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THE PROCESS OF DISTRIBUTION PACKAGING INNOVATION AND ITS RELATIONSHIP TO DISTRIBUTION CHANNEL STRUCTURE

by

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ABSTRACT

THE PROCESS OF DISTRIBUTION PACKAGING INNOVATION AND ITS RELATIONSHIP TO DISTRIBUTION CHANNEL STRUCTURE

by Diana Twede

This research explores the relationship between distribution packaging and distribution channel structure by examining the innovation adoption process.

A case research method was used to compare the distribution package innovation adoption process of five firms with vertical marketing systems to five firms with non-vertical marketing systems. All ten firms had initiated the process of adopting plastic distribution packages. To determine the effect of the channel structure, key informants were questioned.

Systemic innovations (which affect a set of subsystems) have been found to proceed most efficiently in (integrated) enterprises whose boundaries span the various participating organizations. Distribution packaging innovations are such systemic innovations, and vertical marketing systems are integrated enterprises whose boundaries span the various channel member organizations. Therefore, Distribution Packaging innovations were expected to proceed most efficiently in vertical marketing systems. This argument was supported.

The vertical marketing systems were more likely to adopt innovations as a customer service. They transmitted information about end-of-the-channel problems (like trash disposal costs, handling costs, and dispensing costs) which triggered the innovation process for most of the cases with vertical marketing systems, and they easily accepted packaging solutions to these problems.

The free-flow systems were more complex, and only a powerful group of channel members could persuade a firm to consider a package change. Most of the cases with non-vertical marketing systems adopted their innovative packages to lower their own costs, and had to spend more time promoting the new package to channel members.

All of the package innovations lowered costs borne by channel members and the package decision-maker. The innovations studied were incremental. Ideas for the new packages were all inspired by a similar package observed in use by another firm. The only new knowledge required concerned material properties in relation to machinery operation and package performance.

The most significant finding is the relationship between distribution channel structure and distribution packaging. In the past, distribution packages have been relatively standardized throughout all kinds of distribution channels, the result of transportation carriers making rules for package specifications. This research reveals that packaging can be more efficiently tailored to fit specific distribution systems.

Dedicated To Grandma Litson

who said, "Just sit down and do it."

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CHAPTER I

INTRODUCTION

Distribution packaging--the logistical system component comprised of shipping containers, dunnage, and unit loads--has a significant impact on the productivity of distribution channels. For instance, sorting efficiency depends on the number of units handled and their symbolic compatibility with manual or automatic identification systems; warehouse and transportation vehicle cube utilization depends on the size and shape of packages; and customer service depends on the protection afforded to products.

Because a firm's packaging department is most typically managed from an engineering, research and development, or purchasing viewpoint rather than as a distribution responsibility, these implicit distribution costs are often not considered, measured, or controlled by package designers.[1] Much of the time, the only cost visible to the packaging professional is the cost of purchasing packaging materials.

As a relatively neglected area of investigation, shrouded in myths and "rules," the study of distribution packaging represents a significant opportunity for improving distribution efficiency. In the United States, the cost of corrugated shipping containers amounted to almost $14

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[1]Michael A. McGinnis, Charles J. Holton. "Packaging: Organization, Objectives, and Interactions," Journal of Business Logistics, 1 (1978) pp.45-62; and "Profiling the Packaging Professional," Packaging (September 1983) pp.41-46.

billion in 1985.[2] Added to this is the cost of packages made from other materials (such as steel drums and wooden pallets). Furthermore, packaging indirectly affects the cost of all physical distribution activities. The potential for savings throughout the marketing system is dramatic.

It is hypothesized that distribution channel integration and transportation deregulation have a direct influence upon the adoption of packaging innovations. This research addresses the diffusion of plastic materials in the distribution packaging industry. In particular, the research examines the decision process involved in adopting plastic distribution packages. Its objective is to determine the effect of the firm's distribution system on the adoption decision. It examines the impact and potential of distribution packaging upon channel performance and addresses how the packaging innovation adoption process interacts with distribution channel design and performance.

This introductory chapter begins with an overview of distribution packaging innovation that introduces relevant concepts. Next, in order, the research problem, the conceptual model and hypotheses, related research questions, and research methodology are summarized. The chapter ends with a discussion of the significance of this research to marketing theory and practice.

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[2]"Packaging Reference Guide, Value of Packaging Materials," Packaging Encyclopedia and Yearbook 1986 (Boston, MA: Cahners) p.38.

An Overview of Distribution Packaging Innovation

Distribution packaging is one of the most "systemic" of all logistical activities. The same shipping container is transported, sorted, and stored throughout a firm's distribution channels. It must meet each channel member's functional requirements for protection, communication, and efficiency. Distribution packaging is a unique activity that facilitates productivity throughout the logistical system, spanning the boundary of the organization which designs the package, flowing out into the warehouses, distribution centers, retail outlets and vehicles of many separate organizational units. A switch from corrugated fiberboard shipping containers to shrink-packages involves cooperation throughout the channel: new handling methods, new damage perceptions, new material disposal alternatives, and more productivity for some channel members than for others.

A new package which solves a problem or reduces cost for a manufacturer may result in higher costs for some of its channel members. When making the decision whether to adopt a new package, direct package costs (materials, fabrication, and filling costs) should be balanced with associated logistical costs and benefits such as transportation utilization, handling productivity, trash disposal, and loss, damage and claims costs.

Unlike total-cost tradeoff analysis typically used to evaluate logistical system design, the trade-off concept is inappropriate for predicting the relationship between packaging performance and total logistical cost. For example, in many cases, a new package design

performs better in laboratory tests and costs less than traditional corrugated boxes.[3]

It is difficult to identify the decision variables considered by firms who change their distribution package designs. Very little innovation has occurred in distribution packaging in the United States during the past 75 years.

Carrier Association Rules

The primary reason for the lack of innovation has been the mandated use of specific packaging materials and constructions by transportation carrier associations (under authority granted by the Interstate Commerce Commission in 1912). For example, the requirements for transport containers, the railroads' Rule 41 and motor carriers' Item 222, precisely define and specify corrugated board properties, and hundreds of box designs and "exceptions" have been published.[4] Suppliers of corrugated fiberboard shipping containers have traditionally been the source of these box designs, and their associations have worked closely with carrier associations and individual shippers to obtain "approval." Many of these corrugated fiberboard boxes are very expensive, especially for durable goods, and there is little incentive for corrugated suppliers

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[3]James W. Goff and Diana Twede, Boxes, Bags, and Cans; Performance of Packages for the Transportation of Agricultural Products (East Lansing, Michigan: MSU School of Packaging Special Report Number 14, 1979).

[4]National Classification Board of the American Trucking Association, National Motor Freight Classification, Issue N (Washington, D.C.: National Classification Board, 1987); Uniform Classification Committee of the Western Railroad Association, Uniform Freight Classification, 6000D (Chicago: Uniform Classification Committee, 1987).

to develop lower-cost systems. On the shipper side, distribution packaging management is treated as a simple purchasing task with no design responsibility. This tradition represents a barrier to distribution packaging innovation and cost management.

Besides standing in the way of improvements, the appropriateness of carriers making packaging rules can be questioned on three points: technical performance, channel structure, and legality.

The technical performance argument questions whether corrugated fiberboard is the most appropriate material for shipping containers. There is no evidence that corrugated offers the best solution today to provide the desired levels of protection, communication, and distribution efficiency. Rules related to corrugated fiberboard containers have, in effect, institutionalized package designs that originated in the early 1900's. Little attention has been directed to emerging packaging technology. Plastic, today's low-cost material, has been effectively embargoed by these rules.

The distribution channel structure argument raises questions concerning the basic right of transportation carriers to exercise the power of establishing package specification. The relative channel power of carriers has consistently declined in this decade. In general, a carrier's risk is limited to the performance of a specified transportation movement under prescribed service/cost conditions. In contrast, manufacturers, wholesalers and retailers, who carry the burden of risk and cost for the channel, have a great deal at stake (indeed, their very survival) if the channel does not perform. Furthermore, decisions to use a new packaging system do not just affect carriers.

Decisions to use a specific packaging system affect all channel members who handle the product--manufacturers and retailers, as well as the distribution centers owned by manufacturers, retailers and intermediaries. It is important to realize that distribution packaging is a "boundary-spanning" activity; although the packaging activities themselves are performed within a manufacturing organization, they connect it with the entire external distribution channel. In addition, packaging decisions affect many internal parts of the organization: marketing, distribution, purchasing, manufacturing, quality control, research and development, and engineering. Even though carriers are liable for damage, it is difficult to justify their control of packaging, when considering total channel performance.

The legal argument against carrier determination of packaging rules results from recent developments in regulatory legislation and administrative rulings. As a result of transportation deregulation, there is a fundamental concern regarding the current legality of "collective" actions. Deregulation has reduced the power of the carriers' associations to require shippers to use specific package designs. Transportation deregulation has resulted in carriers increasing their marketing efforts. Two marketing trends since 1980 are: increased efforts in loss-and-damage prevention, and increased cooperation with shippers to minimize total distribution costs. Both of these trends run contrary to the tradition of carriers dictating shipper packaging requirements. Eight years into deregulation represents an ideal time to evaluate how the distribution packaging process has been impacted. It is reasonable to assume that carrier resistance to distribution packaging

innovation has declined. A basic assumption of this research is that the potential productivity improvement possible from integrated logistics will only be realized if deregulatory concepts are extended to packaging specification.[5]

The barrier to innovation and competition represented by the "Cardboard Rules" is dissolving. There is a clear trend towards using plastic materials for distribution packaging. The definition of innovation employed by this research follows that of Rogers: "An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption."[6] Although plastic is not a "new" material, it is a new distribution packaging material.

The diffusion of this industrial innovation involves a complex social system in its adoption, spanning boundaries of the firm. The innovation literature is extensive concerning the role of internal organizational structure and behavior in the adoption process[7]. In contrast, there is a lack of research concerning the role of "external," yet strongly affected, business units. Clues to the distribution packaging innovation process can be found in two innovation concepts: incremental and systemic innovation. This study of distribution

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[5]Diana Twede, "Packaging Deregulation," Proceedings of the 1985 Annual National Freight Claim Council and ATA Security Council 1985 Joint Annual Meeting (Jacksonville Beach, FLA: Thyra D. Ellis & Associates, 1985) pp.32-37.

[6]Everett M. Rogers, Diffusion of Innovations, p.11.

[7]For recent literature reviews, see Everett M. Rogers, Diffusion of Innovations, third edition (New York: The Free Press, 1983) pp.347-370; and Anita M. Kennedy, "The Adoption and Diffusion of New Industrial Products: A Literature Review," European Journal of Marketing 17 (1983) n.3 pp.31-88.

packaging innovation presents a unique opportunity to investigate the adoption process of innovations which are both systemic and incremental.

Systemic Innovation and Distribution Channel Structure

Systemic innovation is contrasted in theory with innovations which stand alone. A systemic innovation is one that must perform throughout a system, requiring coordination and readjustment among several organizational units. Distribution packaging innovation is this kind of boundary-spanning innovation.

Past research has identified a relationship between organizational structure and systemic innovation. Systemic innovation has been found to proceed most efficiently in integrated enterprises whose boundaries span the various participating organizations[8].

Distribution channel theory provides a foundation to examine the relationship between structure and performance. Channel theory classifies channel structures on the basis of recognized dependency.[9] Vertical marketing systems are those linked by contracts, ownership or administered by a dominant channel organization Non-vertical marketing systems are not formally organized—and may be created for a single

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[8]David J. Teece: "Economic Analysis and Strategic Management," California Management Review, 26 (1984) 102-4.

[9]Donald J. Bowersox, M. Bixby Cooper, Douglas M. Lambert & Donald A. Taylor, Management in Marketing Channels (New York: McGraw Hill, 1980), pp.9-12.

transaction or for "free flow." For strategic reasons, today's distribution channels are increasingly vertically integrated.[10]

The systemic innovation theory implies that systemic innovations would proceed more efficiently in vertical marketing systems than in free-flow channels. Hence, the central concept of this research is that distribution packaging innovation will, likewise, be facilitated by vertical marketing systems.

An illustration of this concept can be seen in the introduction of unitized loads to replace break-bulk shipments; modification of handling equipment throughout the system is easier to control, and trade-offs easier to measure, in a vertical marketing system. On the other hand, grocery industry attempts to standardize and modularize package sizes have so far failed, because of the free-flow nature of grocery channels and the fact that the transaction would not pass on any wholesaler's handling savings to the shipper who would bear the costs of redesign.[11]

Incremental Innovation

Incremental innovation is distinguished from radical innovation by the degree of technology change required[12]. Distribution packaging

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[10]A. T. Kearney, Inc., Measuring and Improving Productivity in Physical Distribution (Chicago: National Council of Physical Distribution Management, 1984).

[11]Charles William Abdalla, "Problems in Interindustry Coordination and System-Wide Productivity Innovation: An Institutional Analysis of Barriers to Implementing Modular Shipping Containers for Dry Groceries" (Ph.D. dissertation, Michigan State University, 1985).

[12]William J. Abernathy and James M. Utterback, "Patterns of Industrial Innovation," in Readings in the Management of Innovation, ed. Michael L. Tushman and William L. Moore (Marshfield, MA: Pittman Publishing, 1982) pp.97-108; and Robert D. Dewar and Jane E. Dutton, "The

changes do not represent revolutionary changes in technology, but rather are incremental improvements in cost or functional performance.

The use of plastic, although perceived as a "new" distribution packaging material, does not fundamentally change the functions which packages perform. Furthermore, the production technology for molding, extruding, stretching, and shrinking plastics is well established. Although individual adopters must acquire new knowledge to replace a box-filling with a stretch-bundling operation, the technology is readily available. This research will investigate the new knowledge required to change from the technology of corrugated fiberboard to plastic distribution packages.

Research on incremental innovations helps to explain the paradox that cheaper can be better. Incremental innovations are process improvements that have a gradual, cumulative effect on productivity. Incremental innovation has been found to account for more than half of the total ultimate economic gain from innovations.[13] The small new ideas of "how to do it better" can be as valuable as the grand "basic innovation" ideas for new products. The small idea of making a box shorter can save millions in transportation (cube) costs.

This research will also investigate how cost and performance changes as a result of innovation. But since distribution packaging professionals have heretofore had limited opportunity to innovate, it is expected that some relevant distribution costs and benefits may not

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Adoption of Radical and Incremental Innovations: An Empirical Analysis," Management Science 32 (November, 1986) pp.1422-1433.

[13]William J. Abernathy and James M. Utterback, "Patterns of Industrial Innovation."

impact the adoption decision. This research seeks to identify relevant costs affected by packaging innovation , as well as to discover which benefits prompted the adoption process.

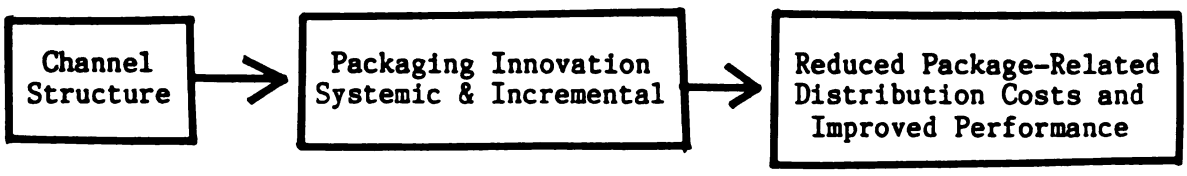
The Research Problem and Objectives

Three relationships will be addressed by this research: the relationship between the distribution package innovation adoption process and the distribution channel's structure, the relationship between the adoption process and changes in logistical costs and benefits, and the gatekeeper relationships between package innovators and their distribution channel members.

The specific objectives of this research are: 1) To identify the effect of channel structures on the process of adopting distribution package innovations, particularly contrasting various vertical marketing systems to free-flow systems. 2) To identify "barriers" to distribution package innovation diffusion. 3) To identify the costs and performance considered in the adoption decision. 4) To identify the costs and performance changes resulting from distribution package innovation.

Conceptual Model and Hypotheses

The model shown below is useful in conceptualizing the hypothesized relationships:



This model conceptualizes the following relationships:

1. Channel structure affects the propensity for packaging innovation because of distribution packaging's systemic nature.

H_1: Systemic innovations are more easily adopted by vertical marketing systems.

H_2: Systemic innovations encounter more resistance in non-vertical marketing systems unless transaction costs reflect package-related cost changes.

2. Distribution packaging innovation's incremental nature predicts that the central purpose is to reduce costs and improve performance in comparison to traditional packages. Which costs are considered? To investigate when in the adoption process costs are considered, the innovation adoption process is conceptualized in the following stages:

I. Initiation Stage
   1. Knowledge-awareness
   2. Formation of attitudes toward innovation
   3. Decision

II. Implementation stage
   1. Initial implementation
   2. Continued-sustained implementation[14]

H_3: Shippers with a vertical marketing system are more likely to discuss package changes with channel members at an earlier substage in the adoption process than are shippers with a non-vertical marketing system.

H_4: Shippers with a vertical marketing system are more likely to consider channel members' cost changes during the decision

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[14]Gerald Zaltman, Robert Duncan, and Jonnny Holbek, Innovations and Organizations (New York: John Wiley and Sons, 1973) pp.158-163.

substage of the adoption process than are shippers with a non-vertical marketing system.

H_5: A non-vertical marketing system better facilitates initiation and a vertical marketing system better facilitates implementation of a distribution packaging innovation adoption.

The theoretical justification for these concepts and relationships is presented in Chapter II.

Research Questions

In addition to the hypotheses concerning channel structure, this research sought answers to the following questions related to transportation deregulation, the packaging innovation adoption process, and cost and performance impact:

1. How has transportation deregulation (i.e. more contracts and less common carriage) altered the diffusion of packaging innovations?
2. What is the relationship between packaging innovation, packaging cost and performance, and packaging's impact on the total cost of distribution? What distribution and packaging costs are involved? What benefits are involved? Who benefits and who pays?
3. What is the adoption implementation process for a new distribution package? What problems initiate the adoption process? What benefits are sought? Where do innovative package ideas come from? Which organizational units participate in the initiation and implementation stages?

What role is played by the supplier of the innovative package? Who are the "gatekeepers" who control the flow of information about the innovation to the channel members, and when in the adoption process are channel gatekeepers involved? How much new knowledge was required to change from corrugated to plastic technology? How was this knowledge acquired? How are these plastic innovations diffused? How are the innovations implemented?

4. What is the perceived strategic impact of distribution package changes?

Research Method Synopsis[15]

A case research approach was used to examine the packaging innovation process. Ten firms identified as early adopters of plastic distribution packages were studied. The range of packaging innovations included such things as composite packaging, shrink- or stretch-bundles, and reusable thermoset containers.

Five of the firms were engaged in vertical marketing systems, and five were free-flow. Questions dealt with the relationship between the ease of adopting systemic innovations and the firm's channel structures. Particular attention was paid to the degree to which contract or common transportation carriers were utilized in the channel.

To examine the adoption process, key informants were interviewed regarding how innovative packaging decisions were made, what evaluation

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[15]A complete discussion of research procedure is presented in Chapter III, "Research Design."

lemented, , and which costs and benefits changed as a result. Although all firms surveyed had not implemented the innovation, they had progressed through the decision substage.

The Significance

The significance of this research is its contribution to the study of industrial innovation, channel structure, and distribution packaging. For the study of industrial innovation adoption, it provides an examination of the process of adopting systemic and incremental innovations. By exploring the relationship between channel structure and the innovation adoption process, this research contributes knowledge concerning: (1) how firms make boundary-spanning decisions, and (2) how distribution channel structure affects the adoption process. The research results provide an exploration of the relationship between the innovation adoption process and system-wide total costs and performance. This research contributes a general taxonomy of cost and performance variables relevant to distribution packaging decisions.

The managerial significance is that the research provides a normative guide for the distribution packaging adoption process. The nature of the case-study method, although on one hand limiting ability to generalize common practices, provides a useful framework to guide the initiation and implementation processes.

Order of Presentation

The balance of this dissertation is organized as follows: Chapter II presents literature relevant to the theoretical development of the

conceptual model. Chapter III develops the case research methodology and introduces the firms selected. Chapter IV presents the support and/or nonsupport of hypotheses, and answers to research questions. Chapter V provides questions for future research. Three Appendices follow: Appendix I provides a historical perspective and analysis of the distribution packaging industry in the United States; Appendix II presents a taxonomy of distribution packaging functions; and Appendix III presents the ten case histories.

CHAPTER II

LITERATURE REVIEW AND THEORY DEVELOPMENT

This literature review develops the theoretical relationships between the three constructs in the conceptual model. First, a taxonomy of **distribution channel structures** is explored along with the generalizations which have been demonstrated to follow. Second, the literature on the organizational adoption of innovations is reviewed and the concept of **systemic innovations** is related to the systemic nature of distribution channels, a theory which is at odds with some free-market notions concerning the propensity to innovate. Third, the concept of **incremental innovation** is related to industrial innovations which result in improved cost and performance, and the literature of distribution packaging is reviewed to discover which costs and performance may be affected.

The three concepts, Distribution Channel Structure, Systemic Innovation, and Incremental Innovation, can be related in the following ways: 1) Channel structure affects the diffusion of packaging innovations because of distribution packaging's systemic nature. 2) Distribution packaging innovation's incremental nature implies that distribution packaging innovation reduces costs (channel and package costs) and improves performance. Whose costs are taken into account, and when they are considered may also be affected by channel structure.

Literature reviewed supplementary to the model, and specific to distribution packaging is found in two appendices. **Appendix** I reviews the **distribution packaging industry** in the United States, presents a historical note on the diffusion and "institutionalization" of corrugated fiberboard materials, and discusses recent market changes which have precipitated a "revolution" in packaging materials. **Appendix II** addresses the **functions of distribution packaging** to provide a basis for the logistics, purchasing, and production aspects of cost and performance which packaging innovations may incrementally affect.

Distribution Channel Structure

What kind of distribution channel structure will facilitate the adoption of innovative distribution packaging? To investigate this question, several definitions are required: "distribution channel", "structure", and "innovative distribution packaging."

The distribution channel concept used in this research is the **transvection.** This represents a departure from the prevalent distribution channel focus on transaction relationships (between intermediate buyers and sellers of goods). The transvection concept, on the other hand, includes all firms who physically manufacture, move, store, and sort the product.

Alderson introduced the "flow-through" concept of transvection: the complete physical sequence of transformations (time, space and form) and sorts for a single product traveling through a single channel. Alderson's definition, **Transvection = Sort, transform, sort, transform, sort . . . ,** holds that two sorts cannot follow each other in any relevant sense

because sorting is the act of developing relevant subsets; two transformations cannot follow without an intervening sort. Alderson uses the transvection as a basic unit of analysis, evaluating additions and subtractions at branching points, rather than attempting to evaluate the entire distribution network as it converges and diverges. Differing scale economies at different points in the system are created in the process. Alderson hypothesizes that transformations of the time (storage), space (transportation), or form utility of a product are performed where the scale economies are optimized. The "discrepancy of assortments" throughout the channels is essential in a marketing system which begins with homogenous supply at some "technological distance" from heterogeneous demand. Assortments are made up to break up at a later level. Sorting has its own economies; sorting out, allocating, accumulating, and assorting functions are the main reason for middlemen who can combine similarly retailed products from different manufacturers. Efficiencies in number of intermediaries are bounded on both ends: at the lower limit, monopolists earn extraordinary profits from the lack of competition; the upper bound is reached when the additional conflict, inertia, and noise added by intermediaries exceed their contribution. The final sort increases the customer's assortment "potency."[1]

The concept of transvection is a powerful one for distribution packaging research, because it describes the trail of each product to each customer and serves to define functions required to be performed by

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[1]Wroe Alderson, Dynamic Marketing Behavior; A Functionalist Theory of Marketing (Homewood, IL: Richard D. Irwin, Inc. 1965); Wroe Alderson and Miles W. Martin, "Toward a Formal Theory of Transactions and Transvections," Journal of Marketing Research, May 1965(b), pp. 117-127.

the packaging system. Sorting, as well as product transformations in time, space, and form, depend for their productivity, efficiency and effectiveness on the distribution packaging system. For example, a package's shape affects: the cube in storage and transportation, its strength and stacking ability, and the productivity of sorting operations. The further downstream a transvection intermediary (like a wholesale warehouse or transport carrier), the more likely it is to handle more heterogeneous package shapes which further affects material handling productivity. The operations of these "downstream" transvection members are therefore affected by distribution packaging decisions made in an earlier transformation.

The "distribution channel structures" examined by this research include all firms in a transvection which physically "interface" with products. Therefore, although a common carrier is only a bailee and does not take ownership, the movement on a common carrier or storage in a public warehouse constitutes participation in the transvection as much as does distribution through wholesalers and retailers. This is because packaging impacts carriers and distribution centers.

Distribution channels can be classified on the basis of the participants' acknowledgement of dependence. Two classes are employed in this research: vertical marketing systems and non-vertical marketing systems.[2]

The essential feature of a <u>vertical marketing system</u> is that the

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[2]Donald J. Bowersox, M. Bixby Cooper, Douglas M. Lambert & Donald A. Taylor, <u>Management in Marketing Channels</u> (New York: McGraw Hill, 1980), pp.9-12.

primary participants both acknowledge and desire interdependence.[3] Vertical marketing systems can be further classified on the basis of the formality of their integration. The most formal integration is corporate ownership by a single firm, such as Frito-Lay or Nabisco Brands' Biscuit Division, which controls all distribution to the store shelf. A less formal common form of integration is contractual such as the arrangements of Whirlpool, Sears, and their contract carriers. A final form of integration is an administered arrangement where a dominant firm provides leadership and direction. An example of an administered channel is Coca-Cola's great influence on "independent" bottlers, transportation companies, wholesalers and retailers.

There are two kinds of non-vertical marketing systems: free flow and single transaction. A free flow channel consists of participants who acknowledge the benefits of specialization but do not seek lasting or committed relationships. When participants in a free-flow channel seek to improve marketing efficiency, they do so without becoming committed as members of a behavioral marketing system. Some examples include most grocery and convenience store wholesale and retail distributors, as well as common carriers. In a single transaction channel, the relationship is limited to a buy/sell relationship with no expectations of further transactions. A full channel capability may be required to meet and fully execute the transaction but the specific arrangement and structure are unique to each transaction.

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[3]Louis P. Bucklin, "The Classification of Channel Structures," in Vertical Marketing Systems, ed. Louis P. Bucklin (Glenview, IL,: Scott, Foresman and Company, 1970), pp.16-31.

The relationship of these channel structures to performance is not entirely clear, but there is evidence that the integration created in vertical marketing channels is necessary if a firm is to realize the strategic potential of its logistics function. The current trend in logistics is to increasing integration, under the assumption that vertical marketing systems are more efficient than non-vertical marketing systems. An influential study has charted 3 stages of development for increasing the management integration of marketing systems and the physical flow of factors of production, and has documented the savings.[4] A recent strategy-oriented study has discovered that integration patterns vary, and depend on the firm's logistical strategy. Three organizational integration orientations--process, marketing, or information--were found in companies with "advanced" logistical systems.[5] Moreover, transaction cost economics stresses the advantages of "governance" in many vertically integrated economic institutions.[6] The assumption behind increasing integration is that logistics performance can be improved by managing the entire process as a system. As in any industrial system, there is a synergy in vertical marketing systems which

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[4]A. T. Kearney, Inc., Measuring and Improving Productivity in Physical Distribution (Chicago: National Council of Physical Distribution Management, 1984).

[5]Donald J. Bowersox and Patricia J. Daugherty, "Emerging Patterns of Logistical Organization," Journal of Business Logistics, forthcoming.

[6]Oliver Williamson, The Economic Institutions of Capitalism (New York: The Free Press, 1985).

results from the precedence of system-wide objectives and economic feasibility over the interests of the subsystems.[7]

But the assumption that an integrated structure results in improved performance cannot be accepted without question. Efficiency depends on more than day-to-day management. If more productive distribution is to evolve, innovation is required in methods as well as organization. The following section explores the systemic nature of distribution packaging innovation and explores its relationship to the structure of distribution channels.

Systemic Innovation

The effect of market structure on the propensity to innovate has been extensively explored and disputed. The literature of industrial innovation suggests two disparate hypotheses, the "conventional dichotomy" described by Williamson, "that, depending on one's lights, the market structure most conducive to technical progress involves large size and monopoly power or, alternatively, small size and competition."[8]

Schumpeter's evolutionary view of the capitalist economy epitomizes the small size argument. He says that it is the "function of entrepreneurs...to reform or revolutionize the pattern of production by exploiting an invention or, more generally, an untried technological possibility for producing a new commodity or producing an old one in a

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[7]Jay W. Forrester, Industrial Dynamics (Cambridge, MA: MIT Press, 1961).

[8]Oliver Williamson, Markets and Hierarchies; Analysis and Anti-Trust Implications (New York: The Free Press, pp.177). Williamson presents a review of the literature supporting the opposing hypotheses.

new way."[9] "Creative destruction" is the "fundamental impulse that sets and keeps the capitalist engine in motion."[10] Entrepreneurs, and not the staid and integrated bureaucratic organizations, have the economic incentive which fuels the "creative destruction" of innovation.

Schumpeter would view the concept of integrated vertical marketing systems as an effective administrative organization, but as a poor system for fostering innovation. An example of this theory at work can be seen in current problems suffered by the United States Department of Defense as it attempts to modernize and automate its warehousing system; bureaucratic roadblocks have defused every attempt. The DOD's latest solution, to provide an economic incentive for modernization by contracting with entrepreneurial firms to implement the new systems, explicitly assumes that the bureaucracy is too heavy to move.[11]

Contrary to Schumpater's theory, this research concurs with the alternate the hypothesis, and reasons that an integrated distribution system will be better at fostering distribution packaging innovation. This is because of the systemic nature of the innovation. Distribution packaging is one of the most "systemic" of all logistical activities. The same shipping container is transported, sorted, and stored throughout the distribution channel. It must be compatible with existing handling

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[9]Joseph A. Schumpeter, Capitalism, Socialism and Democracy (New York: Harper, 1942; reprint ed., New York: Harper, 1975) p.133.

[10]Ibid. p.83.

[11]Admiral Phil McGilivary, interview held during annual meeting of the National Institute of Packaging, Handling, and Logistical Engineers, Virginia Beach, Virginia, May 1986.

methods and must meet each channel members' functional requirements for protection, communication, and efficiency.

Packaging is a unique boundary-spanning activity that affects productivity for business units throughout the logistical system.

> Boundary-spanning subsystems carry on the environmental transactions in procuring the input, disposing of the output, or assisting in these functions. They are called "boundary-spanning" because while the activities themselves are performed within the organization, they connect it with external points of contact. They are systems which link the organization with the relevant world outside.[12]

For example, a switch from corrugated fiberboard shipping containers to shrink-packages involves changes and cooperation throughout the channel: new handling methods, new damage perceptions, new disposal alternatives, and more productivity for some channel members than for others.

The implementation of a boundary-spanning innovation involves gatekeeping behavior on the part of both the firm which adopts the innovation and its distribution channel members. Unless channel members are involved in the initiation and decision-making process, the innovative package is delivered, unexpectedly, to a vehicle or warehouse who may handle it inappropriately. This research identifies gatekeeping roles.

> The complex process of information gatekeeping and transmission is...subject to a number of influences, including the nature of information inputs and their sources, organizational requirements for balancing its needs to reduce uncertainty and to cope with information overloads, characteristics of the gatekeeper, relationship between gatekeeper and decision maker, and environmental receptivity to organizational outputs.
>
> Once information has been filtered through the initial boundary of an organization, it is usually processed in a unity or by a person occupying a role designed specifically for that purpose. Information available to the organization frequently does not

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[12]Stephen J. Carroll and Henry L. Tosi, Organizational Behavior (Chicago: St. Clair Press, 1977), p.162.

> consist of simple, immutable facts; therefore, this processing activity includes interpretation, analysis, and translation. Together, these activities have been called "uncertainty absorption," the process by which inferences are drawn from perceived facts, and only the inferences passed on to others.[13]

Since gatekeeping behaviors regarding distribution packaging have not been explored, this research observes these behaviors in an attempt to form generalizations about these relationships.

By spanning system boundaries, distribution packaging innovation can be characterized as a "systemic innovation." Systemic innovations are those which require coordination and readjustment among several organizational units. Industrial organization research has examined the relationship between organizational structure and systemic innovation. A prevailing theory finds that a structure with common ownership of the various organizational units which must participate in the adoption of an innovation is the structure which is the most likely to facilitate systemic innovation. Systemic innovation have been found to proceed most efficiently in (integrated) enterprises whose boundaries span the various participating organizations.[14]

This theory leads to the central hypothesis of this research: **H_1: Systemic innovations are more easily adopted by vertical marketing systems.** Systemic distribution packaging innovations are expected to proceed most efficiently in integrated distribution channels where management systems span the boundaries of the various participating organizations. The structure of vertical marketing systems is expected

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[13]Robert H. Miles, Macro Organizational Behavior (Glenview, Ill.: Scott, Foresman and Company, 1980) p.331.

[14]David J. Teece: "Economic Analysis and Strategic Management," California Management Review, 26 (1984) 102-4.

to be better than that of non-vertical marketing systems for facilitating systemic packaging innovations.

There may, however, be cases where the market mechanism works to stimulate innovation by competitive and non-vertically-integrated channel members. Where an innovation's costs and benefits can be rationalized through the transaction mechanism of the channel, a vertically integrated channel may not be necessary to facilitate the innovation. Williamson predicts integration only when it is needed to reduce transaction costs; his contracting model joins "technology, price, and governance."[15] If the innovation costs are reflected by transaction costs (i.e. it is worth more to the buyer for the manufacturer to have paid more for the package), vertical integration may not be needed to facilitate the innovation. This speculation leads to H_2: **Systemic innovations encounter more resistance in non-vertical marketing systems unless transaction costs reflect package-related cost changes.**

In the only other study which examines institutional response to distribution package changes, Abdalla concludes that much resistance to the standardization of distribution package sizes and shapes in the grocery trade is due to the inability of the price system to transmit information about distribution costs. Manufacturers would pay for standardization and retail distribution centers would benefit. Furthermore, the distribution centers do not benefit until all

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[15]Oliver Williamson, The Economic Institutions of Capitalism, p.385.

manufacturers standardize; the market cannot create the incentive in its individual transactions.[16]

Organizational Adoption of Innovation

The concept of innovation diffusion employed in this research reflects the influence of Rogers:

> An **innovation** is an idea, practice, or object that is perceived as new by an individual or other unit of adoption. It matters little, so far as human behavior is concerned, whether or not an idea is "objectively" new as measured by the lapse of time since its first use or discovery....[17]

The innovations explored by this research are all plastic packages. Although plastic is not an "objectively" new material, its adoption as a distribution packaging material is relatively new. The reasons for this are detailed in Appendix I.

Rogers describes diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system."[18] The "channels" through which this innovation is communicated, as well as the definition of the social system affected, have not been defined in the literature of distribution packaging. One objective of this research to better define these channels of diffusion and the role of distribution channel social systems in the adoption process. It is well-recognized that many departments within the firm, as

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[16]Charles William Abdalla, "Problems in Interindustry Coordination and System-Wide Productivity Innovation: An Institutional Analysis of Barriers to Implementing Modular Shipping Containers for Dry Groceries" (Ph.D. dissertation, Michigan State University, 1985).

[17]Everett M. Rogers, Diffusion of Innovations, third edition (New York: The Free Press, 1983) p.11.

[18]Ibid., p.5

well as distribution channel members, are affected by distribution packaging decisions.[19]

Some of the roles played by the affected departments and distribution channel members in the adoption process can be inferred, using the Zaltman, et al., theory of organization innovation which links organization behavior and structure variables with stages of the adoption process.[20] Zaltman divides the adoption process into two stages: Initiation and Implementation.

