the outcome of an assessment is the opposite of what conventional wisdom might dictate. Indeed, inherited supply chains often have inherent inefficiencies and are ripe for analysis. There are frequently gains to be made, and lessons to be learned along the way.

As healthcare manufacturers continue to look for ways to pare down their costs, the richest opportunities for savings may be hiding in plain sight. And while improving the transportation of pharmaceutical products and medical devices can have a profoundly positive impact on business costs and efficiency, “getting it right” helps fulfill the most important purpose of healthcare: making people well.

Citations

1: Scott Szswast of UPS examines the relationship between the supply chain and the bottom line in his white paper, “Supply Chain Management is the Key to Top-Line Growth in the 21st Century for Pharmaceutical and Medical Device Manufacturers.”

2: Vincent Pusateri of UPS discusses the role of package intervention and remediation in his white paper “Proactive Monitoring and Intervention: Key Ingredients of an Optimal Supply Chain for Temperature-sensitive Healthcare Products.”

About the author

Susan Li joined UPS in 2011 as a Marketing Manager in UPS Healthcare Strategy group. She specializes in temperature sensitive packaging logistics and manages UPS's Temperature True Packaging program, providing cold-chain package consulting service to healthcare customers. She is also a member of ISTA Thermal Council.

Susan has extensive marketing and product development experience in the healthcare industry, developing her understanding of global cold chain management in the pharmaceutical and biotechnology industries. She was a senior marketing manager and a member of the core strategy team at ThermoSafe Brands, Tegrant Corporation. Prior to ThermoSafe, Susan served as a marketing manager for Abbott Laboratories. Susan acquired her broad healthcare knowledge and experience through assignments at Cole-Parmer, Zimmer and AstraZeneca.

Susan has an undergraduate degree in Biochemical Engineering from East China University of Chemical Technology, a Master of Arts degree in Biological Science from Smith College and an M.B.A. from Kellogg School of Management, Northwestern University.

To discuss with the author any of the issues—and explore any of the solutions—featured in this white paper, please contact Susan Li at susanli@ups.com

UPS 2014 Healthcare White Paper Series

Supply chain management is the key to top-line growth in the 21st century for pharmaceutical and medical device manufacturers

by **Scott Szwast**

Proactive monitoring and intervention: key ingredients of an optimal supply chain for temperature-sensitive healthcare products

by **Vincent Pusateri**

Cold-chain packaging: a new, holistic approach to packaging optimization and small-package cost management

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