Zaltman conceptualizes initiation in three substages: knowledge-awareness, attitude-formation, and decision:

> It is postulated here that at the knowledge-awareness substage such attributes as communicability, gatekeeper, and point of origin are likely to be important....At the attitude-formation substage, status quo ante, social cost, risk and uncertainty, compatibility, and complexity are likely to be perceived as the important factors....The decision substage involves perceived relative advantage, scientific status, and financial cost.[21]

The knowledge-awareness substage raises important questions regarding identification of the point of origin: What came first, the problem or the innovation? Who in the social system came up with the innovation? "Research does not provide a clear answer to this question of whether awareness of a need or awareness of an innovation (that creates a need) comes first."[22] Other question address the

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[19]James L. Heskett, Nicholas A. Glaskowsky jr., and Robert M. Ivie, Business Logistics (New York: Ronald Press, 1973), pp.573-582.

[20]Gerald Zaltman, Robert Duncan, and Jonnny Holbek, Innovations and Organizations (New York: John Wiley and Sons, 1973) pp.158-163.

[21]Ibid. p.163-4.

[22]Everett M. Rogers and F. Floyd Shoemaker, Communication of Innovations: A Cross-Cultural Approach (New York: The Free Press, 1971).

identification and communication behavior of "gatekeepers" to the channel who can "withhold or reshape information that they control as it flows into their system."[23] Does this behavior differ depending on channel structure?

The attitude-formation substage of a distribution package adoption can be expected to include consideration of how well the new package satisfies channel member needs (eg. compatibility with distribution channel handling methods). This assumption leads to H_3: **Shippers with a vertical marketing system are more likely to discuss package changes with channel members at an earlier substage in the initiation of the innovation adoption process than are shippers with a non-vertical marketing system.**

The decision substage is expected to be concerned with costs and benefits. Whose costs and benefits are considered are likely to be a function of the integration of the distribution system. Hence, H_4: **Shippers with a vertical marketing system are more likely to consider channel members' cost changes during the decision substage of the innovation adoption process than are shippers with a non-vertical marketing system.**

Organizational structure has been found to affect the propensity to adopt, as well as the ability to implement, innovations. But the structure which best facilitates initiation has not been found to be necessarily the best for implementation. Initiation is encouraged in an organization with high complexity (specialized task structure), low

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[23]Everett M. Rogers, The Diffusion of Innovations, p.354.

formalization (reliance on rules) and low centralization (locus of authority). On the other hand, implementation is encouraged in a low complexity, highly formalized and centralized organization. The reason for these differences is explained by the different nature of the tasks required during initiation and implementation.[24]

Implementation is divided (by Zaltman, et al.) into "initial" and "sustained" substages:

> At the initial-implementation stage impact on interpersonal relationships are likely to be considered important, as well as the issue of terminality. The continued-sustained implementation substage probably involves the gateway capacity of innovations and its susceptibility to successive modification.[25]

This implies that, initially, implementation of a distribution packaging innovation will require an increase in interpersonal relationships between channel members and the innovating shipper. Channel members may not even be consulted until this stage; an integrated distribution channel structure is expected to be the best facilitator at this stage. This suggests H_5: **A non-vertical marketing system better facilitates initiation and a vertical marketing system better facilitates implementation of a distribution packaging innovation adoption.**

As the new package form is institutionalized, it is likely to continue to be modified and improved by successive users. By choosing first- and early-adopters, this research can trace some early improvements in plastic packaging as adopted by successive users in an industry.

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[24]Ibid.

[25]Gerald Zaltman, et al., Innovations and Organizations, p.164.

The current academic trend has found differences in the adoption process for different types of innovations.[26] The trend has prompted this research which assumes that the distribution packaging innovations investigated are both incremental and systemic. Both of these classifications derive from the following scales:

incremental---------radical

systemic--------stand alone

Distribution packaging innovation represents a unique opportunity to observe how innovations are adopted which are at once incremental and systemic. For instance, of particular interest to this research is the identification of gatekeepers and their roles in the distribution packaging adoption process. For an innovation to be adopted by a firm, there are gatekeepers involved in initiation as well as implementation stages. Dewar and Dutton find that the only consistent predictor of incremental innovation adoption is the depth of knowledge sources.[27] As information concerning the innovation initially enters the firm, gatekeepers to the packaging industry filter and direct the ideas. These ideas include judgments concerning the costs and benefits resulting from the innovation. As an innovation is implemented, gatekeepers to the distribution channel will provide a boundary-spanning role.

The technological concepts of innovation diffusion are concerned with the reasons for adopting innovations. Distribution packaging innovations are adopted for their functional and/or cost improvements.

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[26]Robert D. Dewar and Jane E. Dutton, "The Adoption of Radical and Incremental Innovations: An Empirical Analysis," Management Science 32 (November, 1986) pp.1422-1433.

[27]Ibid.

The "incremental" nature of distribution packaging innovation is discussed in the following section. Its focus specifically on controllable distribution packaging factors represents a shift in this literature review, from the theme of innovation adoption to the theme of distribution packaging "incremental" costs and performance.

Incremental Innovation

The literature of industrial innovation distinguishes between major innovations (like the invention and introduction of computers) and incremental innovations. Incremental innovations are improvements which have a gradual, cumulative effect on productivity, minor improvements or simple adjustments in current technology.[28]

> The major difference captured by the labels radical and incremental is the degree of novel technological process content embodied in the innovation and hence, the degree of new knowledge embedded in the innovation....Since the radical incremental distinction is one of the perceived degree of new knowledge embodied in the technology, managers are likely to differ in their judgment of an innovation based on their level of familiarity and experience....An innovation's placement on this continuum [radical/incremental] depends upon perceptions of those familiar with the degree of departure of the innovation from the state of knowledge prior to its introduction.[29]

Abernathy and Utterback explain that such "incremental innovations" (the economy's "countless minor product and systems improvements") generally result in improved performance as well as lower production/ marketing costs:

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[28]F.C. Munson and D.C. Peltz, "The Innovating Process: A Conceptual Framework," Working Paper, University of Michigan, 1979.

[29]Robert D. Dewar and Jane E. Dutton, "The Adoption of Radical and Incremental Innovations," p. 1423.

> also resulted from such small engineering and production adjustments.[30]

The improved performance occurs because this industrial innovation takes place in the industrial market, with suppliers and users working together on the features of any new system.[31] The incremental innovation classification is useful for explaining why the incremental innovations of distribution packaging may result in lower costs as well as improved functional performance. For example, shrink-wrapping is not only a low-cost packaging method when compared to cardboard boxes, but it also offers the advantage of encouraging gentler handling because the product is visible.[32]

But the functional benefits of distribution packaging are not necessarily without cost. Package costs (materials, fabrication, and filling costs) should be balanced against resulting costs and benefits: basic transportation and material costs and those for productivity, loss, damage, and resulting claims. Unlike the total-cost tradeoff analysis used to evaluate most aspects of logistical system design, there is no law-like basis for predicting the relationship between packaging performance and total logistical cost. In many cases, "better" packaging costs less than traditional corrugated boxes. Hence, the relevance of the

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[30]William J. Abernathy and James M. Utterback, "Patterns of Industrial Innovation," in Readings in the Management of Innovation, ed. Michael L. Tushman and William L. Moore (Marshfield, MA: Pittman Publishing, 1982) pp.97-108.

[31]Yoram Wind,. "Industrial Source Loyalty,," Journal of Marketing Research, vol.7 (November 1970), pp.2-11.

[32]Jerry Earl, interview at Montgomery Ward's appliance department in Lansing, Michigan, February 24, 1987. Mr. Earl, appliance salesman, was describing the handling of an Italian washing machine which is shipped in a see-through shrink-wrap package.

incremental innovation concept; incremental innovations are believed to improve performance and reduce costs.

Which costs are innovative packages aimed at reducing? Which performance is the innovative package aimed at improving? These are related to efficiently performing the functions which constitute a distribution package's performance. These functions are discussed in the following section, and correspond to the following attributes associated with industrial innovation: cost improvement, return to investment, efficiency, and perceived relative advantage.[33] Relative advantage of product innovations is "an important determinant of a product's success."[34]

"Form Ever Follows Function[35]

The purpose of this section is to initiate the development of theory in distribution packaging, with the intention of identifying incremental innovation benefits. It begins with a discussion of the role of functionalism in theory development and the applications of the functional approach to packaging thought. It ends with a literature review of the works of logistics academicians in the field of packaging. These academicians' works form the basis for Appendix II, a functional taxonomy of the possible incremental effects of a distribution packaging innovation.

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[33]Gerald Zaltman, et. al., Innovations and Organizations, pp.33-40.

[34]James F. Engel, David T. Kollat, and Roger D. Blackwell, Consumer Behavior (New York: Holt, Rinehart & Wilson, 1968), p.603.

[35]Louis Henri Sullivan, "The Tall Office Building Artistically Considered," Lippincott's Magazine (March 1896).

Product packages are conventionally categorized into two types: consumer packaging and distribution packaging. Consumer packaging is that which the ultimate consumer takes home, and it is governed by many sales and advertising marketing concerns; this package has been called "The Silent Salesman," a symbol of self-service retail shopping.[36] Distribution packaging, on the other hand, is that which facilitates product flow during shipping, handling and storage. (In reality, these distinctions are not so clear-cut; consumer packages may contribute to distribution flow, and distribution packages may be taken home by a consumer.)

The functional approach has been a useful way to organize thought about package design. The term, "function" is used here to signify the "contribution that an item makes or can make toward the maintenance of some stated characteristic or condition in a given system to which the item is assumed to belong."[37] Distribution packaging's functions contribute to the productivity, efficiency and effectiveness of distribution.

Furthermore, since the functional approach can be seen as paving the way to discovery and general theory in a field[38], any general packaging function taxonomy should encompass both consumer and distribution packaging. Ideally, it should also be comprehensive enough to cover both product and service, as well as public good, packaging.

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[36]James Pilditch, The Silent Salesman (London: Business Books Ltd, 1961).

[37]Shelby D. Hunt, Marketing Theory; The Philosophy of Marketing Science (Homewood, IL: Richard D. Irwin 1983) p.102.

[38]Ibid., pp.104-108.

The functional approach has, as its elements, concepts of how packaging works, rather than what it is.

> Functionalism is the school which is interested in systemic wholes and applies methods for their study....Functionalism looks at a systemic structure to determine the present relationship between inputs and outputs and to lay the groundwork for bringing about an improvement in these relationships....Functionalism asks two characteristic questions about any set of phenomena which can be regarded as a system: "How does the system work?" and "How can it be made to work?"[39]

In a way, a package is its functions. Distribution packages have no great value of their own, but only add value as they perform distribution functions. Any innovative distribution package must perform the same functions that the traditional package performed.

In the case of distribution packaging, the system under study is the transvection, the series of sorts and transformations through which a package must perform its functions. Packaging functions must be performed differently during storage ("time" transformation) than during transportation ("space" transformation) or sorting. The transvection concept provides the means for research in distribution packaging's "broader sense as a process of getting goods from the source to the point of use in the most beneficial manner."[40]

The primary packaging application of the functional approach has been in the area of consumer packaging. Jones, in 1950, is believed to

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[39]Wroe Alderson, Dynamic Marketing Behavior; A Functionalist Theory of Marketing (Homewood, IL: Richard D. Irwin, 1965) pp. 5-22.

[40]Joseph F. Hanlon, Handbook of Package Engineering, 2d ed. (New York: McGraw Hill, 1984) p.1-5.

be the first to articulate a set of "factors" governing the planning of packages: "protection, convenience, economy and appearance."[41]

Other consumer packaging authors and scholars use similar functional schemes. Three popular packaging textbooks have been influential:

> Packaging exists because it performs four basic functions... (1) protection, (2) containment, (3) information and (4) utility of use."[42]

> To understand why packaging is what it is today, we should understand what packaging does. Protection...Containing...Sanitation... Communication...Unitizing...Prevention against pilferage...apportioning and dispensing...[and] Reuse.[43]

> The functions of a package are basically to contain, carry, and dispense....As time went on, other requirements were added, such as to preserve and to measure, and later to communicate and to display. We have now entered into an era in which the package is called upon to motivate, promote, glamorize, and sometimes to build up or even disguise the contents.[44]

On the other hand, writers in the field of distribution packaging have been more pragmatic; their books and articles are useful catalogs, filled with pictures and descriptions of specific packaging and handling systems. Most testify to the tradition of the transportation carriers' classification-commission-mandated packaging forms. For example, Friedman & Kipnees were able to update their classic 1960 Industrial Packaging book seventeen years later (1977) primarily by changing the word "industrial" to "distribution" everywhere it occurred. But since

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[41]Harry Jones, Planned Packaging (London: George Allen & Unwin Ltd., 1950) p.133.

[42]Robert J. Kelsey, Packaging in Today's Society (New York: St. Regis Paper Company, 1978) p. 20.

[43]Jack Milgrom and Aaron Brody, Packaging in Perspective (Cambridge, Mass: Arthur D. Little, 1974).

[44]Joseph F. Hanlon, Handbook of Package Engineering, p. 1-7.

the methods had not changed, neither did the text.[45] Cox and Van Tassel are typical of many practitioner writers, attempting to generalize their specific experience in one industry (chemical, in their case) but limited by their cognitive sets (to a taxonomy of "dry" and "liquid" products).[46]

There are some exceptions, where distribution packaging is described from a more functional point of view. One is Brown's engineering-oriented shipping container functions: protection against mechanical damage, protection from deterioration, facilitate handling and storage, protect against pilferage, identification, and preserve quality and assist inspection.[47] Another is Kearney's grocery shipping container study which lists: contain and constrain, identification, protect, unitize, and assist retailer operations.[48] A third functional taxonomy is supplied by Anthony: containment, protection, communication and utility.[49]

This research's questions concerning changes in package cost and performance, due to incremental innovations, follow a functional organization because any discussion of innovation should not be limited

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[45]Walter F. Friedman and Jerome J. Kipnees, Industrial Packaging (Huntington, NY: Robert E. Krieger, 1960); and Walter F. Friedman and Jerome J. Kipnees, Distribution Packaging (Huntington, NY: Robert E. Krieger, 1977).

[46]Ralph M. Cox and Kenneth G. Van Tassel, "The Role of Packaging in Physical Distribution," in The Distribution Handbook, ed. James F. Robeson (New York: MacMillan, 1985), pp. 737-773.

[47]Kenneth Brown, Package Design Engineering (New York: John Wiley & Sons, 1959), p. 2.

[48]A. T. Kearney, Inc. Opportunities in Shipping Container Design (Washington, DC: Food Marketing Institute, 1986), p.11.

[49]Sterling Anthony, Jr., "Distribution Packaging Design Strategy," SPHE Journal, Spring 1983, pp.2-5.

to the new color of an old box. Accordingly, for the purpose of this research, the following set of elemental functions of packaging will be used. This taxonomy can be seen to apply to both consumer and to distribution packaging, and is flexible enough to include the all of the functions named above. It illustrates how the packaging system extends across subsystems internal to the organization (engineering, purchasing, quality control, etc.) and external (channel members and customers).

1. Protection including preservation is an engineering, research and development, quality control, and distribution customer service function.

2. Utility is an economic function providing "utiles" for consumers and distribution package "users": containment, convenience, production and distribution productivity and dispose-or reuse-ability. Utility can be considered the physical value which a package adds (beyond basic protection). This value may accrue to warehouses, carriers, retailers, or customers.

3. Communication is a marketing information function, both advertising to consumers and for linking packages to distribution information systems (whether humans or computers do the reading).

4. Cost is an economic and purchasing function, minimizing (or optimizing) the cost of the package itself. Packaging is, for the most part, a variable-cost activity.

Appendix II offers an integration of this function taxonomy and the following discussion of the logistics literature pertaining to packaging, to form the basis for the concept of packaging costs and performance.

Distribution Packaging in the Logistics Literature

Although logistics writers do not attempt a comprehensive functional approach, their comments are of a general functional nature. Most discuss what packages should do, rather than describing specific container styles. Therefore, these authors provide better indications of the specific costs and benefits associated with distribution packaging than do most packaging writers.

The logistics literature addresses distribution packaging primarily in its textbooks. Every Logistics Management textbook includes a short discussion, usually tucked into a warehousing/materials handling chapter. It is interesting to note that none of the logistics textbooks discuss the transportation carriers' packaging rules.

The purpose of this section is to explore the scope of the distribution packaging literature produced by logistics academics. These authors' observations and recommendations concerning package design easily fit into the four functions discussed in the preceding section.

Heskett, Glaskowsky and Ivie present the most comprehensive checklist of "the more important considerations in the design of product packages." These "many faces of package design" are the reasons which a manufacturer might decide to make a distribution packaging innovation, whether to solve a problem or reduce a set of costs. They subdivide these considerations by business functions:

engineering (package/product fragility)
purchasing (total cost of packaging materials)
production (equipment required and productivity)
storage (stacking strength & cube utilization)
material handling and order picking (unitization, sorting productivity and equipment required)
transportation (cube, protection, returnability)
marketing (retailing compatibility)

> the ultimate consumer (quantity, assortment, and reuse or disposability)[50]

Heskett et al., raise the question of organizational placement for the packaging function, noting the "interfunctional communication" required. They observe the bias occurring from placement in the purchasing department:

> Manufacturers of packaging materials and equipment are sources of a great amount of free, if potentially biased, consulting advice often channelled through the purchasing engineering personnel in an organization."[51]

Bowersox, Closs and Helferich stress the benefits of unitization and standardization to increase material handling efficiency. In a discussion of the physical hazards which a package faces, they distinguish between the "controlled environment" of privately-owned transportation and the "noncontrolled environment" of break-bulk common carriers.

> The less control a firm has over its physical environment, the greater the packaging precautions required to prevent damage. The logistical environment thus influences the packaging design decision.[52]

Regarding protection, they relate the value of a fragile product to the level of protection which can be economically justified, yet they point out that testing can help to identify the least-cost package which provides a given level of protection; acknowledging that the cost of the package is not directly related to its performance.

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[50]James L. Heskett, Nicholas A. Glaskowsky jr., and Robert M. Ivie: Business Logistics (New York, NY: Ronald Press, 1973) pp.572-84.

[51]Ibid.

[52]Donald J. Bowersox, David J. Closs, Omar K. Helferich, Logistical Management (New York: Macmillan, 1986) p.245.

Lambert and Stock view that the "ultimate goal is to develop a package that optimizes service, cost and convenience factors for all elements of the marketing and physical distribution system." The total distribution costs which distribution packaging affects are: freight rates, handling and storage efficiency, and end-use costs of opening, using, and disposal.[53]

Coyle and Bardi emphasize the importance of information on packages to improve distribution efficiency. They note that the selection of a transportation company affects the amount of protection which is expected from the package. Customer service, in packaging terms, deals with the interface between the material handling systems of successive firms in the channel; packages should be compatible with equipment throughout. And they comment on the "revolution" caused by the introduction of plastic packaging materials: "The new materials have been cheap and highly protective. In addition, their light weight helps to minimize transportation costs."[54] Coyle and Bardi are the only logistics writers who discuss the impact of transportation deregulation on packaging:

> With the advent of deregulation, the common carriers have allowed shippers to experiment with new packaging techniques....Contract and private carriage are alternatives that allow shippers to package goods as they like without rate penalties.[55]

Cavinato writes of the accounting nightmare posed by system-wide measurement of the total cost of loss and damage. Data is usually buried

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[53]Douglas M. Lambert, and James R. Stock, Strategic Physical Distribution Management (Homewood, Illinois: Richard D. Irwin, 1982) pp. 198-200.

[54]John J. Coyle and Edward J. Bardi, The Management of Business Logistics, 3d ed. (St Paul: West, 1984), p.251.

[55]Ibid, p.252.

deep within each participating firm's accounting systems. Neither firms, nor industries, nor government statisticians have access to accurate system-wide data. Products change ownership and liability so often in logistical systems that even shrinkage as great as 11.8% can go unnoticed because a single logistical activity experiences less than 2%:

> The concept of total loss and damage as an element of the firm's logistics system has not been developed for a variety of reasons which may be listed as:
>
> 1. It represents a burden that often can be shifted onto other firms,
> 2. Responsibility for loss and damage in a single firm is often fragmented;
> 3. Performance evaluation and other management information systems rarely measure it in its entirety or even separately in individual logistics components,
> 4. Managements often view loss and damage as a tolerable cost that is not worth reducing or eliminating because the cost of such effort appears greater than the benefit to be received.[56]

In another packaging-related article, Cavinato discusses the fact that palletization and shipping container quantities are usually based on arbitrary quantities, often a dozen, which is neither a convenient quantity to count, nor is it based on any conception of demand. Palletload configurations are commonly derived from utilization of transportation vehicle cube by the shipping containers.[57]

Besides the logistics professors, three other writers have contributed to thought in the distribution packaging area. Carmody presents examples of improving warehouse and vehicle productivity and

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[56]Joseph L. Cavinato, "Analysis of Loss and Damage in a Procurement-Distribution System Using A Shrinkage Approach" (Ph.D. dissertation, Pennsylvania State University, 1975), pp. 6 & 108.

[57]Joseph L. Cavinato, "Toward Efficient Package/Pallet Interfaces," Journal of Business Logistics 1 (1979): 36-47

utilization, as well as exploring the organizational aspects which cut across production, marketing, purchasing and traffic functions. As is the case in most such organizational discussions, channel functions outside the organization's control are represented only by an inside sales representative.[58] Friedman's textbook[59] presents many specific examples of package forms, as well as some general functional commentary. Kearney[60] addresses the packaging problems from a grocery distribution point-of-view.

These logistics professor/authors are not bound by the pragmatic and traditional issues which obsess the distribution packaging authors (such as cardboard bursting strengths and choosing nails for crates). Therefore, their combined comments form the basis for the taxonomy of distribution packaging functions found in Appendix II. This "Functional Taxonomy" forms the basis of this research's investigation into the performance and cost of distribution packaging. Cost and performance improvement is at the heart of the concept of incremental innovation benefits.

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[58]D. B. Carmody, "The Impact of Packaging on Physical Distribution," Packaging's Role in Physical Distribution (New York: American Management Association, 1966), pp.1-6.

[59]Walter F. Friedman and Jerome J. Kipnees, Distribution Packaging.

[60]A. T. Kearney, Inc. Opportunities in Shipping Container Design (Washington DC: Food Marketing Institute, 1986).

CHAPTER III

THE CASE RESEARCH METHOD: COMPARISON AND CONTRAST

Distribution packaging and systemic innovation are largely unresearched topics in the logistics literature. Therefore, this research employs a the case approach. Boulton describes the role of case research in theory development:

> Case research can readily be applied to new areas which require systems thinking. In the earliest periods of research, long before you have developed any theory, data must be gathered in an attempt to describe the territory and raise basic questions about its interrelationships and processes....In fact, one might argue that statistical techniques are seldom used to improve theory, only to accept or reject hypotheses....You need only to find one example in which the theory does not hold to reject or modify a theory.[1]

Furthermore, he argues, in management, large sample research does little more than determine how many firms are using a practice or technology. It cannot adequately explore firms which are most advanced in applying new concepts and technologies. "If you want to research innovation, for example, go to innovative companies."[2]

Bonoma explores the use of case research in marketing theory building and when a researcher seeks to relate phenomena in natural settings.

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[1]William R. Boulton "Case Study as a Research Methodology," Case Research Journal, 1985, 9.

[2]Ibid.

> If properly conducted, research by these methods can provide a "deep understanding (Geertz 1973), a fuller contextual sense of the phenomena under study (Miles 1979), and an explicit provocation toward theory building that often is missing from both simple descriptive work and most cause-and-effect research (van Maanen 1982)....
>
> Many issues of interest to marketers cannot be studied outside the context in which they naturally occur. If, for example, buyer behavior is seen as a dyadic interaction with the seller, interference with the context of that interaction might distort the behavior that is studied.[3]

He distinguishes between "high-data-integrity" statistical methods of theory disconfirmation and case research in terms of the researcher's goals:

> First, the goal of data collection in case research is not quantification or enumeration, but rather (1) description, (2) classification (typology development), (3) theory development, and (4) limited theory testing. In a word, the goal is understanding.
>
> Second, most enumeration is of little value to a case researcher. The goal is not the breadth or representativeness of large-n research, but rather the depth of the knowing. The risks of low data integrity are traded for the currency and contextual richness of what is learned.[4]

Likewise, Rogers chronicles a shift in the methodology of innovation research. Industrial innovation researchers in the 1960's and 70's were primarily concerned with using survey techniques to discover how the structure of organizations affect their propensity to innovate. As a result of inconclusive and contradictory findings, researchers in the late 1970's went back to the drawing board. Case study began to replace

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[3]Thomas V. Bonoma, "Case Research in Marketing: Opportunities, Problems, and a Process," Journal of Marketing Research 22 (May 1985), pp.201-2; citing Clifford A. Geertz, The Interpretation of Cultures (New York: Basic Books, 1973); Matthew B. Miles, "Qualitative Data as an Attractive Nuisance," Administrative Science Quarterly, 24 (December 1979), pp. 590-601); and John van Maanen, "Introduction," in Varieties of Qualitative Research, John Van Maanen, J. M. Dabbs, Jr., and Robert R. Faulkner, eds. (Beverly Hills, CA: Sage Publications, 1982) pp.11-29.

[4]Ibid., p.206.

statistical analysis, in the hopes of learning more about the adoption process.

> Here we trace the important change from studies of organizational innovativeness, in which data were gathered typically from a large sample of organizations in order to determine the characteristics of more and less innovative organizations, to investigations of the innovation process in organizations. These latter studies, generally conducted since about the mid-1970's, are case studies of the innovation-decision process. Such a process research approach has provided important insights into the nature of the innovation process and the behavior of organizations as they change.
>
> The innovation-process studies stress the implementation phases involved in putting a new idea into use in an organization; as such, these studies have improved upon previous diffusion research, which generally stopped short of investigating implementation by focusing on the decision to adopt or reject. The recent research...indicates that implementation of an innovation is by no means a certainty, once the decision to adopt had been made. As compared to the innovation-decision process by individuals, the innovation process in organizations is much more complicated. The latter may involve a number of individuals, each of whom plays a different role in the innovation decision.[5]

In the 1980's, the theory cycle has moved away from the search for a general theory of industrial adoption, in favor of exploring the adoption process for specific innovation categories.

> The search for a universalistic theory may be inappropriate given the fundamental differences that exist across innovation types (Downs and Mohr 1976). Empirical support for this conclusion is accumulating (Damanpour 1984; Kimberly and Evansiko 1982; Moch and Morse 1977)[6]

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[5]Everett M. Rogers, Diffusion of Innovations, third edition (New York: The Free Press, 1983), p.348.

[6]Robert D. Dewar and Jane E. Dutton, "The Adoption of Radical and Incremental Innovations: An Empirical Analysis." Citing: G. W. Downs and L. B. Moore, "Conceptual Issues in the Study of Innovation," Administrative Science Quarterly, 21 (1976), pp.700-714; Fariborz Damanpour, "The Adoption of Technological, Administrative and Service Innovations: Impact of Organizational Factors," Working paper, LaSalle University, 1984; J. R. Kimberly and M. J. Evanisko, "Organizational Innovation: The Influence of Individual, Organizational and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations," Academy of Management Journal, 24 (1981), pp.689-713; and M. K. Moche and E. T. Morse, "Size, Centralization and Organizational

For instance, in their comparison study of radical and incremental technical process innovations, Dewar and Dutton find differences between predictors for adoption of these different types of innovations. They find that organizational size is more important for facilitating radical innovations than incremental; and they posit a difference between predictors of technolgical vs. service innovations.[7]

It is believed that this in-depth process-oriented method of exploring specific innovative firms' decision-making processes yields a rich source of observations leading to hypotheses and research questions for future investigation.

Although the case research approach does not permit the rigorous testing of hypotheses because of the limited sample, the investigation does take place within the domain of a conceptual model. Channel structure, the systemic nature of the innovation, and the incremental cost/functional benefit improvements sought from packaging innovation are at the heart of this case research investigation. Hypotheses are explored by means of comparison and contrast between the effects of vertical marketing systems and non-vertical marketing systems upon the distribution packaging innovation process.

Focus on the conceptual model, however, does not preclude distraction by other concepts. In the open-minded tradition of case research, the clinical process is expected to generate, as well as validate, theory. The "funny" things that happen on the way to the

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Adoption of Innovations," American Sociological Review, 42 (1977), pp.716-725.

[7]Robert D. Dewar and Jane E. Dutton, "The Adoption of Radical and Incremental Innovations."

theory are observed in hopes of guiding future research in the distribution packaging field.

This chapter is organized in the following manner: first, the sample selection criteria are outlined; next, the firms and innovations chosen are described; and last, the method of analysis is explored.

The Case Sample Selection Criteria

The ten manufacturing firms chosen have all initiated the adoption of an innovation in their distribution packaging. A key packaging decision maker in each firm was questioned concerning the costs and benefits considered during the decision-making process, as well as the ability of their distribution channel structure to enable the innovation to be adopted. Good case research methods require the participation of such a "local expert."[8]

"Innovation" is defined herein by the use of plastic. This means a distribution package other than the standard "Rule 41" and "Item 222" corrugated fiberboard shipping container, at least partially constructed from plastic materials. These innovative packages range from shrink- or stretch-bundles made from plastic film to reusable plastic thermoset tubs.

The adoption of plastic distribution packages is assumed to be both a systemic and an incremental innovation. However, degrees of each will be evaluated according to how many subsystems throughout the organization and transvection are affected, how much the innovation increases

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[8]Boulton, "Case Study as a Research Methodology," p.12.

performance and/or decreases costs, and how much new knowledge was required for making the decision.

The initial source of contact with each of these cases was introductions at professional conferences (Pack Expo 1986 and Council of Logistics Management 1986 Conference), articles in practitioner journals and contacts through Michigan State University School of Packaging.

The designation, "initiated the adoption of an innovation" was chosen, rather than only choosing firms who have fully implemented innovations, because this research attempts to identify the barriers, as well as enabling mechanisms, to these packaging innovations. One case of the ten has not yet decided whether to adopt, and one has decided against adoption.

For the purposes of this research, the innovation process is simply conceptualized in the Zaltman scheme, in an effort to define the innovation-adoption process:

I. Initiation stage
    1. Knowledge-awareness substage
    2. Formation of attitudes toward innovation substage
    3. Decision substage
II. Implementation stage
    1. Initial implementation
    2. Continued-sustained implementation[9]

These stages correspond to critical path models in the packaging development literature.[10]

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[9]Gerald Zaltman, Robert Duncan, and Jonnny Holbek, Innovations and Organizations (New York: John Wiley and Sons, 1973) pp.158.

[10]For example, see Michael A. Delia, "Scheduling and Control for a Program of Package Planning," Modern Packaging Encyclopedia, 1971, pp.46-47.

Therefore, "initiated the adoption of an innovation" is defined as progress through the decision substage; more than wild ideas, but not necessarily accepted by the firm nor the transvection channel members. The two-stage innovation process model is also used to discover how behavior involving the distribution channel varies between the stages.

The case sample was chosen with the intent to explore the relationship between channel structure and innovation. Five firms with vertical marketing channel structures and five firms with non-vertical marketing structures were chosen.

The Firms and Innovations Chosen

Following, the five firms with vertical marketing systems and the five with non-vertical marketing systems are listed. The ordering of firms within each category reflects a gradation of marketing channel types, from "most" vertical to "least" vertical (Appendix III explores the channel structures in more depth). The subsequent pages illustrate and describe the packaging innovations for which the firms were chosen.

Five Firms with Vertical Marketing Systems

General Motors B.O.C. Division was one of the first American automobile manufacturers to convert a large segment of its part suppliers to returnable plastic packages. (Administered purchasing system)

Allied's Aftermarket Division was one of the first firms to adopt a plastic bulk-bag for a liquid product. (Contractual relationship with one supplier.)

The ARTEC Division of Kimball International ships "uncartoned" wall panels for custom-built office furniture systems. (Contractual relationship to dealers who contract with installers.)

Shaw-Walker Company is one of the earliest firms to consider stretch-wrapping for custom-built office furniture. (Contractual relationship to dealers who contract with installers.)

Nordyne was an early adopter of stretch-wrap distribution packages, spiral wrapping the furnace onto a pallet. (Only case studied which uses both contractual and free-flow marketing channels.)

Five Firms with Non-Vertical Marketing Systems

Owens-Corning Fiberglas stretch-unitized rolls of insulation which have always been shipped break-bulk. (Free-flow building material channels, including a large segment of high-volume retailers.)

Supreme Equipment was the first firm in the U.S. to stretch-wrap file cabinets. (Free-flow office furniture channels.)

Gerber was the first in the U.S. to adopt a glass-to-glass shrink-bundle for baby food jars. (Free-flow grocery channels.)

Michigan Fruit Canners was a "late early" adopter of the shrink-bundle for canned food, the same "wrap cap" package that Gerber had adopted 4 years earlier. (Free-flow grocery channels.)

Johnson Wax would have been the first (in the U.S.) to use a shrink-bundle for aerosol cans. But, since the U.S. Department of Transportation has traditionally forbidden the use of plastic distribution containers for aerosols, Johnson Wax made the decision not to adopt this package. (Free-flow grocery and drugstore channels.)

Figure 1. General Motors B.O.C. Division was one of the first American automobile manufacturers to convert a large segment of its part suppliers to returnable packages: high density polyethylene injection-molded collapsible or stackable boxes. Part surfaces are protected with heavy plastic cells or dunnage. Although the dunnage is part-specific and is labeled so it can be returned to the same supplier, the boxes are not, and are interchangeable. There are 8 modular sizes, and each box is identified, once it is filled, by the GM part number on 2 tags on the outside of the box. This packaging system replaces 700 different corrugated box designs (many were "pallet boxes"). Suppliers formerly purchased expendable corrugated boxes; the new returnable boxes are purchased directly by General Motors.

Figure 2. Allied's Aftermarket Division was one of the first to adopt a plastic bulk-bag for a liquid product. 225 gallons of "Plastisol" adhesive, which is the viscosity of caramel (45,000 centipoise), is packaged in a multiple-component "bag in a box," replacing 55-gallon steel drums. The adhesive is shipped to Allied to be used in the manufacture of air filters for vehicles. The package has 4 components (listed from outside in):

1. Steel wire-mesh "cage" collapsible container with integral pallet has a 8" trap-door in the bottom for dispensing product.
2. Double-wall heavy-duty high density polyethylene 20 mil shield, on five sides, with a port in the bottom.
3. "Rhino" bulk bag woven polypropylene with a polyethylene coating inside (10 oz/sq. yd.) with 11" top and 6" bottom ports.
4. Inner liner, doubled 6-mil linear low density polyethylene, with 11" top and bottom 6" ports.

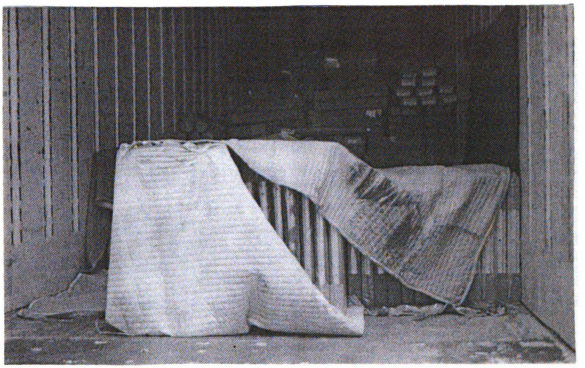

Figure 3. The ARTEC Division of Kimball International ships some of its custom-built office furniture systems "uncartoned". Rather than boxing each wall panel, the fabric-covered modular wall panels are shipped in a plastic bag with corrugated endcaps. Coming off the production line, these bagged panels are unitized in stretch-wrapped palletloads to facilitate handling and storage through Kimball's order consolidation warehouse. This package is only used for shipments directly to an installation, which receives a full trailerload of office systems. Before shipment, palletloads are decomposed, and panels are loaded individually into a "padded van" trailer; all panels for a job are stowed together, standing on edge. The surfaces of the truck and of the panel group are covered by blankets and the panel load is strapped to the trailer wall (usually in the nose of the trailer, with boxed furniture parts in back). This package is not shipped in channels with customer warehouses; all of Kimball's other furniture is boxed, save for these panels when direct to installation. Other products need to be in boxes because of the multiplicity of parts involved with knocked-down furniture. The previous package was a lightweight bag inside of a corrugated fiberboard box.

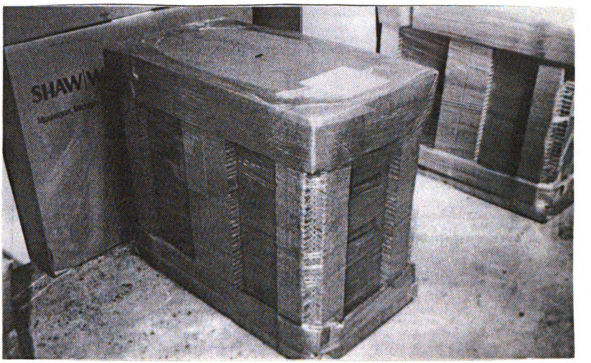

Figure 4. Shaw-Walker Company is one of the earliest to consider stretch-wrapping for custom-built office furniture: desks, filing cabinets, and credenzas. Spiral stretch-wrapping with top cap and bottom tray will replace the two packaging systems currently used: one uses very expensive corrugated cap-and-tube boxes, and the other is uncartoned, shipped by padded van. They have not yet made the decision whether to adopt.

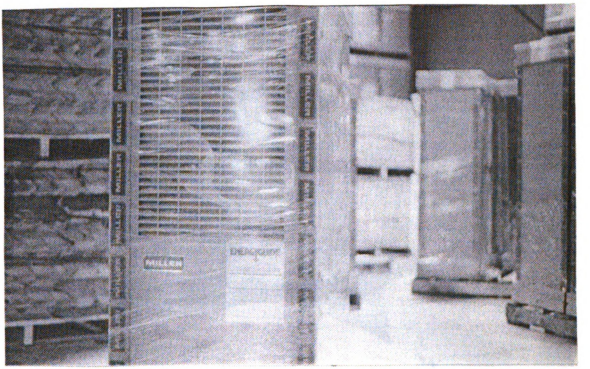

Figure 5. Nordyne manufactures furnaces and air conditioners for mobile homes. It was an early adopter of stretch-wrap distribution packages, spiral wrapping the furnace onto a pallet. Angle-boards at the corners bear the Miller logo, the corrugated top cap has a different color printing on 2 sides for each sku, and a sticker label with the sku information is applied to the outside of the stretch-wrap. This package replaces a corrugated full-length cap with corrugated cornerposts and pallet. Nordyne is the only case studied which uses both vertical and non-vertical marketing channels.

Figure 6. Supreme Equipment was the first firm in the U.S. to stretch-wrap file cabinets. Slit-scored honeycomb pads (1.5" thick x 4" wide) are used on the corners (vertical files also have one on the front and one on the back), and the top and bottom cap are lined with 1" thick honeycomb paperboard material. The film web is as tall as a 2-drawer file. When taller files are wrapped, 2 web widths are used, wrapping first below, spiraling up, and then wrapping the top. Film elongation is 210%. A bulls-eye overlaps the top and bottom caps (file is raised from the machine's pedestal during wrapping) and tightly secures the package. Two stretch-wrapping machines are used because of the volume of production. This package replaces a tri-wall corrugated box with foam pad.

Figure 7. Owens-Corning Fiberglas makes rolls of insulation which have always been shipped break-bulk. Their innovative package is a unitization method which results in a multiple-roll distribution package which can be handled either mechanically or by hand. The rolls of insulation are stretch-wrapped together, in a footprint of 4, two or four high. (Each roll is already "packaged" in a paper wrapper which is applied at the time of rolling; the ends are open.) This is the only case study in this research which documents a change in the number of products in a package and goes from a manual to a mostly mechanical handling system. It is included because of its unique departure from conventional pallet-load unitization methods.

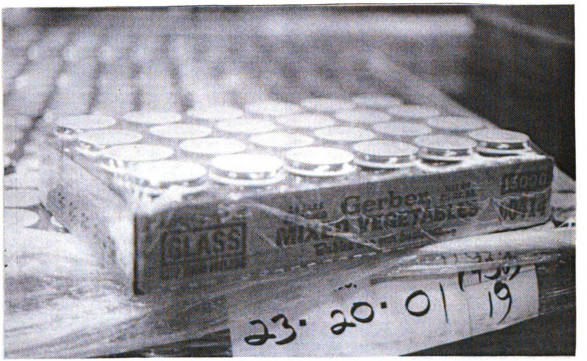

Figure 8. Gerber was the first (in the U.S.) to adopt a glass-to-glass shrink-bundle distribution package for baby food jars in national distribution (packed 24 to a case). This "Wrap Cap" shrink-bundle is partially encapsulated; the film straddles the top, and is adhered to the corrugated tray on all four sides. There are no partitions in this package; the "trick" is that the shrink-wrap so tightly confines the bottles that they can't rattle and break. The package that this shrink-bundle replaces was a corrugated wrap-around box.

Figure 9. Michigan Fruit Canners was a "late early" adopter of the shrink-bundle for canned food, the same "wrap cap" package that Gerber had adopted 4 years earlier. Although this package was, at the time, fairly well accepted in the grocery distribution industry, it was not in widespread use. It is included in this research to see how a later early adopter's behavior might differ from the earliest ones. This package replaces an corrugated "regular slotted container (which is still the most common distribution package in the grocery industry).

Figure 10. Johnson Wax would have been the first (in the U.S.) to use a shrink-bundle for aerosol cans. Traditionally, the U.S. Department of Transportation has classified aerosols as Hazardous Materials and has forbidden the use of plastic distribution containers for them. Edge Shaving Gel, however, is a "semi-aerosol" with the propellant packaged in a separate compartment in the can from the gel, and is less "hazardous" because of the small amount of propellant in the package than are aerosols with both ingredients mixed together. The shrink-bundle is made from two trays filled with 6 cans each, inside a shrunk sleeve with perforations in the film between the trays. Thus, a 12-pack can be easily transformed into a 6-pack for distribution to small drug stores. The package which they hoped to replace has 6 cans packed in a chipboard case; two of these 6-packs, in turn, are packed in a corrugated case. Johnson Wax made the decision not to adopt this package.

The Method of Analysis

Scientific investigation requires both the context of discovery and the context of justification. Discovery is the process whereby hypotheses, laws and theories are generated. Justification is the process of rigorous testing of these hypotheses and laws, and ultimately establishes the theories which explain and predict phenomena in a field.

The field of distribution packaging is largely unresearched; scientific inquiry has traditionally been confined to the development of physical test methods (i.e. shock-and-vibration testing theory is one of the more established). Therefore, in the distribution packaging field this research takes place in the context of discovery. On the other hand, in the industrial innovation field, this research's contribution is to test for the relationship of distribution channel integration with systemic and incremental innovations. This case study method is an example of the deductive approach to generating theory. This approach begins with speculation and assumptions which are used to generate a hypothetical model, which in turn constitutes a framework for the deduction of generalizations.[11] The analysis of the questionnaires from the case study participants, within the framework of the conceptual model (and its constructs of channel structure, systemic and incremental innovation, and functional performance and cost improvements) will be used to deduce generalizations concerning the structures which facilitate or block innovation and the costs and functional benefits which are commonly considered.

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[11]Shelby D. Hunt, Marketing Theory; The Philosophy of Marketing Science (Homewood, Illinois: Richard D. Irwin, 1983), pp.21-25.

Bergman has noted that many philosophers of science, including Hegel and John Dewey, have confused the discovery of scientific knowledge with justification.[12] Although testing the innovation adoption hypotheses listed in Chapter I is at the heart of this research, it is also a search to discover distribution packaging generalizations, using a functional approach to guide observation. These generalizations will be the basis for future research in the field of distribution packaging, to later be tested in the context of justification, and to be ultimately used to explain, predict, and control distribution packaging systems.

Boulton suggests a systems approach to organizing case research data, in order to make comparisons and draw generalizations. This research will follow his approach:

> First, organizations are viewed as a resultant of their history and environment. This requires a basic overview of the company, and its history, if one is to understand the basic structures, processes and functions at work. This then allows for a clearer understanding of objectives and strategy, which is to be discussed next, followed by a description of structure, processes or systems, and operating level functions. It is this move from the general and external character of the firm to the specific and internal factors that aids our understanding of the territory and the relationships being studied. If we systematically organize our data in such a manner, then we can also carry out a comparative analysis of our data between multiple case studies. The analysis of similar data over several organizations allows the researcher to identify similarities and differences which leads to the development of new concepts, language and theory.[13]

The following chapter compares and contrasts the case results and discusses the role of distribution channel structure in the process of distribution packaging innovation. Chapter 5 follows, with

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[12]Gustav Bergman, Philosophy of Science (Madison: University of Wisconsin Press, 1959) p.5.

[13]Boulton, "Case Study as a Research Methodology," pp.12-13.

generalizations prompted by the case observations, limitations of this research, and questions for future research.

CHAPTER IV

RESULTS

This chapter has two parts. The first explores the hypotheses listed in Chapter I. By comparing and contrasting the five cases with vertical marketing systems to the five cases with non-vertical marketing systems, conclusions can be drawn concerning the effect of distribution structure on distribution packaging innovation.

The second part of this chapter explores the other research questions listed in Chapter I. These questions compare all cases on issues of package innovation diffusion, transportation deregulation, cost and benefit impact, and draw generalizations concerning the distribution packaging adoption process.

Four of the vertical marketing systems are contractual (Allied, Kimball, Shaw-Walker, and Nordyne) and one (General Motors) is administered. Two of these are cases of inbound material package changes (General Motors and Allied), two are outbound distribution package changes (Kimball and Shaw-Walker), and one case has both contractual and free-flow channels (Nordyne).

All five non-vertical marketing systems are free-flow (Gerber, Michigan Fruit Canners, Johnson Wax, Supreme Equipment, and Owens-Corning Fiberglas). To simplify the reader's task, the non-vertical marketing systems will be referred to as "free flow marketing systems."

Since the influence of transportation suppliers differs from that of traditional channel members, their roles will be explored separately.

Systemic Innovation Adoption Effects

H_1: Systemic innovations are more easily adopted by vertical marketing systems.

There was support for this hypothesis.

There are many factors which affect an innovation's ease of adoption, and most involve the firm's internal management. However, since the purpose of this hypothesis is to separate out the effect of the distribution channel on the adoption of systemic packaging innovations, the evidence for "ease of adoption" rests in how the channel facilitated the innovation process.

Three firms with contractual marketing systems adopted their package as a customer service, at the request of the channel member who unpacks the product. The fact that these packages were adopted to solve a channel problem, hastened the channel's acceptance of the new packages. The three firms--Kimball, Nordyne and Allied--all received complaints about trash disposal/removal costs associated with their emptied packages. As these firms learned about packages which would solve the trash problems, chose a solution, and made the decision to adopt, the channel's concerns gave the project a clear goal. Test shipments were cooperative ventures, and even failures were viewed as positive feedback to the package design process. When it came to implementing the new package, the contractual channel members were eager to cooperate because the benefits to them were clear.

The benefit that a vertical marketing system can provide is illustrated by Kimball's adoption process. When one of their dealers complained about the cost of trash disposal, resulting from unpacking all of the furniture for a large installation in a downtown big-city building, it was clear that these channel members wanted a package innovation. Once Kimball decided to minimize their packages, they did not develop or test prototypes. They simply started shipping their wall panels in bags (instead of boxes). One of their contract carriers encouraged the change, by promoting "uncartoned" transport service which incorporates the use of blankets, decks, and straps to replace the boxes' protection during shipment. Kimball justifies the costlier transportation on the basis of savings in the purchase and disposal of packaging materials. Feedback from the initial shipment was used directly to modify and improve the package's performance for the next shipment, which was easy to manage since the package was designed by the distribution department. This innovation adoption was facilitated by good communication between Kimball's dealers and its distribution department. The explicit acknowledgement that the dealers' costs depend on Kimball's package can be attributed to their contractual marketing system.

One case, Nordyne, uses both contractual and non-vertical marketing systems. It provides a good illustration of the general difference found between channel structures. In Nordyne's contractual channels, furnaces are shipped directly to mobile home (original equipment) manufacturers. These manufacturers complained of the need to unpack every furnace from a corrugated box, and of disposal costs. Had Nordyne only shipped in these

contractual channels, the adoption process would have been easy. The mobile home manufacturers encouraged the package idea because of good experience with buying stretch-wrapped furnaces from one of Nordyne's competitors. But the fact that Nordyne also used free-flow (aftermarket) channels for the same picked-from-storage furnaces slowed the innovation process considerably. The new package's reduced advertising and protectiveness in the free-flow channels was questioned by the marketing staff. At first independent dealers and LTL carriers objected to the change. Nordyne found that more persuasion and patience was required to implement the new package in its free-flow channels.

The firms with contractual marketing systems in this research were more direct and more simple than the free-flow channels. Fewer sorts and smaller networks, in a way, reduce the systemic effect of the package innovation. This also helped to make the innovations easier to adopt, because fewer intermediaries needed to learn about the new package.

One of the easiest adoptions, from a channel effect point of view, was Allied's, which changed only one package for one factor of production, and affected only one supplier who ships truckload quantities directly to the assembly plant. The adoption process was initially triggered by hazardous waste disposal problems. Allied previously sent the used drums back to the plastisol supplier to re-use. But they could not send them back with more than 1" of product in the bottom of the drum. Often the leftover product was contaminated by garbage, and Allied had to dispose of the drum. But since Missouri had closed their landfills, contaminated drums had to be shipped to Illinois for incineration, at a cost of $1000/drum. Since Allied's supplier had

requested a change to a higher volume package with fewer disposal problems, it helped to facilitate the package change. Despite the technical complexity of Allied's new "bag-in-a-cage" package, the supplier and Allied worked together to overcome the problems which arose during the early implementation.

One benefit of reducing trash disposal costs for channel members is that it can also serve to reduce package purchase costs. Only one of the firms with contractual marketing systems initiated the adoption process for the purpose of reducing its own costs. Although Shaw-Walker has not decided whether to adopt (at this writing), its adoption initiation process more reflects that of the free-flow marketing system cases. Since the package has not been designed to solve a channel member's problems, more prototypes have been developed, and more tests run, than in the other vertical marketing systems. Like the free-flow channel packages, Shaw Walker has been "selling" its package to its dealers and carriers. It is encountering more resistance from its transvection partners than did the others with contractual systems.

The one firm with an administered vertical marketing system, however, experienced the most difficult implementation process of all. Since General Motors' BOC Division did not discuss the new package with its part suppliers prior to the adoption decision, the initiation stage easy. But the implementation developed a great deal of resistance from suppliers when package changes and part price reductions were demanded of them. The suppliers did not want to grant the price reductions, and did not want the control problems associated with a returnable package system. Their resistance can be attributed to two factors: lack of

channel member involvement in the early adoption process, and the complexity of the management task undertaken (the conversion of its many assembly parts suppliers to returnable packages).

Four of the firms with free-flow channels (Gerber, Michigan Fruit Canners, Johnson Wax, and Supreme) initiated the adoption process in order to reduce their own purchasing costs rather than as a customer service. As a result, resistance to the innovation arose from channel members who were afraid that the "cheaper" package would increase their own costs of handling and damage. The competition in free-flow channels discourages unpopular changes. Consequently, the early stages of the adoption process for firms with free-flow channels involved more time spent promoting the new package idea to channel partners, and soliciting feedback. The channel members had to be convinced that the package would also benefit them. This made the adoption process more difficult.

Since Gerber was the first firm in the U.S. to consider using shrink-bundles for bottles of food, it encountered resistance from food distributors and carriers who were concerned about the package's protectiveness. Once the package had been tested and test-marketed, retailers were more convinced of the package's benefits to them: more convenient opening, display, and disposal. It was this process of convincing the channel members of a package's benefits which made the adoption process more difficult in the free-flow channels. Later adopters in the same channel, however, benefit from the channel's experience with the earlier adopters. Michigan Fruit Canners' adoption of plastic bundles was easier because of the pioneering work which had

been done by Gerber and Green Giant (the first to pack bottles and cans in shrink-bundles).

These free-flow channels for consumer products form a more complex network than the vertical marketing systems studied, involving more channels and more intermediaries--various retail outlets, brokers, dealers, and wholesalers--and therefore more various people's needs to satisfy. These consumer products companies' initiation of the adoption process followed their general process for introducing any new consumer product: market research, promotion, and test marketing. This is a much more difficult task than that undertaken by the firms with vertical marketing systems who adopted their new packages as a customer service in direct response to a customer problem.

Johnson Wax experienced the most difficult adoption process. It was so difficult that they decided not to adopt their innovative package. The idea of convincing not only customers and carriers, but also the U.S. Department of Transportation that their semi-hazardous aerosol product would be safe in a shrink-bundle, was too much of a barrier to the innovation process.

Supreme's adoption process was much like Shaw-Walkers.' Their products are similar (both make file cabinets) and their package innovations are both stretch-wrapping. Both initiated the adoption process to reduce their own manufacturing costs. When comparing these two firms, in an effort to detect the role played by the difference in their distribution channel structure, one impression is clear. Shaw-Walker's contractual dealers encouraged adoption when they saw the prototype packages. They "saw the package as a marketing feature" which

differentiates the product. Supreme's free-flow channel dealers, on the other hand, were not enthusiastic about the proposed change, and Supreme changed the package anyway, reasoning that the dealers would grow to accept it, which they have. It is possible to detect more resistance in the free-flow adoption process than in the contractual one.

Only one case with free-flow channels initiated their adoption process in response to a channel member complaint. Owens Corning Fiberglas responded to a chain-store-customer advisory group's complaints about excessive handling costs by developing a unitization method for insulation rolls. It is interesting to contrast OCF's adoption process to that of the contractual channel cases whose packages answered a channel member complaint directly by responding as soon as a package solution/innovation could be developed. Once OCF found a packaging solution, they did not go ahead and implement the new package as the contractual channels did. The decision to adopt was not made until the results of numerous studies (market and technical, internal and consultants) supported the decision. The needs of each market segment were considered, and intermediaries were introduced to the new package by a great deal of promotion: videotapes, special visits, and literature.

The cases with free-flow channels implemented the innovative packages more cautiously than those with vertical marketing systems. This caution is an indicator that implementation was more difficult for the firms with free-flow channels. They were less sure of the channel's acceptance, and worked to insure channel members' acceptance of the new packages.

All of the free flow cases reported that they targeted one specific product line and market area for the early implementation. They sought extensive feedback from these first customers, and once they felt confident in the new package's performance and acceptability, they switched over into more product lines and into more market areas.

H_2: Systemic innovations encounter more resistance in non-vertical marketing systems unless transaction costs reflect package-related cost changes.

This hypothesis was not supported.

There was only one case which provided evidence to support this hypothesis. Nordyne, with both contractual and free-flow channels, encountered some resistance to the new package in their free-flow channels. Aftermarket furnace dealers said that they did not trust the new stretch-film package to prevent damage. Therefore, Nordyne did offer to box furnaces for a premium price. The fact that they did not receive any requests for this "premium" package, indicates that a lower transaction cost for the new package helped to implement the new package innovation.

Contrary to the hypothesis, it was three of the firms with vertical marketing channels which included the package innovation cost/savings in the transaction price of their products. Allied and General Motors both negotiated a price reduction from their suppliers as a result of purchasing supplies in reusable packages. Although Kimball does not get any different price from dealers for its products sold "uncartoned," dealers do pay less for installation, which lowers their total cost.

The firms with free-flow channels emphatically stated that they did not include package savings in their transaction cost, although most believe that the lower cost of their package helped to postpone price increases to their customers. Especially for grocery products, pricing is competitive and is based on more than costs. Although the new package was not facilitated with a transaction cost decrease, it was described as more profitable to channel members because it reduced their opening, display, and disposal costs. All free-flow channel cases described the new package as representing a competitive advantage, and used it for sales support show-and-tell throughout the adoption process.

Stages of the Adoption Process Effects

The innovation-adoption process, is conceptualized by Zaltman in the following two stages and substages:

I. Initiation Stage
    1. Knowledge-awareness substage
    2. Formation of attitudes toward innovation substage
    3. Decision substage
II. Implementation stage
    1. Initial implementation
    2. Continued-sustained implementation[1]

The following three hypotheses explore the role of distribution channel structure on these two stages of the adoption process.

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[1]Gerald Zaltman, Robert Duncan, and Jonnny Holbek, Innovations and Organizations (New York: John Wiley and Sons, 1973) pp.158-163.

H_3: Shippers with a vertical marketing system are more likely to discuss packaging changes with channel members at an earlier substage in the initiation of the innovation adoption process than are shippers with a non-vertical marketing system.

There was some support for this hypothesis.

The firms with contractual channels held the earliest consultations about the packaging innovation with their channel partners, who provided awareness about an end-of-channel problem which required a packaging solution. In three of the contractual marketing system cases, the initial trigger for the adoption process occurred when a end-of-the-channel member requested the package change in order to reduce package disposal costs. In all of these cases, the lot size delivered to each customer is large, full-truckload quantities, which generates a concentration of trash from one source. The channel member responsible for package disposal requested the package change; Allied, Kimball's dealers, and Nordyne's mobile home OEM customers were all concerned with reducing trash generated in their assembly operations. Their desire for a package solution to reduce trash removal costs occurred at the very beginning of these firms' adoption processes, generating knowledge and awareness of the problem.

Firms with free-flow channels introduced their packages to channel members later than those with contractual channels, at the time that they formed their attitudes toward the innovation. Since most of these firms initiated their adoption processes to decrease their own package purchase costs, their knowledge/awareness substage was concerned with the firms'

internal management. Gathering data and opinions from customers followed, during the attitude formation substage.

Gerber, Michigan Fruit Canners, and Supreme Equipment introduced prototypes of their new package to customers as part of regular sales calls. These firms with free-flow channels promoted the idea to their channel members before committing to the change. The purpose of these presentations was to arouse the interest of other channel members as well as to test distributors' reactions to the package and teach them how to handle it. Salespeople, who were responsible for introducing the prototype package to customers, used the package to get more attention and promote his/her products in general. Michigan Fruit canners, using the same channels as earlier shrink-bundle adopters, found that experienced channel members actually facilitated the adoption process, offering advice rather than needing to be convinced. These presentations occur late in the knowledge and awareness substage of the adoption process, illustrated by the fact that Johnson Wax did not get around to presenting its prototypes to customers because the fear of Department of Transportation disapproval led them to decide against adoption early in the attitude formation substage.

There is evidence, however, that customers are considered by the firms with free-flow channels from the very beginning of the adoption process, even though they are not consulted until later. The new package, at initiation, was felt to be a strategic consideration—a way to attract customers—for four of the firms with free-flow channels. Supreme was looking for a way to differentiate their product. Michigan Fruit Canners, a later adopter of shrink film packaging in the canned

food industry, chose to initiate the innovation process as a competitive response. Johnson Wax chose to investigate packages which promote in-store displays and facilitate distributors' sorting-out of small lot sizes. And Owens-Corning Fiberglas wanted to make its itchy product more acceptable to retailers. Owens-Corning Fiberglas was the only free-flow channel case (in this research) in which channel members requested the package change; and this was a retail advisory committee made up of powerful customers.

But, contrary to the hypothesis, the firm with administered channels did not consult with its channel partners at all until after it made the decision to adopt. General Motors formed its attitudes about plastic returnable distribution packages from seeing them used by Japanese competitors, and decided to adopt them at the same time as adopting a "just-in-time" materials management system. GM did not consult its part suppliers at all (who would later be required to adopt the new returnable package system) during the initiation of the adoption process.

The involvement of transportation carriers during the initiation stage of the adoption process depended more on whether the firm felt that it had to comply with any carrier packaging "rules." Gerber, the earliest case, operated strictly within the National Motor Freight Classification test shipment and exception process, and its package specification appears in the tariff classification book. (In fact, Michigan Fruit Canners' package falls under Gerber's exception.) None of the other cases went through this process. But most of them did get some sort of approval from their carriers before they decided to adopt the new package.

The durable goods manufacturers who use common LTL carriers (Shaw-Walker, Supreme, and Nordyne) were the only ones who were asked by their carriers to subject the new package to tests (National Safe Transit Association Tests): free-fall drop, synchronous vibration, incline impact, and (only for Supreme) corner drop of one package onto the face of another. The reasons cited for the test requirement were that common LTL carriers sort packages as many as 12 times during one shipment, and need to be assured that the packaged product can withstand the handling. Shaw-Walker even installed an NSTA laboratory of their own as a result of this experience.

The shippers who use private, contract, or truck-load common carriers did no laboratory tests and got no official approval from their carriers. All, however, conducted shipping tests and/or closely monitored the initial shipments of the new package, with the cooperation of their individual carriers.

In only one case did the carrier influence the initial idea for a package innovation. Kimball's carrier, North American Van Lines, inspired the idea for packing wall panels in plastic bags by promoting its "uncartoned" transportation service. Their salesperson encouraged the change, and helped to develop the packing system within the trailer.

H_4: Shippers with a vertical marketing system are more likely to consider channel members' cost changes during the decision substage of the innovation adoption process than are shippers with a non-vertical marketing system.

This hypothesis was supported.

The most evident distribution packaging-related costs are the purchase and disposal costs. All of the firms considered the costs which their own firm bears (purchase costs for most, but disposal cost for the two materials management cases). But the firms with vertical marketing channels were the only ones to consider these costs when borne by a channel member firm.

Four of the firms with vertical marketing channels considered both purchase and disposal costs. Kimball and Nordyne included disposal costs in their decision because the end-of-the-channel members had complained about excessive disposal costs. Allied and General Motors considered not only their own disposal costs, but also the costs of the packaging purchased by their suppliers. In materials management cases, the cost of purchasing packages for factors of production is indirectly borne by the OEM assembly firm (Allied and General Motors), who buys a filled package from its parts suppliers and must dispose of an emptied one. The GM Lansing Assembly plant alone found that it purchased and disposed of over 2700 corrugated pallet containers per day. Allied's package innovation saved them from both the purchase price of steel drums and the disposal problems associated with drums containing hazardous residue. These two firms found that returnable containers, including return costs, reduced their total cost as well as their per part cost.

The further downstream the disposal is from the package decision-making firm, the less disposal costs are considered. All free-flow channel cases, except Owens-Corning, claimed to have reduced disposal costs (as well as those for pricing and display), but none included them in the return on investment calculations used to make the decision to

adopt. The wrap-cap package used by Gerber and Michigan Fruit Canners is easier to price and display because the plastic on top can be peeled off, and the tray can be used to display product on the shelf. Johnson Wax also sought this benefit for its retailers by considering shrink-bundles. In addition, these film-based packages (including stretch-film packages) cost less to dispose of because the used packaging materials fill less volume.

One of the most significant discoveries was that all of these package innovations, except Owens-Corning's, did reduce both the package purchase costs and the ultimate disposal costs. Although Owens-Corning's package costs were increased slightly, the cost of handling their product in their own facility was reduced dramatically because of the new ability to handle multiple rolls. The effect was to reduce their total costs. OCF seemed to be surprised that they "made money" on the package adoption; they had expected their own total costs to increase because of the added investment and material cost. Owens-Corning is the only unitization case, and the only one to consider its customers' cost of handling as part of the decision process.

H_5: A non-vertical marketing system better facilitates initiation and a vertical marketing system better facilitates implementation of a distribution packaging innovation adoption.

This hypothesis was not supported.

The firms with vertical marketing systems experienced the easiest <u>initiation</u> stage, as a result of their channel partners' input. The

firms with contractual channels were more likely to adopt a package at the request of their channel partners, and since these channel partners participated in the adoption from the outset, they facilitated the initiation substages. The fact that the firm with an administered channel did not even consult with the affected channel members, while it may have facilitated its initiation process, created resistance to implementation.

Although a powerful group of members of a free-flow channel can also successfully initiate a package adoption, most firms with free-flow channels adopted the new package to benefit themselves. The complex nature of free flow channels led these firms to seek approval from more channel members, which lengthened the initiation stage. Knowledge and awareness of a new packaging form, however, was more likely to occur in a free-flow channel where the sales force of manufacturing firms are exposed to competitors' new packages.

The adoption decision was easier for the firms with vertical marketing channels, because they did not invite channel members to approve the change. They did not need to "sell" the new package to channel partners the same way that firms with free-flow channels did. All firms, except General Motors, said that their channel partners affected the decision to adopt.

The ease of <u>implementation</u>, on the other hand, seemed to be more dependent upon the package's technology than upon distribution channel structure. Allied's bulk bag-in-a-box, General Motors' returnable packaging system, and Gerber's shrink bundle had more early implementation problems than others because these package systems are

more complex than the others. Allied's first large shipment suffered disastrous damage, spilling gallons of plastisol adhesive in the trailer and while unloading. General Motors experienced many problems with convincing part suppliers and to reduce prices, convincing transport companies to reduce cycle costs, and training material handling workers to cycle containers in a timely fashion. Gerber's wrap-cap unwrapped during some early quality control problems. Most of the packages underwent modifications during their early implementation, largely as a result of channel feedback.

Carriers did not seem to have much effect on any part of the adoption process, aside from offering some helpful suggestions during the early implementation, when their operations were affected. For example, Nordyne's drivers suggested better methods for unloading trucks once they got a chance to handle the new package. Although some common carriers objected to the package changes and required testing or other qualification during the initiation stages, these were little more than formalities because they did not affect the decision to adopt (although poor test performance was used to improve package designs). The one exception was Johnson Wax which decided not to adopt because of the perception that DOT would disapprove their package for a semi-hazardous material. Especially in the later cases, shippers shared the notion that: 1) carrier deregulation has retired the old classification rules, and 2) carrier competition is strong enough to force carriers to accept any new package, "if they want our business." LTL common carriers were more likely to request qualification tests than either contract or TL carriers.

Additional Research Questions

In addition to the hypotheses concerning the effect of channel structure, this research sought answers to questions about transportation deregulation, the packaging innovation adoption process, and package-related logistics cost and performance.

1. How has transportation deregulation (i.e. more contracts and less common carriage) altered the diffusion of packaging innovations?

No case cited deregulation as stimulating their package change. But all acknowledged the fact that deregulation had made the adoption process easier.

Contract carriers were more likely to encourage innovation than were common carriers. In one case, the contract carrier actually facilitated the initiation of the adoption process; this carrier specializes in uncartoned freight movement, and uses this specialty for strategic advantage.

Less-than-truckload common carriers are the only ones who required shippers to prove the adequacy of a shipping container, presumably because these carriers perform a number of cross-dock operations in the course of a freight movement. The "proof" required was the National Safe Transit Association's recommended tests. The only shipper whose adoption process conformed to the traditional National Motor Freight Classification Committee exception process was Gerber, who adopted their new package during deregulation. The more recent cases did not feel that the "rules" still applied under deregulation.

The only shipper who felt that transportation packaging rules represented a barrier to innovation was Johnson Wax, who aborted their adoption process when they learned of the D.O.T.'s hazardous materials rules forbidding shrink-bundles for aerosol cans. Further investigations (by this researcher) reveal that the D.O.T. is in the process of switching from materials specifications to performance standards for hazardous materials distribution packaging, and that Johnson Wax could have petitioned for acceptance of their proposed package, providing it met the performance test criteria.

2. What is the relationship between packaging innovations adopted, packaging cost and performance, and packaging's impact on the total cost of distribution?

The purchase and disposal costs were the greatest and most visible packaging-related costs. All cases but one were motivated to change their package to reduce either purchase or disposal costs. And all of these nine cases reported that they had reduced both. These nine cases all involved replacing a traditional (cardboard or steel) package with a plastic one. Most of the plastic packages are simple film-with-corrugated-component affairs, with much less material to buy and dispose.

Allied's package is an example; their innovation saved them from both the purchase price of steel drums and the disposal problems associated with drums containing hazardous residue. Allied's adoption process was initially triggered by hazardous waste disposal problems: They previously sent the used drums back to the plastisol supplier to re-process and re-use, but could not send them back with more than 1" of

product in the bottom of the drum. The leftover product is very sticky, difficult to remove, and may contaminated by garbage and Allied had to dispose of the drum; since Missouri had closed its landfills to such contaminated packages, they had to be shipped to Illinois for incineration which costs $1000/drum. Allied's innovative solution is a multi-layered bag-in-a-box; the bag can be squeezed empty and disposed of as ordinary trash (rather than a hazardous material), and the box is reusable.

All of the cases claimed to reduce the cost of both the packing and the unpacking operations. The efficiency of packing operations was improved by either mechanizing a formerly manual operation or improving the speed of packing. Mechanization of a former manual operation was a major benefit for four cases: Shaw-Walker, Supreme Equipment, Nordyne, and Owens Corning Fiberglas. These cases' switch to stretch-wrapping eliminated the need for manual boxing and trailer loading operations. Packing line speed was improved for Gerber, Michigan Fruit Canners, and Kimball.

The efficiency of unpacking operations was improved by eliminating assembly line downtime due to package changeover (for Allied) and by the fact that the film packages are easier to open than the corrugated boxes which were replaced in seven of the cases.

Two furniture makers, Shaw-Walker and Supreme, cited materials management efficiency reasons for triggering their adoption process: to reduce the inventory of packaging materials and automate packaging operations. This is due to the fact that when rigid corrugated boxes are used to package furniture or other large durable goods (which are

packaged one to a shipping container), the inventory investment in box part sizes and shapes is multiplied by the number of product shape variations, with little opportunity for purchasing volume discounts. All of the durable goods manufacturers who replaced corrugated packaging with stretch-film systems rejoice that "one roll fits all." In addition, these large products have traditionally been manually packed, and automation and centralization of this manufacturing operation was desired to improve manufacturing productivity.

Investment cost was a factor for the seven cases who had to invest in a new machine to wrap the package around the products. All of these incurred the investment cost, but all said that they saved labor as a result of either the first-time automation of a manual task or the improved line speeds of the new kind of equipment.

The performance of all of the adopted packages has been satisfactory. The functions of utility, protection, and identification are filled at least as well as with the previous package. The following paragraphs summarize the performance effects.

Packaging utility affects distribution costs. The distribution cost improvements were not as significant as the improvements in package purchasing, packing and disposal costs. The biggest changes in the packages' utility were in the areas of truck loading/unloading and transportation utilization.

The most significant transportation cost change occurred for the two firms who adopted returnable packaging systems. They did not find, however, that the transportation costs had doubled, because of the packages' knock-down features and the ability to use contracted deadhead

and common LTL haulers for the return trips. Since Allied only changed one supplier to a returnable package, it had fewer return problems than General Motors who changed many suppliers' packages to the returnable system at once. The complexity of sorting forced GM to use a separate warehouse facility for cleaning, bundling, and returning the packages to the right suppliers. Since both of these firms' packages had multiple components to be returned, and GM was using a just-in-time system to minimize inventory, they both encountered implementation problems due to forgotten or missing and/or un-returned package components.

Two firms mentioned the premium charged for "uncartoned" transportation service, contracted commercial transport using a "padded van" with blankets for wrapping and decks for stacking. Shaw-Walker had been using this service for the half of their products shipped in truckload quantities directly to installations, and the other half had been boxed for LTL carriage. One of the reasons for their package change was to be able to uniformly pack everything, and utilize less costly (than uncartoned) transportation, as well as less costly packaging for LTL carriage. The new packages should also improve truck loading productivity over the uncartoned product. Kimball's innovative package, on the other hand, relies on the use of uncartoned carrier. They justify the costlier transportation on the basis of savings in the purchase and disposal of packaging materials.

Truck loading/unloading cost reduction was the primary benefit which motivated Owens-Corning Fiberglas' package innovation. Their rolls of insulation had previously been loaded manually into trailers by very itchy workers who manually compressed the product to optimize the cube.

The new tightly stretch-bundled package resulted in a unit that can be manually or mechanically handled in multiple compressed units.

Only one firm's package was more difficult to handle, and that was Allied's. But because the package was 4.5 times larger, the more difficult moving operation was less frequently performed, and resulted in little change in handling costs.

Only one case was designed to facilitate order-picking: Johnson Wax's package separates into smaller modular units for picking small orders for drug-store retailers.

Although there were some slight changes in trailer or warehouse cube utilization, no case acknowledged a cost effect. Wherever possible, packages were designed to optimize cube.

The function of protection was largely unchanged. This supports the incremental innovation assumption that the packages' cost can be reduced without impairing performance. Although a couple of packages were acknowledged to be slightly less protective, the acknowledgement was accompanied by the observation that workers seem to handle the new package more gently. This was repeatedly mentioned for the see-through film packages which replaced corrugated boxes. Besides more gentle handling, these packages have the advantage of concealing neither damage nor product features. Supreme said that there had been fewer shipping mistakes since the color and style of their products (their primary differentiating features) are apparent.

The communication function was marginally affected in other ways (besides improving product identification by making the product more visible). Because there is no printing on any of these packages, there

was some concern from many of the firms' marketing departments about loss of advertising on the cardboard billboard-like panels of boxes. This concern was more serious for the firms with free-flow marketing channels, who resolved it by pre-printing trays or corner-pads with the firm's logo. The mass production food manufacturers also pre-printed their stock-keeping-unit numbers on the trays. SKU numbers and (in some cases) consignee identification for the other products was also achieved with stickers, tags, or stamping.

In order to communicate with management information systems, automatic identification was required of many packages. Bar code location was a problem for all of the firms who needed one. Since it is difficult to "read" a bar-code through film (especially through multiple layers of stretch-wrap), these were also applied with stickers, usually to the outside of the package, although Shaw-Walker intends to "read" right through the film (reflecting improvements in bar-code reading technology). The shrink-wrapped grocery packages in trays (Gerber, Michigan Fruit Canners, and Johnson Wax) are not bar-coded, and Gerber expressed concern that the package tray is too small to accommodate the bar-codes requested by the Department of Defense contracting officers.

3. What is the general adoption process for a new distribution package?

The initiation of the adoption process was found to vary from firm to firm. Although all of the plastic packaging innovations were expected to be lower cost than the corrugated packaging systems which they replaced, the cost "problem" which initially triggered the innovation process varied between cases studied. Respondents cited the desire to

reduce packaging material purchasing costs, packing operations costs, and disposal costs, as well as competitive pressures, as the reasons for entertaining the idea of a new kind of distribution package. But these are very old problems. All informants replied that they had searched before for a solution to their problem, but that awareness of a new packaging system was required to trigger the process. And, in every case except the first-adopters in an industry, the distribution channel played a role in spreading awareness of new distribution packaging forms.

Most of the channel influence on diffusing these innovations occurs because these firms are early, not first adopters in their industry. Since the first adopter shares channels with other firms, salesforce intelligence circulates the new idea throughout the other firms in the channel. This is particularly clear in the non-vertical grocery marketing channels, where every case study was aware of other canned food manufacturers who were using shrink bundles. Green Giant was the first to introduce this package form in the mid-1960's. Two firms with vertical marketing channels also learned of the innovation through their channel: Nordyne learned from their salesforce that competitors were already using plastic packaging, and Kimball learned from an uncartoned transportation salesman that competitors were shipping without boxes. In one case, awareness of a competitor's innovative package arose outside of distribution channels: General Motors' awareness of a Japanese competitor's use of plastic returnable packages occurred during GM's research into Japanese Just-In-Time material supply systems.

Only two cases were first-adopters in their industry. They both became aware of the opportunities for plastic packaging outside their

channels. Both sought out the packaging industry for solutions to their manufacturing problems: Supreme shopped at a Packaging Exposition, and Shaw-Walker called in Packaging Consultants. In both cases, the stretch-wrapping solutions were imaginatively transferred from unit load wrapping technology to the wrapping of a single large product.

The person who triggered the adoption process was, in all cases, in a job position related to the goal or problem perceived. Therefore, when the problem was to reduce disposal costs for customers, a Sales or Marketing manager was credited with the idea (Kimball, Nordyne). When the problem was to reduce manufacturing costs, Industrial Engineers and Packaging Engineers stimulated the process (Gerber, Johnson Wax, Nordyne, Shaw-Walker). When General Motors needed to clean up the manufacturing line, the plant manager initiated the project. And when a small company's competitiveness was the issue, the President of the Company or Director of Marketing were responsible for the strategic idea (Supreme, Michigan Fruit Canners).

The personnel in the firm who participated in the initiation of the adoption process were an artifact of the existing organizational structure. In most of these firms, there was, at the time that the process was triggered, no one directly responsible for the management of Distribution Packaging.

Lack of a Distribution Packaging professional did not represent a significant barrier to innovation (although some pitfalls might have been foreseen by someone with a packaging background). Once the problem had been identified, a project champion was designated. Six of the ten adoption projects were led by an engineer: either an Industrial Engineer,

Manufacturing Engineer, a special Project Engineer, or a Packaging Engineer. In three cases, the leader was in Distribution. Only one case was led by a Packaging professional in a Research and Development department.

Only the large national brand consumer products companies (Gerber, Johnson Wax, and General Motors) had packaging departments. In Gerber and Johnson Wax, where the consumer product depends on packaging, Packaging is a part of Research and Development. The packaging department in Johnson Wax did not champion the adoption process, however, and was blamed for the decision not to adopt. In General Motors, the organizational placement of the packaging function shifted as a result of the returnable package adoption process, from Industrial Engineering to Materials Management (from a design to an operational function).

Although other firms did not have a Packaging professional when the adoption process was initiated, most had evolved one by the time it reached the sustained-implementation stage. Shaw-Walker, Michigan Fruit Canners and Supreme instituted Packaging departments as a result of the adoption process.

In all cases, the project leader received cooperation and help from other members of the firm. Packaging spans boundaries within the organization as well as throughout the distribution system, and the teams which participated in the adoption decision were comprised of people in gatekeeping roles. These gatekeepers related to either internal functions (like manufacturing and material handling) or logistical functions (like sales, distribution, traffic, and/or

purchasing). The project leaders all encountered conflict and the need to persuade others.

Incremental innovations are characterized by the limited amount of new knowledge required to make the change. Indeed, the switch from corrugated to plastic technology required little new knowledge. All of the firms needed to learn a little about plastic properties (like elongation and strength) and machinery characteristics. But the primary information need was to learn about the performance of the complete filled package. They acquired this knowledge primarily through trial and error, comparing different films or package forms in tests. All of the firms left the details of plastic processing to their suppliers; in fact, some did not even know what type of plastic they were using (polyethylene, polypropylene, or nylon). In the cases where machinery investment was required, it was observed that these machines are relatively simple. Shrink-and stretch-wrapping are more straightforward processes than most which occur in a factory.

The supplier of the innovative package or packaging machinery was a primary source of knowledge, and offered a great deal of technical assistance, helping to design the prototype package in all cases. When a piece of equipment was required, the machinery supplier usually provided a loan of equipment for the test shipment period. The new applications of technology could be seen to change the technology itself. An example is Owens-Corning Fiberglas' new application of stretch-unitizing technology. By working together with machinery manufacturers, OCF increased the speed of stretch-wrapping machines from 20 to 50 revolutions per minute.

The general implementation process for a new distribution package varied, depending on the extent of the change. But all firms experienced unforeseen difficulties during the early implementation. Leadership was very important throughout the adoption process, but the early implementation, in particular, required a steadfast champion who is not discouraged by the problems which inevitably arise with any new system. (This champion was usually the same one who led the initiation process.) A couple of cases suffered from a lack of leadership at this crucial phase, and cited delays in implementation due to lack of focus and responsibility. The implementation problems were considerable, ranging from damaged and leaking packages to handling problems. The project leaders closely supervised the first few shipments, and all cases reported that they had made small changes to the package due to channel member feedback about problems.

In all cases, the project leader was assisted in implementation by gatekeepers internal to parts of the firm like Manufacturing, Quality Control, Distribution, Traffic, and Plant Engineering. These gatekeepers got the new system set up and the first shipments out the door. Salespeople (and Purchasing, in the materials management cases) acted as gatekeepers to the channel; smoothing the way for the first few shipments, and filtering feedback concerning package performance.

None of the cases identified barriers to the adoption, except for some references to personalities and "corporate bureaucracy".

4. What was the perceived strategic impact of the package change?

Although no case could quantify any increase in market share due to the new package, all discussed the increase in channel attention and awareness in of their product as a result of the package change. Whether the package specifically solved channel members' complaints or just gave an opportunity for some "show and tell" discussion during a sales call, the firms all felt that more customer service was provided, due to the package change. For Owens-Corning Fiberglas, the marketing aspect was so explicit that they trademarked their "Time-Sav-R" package. In addition, all firms said that since their costs were lower, and that using the new package had delayed price increases.

CHAPTER V

CONCLUSIONS

This final chapter summarizes the conclusions and limitations of this research and suggests future research directions.

Generalizations

The logic underlying this research follows:

Assumption 1: Systemic innovation proceeds most efficiently in (integrated) enterprises whose boundaries span the various participating organizations.

Assumption 2: Distribution packaging innovations are systemic innovations.

Assumption 3: Vertical marketing systems are integrated enterprises whose boundaries span the various channel member organizations.

Therefore, Distribution Packaging innovations will proceed most efficiently in vertical marketing systems.

This argument found support in the ten case studies explored by this research. The generalizations which follow from this logic have wider implications for theory in the fields of distribution channel management and distribution packaging.

The subject of innovation in distribution channel management has been largely unexplored. But this research implies that other types of systemic innovation might also be facilitated by a vertical channel

structure. Indeed, it is easy to think of other innovations which seem to be more easily adopted by vertical marketing systems, in the areas of integrated information management, just-in-time manufacturing, and uniform material handling and training procedures.

One reason that the vertical marketing systems are better adopters of innovations is that the firms in these channels acknowledge that their costs depend on one another. This encourages communication about trash disposal costs, handling costs, and dispensing costs between purchaser and salesperson, across the boundaries of individual firms. This communication serves to inform the package decision-makers about channel problems. The only free-flow channel which successfully transmitted information to initiate an innovation was an advisory group of united customers. This union increased the retailers' power over the manufacturer.

It is significant to note, however, that all of the package innovations lowered total costs for the distribution channel--not only the costs borne by the channel member(s) who complained about the original package, but also package decision-maker's costs. This (the result of the incremental nature of distribution packaging innovation) makes clear the importance of channel members communicating their customer service needs. This communication can be used to identify opportunities for lower costs throughout the channel, regardless of channel structure.

The distinction between types of vertical marketing systems was found to be significant. The contractual vertical marketing firms behaved much differently than the firm with an administered channel. The

firms with contractual systems were more attuned to their channel partners' needs. They changed their package to improve their channel partners' productivity, and implemented the new package with cooperation. The firm with an administered channel, however, also striving for added efficiency, made the decision to change packages without ever discussing the innovation with its parts suppliers, creating a great deal of conflict during the early implementation. Even the free-flow channels were relatively cooperative, compared to the administered one. The successful sustained implementation of this firm's package can be attributed to the power of the channel administrator to force the change. Of course, the packaging professionals in this "forcing" role are not likely to enjoy their task.

In materials management, package purchasing costs are indirectly borne by original equipment manufacturers, who buy filled packages from their parts suppliers and must dispose of an empty one. Firms like General Motors and Allied find that they can reduce their per part purchase cost as well as the disposal cost of emptied packages by cooperating with their suppliers to optimize their part package systems. The use of returnables, however, also induces much higher logistics costs, which are difficult to estimate when making the adoption decision. General Motors, for instance, found that they had to add an unexpected sorting facility and increase the container cycle length beyond the expected expenses.

Vertical marketing systems suffer one disadvantage when it comes to systemic innovation. Because their channels are not intermixed with other firms' goods to the same extent as a free-flow system, there is

less opportunity for gatekeepers (like salespeople) to see innovations adopted by other firms in similar industries. In these cases of distribution packaging innovations, the ideas for the new packages all arose from imitating a package used for another kind of product. The firms with free-flow channels had an advantage in being exposed to more packages of other firms' in the channels. This illustrates the special importance of trade shows and professional conferences for packaging and distribution professionals with vertical marketing systems, to be exposed to innovations which their distribution system excludes.

The competitive advantage posed by a distribution package innovation was a little surprising. Although it could not be documented in sales figures, the advantage was mentioned by all firms. The innovative packages added customer service; they were more protective, more easily identified, easier to handle, and less costly to open, display, and dispose. Furthermore, the firms with free-flow marketing channels used the new package to promote awareness of their product with channel members. Of course, when implementation problems occurred, this also promoted awareness; the memory of early problems was often difficult to dispel. Likewise, other distribution innovations can be high-visibility actions, which should be evaluated before adoption for their strategic impact.

The aspect of this research which addresses the incremental nature of distribution package innovation finds that innovation can reduce total costs for a distribution channel. The very process of innovation insures it. The distribution channel relationship is a series of transactions and transvections, and the innovative packages underwent many iterations

as opinions were solicited from the people who would have to handle it. From prototypes which were used as show-and-tell by salespeople, through the early implementation shipments, feedback from channel members helped to shape the new package to best fit everyone's needs. Incremental changes were gauged to not disrupt any channel firm's operations. This is a process which guarantees that the package will perform at least as well as the former one.

Disposal costs were found to be a very important consideration for all of the innovators studied. The concentrated and homogenous nature of distribution packaging waste makes disposal an explicit cost for firms who empty packages. Every factory empties distribution packages of factors of production; every retailer empties distribution packages for consumer goods. Because of its concentration and homogeneity, distribution packaging waste has more of a tradition of reuse and recycling than does consumer packaging. However, the amount of "expendable" packaging far outweighs the amount of reusable packaging because of the increased logistical cost and investment required by reusable packaging. Recycling is also cited by firms as not being cost-effective or practical given the contamination of many materials. As the word, "expendable," implies, the purchase cost and disposal of many packages is simply an expense. Furthermore, the cost of solid waste disposal is increasing rapidly in the United States. Public and private groups are investigating solutions to mounting piles of garbage. The findings of this research are encouraging: innovation can help to address these waste problems by reducing the amount of packaging materials expended. The ideal package solution would generate no waste at all.

The findings should also alert public and private groups who deal in solid waste that the composition of distribution packaging materials is changing. Firms whose existence depends on recycling corrugated boxes, for example, may soon find that their raw material supply is diminished. The disposal options for plastic materials are, however, much the same as for paper. In landfills, plastics offer the advantage of being inert, and not producing methane gas or groundwater contamination. In incinerators which recover the energy, plastics are routinely burned along with other combustible waste. And the emerging technologies for recycling plastics present the possibility of producing useful products from "trash."

The evidence that packaging innovation can help to reduce total logistics costs, as well as reducing the amount of solid waste generated by logistical activities, also has some implications which should attract the consideration of government policy makers. If government has the objectives of reducing logistical costs and reducing waste, distribution packaging innovation should be encouraged. Governments can encourage innovation by resisting attempts to set packaging rules, and by promoting the idea of defining the performance required of packages. This encouragement could begin with government procurement. The trend towards specifying packages' performance, rather than material specifications should be encouraged. A good example of the application of performance standards is the method used by the United States Department of Agriculture Stabilization and Conservation Service to specify packages for the food that it purchases. The USDA/ASCS, with the help of Michigan State University's School of Packaging, develops

standards based on tests which reproduce the damage suffered by packages in its distribution system, and specifies only a minimum number of critical performance parameters. The performance approach, combined with commodity bid processes, encourages cost-reducing packaging innovation from the USDA/ASCS suppliers.

A more general government policy implication derives from the evidence of increased efficiencies and innovation in vertical marketing systems. Policy which affects logistical operations should not discourage integration. For example, transportation deregulation has, indeed, removed barriers to innovation by encouraging more productive relationships between carriers, shippers, and consignees, as well as packaging professionals.

The incremental nature of these plastic package innovations also reveals the commonplace nature of plastics technology today. The fact that most respondents could not even identify the type of plastic that they were using, confirms the less-than-radical status of plastic distribution packaging. The only new knowledge that was required was of the material properties relating to machinery operation and package performance. There was no basic research involved. All of the technology was already developed, although new applications were found to incrementally improve the technology itself through faster packing speeds and new applications for some packaging materials and forms. Plastics still represent a small portion of distribution packaging materials.

The need to solve a problem is a necessary, but not sufficient, condition for innovation. Distribution packaging professionals have an obligation to monitor their manufacturing and distribution systems for

the existence of such problems. However, many of these firms mentioned that the problem (like the need to reduce manufacturing, handling, or disposal costs) had been known for years before a packaging solution was developed. The adoption process did not begin until an idea for a solution was proposed.

The best place to look for innovative packaging ideas is everyplace: competitors and firms in other industries, packaging shows, and consultants. Once an idea is found, package suppliers can be relied on to offer a lot of good advice when it comes to fine-tuning the idea and operationalizing the new package.

This leads to the observations concerning who does distribution packaging in a firm. This job has traditionally been in the domain of purchasing professionals who simply purchased the box specified in tariffs and left the designing to corrugated box supply companies. Innovation, however, is not a purchasing responsibility. Lacking a packaging professional, innovating firms turn to their industrial or distribution engineers, who may lack particular packaging-related skills to seek new packaging ideas. This deficiency was echoed by all of the industrial and distribution engineers, and was powerfully indicated by the fact that most of the firms in this research had developed a packaging professional position by the time that they implemented the new package.

The packaging professional plays a very important gatekeeper role in the innovation process. He/she is translates customer service needs into package designs, and then implements the packages throughout a complex behavioral system. Many of the packaging professionals responsible for

implementation found that their technical skills were not as important as their interpersonal skills and power to persuade. The emerging distribution packaging field is related to consumer packaging in its materials and methods, to purchasing in its relationship to package and part suppliers, to industrial engineering in its operational designs, and to marketing and logistics in its system-wide effects. Distribution packaging professionals should be educated in these areas and need to develop "networking" management skills to span the boundaries of the firm, especially skills like persuasion, timing, and judgement. And, perhaps most of all, distribution packaging professionals should cultivate a curious, open-minded, and creative nature.
Packaging innovation depends on it.

Limitations

Since only innovation adopters were surveyed, little was learned about non-innovators' distribution channel structures and logic. There was no comparison of adopters to non-adopters.

The case studies were concentrated in the grocery industry to illustrated free-flow channels. Other free-flow channels might reflect a different balance of power from grocery channels. For instance, Owens Corning Fiberglas (the only free-flow case which is not a grocery product) based their decision on a request from a powerful retailer group.

The vertical marketing system cases were concentrated in the furniture and assembly part industries. Although the findings might apply to other durable goods manufacturers, the problem of waste

concentration is more apparent in an industry like these where a full truckload of a manufacturer's products delivered to one unpacking and installation point.

Since projected and actual costs were not available, there is no chance to compare the actual cost trade-offs between an innovator's previous and new packages. Information was limited to the categories of costs which influenced the decision-making process.

Since this research is conducted in a newly-deregulated environment, a significant barrier to competition in the distribution packaging industry has been recently removed. This has uncovered many opportunities to innovate and reduce costs. In addition, logistical management information systems are becoming more sophisticated, and have not yet been extended to include distribution packaging concerns. Therefore, this research reveals a cross-section of time, influenced by its technological and political environment, and generalizations may not extend to other environments.

Directions for Future Research

It has often been observed that research generates more questions than answers. The questions generated by this research fall into three general areas: innovation adoption, distribution channel structure and performance, and distribution packaging.

This research's questions about innovation adoption were not tested, as much as they were explored. There was an assumption that distribution packaging innovations are, at once, incremental and systemic. Yet there was no measure of either construct, and no measure of adoption ease. In

order to more rigorously test the five hypotheses, valid measures and a larger survey sample would needed.

The questions about distribution channel structure and performance arise because of the differences found between structures. The vertical marketing system acted to "pull" an innovation from product suppliers to solve an end-of-the-channel problem. On the other hand, the non-vertical marketing systems (and the administered channel firm) "pushed" their package idea by convincing channel members of its adequacy. One could hypothesize that the structures, likewise, generate other channel performance-related information, and resolve problems in the same way.

Another hypothesis is that the balance of channel power affects the process of innovation adoption. For example, members of an administered channel can be expected to follow orders when the "channel captain" decides to adopt boundary-spanning innovations. On the other hand, a group of retailers are powerful enough to overcome the power of a manufacturer in free-flow channels and can unite to spark an innovation.

The questions about distribution packaging follow:

When a shipper weighs the decision between using a corrugated box or a plastic distribution package, what is the difference between the products for which they use boxes and those for which they use plastic? Kimball, for instance, uses boxes to unitize its hardware, fittings and components, and to protect wall panels and furniture made with/from wood. Only all-fabric panels are bagged and blanket-wrapped. Johnson Wax, for another example, found resistance from the DOT to the use of plastic packaging for aerosols. One could hypothesize that the preferred

distribution package material depends on the product's surface, mechanical, and chemical characteristics.

When a packaging professional initiates an innovation adoption, what interpersonal skills are required? One firm's innovation adoption which was not included in this research (because it is still in the "secret" initiation phase) has been consistently obstructed because of interpersonal rivalries between departments responsible for marketing, production, purchasing, and distribution. One could hypothesize that successful innovation adoption is related to the personality of the project champion.

In the early 1900's, the corrugated industry associations worked closely with carrier boards to institutionalize plastic as a distribution packaging material. Why hasn't the plastic "lobby" organized this time around? Is it due to the competitiveness in the plastics industry, as contrasted to the monopolistic-oriented corrugated board industry? Is there a need for such organization? Who is more interested in organizing: the package suppliers or the package users?

What is the Distribution Packaging Professional's line of organizational authority? A comparison of "packaged goods" to durable goods, and industrial to consumer goods firms might reveal generalized differences in organization. One could hypothesize that distribution packaging for durable goods is an Engineering function; for consumer goods, it is a Research and Development function.

Further research is obviously needed in film properties and specification. Respondents to this research cited differences between cast and blown film, or believed in the special properties of

coextrusions. The basic polyethylene plastic monomer is the same for all of these films, however. How does processing or additives affect these stretch, shrink, and cling properties?

Under what conditions does an original equipment manufacturer specify its suppliers packages? Such power over suppliers could depend on how much of the supplier's production the OEM firm purchases. Or one could hypothesize that firms "advanced" materials and logistics management organization (Stage III and beyond) would be more likely to take control over suppliers' packaging.

Further research on relationship between the Claims and Packaging functions is needed. Packaging professionals usually have no access to damage claims histories. How can packaging's protectiveness be quantified when there is no measure of damage extent? There seems to currently be no relationship between these two departments in a firm.

Likewise, packaging-related cost information is not aggregated and managed by anyone, except during an adoption decision. Even then, many costs are estimated, rather than actually managed. How are package costs accounted for? Could a change in accounting methods help to optimize distribution packaging decisions?

People seem to handle products in see-through packages more gently than when they are covered by boxes. This observation was expressed so often (unprompted) by participants in this research that it should be tested. What do theories from psychology predict about this behavior?

In Conclusion

In conclusion, this research has explored the relationship between distribution channel structure and distribution package innovation. It finds that channels which are vertically integrated are more likely to feedback information, to the firm which packed the product, about problems which an innovation could solve. The package solutions were found to solve not only the channel members' problem, but also to cut costs for the manufacturing firm who adopted the package. On the other hand, firms with vertical marketing channels were more likely to adopt a new package for the purpose of reducing their own costs, and found that they needed to "sell" the package to the channel members who will handle it. Innovative distribution packages can represent a competitive advantage to the adopting firm because they attract attention to the firm's product in the channel and may offer cost and benefit advantages to those who handle it.

APPENDICES

APPENDIX I:

THE U.S. DISTRIBUTION PACKAGING SUPPLY INDUSTRY

The structure of distribution packaging supply industry in the United States has almost never experienced free competition. This section will, first, document the historical factors which have fortified this structure--the liability justification and administration of the transportation carrier packaging rules and their ties to the fiber box industry. Next, the current shift of paradigms is documented: carrier loss of channel power, integrated management of distribution channels, and technological changes in packaging forms and materials. The last part of this section addresses the effect of the paradigm shift on the distribution packaging industry's structure, conduct and performance with regard to innovation.

The Rules: "Nothing but a Pack of Cards"[1]

Since the early 1900's, common carriers have undertaken to "regulate" the distribution packages they will transport. Although many shippers believe that these packaging requirements are "government regulations," they are, rather, the product of transportation trade organizations: the National Motor Freight Classification Board and the Uniform Classification Committee, are parts of, respectively, the

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[1]Lewis Carroll, Alice's Adventures in Wonderland, (reprint ed. by Martin Gardner, The Annotated Alice; New York: Bramhall House, 1960), p.161.

American Trucking Association and the Association of American Railroads. These associations derive their authority from the Interstate Commerce Commission to establish Classification rules for the transportation pricing of "common" freight. The packaging rules are part of the tariffs.

This regulation takes the form of rather precise descriptions of acceptable package materials and construction for every product, and reflect the carrier associations' close ties with the Fiber Box Association. For the last 50 years, most of the "approved" packages have been made from corrugated fiberboard. The effect has been to create a virtual monopoly in the distribution packaging industry for corrugated fiberboard shipping container suppliers.[2] The railroads' Rule 41 and the truckers' equivalent Rule 222 precisely limit the properties of the corrugated board, and hundreds of package designs and "exceptions" are published in the National Motor Freight Classification and the Uniform Freight Classification.[3]

These "exceptions" are "new" package designs which are not specifically addressed by the 1912 rules. They have traditionally been submitted by package designers (many are corrugated box salespeople) to the carrier Association Classification Board for approval.

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[2]Although steel, fabric and wood shipping containers are also prevalent and accepted by the classification commissions, their use is generally limited to non-consumer goods like hazardous materials and machinery. This research will not address, except indirectly, innovations in shipping containers for these products.

[3]National Classification Board of the American Trucking Association, National Motor Freight Classification; Uniform Classification Committee of the Western Railroad Association, Uniform Freight Classification.

When proceeding according to the rules, the distribution packaging innovation process is fraught with bureaucratic tangles. Once a packaging department makes the decision to change a shipping container specification, it finds that designing and testing are only the beginning. The ensuing procedure for "exception" can take as long as one year. First, a test shipment period is ordered by the Classification Committee, during which special documentation is expected to accompany shipments. Feedback concerning damage is expected to be forwarded to the Classification Commission. Once the test permit period is over, a new package is awarded a Classification number and entered into The Book. The Classification Boards maintain that this test-permit-and-approval method validates a package and gives the information feedback required to insure sufficient performance.

In fact, the test permit process engenders information delays and distortion. Furthermore, it discourages innovation.

> The test shipment program, while utilized correctly by many, has been subject to abuses. These include failure to stamp the bill of lading and/or delivery receipt and/or other means of avoiding an awareness of claims problems regarding the package by the carriers."[4]

Concealed damage can go undetected for months, and receiving personnel often fail to transmit pertinent information. The specific damage which the package was designed to prevent may not even be surveyed because of the lack of appropriate expertise on the part of dock personnel. For these reasons, the information available to a packager who "follows the rules" is limited. Furthermore, these are the reasons that many

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[4]National Freight Claim Council Statement to the National Classification Board of the Motor Carrier Industry (September 11, 1984).

distribution package researchers discount the exception process's feedback and advocate that packaging engineers personally follow test shipments in order to really learn about a new package's performance.[5]

The carriers' packaging rules also distort information about an extant package's performance by suppressing damage claims. The way to monitor and improve any problems with an existing package's performance is to study the damage claims. Unfortunately, damage claims on the basis of "insufficient packaging" are by definition not filed for damaged products which are packaged in compliance with the Classification Rules.

Transportation damage claims are settled on the basis of common law since a carrier is considered the bailee of a shipper, entrusted with goods. The Carmack Amendment of 1906 to the Interstate Commerce Act codified the common law governing carrier cargo liability in the United States and provided a uniform liability standard for transportation loss and damage.[6] Under Carmack, the carrier is absolutely liable for "full and actual" loss if the shipper can show that the cargo was delivered to the carrier in good condition and was in a damaged condition when offered for delivery to consignee. Thereafter, the burden of proof reverts to the carrier, and remains there, to demonstrate that the sole cause of the loss or damage was due to one of the five common law defenses: an act of God, the public enemy, an act of the shipper, public authority, or the inherent vice or nature of the goods; and, in the majority of cases, that it was not negligent.

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[5]James W. Goff and Diana Twede, Shake and Break; Laboratory Adventures in Package Dynamics.

[6]Interstate Commerce Act, 49 U.S.C., sec. 11707, Carmack Amendment of 1906.

And so if a damaged shipment is packaged according to the carriers' rules, a claim of "deficient packaging" will never, by definition, be filed. Any packaging deficiencies, by definition, cannot be an act of the shipper nor, technically, an inherent vice in the goods since it is the carrier who determines the package. Thus, the carriers rules prevent damage information from ever reaching the package designers.

Furthermore, given the Carmack Amendment, a basic question is raised concerning the lawful nature of the carriers' packaging "regulations." Although they have been a conventional defense against carrier claims of deficient packaging, they are by no means a legal requirement. The law requires only that the shipper not make negligent packaging decisions. Furthermore, shipper negligence must be proven by the carrier.[7]

In fact, the history of the carriers' packaging rules has been more political than technical or legal. In the early 1900's, the railroads eastbound from California required wooden crates for all shipments, and embargoed corrugated boxes. Cardboard used less of the profitable railroad-owned forest and forest products. A railroad's first act in a new town was to build a lumbermill and a "box factory."[8]

It took a 1912 lawsuit brought by R.W. Pridham, a Pacific Coast corrugated box manufacturer, against Southern Pacific Railroad before the Interstate Commerce Commission, to get tariffs revised to permit corrugated fiberboard shipping containers at the same rates as wood

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[7]William J. Augello, Freight Claims in Plain English, Revision (Huntington, NY: Shippers National Freight Claim Council, 1982) pp.532-546.

[8]For example, an account can be found in Robert M. Ormes, Tracking Ghost Railroads in Colorado (Colorado Springs: Century One Press, 1975), p.85.

boxes, in a "landmark decision." There was just one catch: the corrugated shipping containers must conform to certain rules concerning their fabrication.[9] These rules were formed jointly and then institutionalized by the rail Classification Bureaus and the corrugated fiberboard trade associations:

> The growth of the ["corrugated paper shipping container"] industry to its present great stature would hardly have been possible were it not for the friendly co-operation between the Classification Bureaus and container trade associations.[10]

Even today, our distibution packaging rules are still based on the resulting Railroad Rule 41, denoted by the familiar stamp on the bottom of every box. That stamp specifies basis weight and "bursting strength" of the board, two measures which have never been correlated to package performance, but are directly related to the amount of fiber in a piece of cardboard.[11]

In 1912, rules like these made sense. "Cardboard" was a new material with unstandardized properties (a lot of it was made from straw).[12] Packaging expertise was not generalized. It was a good idea

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[9]"The Memory Book of Box Making," Boxboard Containers, (October 1950) p.161.

[10]Wilbur F. Howell, A History of The Corrugated Shipping Container Industry in The United States (Camden, New Jersey: Samuel M. Langston, 1940) p.30.

[11]Mark W. Holmes, "Rule 41--Performance Standards vs. Material Requirements" (Master's Thesis, Michigan State University, 1978); Kevin A. Howard, Corrugated Boxes: A Systems Approach (Master's Thesis, Michigan State University, 1983); and David L. Olsson, "The Possible Impact of New Packaging System Concepts on Traditional Box Markets" (Ph.D. Dissertation, Michigan State University, 1976). In fact, the Mullen Bursting Test originated as a test to judge the ability of knit fabrics to resist elbow rupture.

[12]"The Memory Book of Box Making."

to make rules like: "All partitions in boxes [for bottles] must be not less than full shoulder height." It made sense for the powerful railroads to provide its diverse (albeit captive) shippers with some guidelines concerning the different styles of boxes.

Shifting "Conceptual Boxes"[13]

When people think of shipping containers, they think of cardboard boxes. The aforementioned "Cardboard Rules" have been enforced this distribution packaging paradigm for over 60 years. Kuhn would call them "an apparently arbitrary element, compounded by personal and historical accident, [which] is always a formative ingredient of the beliefs espoused by a given scientific community at a given time."[14]

There is evidence of a shift in distribution packaging paradigms. We are beginning to imagine shipping freight in plastic film. Many shipping firms are experimenting with various shrink- or stretch- film packaging systems, for everything from baby food jars to appliances.

As in every scientific revolution, the discovery of anomalies have precipitated the "crisis."[15] These anomalies are based on modern advances in packaging and distribution in three areas: integrated physical distribution management, transportation deregulation, and the new packaging technologies and technologists.

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[13]Thomas S. Kuhn, The Structure of Scientific Revolutions, 2d ed., enl., (Chicago: University of Chicago Press, 1970), p.4.

[14]Ibid.

[15]Ibid.

The Packaging Technology Anomaly

Today's packaging practitioners are much more sophisticated than their counterparts of 1912. Many have been educated in college and professional programs to effectively manage these activities.[16] Trade organizations of package suppliers and users, like the Society of Packaging and Handling Engineers, have served to increase the status of the packaging professional. More and more of the "new" distribution packaging professionals challenge carriers' historical authority.[17]

Packaging materials and forms have also changed since 1912. Plastics, are the most notable change, and can be made into many forms of packaging materials, including flexible films, engineered foam cushions, rigid thermoforms, laminates, plies, yarns, and even corrugated board. Some of these simulate older packaging forms and others offer the possibility for entirely new packaging systems.

There are parallels between the diffusion of plastic materials and the diffusion of corrugated board into the distribution packaging industry. In both cases, the materials were first invented for other purposes. A historian notes:

> It would be in order at this point to name the inventor of the Corrugated Paper Shipping Case suitable for freight shipments, but in our research we can discover no one person who can be credited wholly with this invention. It is rather the development of various creations for a number of purposes such as paper linings, bottle

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[16]"Profiling the Packaging Professional," Packaging, September 1983, pp.41-46.

[17]Diana Twede, "Responsibility for Distribution Packaging," SPHE Technical Journal, 4 (Spring 1985) pp.2-7.

> wrappings, padding for hat sweat-bands, interior packing, express boxes, etc.[18]

Both plastic and corrugated board have been modified for use as packaging materials. In fact, disposable packaging materials have traditionally been formed from a society's lowest-cost materials, from vegetable matter in less developed societies to plastic (formed from the by-products of oil refining) in our fossil-fueled economy.[19]

In many cases, a plastic or composite package offers substantial cost savings in material and packing costs over traditional corrugated fiberboard forms.[20] Plastic and composite distribution containers have been used successfully in other parts of the world where forest products are not so plentiful. Japanese and European distribution packaging is far more diverse than that in the United States; for example, Electrolux and Avanti refrigerators have long been shrink-wrapped, a packaging form forbidden for that commodity under current U.S. carrier tariff rules.

The Logistics Management Anomaly

The locus of control in logistical systems has changed significantly in our century. In 1912, when the Cardboard rules were born, the railroads were a mature industry, monopolistic and powerful. The following decades' introduction of competition from motor carriers began to erode the railroads' power, and as manufacturing companies grew larger, shippers began to take more control over distribution functions.

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[18]Wilbur F. Howell, A History of The Corrugated Shipping Container Industry, pp.9-10.

[19]Five eggs book.

[20]Kevin A. Howard, "Corrugated Boxes."

In 1912, manufacturer/shippers could be expected to manage neither their distribution channels nor their damage levels. The necessary concepts, information, and channel structures were too fragmented. Stewart and Dewhurst, 37 years later, still described the distribution field as a "residual occupation," overcrowded with independent businesspeople who had been "forced out of highly organized industry through incompetence, old age, or the introduction of labor-saving machinery."[21]

The central logistical concept of "total cost" did not emerge until 1956.[22] Following in quick succession, the application of the systems concept in the 1960's, the focus on customer service in the 1970's, and the computer network information revolution of the 1980's, as well as our modern "marketing orientation," have served to facilitate integration and control by the transacting members of distribution channels.[23]

The Transportation Deregulation Anomaly

The Motor Carrier Act of 1980 and the Staggers Rail Act of 1980 were roundly applauded by shippers. In 1984, the National Council of Physical Distribution Management selected Senator Bob Packwood for its

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[21]Paul W. Stewart and J. Frederic Dewhurst, Does Distribution Cost Too Much? (New York: The Twentieth Century Fund, 1939).

[22]Howard T. Lewis, James W. Culliton, and Jak D. Steel, The Role of Air Freight in Physical Distribution (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1956).

[23]Donald J. Bowersox, "Physical Distribution Development, Current Status, and Potential," Journal of Marketing 33 (January 1969) pp.63-70; Bernard J. La Londe, and Paul H. Zinzer, Customer Service: Meaning and Measurement (Chicago: NCPDM, 1976); and Robert Bartels, The History of Marketing Thought, second edition (Colombus, Ohio: Grid Inc., 1976).

Distinguished Service Award for "spearheading the restructuring of the United States transportation system into a more efficient and competitive posture." The enthusiasm created by the "marketplace environment...has led to innovations in the management of transportation, enhancement of the productivity and quality aspects of the transportation system."[24]

Deregulation increased competition between carriers, and provided shippers with the opportunity to exercise greater negotiating leverage to control rates and service. Deregulation has made possible many logistical innovations such as just-in-time procurement management because it gives the more service-oriented carriers a strategic advantage.

Transportation deregulation affects the carriers' authority to regulate distribution packaging in three ways: it permits limited liability, may involve contract rather than common law, and has pulled the legitimacy from beneath carrier collusion.

To give carriers more pricing flexibility, the 1980 Motor Carrier and Rail Acts introduced alternatives to the Carmack Amendment's full liability restriction. The released rate provisions permit ICC-regulated (common and exempt) carriers to file tariffs with reduced transportation rates in exchange for a limited liability for loss and damage. The ICC may require that full liability tariffs be offered simultaneously. The provisions also extend to rail (only) permission to write a deductible into the tariffs.[25] The 1980 Acts also encouraged the use of contracts

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[24]NCPDM Comment, November/December 1984.

[25]Released rate provisions in the Carmack Amendment (Section 20[11] of the Interstate Commerce Act) as amended by the Motor Carrier Act of 1980 and the Staggers Rail Act of 1980, Section 10730(a-c).

between shippers and carriers. In the eight intervening years (1980-1988), contract movements have become much more common. Since contract carriers are not subject to ICC regulation, tariffs and classifications and the attendant packaging rules do not apply. Contract and private carriage give a shipper more control over negotiating pricing and liability.

Contract carriers are not governed by common law. Rather than being considered bailees, they are considered simply as the providers of a service. Therefore, claims are not settled according to the Carmack provisions (under which the shipper needs only to establish a prima facie case of good condition at origin; then the burden of proof shifts to the carrier and remains there.[26] Rather, liability terms are negotiated into the contract (value, deductibles, burden of proof, and limitations), and settled according to the agreed terms. Terms can range from reduced liability to consequential liability for "special damages."[27]

The effect of these deregulation liability changes has been for shippers to take on more of the liability for loss and damage. "Full liability" no longer governs every tariff. This should precipitate a greater awareness of the factors governing cargo loss, and closer attention to (and responsibility for) the performance of distribution packaging functions.

Transportation deregulation has also raised the last gasp of the questions concerning the lawfulness of the Cardboard Rules. In the ICC's

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[26]Super Service Freight Co. v. U.S., 350 F.2d 541 (3rd Cir. 1965).

[27]William J. Augello, "Liability Developments in the '80's," seminar manual (Huntington, NY: Shippers National Freight Claim Council, Inc., 1986) Appendix H.

mood of forbidding collective action, a 1983 move by the National Freight Claims Council (of the American Trucking Association) to suspend their own packaging rules was vetoed because it was "collectively filed." Catch 222: you can still collectively keep rules, but cannot collectively make or break them.

Contestability: An Invitation to Innovation

The structure of today's distribution package supply industry has been shaped by the carriers' Cardboard Rules. By forbidding the use of new forms of packaging, the rules have constituted a "barrier to entry" into this industry. The effect of the "paradigm shift," brought about by deregulation, integrated distribution, and new materials, has been to lower that barrier, although not all at once. No formal repeal of the rules has, to date, occurred.

A change like this, in the contestability of an industry, changes the structure of that industry. This section addresses the changing structure and expected changes in the performance and conduct of the distribution packaging industry, particularly with regard to innovation. Although an "industry" is often defined as a group of firms producing similar products, here the concept is used in the marketing sense, including firms whose products' function is the same--substitutes in use. Therefore, the distribution packaging industry includes not only corrugated fiberboard container producers, but manufacturers of alternative distribution packaging forms as well. The barriers to entry into this industry include not only the rule-based exclusion of alternative packaging forms, but also the capital investment barriers

presented by vertically integrated pulp/paper/corrugated board/container firms.

The theories concerning an industry's condition of entry and contestability have influenced thought in both government regulation and strategic management. It has been advocated that government policy can affect an industry's conduct and performance by regulating the condition of entry aspect of its structure"

> The most important implication of the new analysis is the prime importance of the reduction of barriers to entry. Certainly, all artificial barriers and particularly those which result from governmental intervention are put into question. Not only must firms be left free to enter an industry but they must be free to do so at the time and place they choose, without advance notice to regulators or anyone else. For otherwise the swift entry that takes advantage of an incumbent's misbehavior and which is the key to the power of contestibility will be precluded.[28]

On the other hand, the strategic marketers, in the spirit of profit maximization, advocate that firms should attempt to institute and maintain barriers to entry: economies of scale, product differentiation, capital requirements, switching costs, access to distribution channels, established firm cost advantages, and restrictive government policy.[29]

In his discussion of the importance of the condition of entry to the competitive structure of an industry, Bain defines an industry's "condition of entry" thus:

> the advantages of established sellers in an industry over potential entrant sellers, these advantages being reflected in the extent to which established sellers can persistently raise

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[28]William J. Baumol, "Contestable Markets, Antitrust, and Regulation," The Wharton Magazine, Fall 1982, pp.23-30.

[29]Michael Porter, Competitive Advantage, (New York: The Free Press, 1985) pp. 7-13.

> their prices above a competitive level without attracting new firms to enter the industry.[30]

An industry which blockades the entry of new firms is expected to generate "extreme monopolistic excesses of price over minimal cost, with a stable market structure."[31]

This has certainly been true of the corrugated fiberboard industry. Its associations have a tradition of solidarity and anti-trust collusion.[32] The restructuring wave of mergers (15% changed hands between 1984 and 1986) has been accompanied by over-utilization of existing factory capacity and a moratorium on building new capacity. Corrugated industry officials, in the packaging press, warn customers of a projected shortfall of containerboard raw materials, rising prices and an inability to meet expected demand. Although recent profitability has been poor for corrugated fiberboard industry, forecasts are for an industry "healthier, more profitable, and with fewer decision makers."[33] Within the last two years (1986-88), the price of linerboard has risen 52%.[34]

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[30]Bain, Joe Staten, Barriers to New Competition; Their Character and Consequences in Manufacturing Industries, (Boston: Harvard, 1956) p.5.

[31]. Bain, Joe Staten, Barriers to New Competition, p.41.

[32]"The Memory Book of Box Making," p.267 documents the prosecution by "trust busters" of the 1930's when the National Container Association was fined for controlling 65% of the corrugated paper and paper box output of the United States. More recently, "24 Carton Makers to Pay $200 Million to Settle Price Fixing Damages Suit," Paper Trade Journal, October 15 1979, p.17.

[33]Fred Sharring, "Liner Shortage Inevitable?" Paperboard Packaging, October 1986, p.26.

[34]Official Board Markets, vol. 63, no. 51, December 19, 1987, announced price increase for February 1, 1987 $410/ton for 42-lb kraft linerboard; two years before, the price had been $270.

But the entry barrier is beginning to dissolve from beneath the corrugated fiberboard producers. As the carriers' packaging regulations lose their aura of government authority in a deregulated transportation environment, and as the price of corrugated fiberboard boxes rises, the theory of contestable markets would predict that competition will increase in the distribution packaging marketplace, and that the price of packaging materials will ultimately fall.

This competition, in the emerging paradigm of plastic packaging technology, will be more than lower-cost cardboard boxes. An invitation to innovation, the new environment is evolving composite as well as all-plastic shipping containers. The forms may be different, but they will need to perform the same functions.

APPENDIX II:

A DISTRIBUTION PACKAGING FUNCTIONAL TAXONOMY

Distribution packaging-related trade-offs, design considerations and costs noted in logistics textbooks and other general texts[1]:

Protection Function

Loss and damage sources:

- -physical environment: vibration, impact, puncture, and compression resulting in surface scuffing and marring, product crushing, buckling, cracking (B,C)
- -protection required may be a function of the number of times as well as methods by which it is handled (H)
- -warehouse handling, fall off conveyor or hit by lift truck (C)
- -stacking failure (B) and pallet overhang (H) can cause damage
- -element environment: temperature (melt, spoil, blister, peel, fuse, discolor, crack), humidity (dissolution, separation, corrosion, pitting) and foreign matter (contamination, absorb tastes & odors, insects & rodents, air and light) (B,C)
- -privately owned and operated transportation yields a relatively controlled environment compared to common carriers; break-bulk terminals increase the likelihood of damage (B)
- -dynamic compression may be greater than static compression forces (H)
- -retailer "cutter" damage (K)

Loss and damage prevention:

- -strength and shape of package (H,K)
  - -column stacking strength (K)

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[1]The entries are from popular logistics textbooks:
(B) = Bowersox, Logistical Management pp. 242-250.
(C) = Coyle, The Management of Business Logistics, pp.248-253.
(CV) = Cavinato, "Analysis of Loss and Damage in a Procurement Distribution System Using A Shrinkage Approach"and "Toward Efficient Package/Pallet Interfaces"
(H) = Heskett, Business Logistics, pp. 571-584.
(L) = Lambert, Strategic Physical Distribution Management, pp.198-201.
(F) = Friedman, Distribution Packaging, pp.52-57. Not a logistics textbook, but its "Economics of Distribution Packaging" does address cost trade-offs.
(K) = Kearney, Opportunities in Shipping Container Design. Not a textbook, but one of the few such publications from a distribution point-of-view.

-transverse strength so that containers may be metered from gravity feed lanes of automatic order selection equipment and stability for conveying (K)
-resist internal force damage from contents and protect contents from external forces (K)
-consumer package and interior dunnage can contribute to distribution package strength (B,K)
-consumer package's appearance may need protection (F)
-deter pilferage (H,B)
-fragility testing of product to design cushioning needed, "interior protection" (C,B) or to compare alternative product designs (B,H)
-laboratory and field testing to determine interaction of product fragility and packaging materials and design (B)
-secure packages while in transit: strapping, tiedowns and dunnage reduce shifting and damage (B); unit load stabilization (K)
-controlled distribution environment: specialized household mover transportation can reduce damage and reduce the protective packaging needed (B,C); temperature and humidity controls (B)
-distributors should establish improved employee training programs emphasizing proper materials handling techniques and should modify their equipment and systems to reduce damage hazards (K)
-packaging intended for multiple purposes needs added protection (F)

Costs (besides the cost of the package itself) affected by protection:
-transportation rate, claims, loss (CV,H)
-the cost of absolute protection is prohibitive; value and fragility of the product determine protection justified (B)
-loss of future sales due to poor customer service (C,CV)
-special transportation, handling, storage for added protection (L)
-the concept of total loss and damage as an element of the firm's logistics system has not been developed (CV)
-production wasted, insurance wasted, warehousing and material handling wasted (CV)
-research and development and procurement wasted if performance is not tracked (CV)

Utility Function

Facilitates transportation and storage to reduce warehousing and transportation costs (H), add "convenience" (L), and incorporate efficiency and economy through the entire system (K)
-product and logistics system requirements must be considered (B,C)
-standardized dimensions and modular fit with standard pallet (B,K)

Affects the cost of storage:
-compatible with storage methods (H)
-cube utilization affects storage costs (C,F,H,K,L)
-compression strength and stacking method determines height of stacks in storage, increasing capacity/floor space in warehouses (H,C,L)

-compression strength determines stacking hardware required (H)
-shape determines cubic storage requirements (H)
-low-density package requires greater warehouse space utilization(B)
-unitized products utilize space better than non-unitized (C)

Affects the cost of handling:
-compatible with handling methods (H,L)
-size and weight (C)
-manual or automatic (C), "mechanical pick-up" (F)
-"4-way entry," be able to pick it up from any side (K)
-provide ease and economy in handling and picking (H, F)
-containers which are too heavy are likely to be dropped and cause back injuries (K)
-items are handled differently, even within a given organization, and packaging must be designed for the most restrictive handling (H)
-unitization for simultaneously handling many units (H,C)
-nonrigid containers: pallets & slipsheets 40" x 48" grocery standard, stacking patterns, and load securing with ties, straps, tape, anti-skid coatings, adhesives, shrink- and stretch-wrap; provide resistance to spreading or shifting (B,K)
-rigid containers: reusable shipment unit reduces damage, pilferage, and protection needed (B)
-package dimensions contribute to unitiz-ability (eg. column vs. interlocking), efficient storage and full pallet footprint utilization (H,K,L)
-modular packages fit together in combination units, which is a benefit for handling, but shipping quantities per package are affected and may cause counting problems and "odd lots" (H)
-standardized cartons are necessary for automated handling (B)
-unitization minimizes loading/unloading time (C)
-specialized reusable containers may facilitate handling (F)

Affects the cost of picking:
-ease of opening, selecting "broken case" quantities, reclosing and re-shipping (H)
-order picking efficiency is facilitated by standard carton quantites which match standard order quantities, and makes mechanized sorting feasible (H)
-order picking productivity is determined by the number of packages handled; pack in convenient handling quantities (H)
-discourage "unauthorized order picking (pilferage)" (H)

Affects the cost of transportation:
-transportation costs affected by density and number of products per vehicle load, related to tare weight and size of package and its contents (F,H,L)
-low-density package increases transportation rates (B)
-light-weight packaging materials reduce transportation rates (B)

-air and highway rates are most affected by cube utilization constraints (H)
-pallet footprint sizes should maximize floor usage (H)
-postponement of packaging for products which nest (H)
-special transportation rates for returning and/or exchanging packages and pallets (H)
-privately-owned transportation with empty backhaul is ideal for reusable packaging (F)
-packages that are too large cannot be transferred into some transportation equipment (B)
-carrier rates are higher for packaging offering less protection from damage (B)
-intermodal rates are lower than un-containerized because sorting between modes is streamlined (C)

Affects revenue from sales, customer service (to retailer):
-master carton standardization and modular compatibility facilitates system integration (B)
-integrate packages to interface with customers' material handling equipment (C), especially when customer picks less than full case quantities (L)
-retailer buying habits concerning quantity and assortment should be considered to minimize occupying the retailer's storage space with partly-empty boxes (H)
-full-unit load ordering and shipping decrease sorting costs; multi-case ordering in full unitload (or at least full layer) increments increase distribution efficiency (K)
-size and shape of consumer package influence shipping container dimensions; size and shape are determined by retail shelf facing (H) and other marketing considerations (C)
-quantities should conform to discount pricing policies (H)
-quantities should correspond to demand (CV)
-shipping container affects retail productivity--ease of opening, unpacking, price marking and display (H,K)
-standardized cartons can be more easily stocked by retailer (B)
-packaging of production materials can add convenience and productivity to customers' assembly line (L)
-pallet exchange and reusable package return increase retailer costs (K)

Affects environmental and consumer protection:
-tamper concerns (C)
-government regulations (C)
-disposal costs (F,K,L)

Communication Function

Affects the cost of sorting:
-adequacy and clarity of marking affect order-picking efficiency (speed, cost and accuracy) (H)

-provide information to warehouse workers, so that they can locate goods easily and correctly, colors, weights (C)
-concise and legible marking on all 4 sides near the natural bottom of the case identifying manufacturer, brand, pack, UPC (K)
-advertising messages obscure shipping and unpacking instructions and decrease picking efficiency, but promotional merchandise should be clearly identified (K)

Affects the cost of time:
-shipping delivery efficiency depends on adequate package marking (H,L)

Affects damage:
-opening advice minimizes "cut-open" damage (K)

Affects accounting
-standard quantities (L)
-easy-to-understand code dates (K)

Identify contents (K)

Techniques: color codes, UPC, heat transfers, computer-readable tables, symbols, and number codes (C,K,L)

Package Cost Function

Cost of packaging material per unit (H)
-packing and packaging labor (F)
-material costs depend on value of product, fragility, merchandising considerations, multiple-uses expected (F)
-purchasing considerations:
-standardized dimensions increase quantity discounts (H)
-shape of package affects its costs (H)
-packaging material and equipment salespeople are sources of a great amount of free potentially biased consulting advice.
-methods & equipment depend on volume, lot sizes, assortment, product characteristics, package characteristics, manufacturing facility, handling methods (F); need for new equipment investment (H)
-costs for a given level of performance (H)

Unitizing/de-unitizing costs (C)
-cost of packing for re-distribution of fractional quantities, labor and material, "is influenced by the type and quantity contained in the incoming package"(F)
-intermodal containers (C)

Recent trend toward "softer materials...corrugated...[and] plasticised materials...cheap and highly protective, light weight" (C)

Re-usable containers when the cost of container & interior packaging is high, cost factors to consider: initial cost and anticipated number of return trips, loading/unloading costs, capital involved in furnishing an adequate supply, assembly, disassembly and repair costs, loaded and empty handling and storage costs, freight costs of loaded & empty units, accounting and inventory costs (F)

APPENDIX III

"CASE" STUDIES

This appendix summarizes the ten case studies. Each case is described in the same systematic manner. First, the adoption process within the firm is explored, from initiation to implementation.

Second, the distribution structure is illustrated, emphasizing transvection and carrier relationships. The number of transvection sorts has been standardized for the purposes of comparison, so that "out of a truck and into a warehouse" counts as one sort (and "warehouse storage" or "transport" consists of one transformation). It is understood, however, that there may be many more sorts and transformations involved. For instance, a package may be staged and sorted several times on its way out of a truck and into a warehouse, and a less-than truckload shipment might be sorted many times in one transport journey. In all cases, the transvection begins with the sort off of the factory production line, and each transvection ends with the package's disposal transformation as it is removed from the retail store or product installation site.

Third, the systemic effect of the package innovation is discussed in terms of which channel members benefit and which ones pay more. Last, the incremental nature of the innovation is reviewed, emphasizing new knowledge required, and how the cost and performance of package functions have changed.

The cases are arranged in two parts; the first is the cases with free-flow marketing systems, and the second is the cases with vertical marketing systems. They are arranged within these classifications roughly in chronological order of adoption, for a historical perspective on the progress of the diffusion of plastics in the distribution packaging industry. Some of the firms in later cases obtained knowledge from some of the earlier ones, although all are not so linked. After the cases, the questionnaire used is presented.

Cases With Free-Flow Marketing Systems

Gerber Products Company

Gerber[1] was the first (in the U.S.) to adopt a glass-to-glass shrink-bundle distribution package for national distribution. The baby food jars are packed 24 to a case, 4 x 6 x 1. In this "Wrap Cap" shrink-bundle, the film straddles the top, and is adhered to the corrugated tray on all four sides. There are no partitions in this package; the "trick" is that the shrink-wrap so tightly confines the bottles that they can't separate and subsequently impact each other. The package that this shrink-bundle replaces was a corrugated wrap-around shipping case.

The Initiation of the Adoption Process: The innovation process was initially triggered by awareness of shrink-bundles being shipped by the canned food industry through the same distribution channels. The initial benefit sought was reduction in the cost of packaging materials and the case packing operation. The Packaging Research department, under Research and Development management, initiated the innovation process.

The adoption process took three years from initiation to implementation of the first line in 1981. Machinery supplier presentations were the primary source of knowledge and awareness of the idea. A corporate packaging committee conducted the early discussions, where attitudes were formed toward the innovation idea; this committee included managers of Packaging (R&D), Manufacturing, Sales/Marketing, and Purchasing.

The prototypes were designed by Packaging (R&D) with the help of suppliers of wrapping and shrinking machines. Many variations were considered: full wrap verses partial wrap, closed vs. open ends, and various tray heights. The full wrap designs were rejected, after 3 years of experimentation, because they trap moisture inside the package and had problems with sliding down order-picking chutes in warehouses with automatic storage and retrieval systems (ASRS). The open ends were rejected because the Classification Committees would not allow a bulls-eye. The tray height was chosen to minimize materials and maximize performance. The final decision to adopt was made in a recommendation to management by the corporate packaging committee, which included representatives from Packaging, Manufacturing, Sales, Purchasing, Traffic, Logistics, and Quality Control. The committee was unanimous in its recommendation for adoption.

The Implementation of the Innovation: Packaging R & D got the implementation started; wrote specifications for machinery and materials, and "held Manufacturing's hand," working on fine-tuning the sealing temperature and speed. Manufacturing (responsible for revamping the

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[1]Interview with Cameron D. Keim, Corporate Packaging Manager, Gerber Products Company, Fremont, Michigan, July 13, 1987.

plant layout) installed the new system and planned for the downtime during remodeling. Quality Control worked on setting up specs for incoming materials and checking for tray/film/weld, adequate shrink, and that the "skirt" is welded down. Purchasing worked with suppliers of plastic materials and corrugated board. (The Fremont facility die-cuts their own trays; two other Gerber plants buy them.) Since the implementation, the package design has changed a little: film thickness has been changed from 3 mil. (started conservative) to 2 mil. (too thin) to 2.5 mil. The tray has been changed from 150 to 175-lb. mullen burst test. The "skirt" around the heatseal has caused problems, because it is easy to snag during distribution; therefore the sealing process was modified to seal it firmly to the tray. Gerber is "generally" happy that they adopted shrink cases, although "isolated problems" surface from time to time that require salesforce personal attention to individual customers.

Distribution Structure and its Role in the Innovation Process: Gerber's distribution channel is a non-vertical marketing system: free flow. The typical transvection consists of 6 sorts (see figure 11). Common carriers predominate.

During the initiation of the adoption process, channel members affected initial knowledge and awareness of the package innovation, because the package had been used by canners in the same channels. Samples were shown by salesmen to wholesalers to get them used to the idea and solicit their comments. Retailers reinforced the decision to adopt; they liked it and gave positive feedback: less waste and easier to open, price, and display.

During the implementation, selected channel members were involved in test shipments. This was early deregulation, but Gerber took this package through the Classification package rule exception process anyway. The resulting package description is very specific: for a 13-lb case of specifically described jars. Later, they appealed and got the package accepted for slightly larger and heavier bottles. Carrier test permits were obtained and shipping tests were performed between plants; test shipment product was inspected and then sold. This system was introduced in just one line: juice from Fremont. It was first distributed in the Northeast, and then the territory was extended. After 2 years of experience, they extended the packaging system to the balance of the packaging lines for juice and strained-food packed in glass, representing 80% of their volume.

Gatekeeper relationships between the firm and channel were important. Marketing and Sales introduced the package to retailers and wholesalers, as much to persuade as to learn about their needs; and Traffic dealt with the truck and rail carriers and with their classification commissions. There were no channel members who blocked the innovation. Retailers encouraged it because of trash reduction; the Classification Committees were cooperative once the decision was made to adopt; wholesalers were neutral; and there some complaints from automatic warehouses because loose film could snag on conveyors. Typical start-up

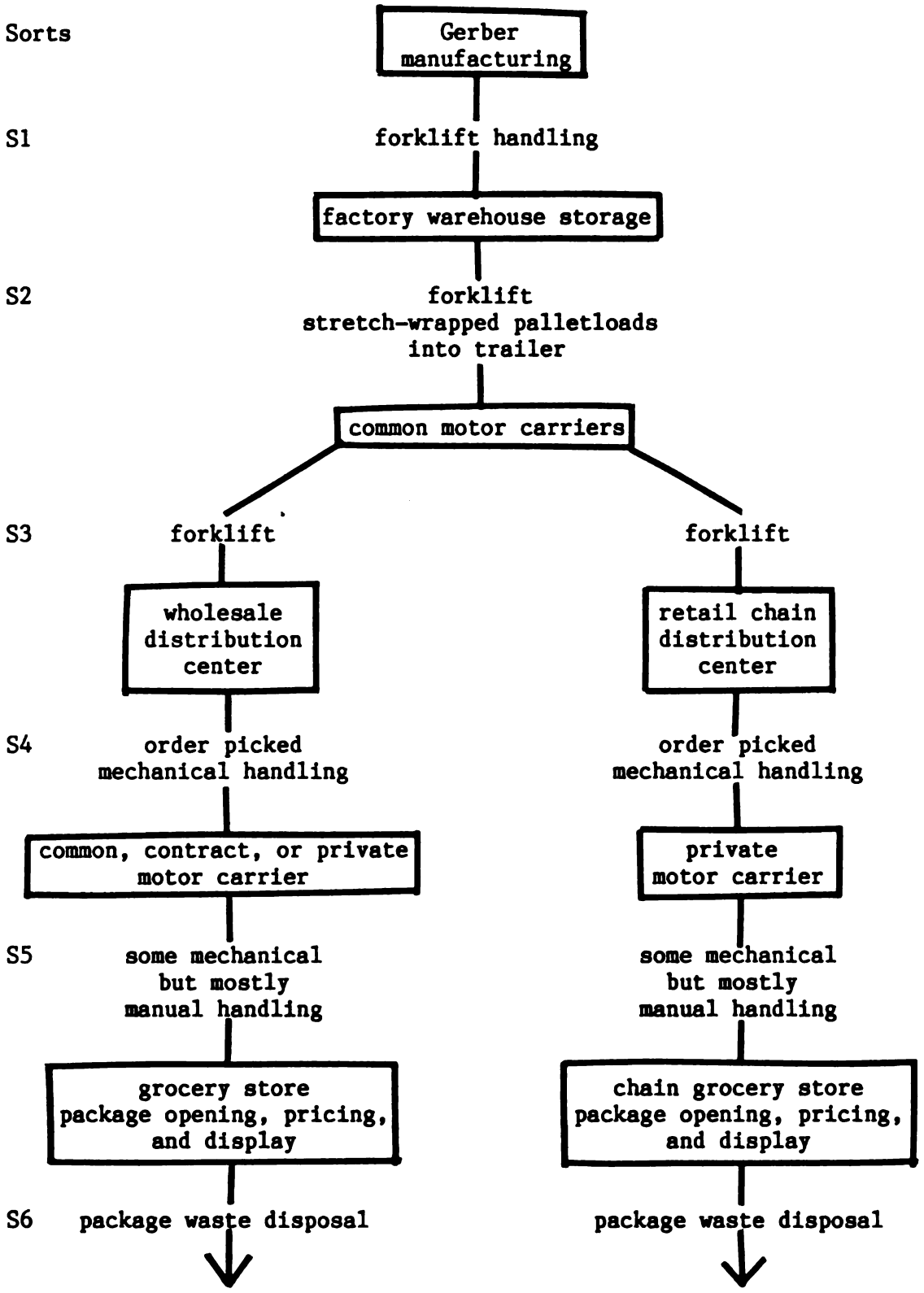

Figure 11. Gerber's distribution channel/transvection is a free-flow non-vertical marketing system. Common carriers predominate.

and learning problems related to new systems were quickly corrected with adequate attention to good manufacturing practices.

The Systemic Nature of the Innovative Package: Retailers are the only channel members whose costs have changed: decreased cost for pricing, display and scrap. Retailers do not pay more for this benefit. Likewise, Gerber's packaging savings were not passed on, although they do contribute to "postponing price increases." Although carriers costs did not change, this package went through the classification commissions' package exception process.

The Incremental Cost and Performance Effect of the Innovative Package: This innovation is perceived by Gerber to be more incremental than radical. It did not require much new knowledge: a little about shrink film properties and a little more about the packaging machinery operation, but it was basically off-the-shelf technology. Most of the learning was about package performance through test shipments (i.e. trial and error), since Gerber was the first to use this package for glass. The previous wrap-around package also had no partitions, and so the glass-to-glass concept was not a radical change.

The following components of container-costs-per-unit changed with the new distribution package design: packaging material costs less; a couple of films fit all product lines (minimizing package inventory); less labor is required on the packaging line; machinery investment was required (equipment was not quite due to be replaced but they would have had to buy a new case packer of some sort soon anyway); and production speeds are faster (75/minute, vs old case packer at 40/min). When Gerber tracks the cost of distribution packaging, it includes: purchasing materials and machine, operating labor and power, and warehousing and holding cost of materials.

The packaging function of utility changed for warehouses and retailers. In warehouses, the new package is slightly less conveyable than a box; damage is not concealed, cases cannot be broken into smaller orders; and cube is better (1 more layer per pallet, and since the stack is 3 palletloads high in factory warehouse, there are 3 more layers per stack). They decided not to use a fully encapsulated wrap because it doesn't slide like a box on ASRS conveyors. In retail stores, the new package reduces the retailers' opening, unpacking and pricing labor costs; it is better for displays which use the tray; and the retailer's disposal costs are lower because it is less material than a box. Throughout distribution, the package is slightly more secure from tampering because it is more difficult to reclose. It is easier to inspect through the plastic to see pack codes and if there is damage or a "dud" (absence of vacuum in a jar is indicated by the contour of the lid) so that damaged packages are not shipped on. There is no difference in transportation or vehicle loading productivity.

The packaging function of protection did not change. But in order to insure this, many field tests were run with half of a railcar filled with shrink-bundles and half filled with wrap-around corrugated cases,

100% inspected while loading and on arrival. A primary reason for these tests was to comply with classification commission rules, and railroad agents used shock recorders. The packages thus "transportation tested" were then sent into Gerber's distribution channels to be "tested" and handled by customers. A year of laboratory tests included incline impact which crushes the packages to test for damage which occurs in conveyors, and vibration tests in which shrink-bundles amplified vibration less than boxes. As a result of testing, the tray ends were rounded to prevent film from being cut by the top of the tray, because the edge of the corrugated board can perforate the film. The shrink-bundle appears to be as strong as a box, with no difference in damage rates. But Packaging has little direct contact with transportation claims handled by the traffic department. The salesmen's forms include damage which Sales buys back from wholesaler or retailer. But this information rarely reaches Packaging unless it exceeds normal amounts "expected in doing business," in which case special attention is given to the claim and customer involved, including visits by corporate-level personnel.

The packaging function of communication changed little with the new package. Three sides of the tray are preprinted with the stock keeping unit number, UPC number, and Gerber product identification. Meat also needs a government stamp. Code dates are ink jet printed on the fourth side with production time and lot number. There is no bar code (the military has requested Interleaf 3 of 5 code, but there is not room on the tray). Grocery warehouses may put on their own bar code stickers, but neither warehouses nor Gerber uses the UPC bar code.

Michigan Fruit Canners

Michigan Fruit Canners[2] was a "late early" adopter of shrink bundles for cans. Although this package was, at the time, fairly well accepted in the grocery distribution industry, it was not in widespread use. Corrugated boxes still predominate in the canning industry. Like the Gerber package, this "Wrap Cap" shrink bundle is partially encapsulated, enclosing 12 cans in a 3 x 4 x 1 configuration. This package replaces an RSC.

The Initiation of the Adoption Process: The innovation process was initially triggered by awareness of shrink bundles being used by competitors in the grocery industry, including a sister division. It was a "competitive response," initiated by the Director of Marketing.

It took only three months to make the decision to use a shrink-bundle. Other shrink package users were the source of knowledge and awareness of the idea; in fact, Michigan Fruit Canner personnel visited Gerber to see their system. Since there was no packaging manager at that

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[2]Interview with Mike Klintworth, Distribution Vice President, Michigan Fruit Canners, Sodus, Michigan, July 20, 1987.

time, the distribution manager researched the cost implications. This is because the fruit-canning business packs products seasonally and stores the unlabelled "bright" cans. Since labeling and case packing are postponed, they are more of a distribution function than a product packing function. Many parts of the firm participated in the early discussions, so that all departments involved would have a "pride of authorship": Distribution, Marketing, Sales, Sales service, Material Handling, plant managers, and truck lines. After the decision was made to adopt a shrink bundle, however, no one championed the implementation, and it was not until one year later, in 1985, that responsibility for implementation was assigned to Distribution.

The specific "wrap-cap" system was not chosen until after the decision was made to adopt a shrink-bundle. Then, Distribution worked with equipment suppliers to develop the packaging system; different styles of full- and partial-encapsulation were considered. Full encapsulation was rejected because Meijers (grocery chain) said that a full shrink bundle could not be used in their SI Ordermatic warehouse. Furthermore, the wrap cap resulted in savings over full wrap because it uses less material. The system chosen was designed by two different companies, one sells the wrap-cap (plastic application and shrinking) machine, and another makes the tray former and packer. Marketing and an ad agency designed the tray graphics. The final decision to adopt was recommended by Distribution to the long-range planning committee, who approved the recommendation. No one was against adoption.

The Implementation of the Innovation: Distribution was assigned responsibility for implementation. Since the new package was to be installed on one line in Benton Harbor, Distribution worked with the Benton Harbor plant manager on installation and with Purchasing on equipment buying. Once the system was purchased and installed, it was turned over to the plant manager to run. (When that plant manager soon retired, and an equipment problem occurred, Distribution once again came in, took over and solved the problems, training the new plant manager.) Most of the production problems were with inconsistent sealing and a loose "skirt" around the heatweld; a minor piece of equipment was added to roll down the skirt (which was much less expensive than the one that Gerber added). Since the implementation, no other packaging lines have been changed over from cartoning to shrink-wrapping, and new lines are not currently planned, due to some other capital expansion plans. Nevertheless, Michigan Fruit Canners is happy with this package.

Distribution Structure and its Role in the Innovation Process: Michigan Fruit Canners' distribution channel is free flow to grocery stores; their bright cans are private-label branded (mostly store brands). The typical transvection consists of 6 sorts (see figure 12). Michigan Fruit Canners uses all three kinds of carriers: their small private fleet carries 7-8% out of their factory, but contract and common carriers predominate.

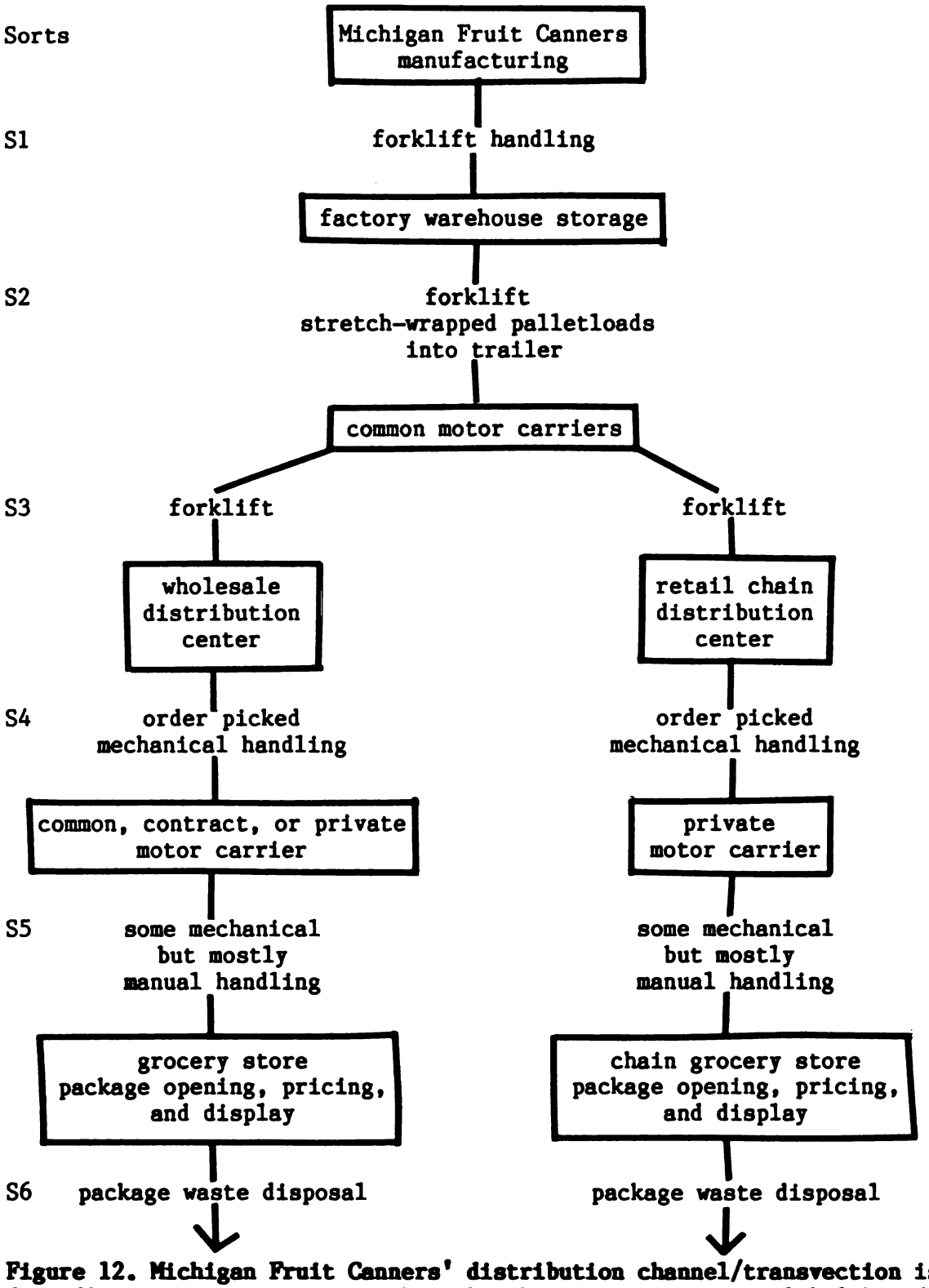

Figure 12. Michigan Fruit Canners' distribution channel/transvection is free flow to grocery stores; their bright cans are private-label branded (mostly store brands). Michigan Fruit Canners uses all three kinds of carriers.

During the initiation of the adoption process, its channel members were the source of Marketing's knowledge and awareness of competitors using a similar package. Public warehouses (recommended by shrink-bundling machinery manufacturers), retail warehouses, and trucking companies alerted them to the need for a good package which is conveyable and secure. One warehouse refused to put fully encapsulated bundles into their system, because their conveyor is designed for the surface friction properties of corrugated board. Although the experienced channel members voiced concerns, all were supportive and reinforced the adoption decision.

During the early implementation, channel members were involved in shipping tests which were done before the machinery was purchased (but after the decision was made to go with a shrink-bundle). Inter-plant shipments were thoroughly inspected, looking for in-transit damage. Test shipments were also run through an SI Ordermatic system. In the course of the continued implementation, a problem arose with poorly adhered caps. The warehouse consignees "chewed out" Michigan Fruit Canners. As a result, a Quality Control person was assigned to inspect packages and shut down the line whenever there was a problem. This gave a clear signal to production workers of the importance of a secure package. When the problem was solved, the QC function was relaxed.

Gatekeeper relationships between the firm and channel were important. Distribution and Traffic talked to trucking companies. The broker network talked to customers. Sales and Marketing talked to major accounts. Marketing's interests were concerned more with competitors' and sister division's package and that the "innovation" reflected competition, than they were with reflecting customer needs. They touted the package's advantages to retailers, and when asked, retailers encouraged the new package because of the trash reduction, but retailers did not request the new package. Michigan Fruit Canners' Distribution worked with Meijers' Distribution to run tests through the SI system. Some carriers didn't like it, but were convinced through test shipments; and some warehouses were worried about conveyor compatibility. But no channel members blocked the innovation.

The Systemic Nature of the Innovative Package: Retailers are the only channel members whose costs have changed: decreased cost for pricing, display and scrap. Retailers do not pay more for this benefit. Likewise, Michigan Fruit Canners' savings are not passed on, because the price change would be negligible, and fruit pie filling prices are competitively set, not based on costs.

The Incremental Cost and Performance Effect of the Innovative Package: This innovation is perceived by Michigan Fruit Canners to be more incremental than radical. It did not require much new knowledge because other canners were using it. A little new knowledge about plastic was necessary, like the fact that a single layer of film would not work for the wrap-cap. The equipment supplier claims that this system requires coextruded film with one sealable side (but the user is not required to know what material this is). No new mechanical knowledge

was needed; but MFC did need to learn the difference between different manufacturers' systems. The needed new knowledge concerning performance was acquired by conducting test shipments and talking to warehouses.

The following components of container-costs-per-unit changed with the new distribution package design: material costs (8-12 cents less per pkg); labor savings because machine speed is greater than cartoner (so they souped up the line); and capital expense (equipment was not due to be replaced). When tracking the cost of packaging, Michigan Fruit Canners only includes the purchasing costs of materials and machinery.

The packaging function of utility changed for warehouses and retailers. Initially, the package decreased handling productivity in Michigan Fruit Canner's own warehouse since they were accustomed to picking pallet layers with a "palletless carton clamp". But tray packs cannot be clamped off in this manner, so it was necessary to replace this system with a magnetic "fingerprint" system to pick up a layer. This cost was included in the payback calculations. Once the palletload is stretch-wrapped and handled as a unit, there is no difference in handling productivity. In automatic or mechanical warehouses, there is no difference in handling productivity, but at first some automatic systems threatened that plastic packages would not be permitted in the conveyor system and would have to be stacked on the floor. This led adopting the "wrap-cap" system. Cases cannot be broken into smaller quantities without losing package integrity, but 12 in the case (rather than 24) is efficient even for small orders. In retail stores, the new package improves the productivity of opening and pricing, as well as contributing a more efficient display of product is the store displays in trays and partial boxes. (A sleeve-packer is being considered which would bundle 3 or 4 cans together for some retail applications.) A dozen count was chosen because of the realization that pie filling would not get a larger shelf facing in a store. For special promotions with a palletload display, the wrap-cap plastic is left off, and the palletload of cans in trays is stretch-wrapped. The shrink bundle also results in lower disposal costs. Since transport vehicles weigh out, there is no difference in transportation or vehicle loading efficiency.

The packaging function of protection did not change, but automatic handling requirements for protection were considered. No laboratory tests were performed, just shipping tests in vehicles. There were no conveyor tests, but the hazards were considered. For the most part, Michigan Fruit Canners files claims with carriers, even if product is shipped FOB their dock; retailers just write it off as a credit, facilitated by reclamation centers which take damaged product from a retailer or intermediary, read the bar code, and report the amount to the store or intermediary (who deducts it from their bill).

The packaging function of communication changed little with the new package. Stock keeping unit identification (brand and product) is found on 4 sides of the tray; the UPC number appears on 2 sides, and lot and code information is printed with ink jet onto one side as packed. Bar code stickers are placed on each palletload (but not on the case) for

reading in Michigan Fruit Canner's own system. If wholesale or retail warehouses use bar codes, they apply their own stickers.

Owens-Corning Fiberglas

Owens-Corning Fiberglas[3] (OCF) makes rolls of insulation which had always been shipped break-bulk. Their innovative package is a unitization method which results in a multiple-roll bundle which can be handled either mechanically or by hand. The rolls of insulation are stretch-wrapped together, in a footprint of 4, two or four high. (Each roll is already "packaged" in a paper wrapper which is applied at the time of rolling; the ends are open.) This is the only case study in this research which documents a change in the number of products in a package and goes from a manual to a mostly mechanical handling system. It is included because of it represents a unique departure from conventional pallet-load unitization methods.

The Initiation of the Adoption Process: The innovation process was initially triggered by a desire to increase customers' handling productivity. This problem of how to unitize lightweight insulation was investigated for years, ever since OCF's retailer advisory council (representing large retail firms) had asked for units which could be mechanically handled. All of the ideas, up until this "Time-Sav-R"[4] package was developed, had involved pallets or slipsheets for handling, and they were rejected because they reduced cube utilization in trucks (which were smaller than today's) because the break-bulk insulation could not be compressed. OCF also wanted to automate their own sorting operations, to replace the practice of stacking loose rolls on racks at the end of the line and loading trucks by hand. The Operating Division Vice President decreed, "We can be smart enough to think of a package without a pallet." An Industrial Engineer in the Insulation division, was assigned the job. He got the present package idea within six months. It took 1.5 years, thereafter, before the decision was made to implement the innovation in 1984.

The source of knowledge and awareness of this package was an innovative stretch equipment manufacturer in Toledo who had just begun to pre-stretch film; the stated purpose was to avoid compressing the load. This led OCF to realize that was what they wanted: a package which will compress the insulation and yet not deform it so much that it can't pop back. In the OCF stretch-wrapping machine, pre-stretch is minimized; the film payout (as the load spins) is allowed to crush the product. The departments who were involved in the early discussions, where attitudes were formed toward the innovation idea, were: Industrial Engineering,

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[3]Interview with Tom Williams, Manufacturing Engineer, and Shreve Davis, Industrial Engineer, Insulation Division, Owens-Corning Fiberglas, Toledo, Ohio, September 4, 1987.

[4]"Time-Sav-R" is a trademark of Owens-Corning Fiberglas.

Manufacturing, Marketing, Sales, and Corporate Engineering; Technical and Quality Control tested recovery of insulation after compression.

The innovative prototype package was designed by a Senior Staff Industrial engineer for the Insulation Operating Division, who had a lot of help from stretch-wrap equipment suppliers. Industrial Engineering does the packaging and material handling functions at OCF. In addition, consultants were asked for their opinions on the proposed package. Originally, the package sizes were 12- and 16-packs, but the 16-pack was supplanted by 8-packs when they found that the 16-pack was too heavy and bulky to be manually handled. Early on, before OCF thought of this package, many designs had been considered, using pallets, slipsheets, or strapping. These designs were rejected because pallets and slipsheets make the load incompressible, and strapping results in "point compression." The decision to adopt was made by Marketing, for all three divisions: Residential, Commercial and Industrial. Industrial engineering championed the adoption. But the plant was less enthusiastic because it added to their costs (in the short run).

The Implementation of the Innovation: The innovation was implemented by Industrial Engineering, who installed and debugged the system; by Corporate Engineering, who designed and integrated the new process into their existing system of controls and layouts, vendors, specs; by Manufacturing, who learned to run it, and by Quality Control, who helped to fine-tune the process, checking the unit's "diagonal" measurements for loosening after handling. Marketing helped identify the first customers which were introduced to the new package. Since the initial implementation, they have increased the thickness of the plastic film, and they have switched from 16- to 8-pack. They are happy with the new package, and so are most customers.

This package inspired innovation in the stretch-wrap machinery industry, and has resulted in improved wrapping productivity. This type of stretch-wrapping equipment spins the load as it spirals the film (by raising and lowering the film carriage). Since crushing of the lightweight insulation was desired, and since all loads are standardized, stretch-equipment manufacturers competed to speed up the rotation. In 1984, they achieved 50 rpm, an increase of 30 rpm over conventional (20 rpm) stretch-wrap machines.

Distribution Structure and its Role in the Innovation Process: OCF's distribution channel is a free-flow non-vertical marketing system. Their fiberglass insulation is distributed through three channels: Retail (sold in discount stores and lumber yards, primarily chain stores), Commercial (sold to contractors), and Industrial (sold to factories which make pre-fab homes) (see figure 13). They use mostly common and contract carriers.

During the initiation of the adoption process, OCF gave its channel members plenty of opportunity to affect the attitudes formed toward the innovation. Prototype packages and a video about handling the new package were shown to the Retailer Advisory Council; limited customer

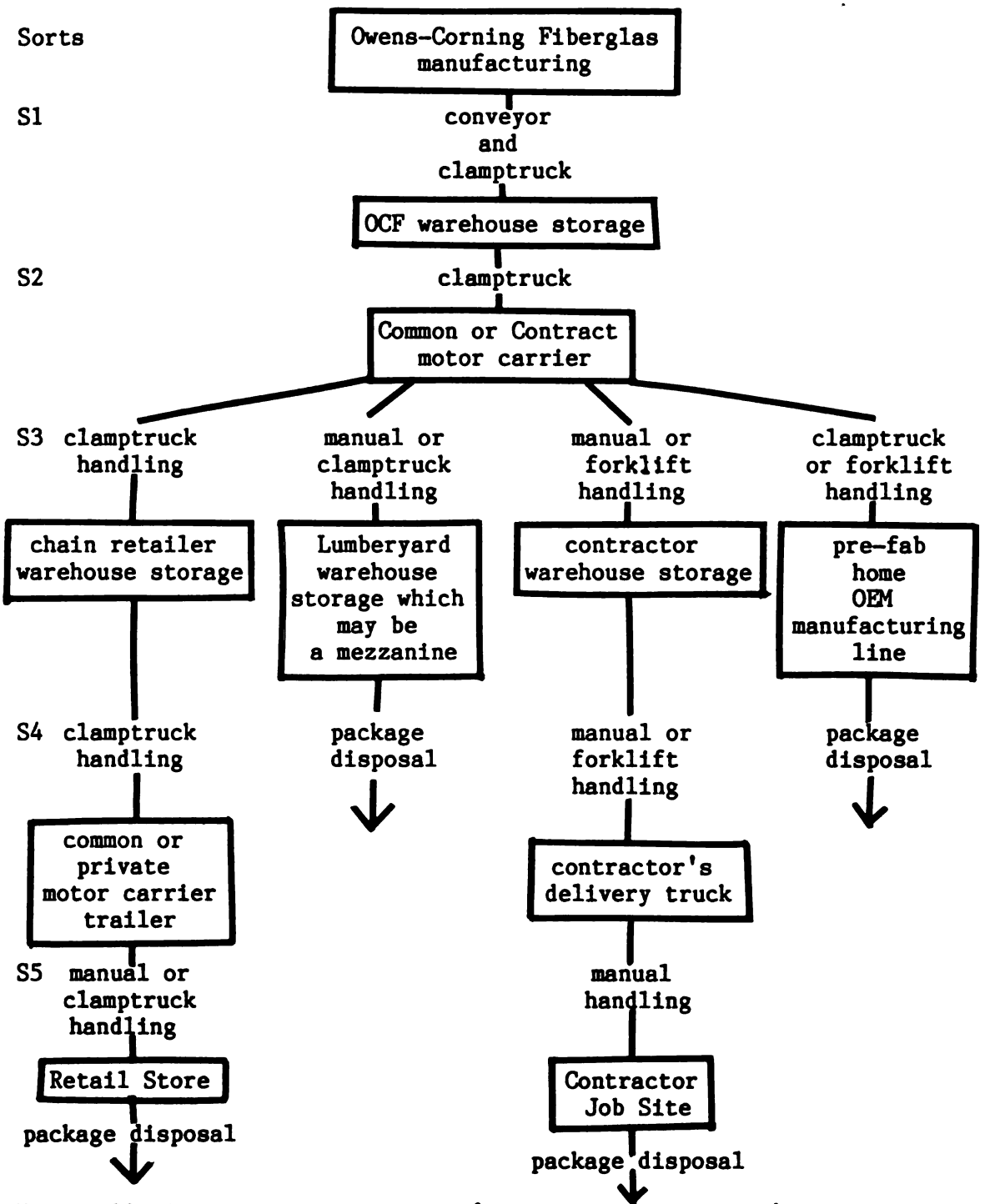

Figure 13. Owens Corning Fiberglas' distribution channel/transvection is a free-flow non-vertical marketing system. Their insulation is distributed through four channels: Retail (sold in discount stores and lumber yards, primarily chain stores), Commercial (sold to contractors), and Industrial (sold to factories which make pre-fab homes). They use mostly common and contract carriers.

trials were made on semi-automatic machines, at first, and later on automatic machines for full-scale testing. A survey of dealers followed, which supported the decision to adopt: 80% of the retail and manufactured housing customers and 40% of contractors preferred new package. Retail and manufactured housing customers are larger and more powerful than contractors, and so their preference was weighed more heavily. Transportation worked with the American Trucking Association to insure no change in classification.

During the implementation, OCF's channels were not all involved at once. The first customers to receive the package were carefully selected, and initial shipments were met by OCF personnel to insure appropriate handling methods. Test shipments surprised some consignees' workers, but wherever there was mechanical handling, there was no problem with the new package. OCF worked with truck owners and drivers to get them used to the new handling methods, and they surveyed drivers to get their feedback on the initial loads. Some contractors still don't like the new package because they have always stored insulation tossed up on a mezzanine; these contractors prefer bagged insulation.

Gatekeeper relationships between the firm and channel were important. Industrial Engineering, Manufacturing Project Manager, and Physical Distribution talked to drivers. Marketing brought back the initial concerns from customers, which started the innovation process. Sales followed up with customers, once they were receiving the package. Retail and manufactured housing segments encouraged the change. Contractors were least responsive, and had to be convinced that the rolls could be manually handled. Carriers and warehouses needed to be educated but had no effect on decision.

The Systemic Nature of the Innovative Package: All distribution channel members were affected by the new package. "Customers," especially the retailers and housing manufacturers, incur lower handling costs. Carriers get less fiberglas dust in their trailers, and the turn-around time for loading and unloading trailers is reduced and much less itchy. Warehouse handling costs are reduced as well. Channel members do not pay more for this benefit, but it is expected to help increase sales.

The Incremental Cost and Performance Effect of the Innovative Package: This innovation is perceived by OCF to be more incremental than radical. They had previous experience in shrink-film, but needed to learn about stretch film characteristics, thicknesses, and formulations, esp. LLDPE. They also had to learn about stretch-wrapping equipment and its capabilities. There was less to learn about the package's performance; it was a simple concept, an obvious improvement.

The container-costs-per-unit are higher with the new distribution package design; materials and operations cost more. But overall, OCF "came out ahead" because of the reduction in handling costs in their own warehouses (the recent addition of new OCF regional warehouses increase the savings even more). They had not expected the cost reduction, but rather had adopted the package to sustain or increase market share at a time when competitors were going to a totally enclosed bag for each

insulation roll. Therefore, this package enabled them to avoid the cost of going to a totally enclosed container. When it made the decision to implement, OCF considered the cost of material, transportation, and capital equipment costs. But these costs are not tracked on a regular basis.

The packaging function of utility changed for everyone who handles this insulation. This package change resulted in increased productivity through mechanical handling of multiple units. The package was compatible with most of the distribution system, especially for retailer and manufactured housing customers, where lift trucks are common (but clamp trucks are not). The package sizes were decreased from 16 and 12 rolls to 12 and 8 to make them easier to manually handle multiple units. Manual handling productivity is improved, although some contractors with mezzanine storage have handling problems. Transportation cube utilization is improved because the rolls are compressed; and legalization of trailer size increases (insulation cubes out), improve the load count even more.

The packaging function of protection changed little. Based on field obvservations, overwrap falling off rolls (the most common damage) was reduced by 5-10% because the stretch-wrap covers this paper overwrap. The only tests performed were shipping tests, with an emphasis on weatherability (performance in heat and cold). Claim feedback has been minimal. There have been a few formal complaints through the advisory council, resulting from loose wrapping or too little top and bottom overlap.

The packaging function of communication did not change. The pink panther logo and all other information can be easily read through the film. The retail package's appearance was improved because it is less scuffed.

Johnson Wax

Johnson Wax[5] would have been the first (in the U.S.) to use a shrink-bundle for aerosol cans. Traditionally, the U.S. Department of Transportation has classified aerosols as Hazardous Materials and has forbidden the use of plastic distribution containers for them. Edge Shaving Gel, however, is a "semi-aerosol" with the propellant packaged in a separate compartment in the can from the gel, and is less "hazardous" because of the small amount of propellant in the package than are aerosols with both ingredients mixed together. The shrink-bundle is made from two trays filled with 6 cans each, inside a shrunk sleeve with perforations in the film between the trays. Thus, a 12-pack can be easily transformed into a 6-pack for distribution to small drug stores. The package which they hoped to replace has 6 cans packed in a chipboard

[5]Interview with Bridget R. Revere, Senior Engineer, S.C. Johnson & Son, Inc., Racine, Wisconsin; March 19, 1987.

case; two of these 6-packs, in turn, are packed in a corrugated case. Johnson Wax made the decision not to adopt this package.

The Initiation of the Adoption Process: The innovation process was initially triggered by awareness of shrink bundles used for other consumer products' distribution and the fact that the cost of materials and packaging line would be much lower than the current double-boxing method. The chipboard case packer is a unique machine, and produces a very expensive package. Another benefit sought was a display package. Johnson Wax has talked of shrink-bundling for many years and it is not clear who initially brought it up. New Package Development, under the Package Development Department in Research & Development, initiated the most recent innovation process.

The project had been looked at several times spanning a 5-year period, each time halted by internal roadblocks related to transportation issues. The latest investigation took 1.5 years from initiation to the decision not to implement in 1986. Other consumer products manufacturers were the source of knowledge and awareness of using shrink-bundles for distribution packages, although no one uses them for an aerosol. In the early discussions, where attitudes were formed toward the innovation idea, New Package Development asked for Manufacturing and Distribution to work together to develop a package.

Once Distribution & Manufacturing, with the help of material and equipment suppliers, came up with five or six prototypes, Marketing approved money for testing the best one. (In a consumer products company like this, "Marketing runs the company".) Other prototypes were rejected because they were less cost effective or less stable in stacks. But the Package Development Department (a different section than the New Package Development initiator) replied unequivocally that DOT would not permit the shipping of aerosols in shrink-bundles. Therefore, the decision was made not to implement, and the project was aborted before any money was "wasted" on testing. The departments which were for adoption, had the test results been favorable, were Marketing, Distribution, and Manufacturing. Package Development was against testing.

The Implementation of the Innovation: This package was never implemented. But Distribution is still dissatisfied with the decision not to test.

Distribution Structure and its Role in the Innovation Process: Johnson Wax's distribution channel is a non-vertical marketing system. Retailers for their product include grocery, drug, and convenience stores. The transvection consists of 8 sorts (see figure 14). Carriers are regulated common carriers; or contract for full loads from factory to the warehouse. Hazardous materials carriage is still regulated.

During the initiation of the adoption process, the presence of other shrink-bundles in the same channels affected initial knowledge and awareness of the package innovation. Marketing's discussions emphasized the benefits to retailers and a sensitivity to store stocking needs.

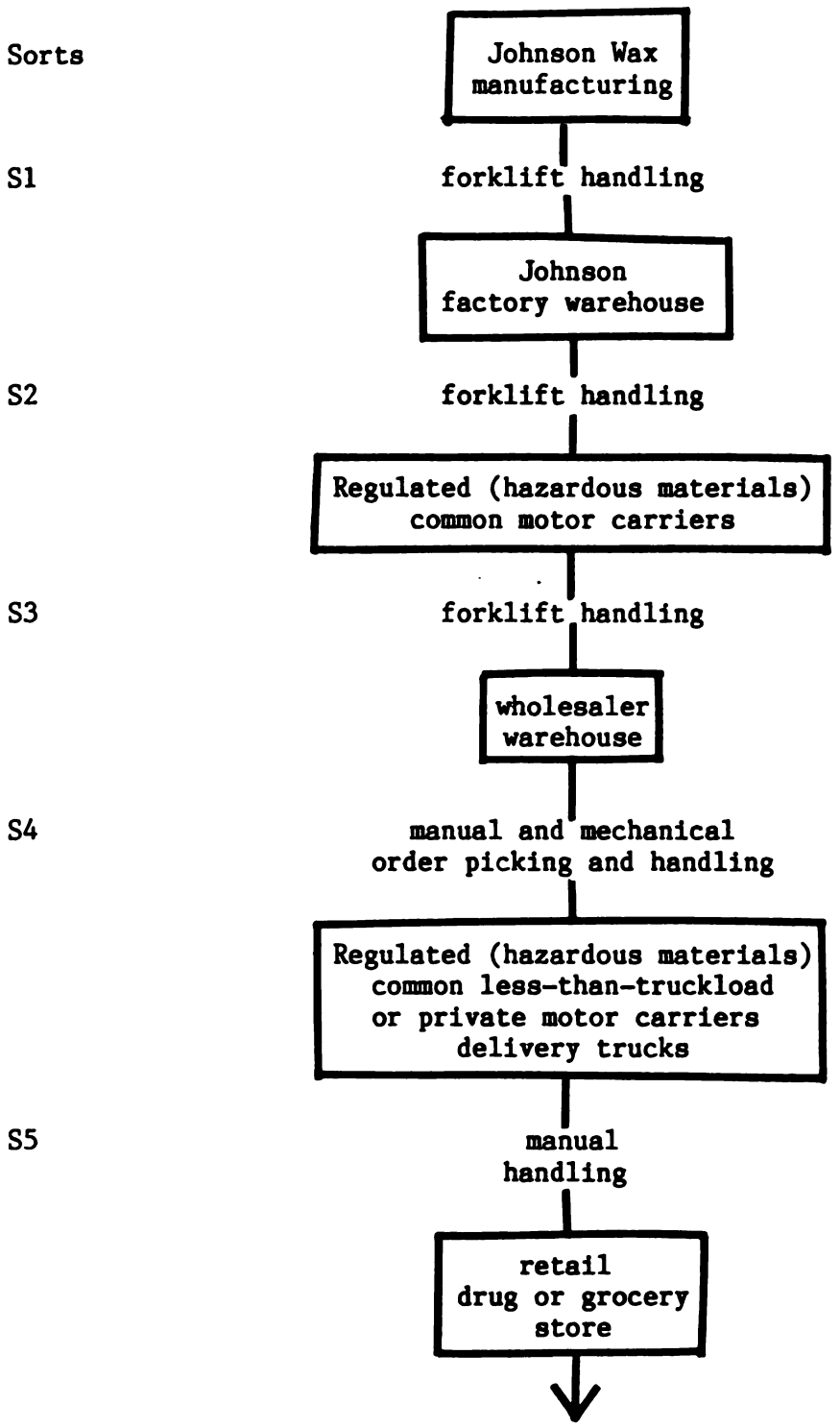

Figure 14. Johnson Wax distribution channel/transvection is a non-vertical marketing system. Retailers for their product include grocery, drug, and convenience stores. Carriers are regulated common carriers; or contract for full loads from factory to the warehouse. Hazardous materials carriage is still regulated.

Store stocking needs include small order quantities and packages which are easy to open, price, and display. But the DOT position on shrink bundles for aerosols had the greatest effect onattitude formation, even though they were not directly consulted by the package's promoters within the company.

Gatekeeper relationships with the channel were limited. Although Marketing emphasized retailer benefits, retailers were not consulted. It is not known whether Traffic talked to the DOT, even though Johnson feels that the decision not to adopt is directly attributable to the DOT.

The Systemic Nature of the Innovative Package: Although the package was not implemented, it is speculated that it would decrease retailer costs of opening, pricing, and display, and would facilitate sorting into 6-packs better than the current package. The reason for DOT's disapproval of shrink packages is the belief that they are not strong enough.[6] [Performance test standards, however, proposed in 1987 by DOT, would permit the approval of such packages if they could be proven as strong as the box. ed.]

The Incremental Cost and Performance Effect of the Innovative Package: This innovation is perceived by Johnson Wax to be more incremental than radical because it is used for other consumer products' distribution. The only new plastics knowledge gained was with respect to thickness and elongation properties. The machinery suppliers were a ready source of knowledge about package production. Knowledge concerning package performance, however, was not pursued because of the project's early demise.

The following components of container-costs-per-unit were expected to change: material costs should decrease, labor costs should decrease, and the equipment investment would be a major investment, although their cartoner is due for replacement, and will probably need to be replaced with a more expensive system. Johnson Wax Distribution does not track packaging costs; this is done by the Cost Management Department.

The packaging function of utility was expected to change for warehouses and retailers, as well as potentially eliminating overhang on palletload. For warehouse picking, the perforations allow the package to be split into 6-packs. Although this is also a feature of the current package, splitting the corrugated 12-pack entails removing the outer carton and shipping on the two inner cartons. This results in a larger trash bill for warehouses than would the proposed shrink package. The perforated shrink bundle is a unique design, different than other shrink-bundles in distribution. It also would result in slightly better warehouse cube utilization because so much corrugated and paperboard are eliminated. (Their trucks weigh out.) The proposed package would also add to retailer productivity in opening, pricing, displaying, and

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[6]Interview with Mario Gigliotti, Hazardous Materials Packaging, United States Department of Transportation, Washington, D.C., July 16, 1987.

disposal. The 6-pack is designed for especially for its utility for small stores, yet can be left in 12-pack for larger retailers.

It is not known whether the packaging function of protection would have changed, since no tests were performed. The shrink-bundle might be more flammable or may be quicker to "flash," and this may be one reason why the DOT will not permit it. But it is difficult to imagine a more flammable package than combined paperboard and corrugated board. DOT claims that it is less strong, but this has not been tested. The following tests were proposed: free-fall drop, vibration, puncture, compression, incline impact, and fire. The claims function is in the Traffic Department. However, at the present time, damage information isn't filed or sorted in a way to allow for easy access.

The packaging function of communication was expected to change little with the new package. The brand, stock keeping unit information, and other code information would have been on the tray.

Supreme Equipment and Systems Corporation

Supreme[7] was the first firm in the U.S. to stretch-wrap file cabinets. Slit-scored honeycomb pads (1.5" thick x 4" wide) are used on the corners (vertical files also have one on the front and one on the back), and the top and bottom cap are lined with 1" thick honeycomb paperboard material. The film web is as tall as a 2-drawer file. When taller files are wrapped, 2 web widths are used, wrapping first below, spiraling up, and then wrapping the top. Film elongation is 210%. A bulls-eye overlaps the top and bottom caps (file is raised from the machine's pedestal during wrapping) and tightly secures the package. Two stretch-wrapping machines are used because of the volume of production. This package replaces a tri-wall corrugated box with foam pad.

The Initiation of the Adoption Process: The innovation process was initially triggered by the President of the Company who was looking for a competitive advantage. The new package was seen as a strategic marketing move; the new package would "look nicer." Other initial benefits sought were to reduce the cost of buying and maintaining a wide inventory of corrugated board. The President and his Vice President of Manufacturing and Engineering, looking for something new, saw stretch-wrapping unitization at a Pack Expo in Chicago.

The adoption process took eight months from initiation to implementation of the first machine purchase in January 1986. Stretch-wrap equipment suppliers and honeycomb paperboard salespeople were the source of knowledge and awareness of the idea. The early discussions,

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[7]Interview with Asit Patel, Engineer assigned to implement the package; and Philip Valentino, Industrial Engineering Manager, August 5, 1987. Supreme, founded in 1955, was the first to make lateral files.

where attitudes were formed toward the innovation idea, involved the President, the Vice President of Manufacturing and Engineering, Traffic, and Marketing ("from a quality point of view"). Supreme's warehouses were not consulted.

The prototypes were designed by the Vice President of Manufacturing and Engineering, the honeycomb supplier, and the equipment supplier who loaned them a machine for 3-4 months. They considered 4 or 5 different ways of holding the corners and/or base, as well as expanded polystyrene corners. The other designs were rejected because they were either too costly or too impractical (EPS breaks when dropped and can't withstand a later blow). Only one equipment manufacturer was considered. The final decision to adopt was made by the President and the Vice President of Manufacturing and Engineering. The least enthusiastic department was traffic because of hassles with carriers who were worried about the package's damage resistance.

The Implementation of the Innovation: Industrial Engineering, under direction from the Vice president of Manufacturing and Engineering, implemented the new system. A newly-hired engineer with some packaging education was chiefly responsible. It took about 4 months to fine-tune the process, trying different films. Because 210-225% stretch tension is required for impact resistance, the film can easily break (the originally supplied film did). Now they are using a different brand of film (1.25 mil.) which suffers fewer breaks. They also switched to curved-corner caps and trays to avoid poking holes in the film. They invented a trick to improve wrapping machine productivity: wrapping two short files together, one atop the other, and then cutting them apart. Are they happy that they made the change? "Oh yes, without question."

Distribution Structure and its Role in the Innovation Process: Supreme's distribution channel is a free-flow non-vertical marketing system. Dealers are not under contract. There are up to 5 sorts (see figure 15). Common carriers are used.

During the initiation of the adoption process, their channel members had no effect on Supreme's knowledge and awareness of the new package. When shown the package, channel members' opinions were solicited. Truckers, concerned about strength, requested NSTA testing. Marketing introduced prototypes to dealers, who were not enthusiastic. These opinions, however, did not deter the decision to adopt. Supreme correctly reasoned that once the package was adopted, dealers and truckers would accept it.

During the implementation, channel members were involved in test shipments. Using a loaned machine, test shipments were sent to major warehouses and dealers; Salespeople solicited comments. Truckers complained that units stuck together in a hot truck, so the film chosen has one-side cling. Truck drivers complained about difficulties in unloading trucks, tipping and manually handling the product, so a "handle" was recently added; at first it was a vertical strap, and now it is a horizontal one. Everyone has now accepted the package.

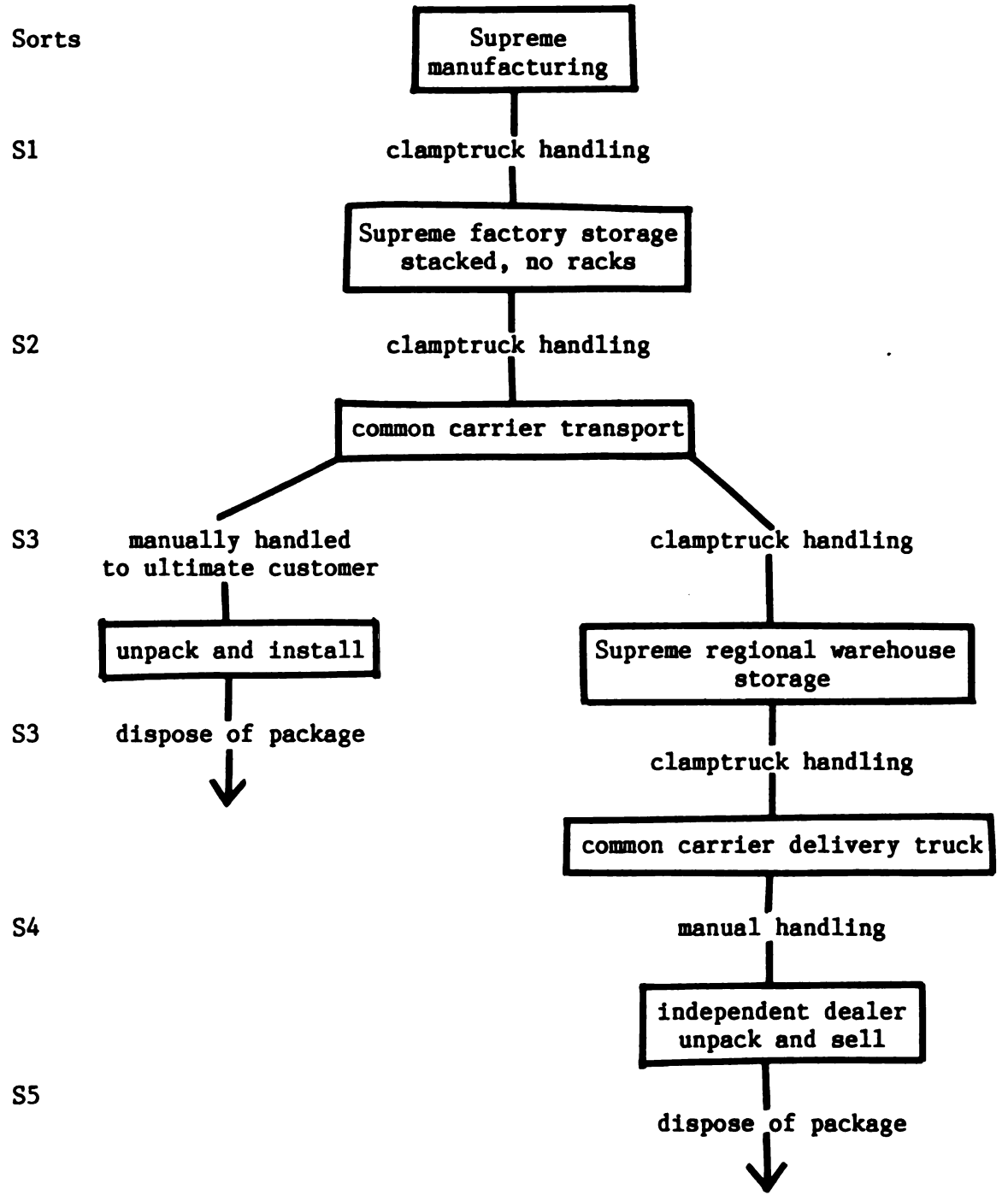

Figure 15. Supreme's distribution channel is a free-flow non-vertical marketing system. Dealers are not under contract. Common carriers are used.

Gatekeeper relationships between the firm and channel were important. Marketing and Sales talked to dealers about the new package, at first to introduce it, and later to see how well it holds up in transit. Traffic and Marketing talked to carriers. There was no feedback from the ultimate customers because files are sold unwrapped. Carriers were only concerned about problems that they experienced unloading trucks. The dealers' warehouses initially blocked the innovation because they have to open and inspect each file for delivery; if it is damaged, they no longer had a package for returning the unit. (Supreme's own warehouses were given no opportunity object to the package change.)

The Systemic Nature of the Innovative Package: The dealers cost of package disposal has decreased "especially for large installations." Dealers do not pay more for this benefit, although customers "may have been saved a price increase." Carriers' and warehouses' costs have not changed due to the new package; conventional clamp truck and manual handling methods are appropriate for the new package. There was no involvement with carrier classification boards.

The Incremental Cost and Performance Effect of the Innovative Package: This package innovation is perceived by Supreme to be incremental because they were familiar with stretch-wrapping from receiving manufacturing materials shipped in stretch-wrapped palletloads. However, the application is a creative departure from earlier stretch-unitizing applications. Furthermore, Supreme had no familiarity with the stretch-wrapping process itself, and so they learned about machines from machine salesmen, for example that force-to-load varies from machine to machine. They needed to learn the following about plastic stretch film: roll sizes, gauges, colors, shrink vs. stretch force,. % stretch, and the difference between cast and blown film ("blown gives too much and decomposed on the product"). They learned about package performance from tests.

The following components of container-costs-per-unit changed with the new distribution package design: material cost is lower; standardization allows purchasing to negotiate quantity discounts and reduce the inventory of packaging materials (at least 12 boxes have been replaced by 4 sizes of corners, 3 sizes of caps and one width of film); labor costs are up slightly; and the machinery cost was a capital investment. When this decision was made, 3-4 years of package costs were studied, and Supreme projected substantial package savings (although the subsequent package changes reduced the actual savings). There is no ongoing accounting of the cost of packaging.

The packaging function of utility changed little. There is no difference in handling efficiency; clamp trucks and manual handling are used for both plastic and corrugated packages in this system. Shipping mistakes have been averted, however; since the product and color is visible through the clear film package (no colored film is used), it is easier to tell what is inside. There is no problem with stacking because this package allows the file cabinet itself to contribute the stacking

strength. There is an insignificant cube increase, but the same number fit in a trailer (where there used to be a void, now it is filled). There has been no tariff change; some are shipped LTL. Unloading the truck, especially in places without adequate docks and equipment has been difficult; complaints inspired the addition of a strap as a handle to tip the package onto a dolly. Dealers find it easier to open, unpack, and dispose of the new package. (Dealers sell files unpackaged.) Since it is difficult to reclose an opened package for return in the case of damage, dealers' warehouses were provided with hand-wrappers. On the other hand, the new package is easier to inspect and see if the product is damaged. Dealers claim that there is a psychological advantage: when people who handle freight can see the product, they are more careful.

The packaging function of protection change did not change. The new package is "as protective as the box" in handling and stacking. Since the package is easier to open, there may be less opening damage. The following NSTA tests were requested by carriers: impact from 1 foot on corner, synchronous vibration, puncture (drop a 20-lb box from 30" on its corner into the stretch-wrap side), and incline impact on six sides. As a result of these tests, the package was modified with thicker honeycomb with larger cell sizes (if cells are too stiff, the shock is transmitted instead of absorbed) There has been no significant difference in damage rates as perceived by Industrial Engineering, although Traffic and Customer Service departments handle damage claims.

The packaging function of communication changed little. The Supreme logo is on cap, and labels on two adjacent sides announce the model and color. The consignee label is stamped on at shipping dock. Being able to see through the package helps to cut down on shipping mistakes, since color is the primary difference between the file cabinets. No bar codes are used.

Cases with Vertical Marketing Systems

Kimball International

The ARTEC Division of Kimball International[8] ships some of its custom-built office furniture systems "uncartoned". Rather than boxing each wall panel, ARTEC fabric-covered modular wall panels are shipped in a plastic bag with corrugated endcaps. Coming off the production line, these bagged panels are unitized in stretch-wrapped palletloads to facilitate handling and storage through ARTEC's order consolidation warehouse. This package is only used for shipments directly to an installation, which receives a full trailerload of office systems. Before shipment, palletloads are decomposed, and panels are loaded individually into a "padded van" trailer; all panels for a job are stowed together, standing on edge. The surfaces of the truck and of the panel group are covered by blankets and the panel load is strapped to the trailer wall (usually in the nose of the trailer, with boxed furniture parts in back). This package is not shipped in channels with customer warehouses; all of Kimball's other furniture is boxed, save for these panels when direct to installation. Other products need to be in boxes because of the multiplicity of parts involved with knocked-down furniture. The previous package was a lightweight bag inside of a corrugated fiberboard box (no endcaps).

The Initiation of the Adoption Process: The innovation process was initially triggered by a large trash bill, incurred by a customer's installers at a big State and Federal Building project. The initial benefit sought was the reduction in the cost of package disposal. The National Sales Manager initiated the innovation process in the firm.

The adoption process took 2.5 years to the first uncartoned shipment in 1985. Knowledge and awareness of the idea arose from the fact that the distribution manager had just been hired from a furniture company who shipped wall panels in plastic. The following departments were involved in the early discussions where attitudes were formed toward the innovation idea: Sales, Distribution, Operations, Purchasing, and Engineering.

At Kimball, the Distribution Department designed the package by evolution. First, it got rid of the carton (the plastic bag was always there, inside carton), then plastic gauge was increased, then (due to friction burns on one shipment) Sales and Distribution Engineering added cornerpads. Three other package designs were considered: 1) leaving the bagged panels stretch-wrapped to pallets (as they are in the factory consolidation warehouse), rejected because palletloads cannot be stacked and didn't utilize truck cube well; 2) heatseal/pass-through shrink wrap, rejected because of product incompatibility problems; and 3)

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[8]Interview with Richard Grace, Distribution Manager, Kimball International Office Furniture Division, Jasper, Indiana; March 18, 1987.

several film thickness and endcap variations were considered and tried until damage and installer concerns were minimized. The final decision to adopt was encouraged by Distribution, Sales (less refuse), Engineering, Operations (less packing), and Purchasing (less cost). On the other hand, the ARTEC warehouse manager and supervisor were against adoption because of damage possibilities in the warehouse and the difficulty of storing panels in plastic bags. These objections were the reason for stretch-wrapping the bagged panels as they move through this warehouse, even though these unit loads cannot be stowed in the truck. With this final package modification, the affected departments were unanimous in the recommendation to adopt.

The Implementation of the Innovation: Distribution conducted the test shipments and designed the truck loading techniques, as Operations revised the packaging line. Once the innovation was institutionalized, the package evolution occurred. At first thinner plastic and no endcaps were used (just like the panel used to be packaged, but without the box), but the fabric got "friction burns." Distribution and Engineering worked with bag thickness and endcap improvements. Everyone at ARTEC is happy with this package system; even the employees on the manufacturing line like it.

Distribution Structure and its Role in the Innovation Process: Kimball's distribution structure for the ARTEC line is a contractual vertical marketing system through an independent dealer network which also sells competitors' products. A dealer is involved with every sale, even if it results from an ARTEC contact. Installers may be independent contractors. A project manager and installer from ARTEC oversee each installation site. The transvection in which this package is used consists of 4 sorts (see figure 16). Uncartoned contract carriers are used in this transvection. This package is not used in other transvections where furniture must be stored in customers' warehouses, or shipped on Kimball's own private fleet, which are not equipped for uncartoned shipping. The trend toward more "just in time" shipping (no storage in customers' warehouses) is increasing the number of shipments where this package is feasible.

During the initiation of the adoption process, channel members were involved from the beginning. End users were the initial trigger, complaining of waste problems. Uncartoned carrier representative affected the formation of favorable attitudes towards uncartoned shipping, and cited examples of other furniture shippers who use no cartons. End users and carriers encouraged the adoption decision.

During the implementation of the adoption, channel members' feedback was solicited for actual shipments. Installer, ARTEC field representatives, and carriers made suggestions which were used to improve the protection afforded by the package.

Gatekeeper relationships between the firm and channel were important throughout the adoption process. The relationship between the District Sales Managers, Dealers and Installers was responsible for awareness of

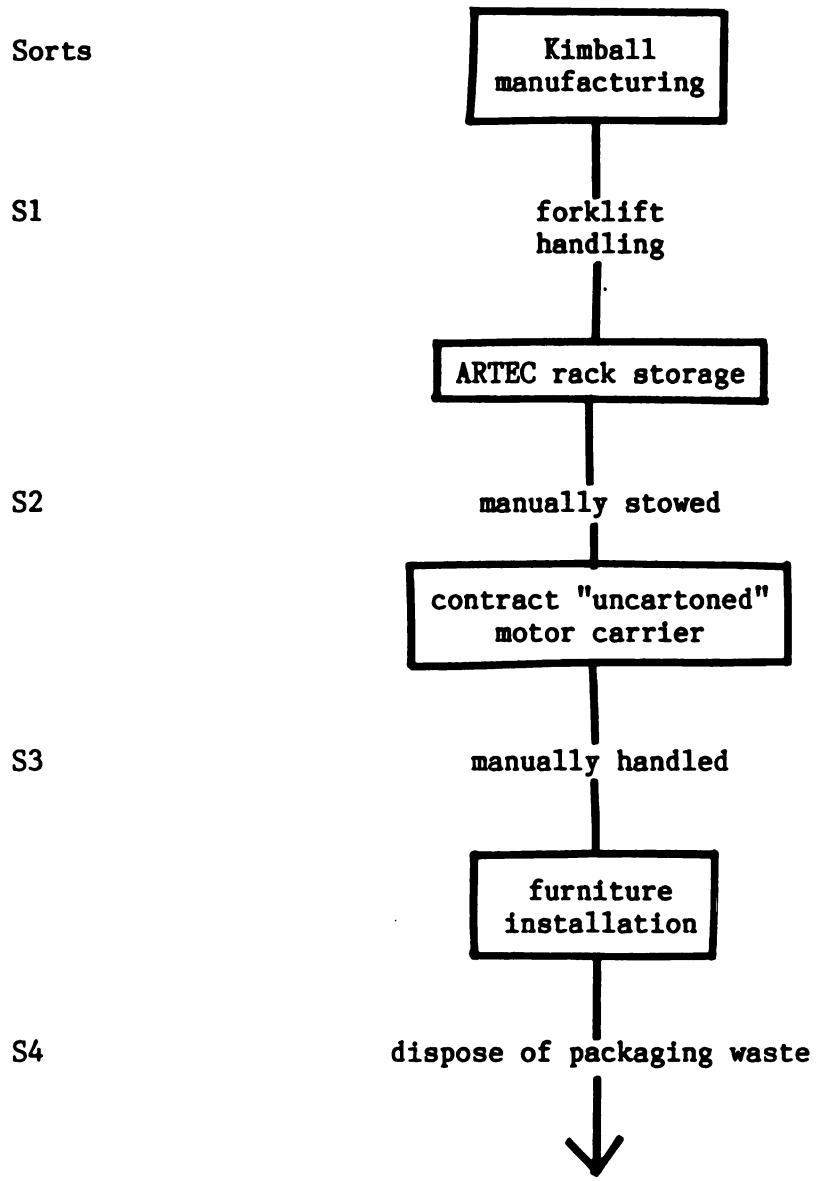

Figure 16. Kimball's distribution channel/transvection for the ARTEC line is a contractual vertical marketing system through an independent dealer network which also sells other firms' products. Installers may be independent contractors. Uncartoned contract carriers are used in this transvection.

the disposal problem. The relationship between the Distribution Manager and uncartoned carrier representative was responsible for the knowledge and awareness as well as favorable impressions concerning the innovation. The Marketing/Sales function definitely reflected the customers' refuse disposal concerns, and forwarded information where needed.

The Systemic Nature of the Innovative Package: Installers, Dealers and uncartoned carriers are the channel members who benefit from this innovation. The disposal costs have decreased, which benefits installers (and therefore dealers who pay installers), and the transportation price for uncartoned carriage is greater than that for ordinary contract carriers. In addition, ARTEC's own consolidation warehouse benefits because handling the stretch-wrapped palletload is easier than was the former stack of boxes. There are two transaction cost differences between cartoned and uncartoned shipping: the price of shipping is higher, and the price of disposal is lower, as reflected in lower installer charges to dealers. Although dealers benefit from decreased disposal costs, they do not pay more for the uncartoned product.

The Incremental Cost and Performance Effect of the Innovative Package: This innovation is perceived by ARTEC to be more incremental than radical since the Distribution manager was previously employed by a furniture manufacturer shipping wall panels in plastic. Knowledge about package performance was gained through experience, trial and error.

Container-costs-per-unit changed little with the new package: material costs are probably lower, and the packaging operation may require less labor because manual boxing operation has been eliminated, although the stretch-wrapping operation is added. Package cost reduction was not a goal of this package change.

An improvement in the packaging function of utility for installers was the reason for the package change. Before the decision, the following costs were compared for the box vs. plastic: transportation cost, cartoning cost, box purchases, dealer labor savings, and average disposal differential. The disposal differential (about $15,000 for a large job) was the deciding factor. Since the plastic bag-wrapped panels are difficult to handle in warehouses, ARTEC decided not to ship uncartoned to customer warehouses. Special material handling training is required for manual handling of uncartoned freight. For protection and ease of handling and storage, panels are unitized for the shuttle from factory to order consolidation warehouse. The units are then broken down for trailer stowage to maximize trailer. This manual truck loading takes more time and care, but it has always been manual and break-bulk. They considered shipping unit loads, but cannot maximize the cube in the delivery vehicle. Furniture cubes out before it weighs out. Furthermore, installers must manually unload the trailer at installation sites, because there is seldom a loading dock. There is no difference, however, in cube utilization with bags or boxes as panel packages. The full trailerload is delivered directly to the installation site. Uncartoned carriers' trailers are much easier to stow because of fixtures, belts, and blankets. The uncartoned service is premium priced,

depending on distance. From Indiana to Nashville is no difference in price, but it may be as much as 45% higher to the coast (insurance is higher too). Installation is much easier, now that packages are easier to open and unpack. There is less concealed damage because you can see through the plastic bag. They don't think that there is any difference in damage rate. This package is designed specifically for this direct delivery to an installation transvection.

The packaging function of protection did change. In the first shipments using just a thin bag, abrasion occurred. With package improvements, however, its protectiveness has increased. It is still not considered strong enough to send to a customer's warehouses or to ship in conventional trailers. Since the package is easier to open and see the product, damage is avoided in the opening operation. The bag's primary purpose is to protect from dirt. The first shipments were closely watched. As a result, the bag thickness was increased and the end-caps were added. Since this furniture is custom-built, damage is tracked very carefully in case replacement is necessary. Distribution gets direct feedback from dealers, installers and on-site people (ARTEC has its own representative there) Since it's shipper load and count, there are no stops, in-transit damage is negligible. ARTEC says that people are more careful with plastic-wrapped panels than with boxes.

The packaging function of communication was a definite consideration when replacing a billboard-sized box with a clear bag. A sticker tag with a bar code (stock-keeping-unit and customer identification) on outside and a "manifest" inside the bag (identifies stock-keeping-unit, fabric, and where to fit the panel in the installation). Bar codes are used to track products through the production and distribution system. Since orders are custom-built, there is less need to identify products for picking.

General Motors B.O.C. Division

General Motors B.O.C. Division[9] was one of the first American automobile manufacturers to convert a large segment of its part suppliers to returnable packages: high density polyethylene injection-molded collapsible boxes. Part surfaces are protected with heavy plastic cells or other dunnage. Although the dunnage is part-specific, and is labeled so it can be returned to the same supplier, the boxes are not and are interchangeable. There are 8 modular sizes, and each box is identified, once it is filled, by the GM part number on 2 tags on the outside of the box. This packaging system replaces 700 different corrugated box designs (many were "pallet boxes"). Whereas suppliers purchased expendable corrugated boxes themselves; the new returnable boxes are purchased directly and owned by General Motors.

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[9]Interview with Steven Lyman, Material Handling/Packaging Engineer, General Motors B.O.C. Division, Lansing, Michigan; June 1, 1987.

The Initiation of the Adoption Process: The innovation process at BOC's Lansing Car Assembly plant was initially triggered when the Plant Manager saw reusable plastic packages in Japanese factories. The housekeeping aspects of returnable packages sparked the initial investigation. Japanese factories are generally much cleaner because they are not filled with corrugated packages on their way to the baler.

The adoption process at Lansing Car Assembly took 2 years from initiation to implementation of the first supplier in 1986. Although cost reduction was not the initial concern, costs were carefully projected as GM acquired knowledge about returnable plastic packaging systems. Information came from suppliers of plastic containers to other industries; there were many similar packages produced for other products (i.e. bread and pharmaceutical distribution). Plant and Industrial Engineering were involved in the early discussions where attitudes were formed toward the innovation idea. Buick City, a sister plant in Flint, was adopting a similar packaging system, and ideas were shared.

At the time, Packaging in Lansing Assembly was an Industrial Engineering function. Packaging compiled surveys of the number of corrugated pallet containers per day (2750), clocked time-and motion-studies, counted personnel, and calculated the cost of trash smashing and disposal. Packaging used this data to sell the other departments. Purchasing and Traffic had to be sold on the idea, and were not really involved in the project until the decision was made. Traffic was not consulted until a year after consideration had begun. The forklift drivers were not involved in the decision. Suppliers were not involved in the decision either. As the decision was made to implement, the Packaging Department was moved from Industrial Engineering to Materials Management, to better align it organizationally with Traffic and Purchasing.

The Packaging Department reviewed five different plastic package designs, submitted by container suppliers. Most were rejected because of higher cost (of material, weight and handling), or because the design was propriatary. GM's desire was to own the container tooling. The final adoption decision was approved by Production, Engineering, and Materials Management (including packaging, traffic and purchasing. Some individuals in these departments were still resistant.

The Implementation of the Innovation: Packaging championed the implementation within the Materials Management department. A group of suppliers from a small geographic area was chosen for the pilot implementation. Packaging worked to obtain price reduction commitments from suppliers and then worked through purchasing to have them written into the contracts. Many of the parts suppliers were resistent until they understood the overall benefits. Packaging also got Traffic involved to get lower round-trip low rates, and obtained a rate commitment 10%-50% lower than the one-way price for the backhaul trip. Once the new containers showed up on the factory line, Packaging reasoned with the union forklift drivers to show them the benefits of the new

containers. The drivers resisted the containers because they resented the extra work: where they used to deadhead back from the assembly line, now they have to carry an empty.

Since the implementation, GM-BOC has decided against dedicating containers to suppliers in order to make the system more flexible. They extended the cycle time from 10 days to 18, trading package inventory cost against transportation cost: one drop-off costs about $45, no matter how many containers are dropped off. (Thus, they avoided the problem of lack of flexibility due to dedicated containers in too short of a cycle, which can foster an adversary relationship with suppliers.)

Returning and sorting containers was not as easy as expected; it requires space to sort and clean the packages. So GM-BOC set up a separate consolidation facility down the street, for preparing empty packages to be returned to suppliers: cleaning, stacking, unitizing, staging, and loading them into the right trailer to return to the part supplier in a timely fashion.

GM also decided against a couple of package styles, after the initial implementation experience. They found that structural foam cracks more easily (40% loss per year on a couple of container styles). Rotationally molded high density polyethylene has provided the best performance. They decided against using polyethylene foam dunnage because it gets dirty, and are now using thick plastic sheeting for cell as well as some expendable dunnage when it is more economical.

GM-BOC Lansing Car Assembly "in general" is happy that they made the change. The program is being expanded to other manufacturing sites within GM-BOC. Even suppliers who were initially resistant like it now, because they find that the reusable packages increase their productivity. Purchasing came to understand how packaging savings could help them to comply with a GM goal to reduce cost per part.

Distribution Structure and its Role in the Innovation Process: GM-BOC is related to its OEM parts suppliers in a vertical marketing system, administered purchasing by GM. The transvection traveled by a reusable package consists of an almost infinite number of sorts, 7 per product/trip (see figure 17). Contract carriers are used, and return rates are included in the contract. GM has obtained 10% lower inbound tariff ("less damage"), but since the new packages are heavier, the overall inbound rate is about the same as before. Return rates are as much as 50% lower than the original one-way tariff.

During the initiation of the adoption process, channel members were not involved. Suppliers and Transport companies were not involved until after the decision was made, and then they were directed to comply. Trailer size was considered in package design, to maximize cube.

During the implementation of the adoption, Part Suppliers worked to adapt the innovation to meet their needs. They requested a longer return cycle and advised on container and dunnage designs. When their requests

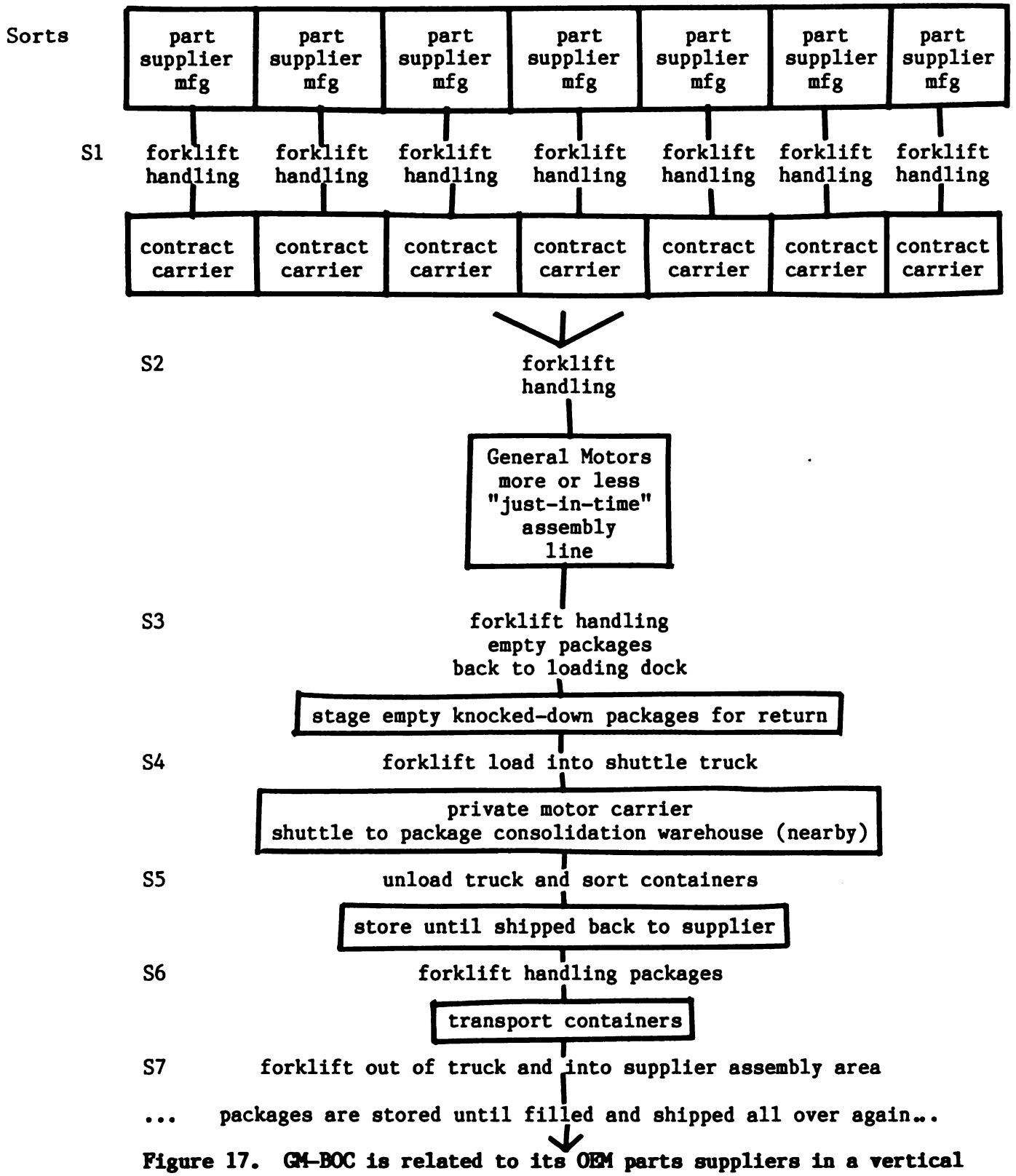

Figure 17. GM-BOC is related to its OEM parts suppliers in a vertical marketing system, administered purchasing by GM. The transvection traveled by a reusable package consists of an almost infinite number of sorts, 8 per trip. Contract carriers are used.

were granted, suppliers became more cooperative. As time goes on, suppliers have become more helpful and have worked with GM and its competitors (who buy from the same suppliers) to institutionalize the package change across the industry. A technical resource organization, the Automotive Industry Action Group, has been formed to study and recommend returnable plastic packaging forms to automotive companies and their suppliers. Since GM-BOC is the consignee, it watched over the implementation in the factory and docks; it is easier to monitor a package's performance on the consignee side of a transvection. Carriers were very helpful and participated in test shipments with no damage problems. The only carrier problems involve taking too long to return packages.

Gatekeeper relationships between the firm and channel were important. Packaging found that it needed to deal directly with the Part Suppliers, that Purchasing did not have the expertise to determine package designs or to negotiate price reduction based on package savings. Purchasing's resistance resulted from the part suppliers' initial reluctance to grant price reductions. But later, Part Suppliers accepted the new packaging system; Japanese suppliers are the best about compliance, negotiation, and communication; internal GM suppliers are less involved because they have traditionally used returnable metal racks. Later, Traffic was able to negotiate lower carrier rates without Packaging's help. Carriers were anxious to receive the GM contracts (which now include less deadhead backhaul), and transportation rates have been negotiated lower than expected.

The Systemic Nature of the Innovative Package: Suppliers' costs have decreased because they no longer have to repeatedly purchase expendable containers. Transportation cost is increased, however, over one-way packages because of hauling back the empties; some transport legs have decreased costs by creative routing and "milk runs." The Classification Commissions were not involved in the package change. The addition of the consolidation center for empty containers was an increased cost. Suppliers' cost savings are passed on to GM-BOC in decreased per-part purchasing costs. GM-BOC has a computer program to generate "payback" for implementing the package with a supplier, it includes price reduction, transportation cost increase, the consolidation warehouse ($4,000/month), and the package cost. GM buys the packages directly.

The Incremental Cost and Performance Effect of the Innovative Package: GM-BOC Lansing Assembly did not perceive this innovation to be radical. The plastics fabrication knowledge was well developed. Knowledge of package performance and relative durability of different forms was learned through experience. Although GM has used reusable metal racks for many years for some parts, the most knowledge required was in the management of the returnable container system in part supplier price negotiation and sorting management.

The container-costs-per-unit is much greater for the returnable packages; the investment in the containers is equal to 2.3 years'

purchases of corrugated boxes. (This was the original estimate, before the cycle was lengthened and inventory increased.) The contributors to this cost are: material cost, size and shape, and volume discount because GM buys all packages rather than suppliers buying smaller quantities. The number of uses is greater than estimated (except for one discontinued design). The cost of unpacking is less, and package disposal for GM-BOC is practically eliminated with this package. There is also less damage costs, since this package is more protective. One of the unforeseen cost benefits from standardizing the package, is that it facilitates a more uniform material handling system. The costs of distribution packaging materials, transportation, and sorting are now tracked by GM.

The packaging function of utility changed throughout the channel. Standardized packages make handling more uniform and efficient. Less refuse handling is required, and disposal is eliminated. The package size and shape were planned to maximize space and weight, so that the maximum number of parts are handled at once. The empty packages nest into 1/4 return ratio, and can easily be returned in unit loads. They are compatible with existing material handling equipment. Picking efficiency is not affected because "just in time" manufacturing philosophy change accompanied the package change. Packaged part quantities conform to filling the box and box dimensions conform to trailer size. Vehicle loading is a little faster and easier to plan for, although this was not a consideration in the decision to adopt. Packages stack better because the plastic is strong in compression and does not sag in a humid environment, and stacked loads interlock. The full truckload from inbound consolidation centers (for just-in-time) is better for utilizing cube because of modular design, but LTL (70% of movements) is no different. Trucks weigh out before they cube out, however, and the returnable is a little heavier then the former package. The inbound tariff is 10% less because the package is more protective and carriers get backhaul rates as well, which was not considered in the decision to adopt. Package return costs are higher, and return management hassles are greater for returnable packages, but disposal costs are eliminated. GM-BOC's unpacking and line costs are lower. In the spirit of just-in-time, part quality is more dependable and there is less in-transit damage as a result of the new package. System-wide, package handling efficiency has been improved.

The packaging function of protection improved with the new package; it is more protective than a corrugated box. It stands up to multiple handlings, stows safely in a trailer, stacks better, and is less easy to burn (tested for toxic fumes). Laboratory tests include: impact, synchronous vibration, compression, dynamic compression, and "stress analysis performed on a computer." As a result of testing, the package was modified by adding ribs and heavier material to increase strength. Whenever parts are delivered damaged, a copy of the claim is forwarded to Packaging, Traffic and the Supplier, to figure out why damage occurred.

The packaging function of communication changed little with the new package. Rather than using dedicated containers, GM-BOC decided to add id tags attached every time a supplier fills the container. This

improves the system's flexibility, and results in no significant difference than with corrugated boxes which had similar tags on 2 sides. Quantity is dependable, and there are always the same quantity from the same supplier in the "same" box.

Nordyne

Nordyne[10] manufactures furnaces and air conditioners for mobile homes. It was an early adopter of stretch-wrap distribution packages, spiral wrapping the furnace onto a pallet. Angle-boards at the corners bear the Miller logo, the corrugated top cap has a different color printing on 2 sides for each sku, and a sticker label with the sku information is applied to the outside of the stretch-wrap. This package replaces a corrugated full-length cap with corrugated cornerposts and pallet.

The Initiation of the Adoption Process: The innovation process was initially triggered by awareness of stretch-wrapped furnaces being shipped by a competitor. Some of Nordyne's mobile home manufacturer customers, (Nordyne sells to both OEM customers and dealers) also buy the competitor's package and liked it; the OEM customers requested the change to reduce their cost of disposing of corrugated board. The initial benefit sought by Nordyne was the reduction in the cost of packaging materials and operation; the boxing operation was a full-time job. "Times were lean and we were looking for cost savings." The Manufacturing Engineering department initiated the innovation process.

The adoption process took 7 years from initiation to implementation in 1986. Their competitor's package was the source of knowledge and awareness of the idea. Early discussions, where attitudes were formed toward the innovation idea, involved Marketing, Sales and Manufacturing Engineering departments. When the Industrial Engineering initially proposed this innovation, the Marketing department dismissed the idea because they wanted to retain the advertising on the box. The project was revived when the new Sales manager was more interested in the idea of saving money on the packaging materials and operation. The innovative prototype package was designed by the Manufacturing Engineering department. There is no packaging professional at this company. Purchasing did not design the package, but did contact suppliers; one supplier (their regular corrugated box supplier) designed the corrugated cap, and the machinery distributor provided a lot of helpful technical advice plus a demo machine to try. Four variations were considered:

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[10]Interview with Wayne Boeve, Manufacturing Engineering Manager, Nordyne, 900 Brooks Avenue, Holland, Michigan, March 20, 1987. At the time of the interview, the company's name was Miller Heating and Air Conditioning Co., and before that, when the decision was made to adopt the innovation, their name was Lear Sigler Home Division. The Nordyne product is marketed under two brand names: Miller and Innertherm.

other stretch-wrapping machinery manufacturers and shrink-wrap. The other systems were rejected because the equipment chosen is the best designed and has the best features in stretch-wrapping systems (high stretch rate and secure film-end); shrink-wrapping was rejected because of the high energy requirement. The decision to adopt was made by Manufacturing Engineering, Marketing, Quality Control, and Transportation. No one was really against adoption, but Marketing was skeptical because of some negative feedback from dealers (OEM customers, however, encouraged the adoption).

Implementation of the Innovation: Manufacturing Engineering planned and Plant Engineering installed the operation. Purchasing picked out the angle-board. Marketing assisted in the prototype design. Since the implementation, Quality Control requested a change of angle-board suppliers because of inconsistent thickness from the initial supplier, and Purchasing switched film suppliers to a less expensive one. Nordyne is happy that it made the change; the new package has been well received, and there is no resistance to it.

Distribution Structure and its Role in the Innovation Process: Nordyne uses both kinds of distribution channels: vertical and non-vertical marketing systems. The vertical channel is contractual, furnaces are shipped directly to mobile home original equipment manufacturers (OEM). The non-vertical system is free-flow to the mobile home aftermarket, shipping to independent dealers' warehouses and then on to installers. The OEM transvection is very short, only 4 sorts, and the free-flow system is six (see figure 18). Nordyne uses all three kinds of carriers: most deliveries out of their factory are on their privately owned trucks, but contract and common carriers are used in some transvections.

During the initiation of the adoption process channel members affected initial knowledge and awareness of the package innovation, because OEM customers requested the new package, after using the competitor's package. OEM customers, therefore, encouraged favorable attitudes from the outset; but dealer customers were less enthusiastic. Nearly one year before the decision was made to adopt, a demo machine was used for wrapping 500 units, and over 150 shipping tests to major customers were conducted to determine problems but mostly to educate Miller personnel, truckers, and customers. Roadway objected at first but when threatened with losing the business, it decided that the stretch-wrap was ok. OEM customers affected decision to adopt. Dealers' wishes did not deter adoption, but only affected how much persuasion was required.

By the time that the adoption was implemented, the pre-decision test shipments had primed the channel; channel members were accustomed to the package, and routine shipments began immediately. The only problems occurred in manual handling and truck unloading, and were solved within 4 months. One problem occurred when the furnace was tipped onto a dolly--the cap would come off and impair the package integrity. To solve this problem, the cap was modified by cutting notches into the cap corners so

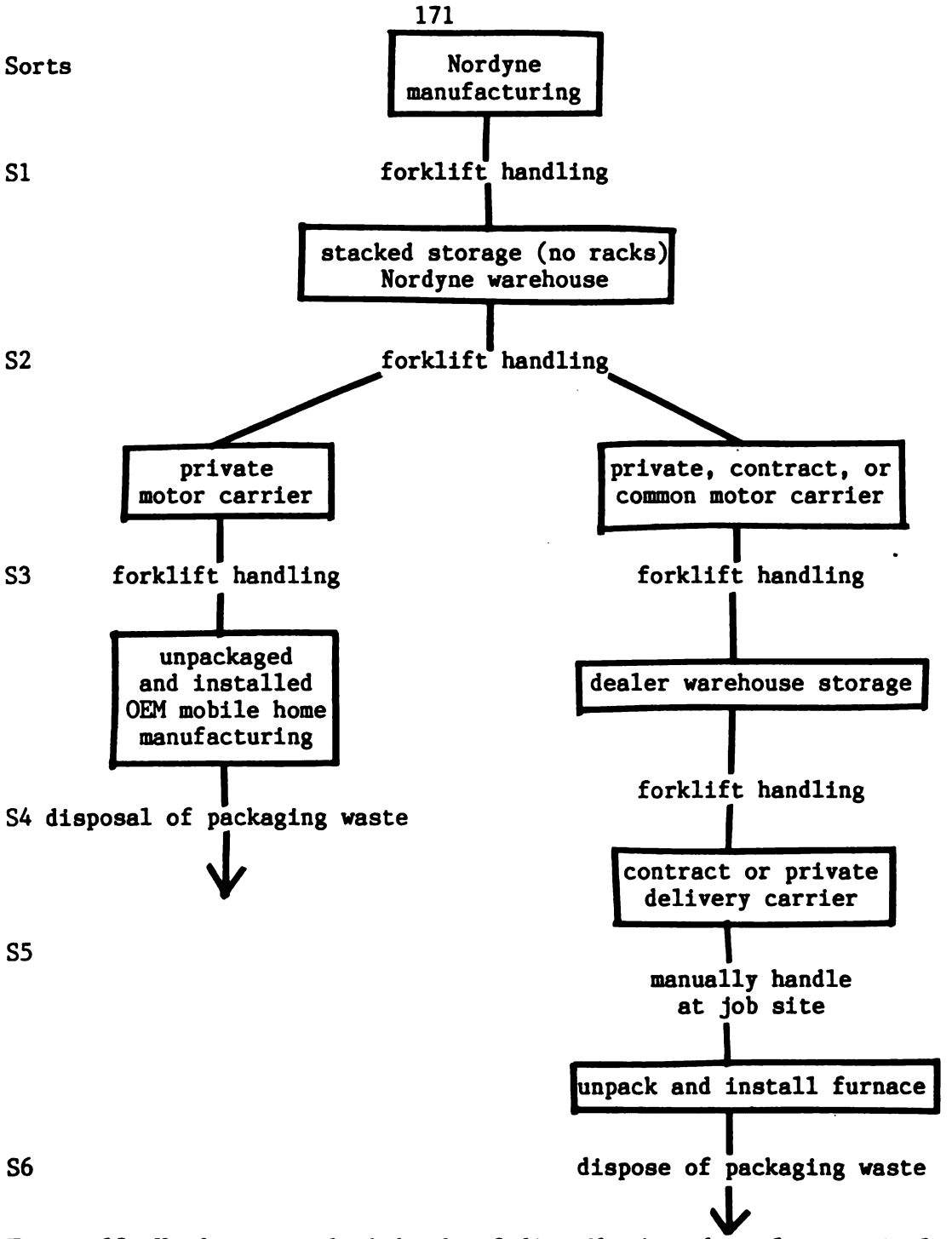

Figure 18. Nordyne uses both kinds of distribution channels: vertical and non-vertical marketing systems. The vertical channel is contractual, furnaces are shipped directly to mobile home original equipment manufacturers (OEM). The non-vertical system is free-flow to the mobile home aftermarket, shipping to independent dealers' warehouses and then on to installers. Nordyne uses all three kinds of carriers; most deliveries out of their factory are on their privately owned trucks, but contract and common carriers are used in some transvections.

that the stretch-wrap can "rope" into the cap. A second manual handling problem was solved when a driver suggested hooking a roller onto the tailgate for easing furnaces onto the ground where there is no loading dock.

Gatekeeper relationships between the firm and channel were important. The early dismissal of the project by Marketing did not reflect the customers' needs; Marketing had received no negative comments from customers regarding possible stretch-wrapping, and was "just saying what he thought." On the contrary, most customers prefer it. Later, Customer Service (under the Marketing department) worked with customers and provided them with information and prototypes. Purchasing dealt with machinery, film, cornerpost, and cap suppliers. Traffic worked with carriers. No channel members really blocked the innovation, but there were various degrees of enthusiasm: OEM customers prefer the stretch-wrap; after-market installers encouraged the innovation because it would diminish waste; dealers who handle the competitor's stretch-wrapped furnaces encouraged the innovation; but some dealers were concerned that there would be more damage, and one common carrier raised objections, but both have since been convinced.

The Systemic Nature of the Innovative Package: OEM customers and installers are the only channel members whose costs have changed: their disposal costs are lower. But they do not pay more for this benefit. Likewise, Nordyne's packaging savings are not passed on. Some dealers' concerns led them to offer "to carton for an extra charge," but there were "no complaints."

The Incremental Cost and Performance Effect of the Innovative Package: This innovation is perceived by Nordyne to be more incremental than radical. It did not require much new knowledge since it was already adopted by a competitor. It required so little knowledge about plastic that they do not know what kind of film is used. It required more knowledge about machinery: pre-stretch, speeds, styles and suppliers, methods to seal off the film end. Test shipments provided knowledge concerning performance.

The following components of container-costs-per-unit decreased with the new distribution package design: packaging material costs less, one roll fits all less material inventory, the packaging operation is automated and requires less labor. The stretch equipment investment was the only cost that "increased."

The packaging function of utility changed primarily for customers, by making the package easier to open, unpack, and dispose of. In handling, there is not much difference except for the fact that there is no concealed damage, because product is visible. Furthermore, Nordyne believes that stretch-wrapped furnaces are handled more carefully because the material handlers can see the product. Initially, there was some problems in manual handling; when the furnace was tipped, the cap would pop off; 3-4 months after implementation, notches were added to the cap so that film will "rope in" and hold the cap on during manual handling.

To help with manually unloading truck, a truck driver offered the idea of a roller that could hook onto the tailgate, so that the furnace can be rolled onto the ground; now Nordyne's fleet is so equipped.

The packaging function of protection did not change. But in order to insure this, field tests were run and feedback was sought from customers, but there were no complaints. National Safe Transit Association tests performed by their box supplier who was hoping to retain the cap and cornerpost business; these tests include free-fall drop, incline impact, synchronous vibration. In addition, stacking tests were performed in Nordyne's warehouse. Damage rates were checked before and after the new package was implemented and no difference was found. "There are not enough claims to worry about." The transportation claim function is in the accounting department.

The packaging function of communication was an early consideration because the Marketing department was concerned about the loss of brand identity once the box could not be used as a billboard. This was resolved by printing all four cornerposts with the brand logo. Stock keeping unit information is found on stickers on two sides (outside the plastic), and there is a different color code for each product printed on 2 sides of the cap. There is no "ship to" information or bar code on either the box or the stretch-wrap. As a result, there has been no change in package-reading productivity.

Allied, Aftermarket Division

Allied's Aftermarket Division[11] was one of the first to adopt a plastic bulk-bag for a liquid product. 225 gallons of "Plastisol" adhesive, which is the viscosity of caramel (45,000 centipoise), is packaged in a multiple-component "bag in a box," replacing 55-gallon steel drums. The adhesive is shipped to Allied to be used in the manufacture of air filters for vehicles. The package has 4 components (listed from outside in):

1. Steel wire-mesh "cage" collapsible container with integral pallet has a 8" trap-door in the bottom for dispensing product.
2. Double-wall heavy-duty high density polyethylene 20 mil shield, on five sides, with a port in the bottom.
3. "Rhino" bulk bag woven polypropylene with a polyethylene coating inside (10 oz/sq. yd.) with 11" top and 6" bottom ports.
4. Inner liner, doubled 6-mil linear low density polyethylene, with 11" top and 6" bottom ports.

The Initiation of the Adoption Process: The adoption process was initially triggered by hazardous waste disposal problems. Allied previously sent the used drums back to the plastisol supplier to re-

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[11]Interview with Gerry Schafer, Plant Engineer, Allied Corporation, Nevada, Missouri, September 11, 1987.

process and re-use. But they could not send them back with more than 1" of product in the bottom of the drum. Often the leftover product was contaminated by garbage and Allied had to dispose of the drum. Since Missouri had closed their landfills, it had to be shipped to Illinois for incineration which costs $1000/drum. A second reason for the change is that the plastisol supplier promised 2¢/lb savings if Allied in bulk. The plant engineer initiated the innovation process.

The adoption process for this package took one year from initiation to implementation with the first shipment in 1987. Investigations into ways to solve the waste problem, however, had began back in 1978; in 1982 they looked at tanks, but decided that they were too expensive, and too heavy to get a full load of plastisol and tanks on a common carrier—too much investment even though they would be reusable. Allied became aware of the bag-in-box package idea when it saw that a sister plant was using a liner in Gaylord corrugated pallet boxes for a similar product; Allied considered this package, but it was vetoed because of insufficient strength. In the course of this investigation, they met the supplier of the plastic liner, who proposed this packaging concept. The package supplier proposed the use of the bulk bag, but not the idea of dispensing out of the wire totes (this was the plant engineer's idea). The package was designed by this supplier working with Allied's Plant Engineer to fine-tuned the package and emptying process. There is no packaging professional in this division. The participants in early discussions, where attitudes were formed toward the innovation idea, were Plant Engineering, Resident Engineering, the Plant Manager and staff, and the Engineering Manager.

In the prototype stages, they tried a few different liner and top-holding methods to avoid sucking out the inner liner when emptying. The other designs were rejected because of insufficient strength. The decision to adopt was made at the division level by the Plant Engineer, Plant Manager, Engineering Manager and Purchasing; then it was recommended to Division management, detailing projected savings. The decision to adopt was not fully supported by the Manufacturing personnel, however. Due to problems in the trial stage (inner liner was sucked out the bottom hole), the Manufacturing Manager and Production Supervisor were opposed to adoption, and needed a great deal of convincing.

The Implementation of the Innovation: The Plant Manager and his staff approved the innovation. Plant Engineering developed the design, process, and made the stand from which package is dispensed. Production workers learned to make the system work. Materials Management took responsibility for the return of totes, overseeing Shipping to make sure the package is complete when sent back. Since the innovation was institutionalized, the package design has changed a little. They added a trap door on the basket, as a result of a disastrous shipment wherein they experienced a spill when several packages dragged through the hole and ruptured. They also doubled the liner as a safeguard. Allied is very glad that they made the change, especially about the material savings and disposal ease. They can get rid of the liner in a local landfill if there are less than 10 lbs. of plastisol left in it, which

always occurs because the bags are squeezed empty. There have been a few problems, like the spill, which have scared the production workers, but generally everyone likes it. The implementation was very recent, and seven shipments have been made, at this writing, without failure.

Distribution Structure and its Role in the Innovation Process: Allied's relationship to its plastisol supplier is contractual. Their contract is annually approved. There is another supplier of this product, but it is not usually used because it has a higher cost. The transvection consists of 5 sorts (see figure 19). Common carriers are used; this product is almost always shipped in truckload quantities.

During the initiation of the adoption process, the supplier encouraged Allied's favorable attitude towards the new package. In fact, the alternative plastisol supplier liked the package so much that they tried to buy the company that designed and sold the bulk bags.

During the implementation of the adoption, the supplier cooperated with test shipments, at first 2-3 totes per shipment. The first big test shipment, however, suffered a big spill; 3 of the 9 containers leaked due to the discharge tube hanging out the bottom hole which was not then covered by the "trap door." Several package changes resulted, but the spill set the project back by 2 months. Although the plastisol supplier was "miffed" by the spill, it paid for the loss.

Gatekeeper relationships between the Allied and the channel members were important. [ask who talked to whom] Purchasing was sensitive to the request for bulk shipping, and the supplier encouraged the project from the beginning. The carrier was cooperative, since full-truckload shipments are never handled by the carrier. The product is not warehoused except in Allied's own storage.

The Systemic Nature of the Innovative Package: The new package saves supplier time and decreased its cost of filling and handling. It is stackable, eliminates the need to stop the assembly line for change-over, and reduces the cost of returning bulky empty drums. It does not affect the truckers, and there was no involvement with classification boards. It quadrupled material handling productivity because the package is over 4 times larger. Since the package decreased the suppliers' costs, it passes on the savings by decreasing the price by 2 cents per pound.

The Incremental Cost and Performance Effect of the Innovative Package: This innovation is perceived by Allied to be incremental in the sense that the package concepts were not new. Bulk bags have been used for many years for dry powder and granular products, and the bag-in-box idea has been used for beverages and institutional packages for liquid food products. But the application of these package concepts to a viscous industrial product was unique. Allied did not need to learn anything new about plastic materials, but did need to learn how to use and handle the new package, by trying. The Plant Engineer stressed the need to not be discouraged in a new project by early failures.

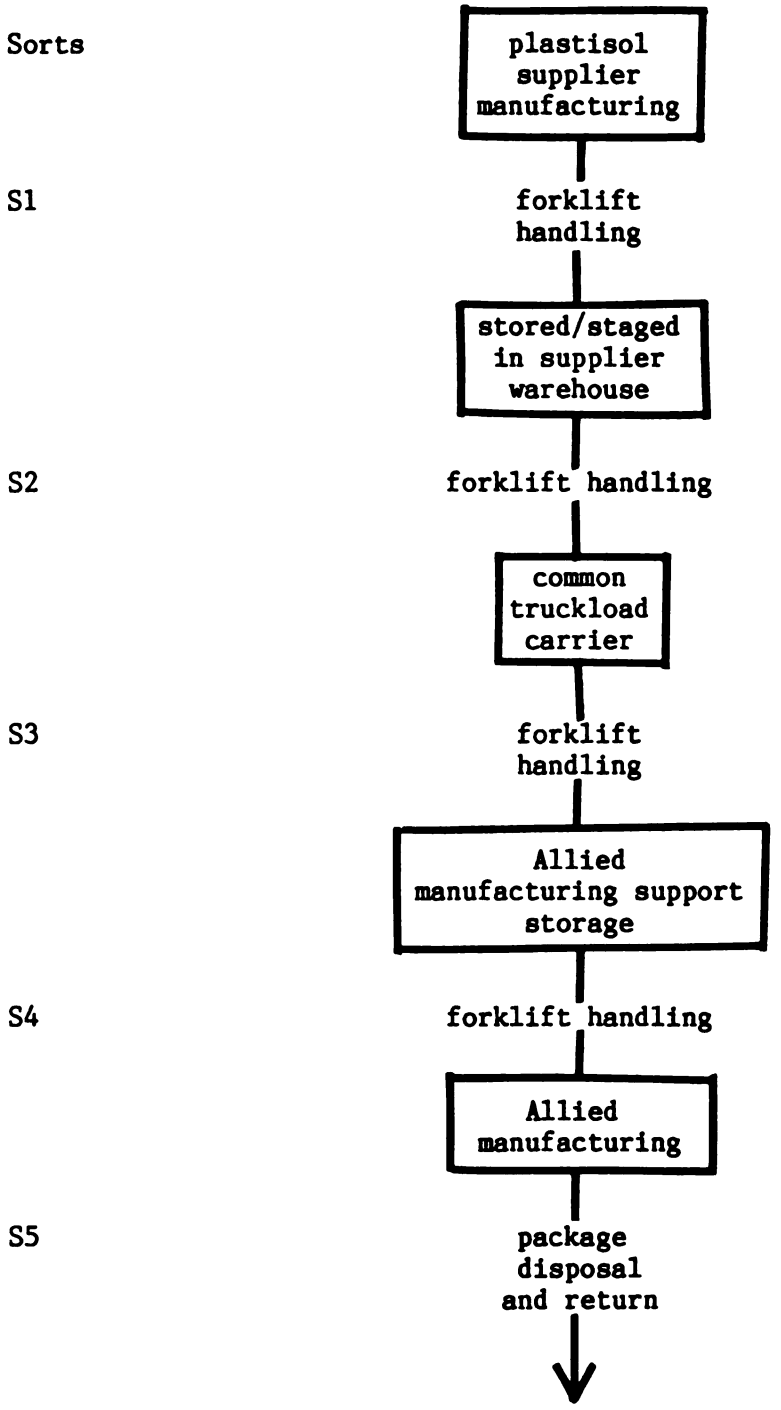

Figure 19. Allied's relationship to its plastisol supplier is contractual. Their contract is annually approved. There is another supplier of this product, but it is not usually used because it has a higher cost. Common carriers are used; this product is almost always shipped in truckload quantities.

The container materials costs-per-unit decreased with the new distribution package design, considering that most of the package is reusable. The price of the plastisol is also lower, approximately $12,000 savings annually. But the real savings is in the emptying costs on the line because it does not stop the assembly line for change-over of packages. It used to take 10 minutes of line downtime, but now they do not need to shut it down at all. Furthermore, since the bulk bag holds 4.5 barrels, changeover is less frequent, about once per day. They have no separate accounting of package costs, but to make this package decision, they got a break-down from Accounting, of how much the packages cost, including disposal costs and package return costs.

The packaging function of utility changed a great deal, although the pallet-style bottom can be handled by everybody. Allied finds that this package is more difficult to handle (because of transferring heavy weight overhead), but that there are 4.5 times fewer handlings, and the line needn't be shut down for changeover. The package is elevated, so that gravity helps to empty it. The changeover process is this: a level indicator lets the set-up person know when to change the package; the top is tied to the chain hoist, the bottom discharge tube is cut open, and the bag is slightly lifted to get the product to run out the bottom; then the liner is removed and the excess product is squeezed out through rollers. The filled packages are stored 2 high and take less room than drums, but more room to maneuver is required. In transportation vehicles, this product weighs out, and there is no difference in transportation efficiency, except for the addition of LTL empty package return costs, which is offset by the previous cost of returning empty drums. The tote collapses to a 42" x 42" x 9" package; five are strapped together for return. The original benefit sought has been satisfied: the liner can be legally disposed in a local landfill.

The packaging function of protection also changed. This package is less strong than a 55-gallon drum, and must be handled more carefully. There have been no leaks since the big spill. The package is vulnerable to mechanical damage to the seals and liner. There have been no product/package compatibility problems. There we no lab tests performed; only shipping tests. When there is a claim for damage, transportation handles it.

The packaging function of communication changed a little. Now wire-affixed tags identify material, lot number, Allied as consignee, and the supplier's name.

Shaw-Walker Company

Shaw-Walker Company[12] is one of the earliest to consider adopting stretch-wrapping for custom-built office furniture: desks, filing cabinets, and credenzas. Spiral stretch-wrapping with top cap and bottom tray will replace the two packaging systems currently used: one uses very expensive corrugated cap-and-tube boxes, and the other uses no cartons but is shipped by padded van. As of this writing, Shaw-Walker has not yet made the decision whether to adopt.

The Initiation of the Adoption Process: The innovation process was initially triggered by a space problem. Too much corrugated board was stored everywhere in the furniture factory. Since each stock keeping unit requires a different package (size and shape), the investment in inventory and storage of cardboard is immense. The goal was to reduce package inventory and improve floor space efficiency. Furthermore, since packaging operations are manual and fragmented at the end of each product's production (chairs are made in one place, file cabinets in another, desks in another...), a goal was to automate and consolidate packaging operations at one place in the factory ("condense and transport"), to better utilize floor space currently devoted to packaging operations and material storage. Industrial Engineering originally discovered the problem during time-and-motion studies to reduce line costs; after that, Plant Project Engineering led the adoption process.

The adoption process is still underway. It began in 1985, and the first stretch-wrap machine installation has been planned to occur sometime during 1987. Consultants asked to investigate the plant utilization and packaging automation problem were the source of knowledge and awareness of stretch- or shrink-wrapping as a solution, since one roll of film fits all products, and the packaging operations could be automated and centralized. The primary benefit sought from this package is an improvement in manufacturing efficiency. Industrial, Project and Manufacturing Engineering, Shipping, Operations Management, Marketing, and outside transport vendors were involved in the early discussions where attitudes were formed toward the innovation idea. The prototypes were designed by material and equipment suppliers. An Industrial Project Engineer and an Industrial Engineer have championed the project. During their investigations, they visited Nordyne to see its furnace-wrapping system at work. There was formerly no packaging function except for Purchasing's relationship with corrugated board suppliers; but Purchasing has not been directly involved in the innovation process. Shaw-Walker plans to change its packaging function to become more of an engineering and less of a purchasing responsibility; they have just purchased an National Safe Transit Association lab and plan to hire or train a packaging engineer. Five variations on basic stretch-wrapping idea were

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[12]Interview with Barry Mahal, Plant Project Engineer, and Jim Kenny, Industrial Engineer, Shaw-Walker Company, Muskegon, Michigan; March 20, 1987. Since the decision has been made to implement, and they are in the early stages of implementation, a second interview will be conducted in August to document implementation events.

considered for filing cabinets, as well as many different chair and desk wrapping designs. The other designs were rejected because they either looked bad, were not strong, took too much time to wrap, or did not pass the NSTA tests. Although they are still trying, they have not found a good stackable plastic chair package, and it looks like chairs will stay in boxes.

The Implementation of the Innovation: The decision has not yet been made whether to adopt, and no implementation has occurred.

Distribution Structure and its Role in the Innovation Process: Shaw-Walker's distribution channel is a vertical marketing system: contractual through authorized dealers (installers contract with dealers). The typical transvection consists of 3 sorts (see figure 20).

Dealers said that they like what they saw in the test shipments, and indicate that the package is a "marketing feature" which differentiates the product.

There has been no carrier classification commission involvement. Shaw-Walker feels that as a result of transportation deregulation, ATA approval is no longer required. Their LTL carriers suggested the NSTA tests, and the NSTA has recently approved this type of package for furniture.

The Systemic Nature of the Innovative Package: Marketing had little involvement in the adoption, but they "love" the new package concept. The ultimate customer never sees the package because the furniture is installed. Dealers who have been shown the package like the see-through feature because it is easy to discern product colors and damage. Furthermore, their package disposal costs would be lower.

The Incremental Cost and Performance Effect of the Innovative Package: The innovation is perceived by Shaw-Walker to be more incremental than radical. Although the application is an inventive use of stretch-wrapping, the technology is well developed and the process is easy to understand. They needed to learn a little about the differences between stretch-wrapping machines, and more about the properties of different stretch-films. They needed to learn the most about package performance, and test shipments were the source of this knowledge.

The following components of container-costs-per-unit would change due to the new distribution package design: lower material costs, lower package inventory requirements, and lower labor requirements, but the investment is large. Shaw-Walker does not currently track the cost of packaging, but did calculate material and labor usage for this project.

The packaging function of utility is expected to improve a great deal. Since uncartoned furniture is manually handled and stretch-wrapped furniture can be mechanically handled, handling should be more productive than for blanket-wrapped shipments, but no different from cartons. However, since everything will be packaged uniformly and bar coded,

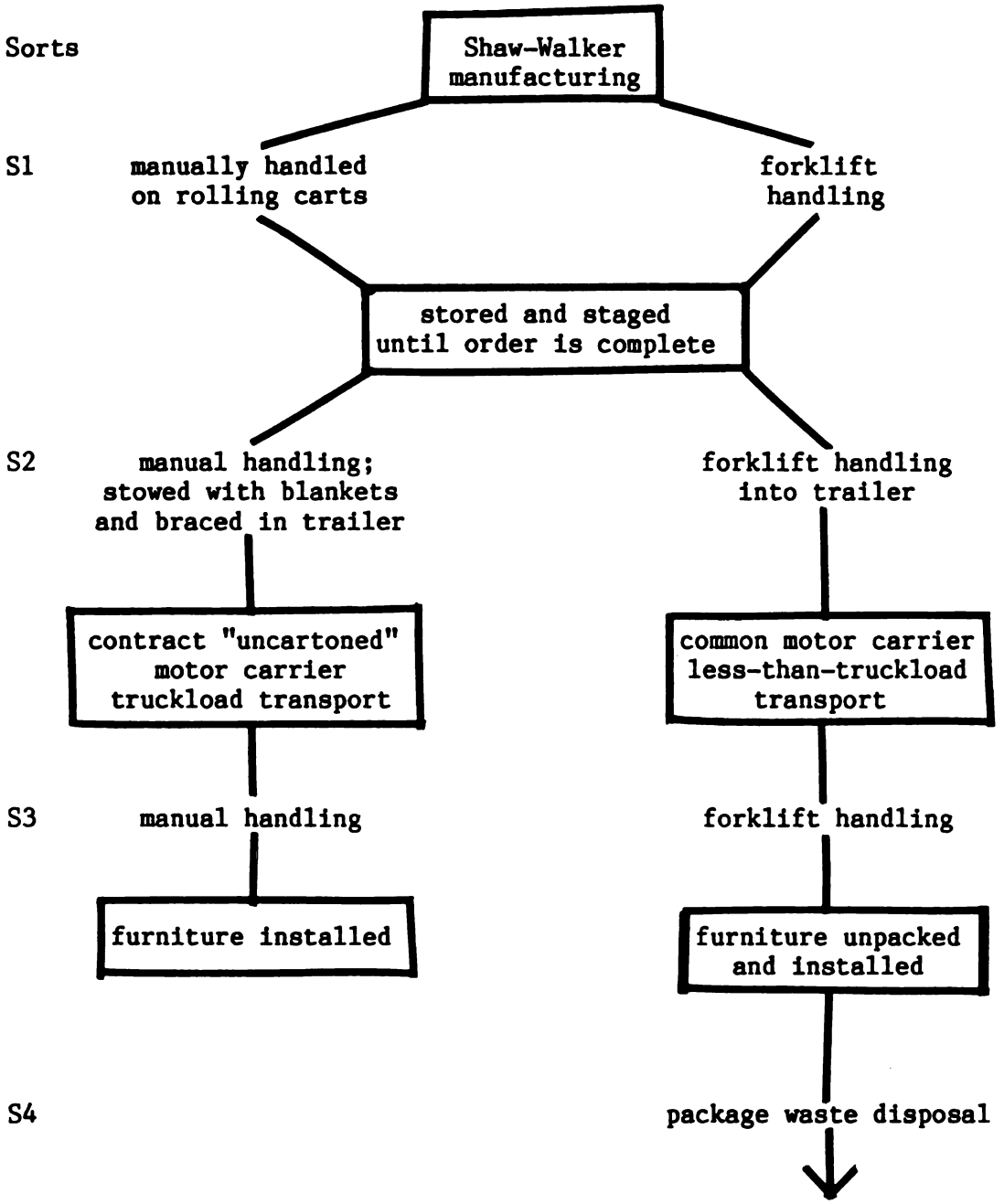

Figure 20. Shaw-Walker's distribution channel is a vertical marketing system: contractual through authorized dealers (installers contract with dealers). Common carriers are used for LTL, and contract carriers for full truck loads, shipped directly to an installation site.

shipping operations will be more automated. Since the furniture is built-to-order, there is no product storage concern. On the other hand, at least 40,000 square feet that are devoted to corrugated box storage will be freed for factory expansion. In a transportation vehicle, the cube is not utilized as well as an uncartoned load. The packages are stackable, however, and the trailer utilization is the same as when shipping in boxes. Furniture loads cube out before they weigh out. Furthermore, this package would permit everything to go by common carriage, which is much less expensive than contracted uncartoned carriage, and offers less-than-truckload services. Dealers' productivity will also be improved because the new package is easier to open. Dealers who have been asked like the package because product colors are easy to identify and damage is not concealed because of the see-through plastic. Disposal costs are less.

The packaging function of protection was definitely considered because Shaw-Walker felt that the new package would be less protective than the box, but they also felt they were probably "over-packaging" with the corrugated box. Test shipments to 12 dealers were conducted to learn about protective performance. They found that the visible furniture inside of the plastic encouraged gentler handlings than boxes which conceal the product and damage. Since a product may get as many as 15 handlings, an LTL test shipment was subjected to 15 handlings. Product strength is a key determinant of survivability; the primary protection required is from dirt and abrasion. Under the advice of carriers, National Safe Transit tests were performed (free-fall drop, synchronous vibration, and incline impact). Although no modifications resulted from these tests (six packages are "NSTA-certified"), their credibility with carriers has led Shaw-Walker to purchase its own NSTA lab. On the other hand, as a result of field test results ("93% successful), they have redesigned the tray and corner protectors. There is no routine claim feedback to Industrial Engineering, but they observed the delivery of each test shipment and discussed the package with dealers.

The packaging function of communication is not expected to change much. Tags are inside the stretch wrap (newer bar code readers can read right through the plastic). The shipping dock will use bar codes to verify orders, and warehouses will use bar codes to register product location. Furthermore, "it will be easy to see what it is," since the product will be visible. For advertising, corrugated trays will be printed with the Shaw-Walker logo.

The Questionnaire

The preceding case histories were obtained by administering the following questionnaire to the distribution packaging professional or other relevant "key informant" for each shipper. The questions are in five parts: the first and second inquires into the adoption process (initiation and implementation) ; the third seeks to find whether the channel structure facilitates or blocks the adoption process; the fourth

explores the systemic extent of the innovation; and the fifth category examines the total cost implications for the firms' transvections.

The Initiation of the Adoption Process

1. What initially triggered the desire to innovate your distribution packaging? Note all of the following which apply:
    a. Awareness of a new form of packaging which could be used for your product.
    b. Cost considerations
        i. cost of packaging materials and operations
        ii. logistical costs
            (1) sorting
            (2) transportation
            (3) storage
            (4) manufacturing
    c. Benefit considerations
        i. Protection
        ii. Utility
        iii. Communication

2. Who (what position in the firm) initiated the innovation process? How long did the initiation process last (from initial trigger to implementation)?

3. How did the firm get knowledge and awareness of the idea for the package innovation?

4. Who (what departments) were involved in the early discussions where attitudes were formed toward the innovation idea?

5. Who designed the innovative prototype package?
    a. packaging professional under the authority of:
        i. engineering
        ii. logistics/physical distribution
        iii. purchasing
        iv. operations
        v. research & development
    b. packaging material supplier
    c. packaging equipment supplier
    d. consultant

6. How many different package designs were considered?

7. Why were the other designs rejected?

8. Who (what departments) were involved in the final decision to adopt?
    a. Who was for adoption?
    b. Who was against adoption?

The Implementation of the Innovation

9. Who (what departments) were involved in the implementation of the innovation? What role did each play?

10. What changes have been made once the innovation was institutionalized? (i) Has the package design changed any?
    a. Are you happy that you made the change?
    b. Are there any individuals or departments which still resist the new package?

Distribution Structure and its Role in the Innovation Process

11. What is the structure of your distribution channel?
    Vertical Marketing System: Corporate, Administered, Contractual
    Non-vertical Marketing System: Free-flow, Single Transaction
    a. How long is the transvection? List each transformation (time, space, form) and intervening sorts in which the new package must perform. Note how the new package changes that activity.

12. What is your relationship to your carriers (factory to warehouse, warehouse to retail)?
    Common
    Contract
    Private

13. During the initiation of the adoption process, how were channel members involved?
    a. Did they affect your initial knowledge and awareness of the package innovation?
    b. How did they affect the formation of your attitudes toward the innovation?
    c. How did they affect the decision to adopt (or not to adopt)?

14. During the implementation of the adoption, how were channel members involved?
    a. During initial implementation:
        i. test shipments
        ii. claims or other feedback.
    b. During continued-sustained implementation.

15. What individual relationships between channel members and those internal to the firm were instrumental to the adoption process?

16. Describe how distribution channel members performed to facilitate or block innovation.
    a. customers
    b. intermediaries
    c. carriers
    d. warehouses

The Systemic Nature of the Innovative Package

17. How new was the idea of plastic packaging to you when you began?
    a. What did you have to learn about plastic package technology in order to adopt the innovation? Who did you learn it from?
        i. plastic properties
        ii. packaging operation and/or machinery
        iii. plastic package performance

18. How were distribution channel members affected by the new package? Did it increase or decrease their costs?
    a. customers
    b. intermediaries
    c. carriers
        i. Was the package approved by a carrier classification board?

        ii. Any involvement at all with classification boards?
    d. warehouses

19. If the package increased or decreased channel member costs, do they pass on the costs or savings in transaction costs?

20. If your Marketing department played a role in the innovation process, how do their concerns reflect their sensitivity to the "needs of customers"?

The Incremental Cost and Performance Effect of the Innovative Package

21. Which of the following components of container-costs-per-unit changed with the new distribution package design? Besides noting which of the following have changed, indicate which factors were considered when the decision was made.
    a. material costs
        i. material type
        ii. shape
        iii. quantity discounts due to standardization
        iv. number of uses, if reusable
            (1) capital investment
            (2) assembly, disassembly and repair costs
            (3) loaded and empty storage and freight costs
            (4) accounting and inventory costs
        v. material costs relative to fragility or value of product
            (1) relative to a given level of performance
    b. packing operation costs
        i. labor
        ii. capital
            (1) Was equipment due to be replaced?
        iii. overhead
    c. Do you track the cost of distribution packaging?
        i. What costs do you include?
            (1) purchasing costs

(2) operations costs
(3) logistics costs
(4) customer service costs
(5) claims costs

22. How did the packaging function of utility change when you implemented the innovation? Generally, "utility" refers to how the package makes itself useful, its contribution to logistical efficiency and costs. Besides noting which of the following have changed, indicate which factors were considered when the decision was made.

a. warehousing efficiency
i. handling efficiency
(1) equipment productivity
(a) investment
(2) labor productivity
(a) training
(3) multiple unit handling: unitization, containerization
(4) compatible with existing handling methods
(a) weight and dimensions
(b) manual or automatic
(5) stability of unit loads
(a) overwrapping, interlocking, or frictive
ii. picking efficiency
(1) equipment investment, productivity
(2) unitized in order quantities
(a)conform to discount pricing policies
(b)conform to demand
(3) "broken" cases: easy to open, select,reclose and ship
(a) discourage pilferage
iii. vehicle loading and unloading productivity
iv. storage efficiency
(1) compatible with existing methods
(2) compression strength vs. stacking hardware
(3) cube utilization
b. transportation efficiency
i. cube utilization
ii. density and number of products per load
(1) weight
iii. size may disqualify product for some modes
iv. stowage and unit load stabilization
v. intermodal rates for containerized cargo
vi. tariff may depend on packaging
vii. specialized carrier services required
(1) household goods movers
(2) reefers
(3) private fleet
viii. return costs and inventory velocity, for reusable packages
c. customer service "quality"
i. opening, unpacking, and pricing costs
ii. "merchandising" considerations
(1) modular compatibility with retail shelf space

(2) displays
(3) standardized packages facilitate retail stocking
iii. industrial customer: add convenience and productivity to assembly line
iv. returnable packages and pallet exchange costs
v. tamper concerns
vi. damaged goods (particularly concealed)
vii. methods, quantity and assortment
viii. consistent with retailer's buying habits
ix. handling methods
x. storage space
xi. disposal costs

d. system-wide efficiency
i. interface between firms: common handling and package
ii. modular shapes
iii. designed for the most restrictive handling

23. How did the packaging function of protection change once you implemented the innovation? Besides noting which of the following have changed, indicate which factors were considered when the decision was made.

a. protection from physical environment (breakage, scuffing, crushing)
i. related to number of handlings and handling methods
ii. related to transportation mode
iii. related to stack height in storage
iv. related to opening the package

b. from element environment (melt, spoil, contamination)

c. What laboratory testing or other measurements were performed?
i. impact
ii. vibration
iii. puncture
iv. compression
v. dynamic compression
vi. shelf-life (specify which methods)
vii. transverse strength
viii. is product redesign considered as a result of laboratory testing?

d. What claim feedback is relayed to the packaging department? Has damage rate changed?
i. from transportation companies
ii. from warehouses: manufacturing, wholesale, retail
iii. from customers
iv. replacement costs: wasted production, transportation, insurance, warehousing & material handling
v. lost sales

24. How did the packaging function of communication change once you implemented the innovation? Besides noting which of the following have changed, indicate which factors were considered when the decision was made.

a. package "reading" productivity

i. differentiation between products and addresses
b. affects the cost of sorting
i. order-picking speed, cost and accuracy
ii. location information
iii. concise and legible on all 4 sides:
(1) manufacturer, brand
(2) easy-to-understand code dates
(3) promotional merchandise
iv. standard quantities
c. timely delivery depends on adequate address and marking
d. opening advice
e. manual or automatic reading
i. what are the uses for automatic reading
f. to deter pilferage
g. laboratory testing

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