4.2 Functions of logistical packaging

There are three inter-related functions of logistical packaging: protection, utility and communication. There is an increasing trend to view packaging in terms of

the functions and value that it provides, rather than just in terms of traditional materials. (Materials are discussed in the third section of this chapter.) Packaging is part of a total system, with responsibility to minimize the cost of delivery as well as to maximize sales.

4.2.1 Protection

The first function is to protect the food and the consumers. Protection is an important packaging function because spoilage and distribution damage, wastes production and logistics resources. Replacement orders add further costs, and delays can result in lost customers. A loss of integrity in certain food packages can lead to product quality and safety issues. The type and amount of protection that a package is expected to provide depends on the characteristics of the product and the distribution environment with its associated hazards. A key aim of packaging is to provide the required protection using the lowest cost materials. The relationship can be conceptualized thus:

$$\text{Product characteristics} + \text{Logistical hazards} = \text{Package protection}$$

The relevant product characteristics are those that deteriorate or can be damaged over time. Food products are particularly vulnerable to biological and chemical changes that can affect quality and food safety. The hazards of the distribution environment range from exposure to extreme temperatures, dynamic forces, and insect infestation to ambient foes such as oxygen, moisture and time. The preservation ability of food packages and their characteristics and properties of packaging importance are discussed elsewhere in this book. It is important to note here that the required length of a food package's shelf life is directly related to how long it is in storage, transit and on the supermarket shelf. Short temperature-controlled channels for fresh food require less shelf life from their packages.

Protection from dynamic forces, handling impacts, in-transit vibration and warehouse stacking, is usually provided by the shipping container. Testing can determine how much abuse a product can withstand, and can be used to predict how well its package will prevent physical damage such as bruising, breaking, denting and smashing. Some standard dynamic tests are described later in this chapter.

The dynamic hazards of a logistical system and hence the most appropriate tests conducted depend on handling, and, the types of transportation and storage used. Firms that use a number of different types of distribution channel may need to package for a variety of conditions.

Damage is a symptom of an underlying problem that can be solved by changing the packaging or by changing distribution practices. In many cases, it costs less to reduce the hazards than to *improve* the packaging. For example, it costs less to reduce the force exerted by a clamp truck than to switch to

stiffer boxes. Alternative methods of transportation (e.g. special equipment, refrigeration and/or dedicated carriers) and storage racks in warehouses can reduce damage; appropriate hygiene and pest control practices during distribution can reduce the need for packaging to protect against pest infestation.

4.2.2 Utility/productivity

The second packaging function, utility, is defined as value to a user. In the case of logistical packaging, the user is the logistical system and the value is productivity. Productivity in logistics is a very important concern because distribution is labor and capital intensive. Productivity is measured simply as the ratio of real output to real input:

$$\text{Productivity} = \text{Number of packages output/logistics input}$$

Logistical productivity is the ratio of the output of an activity, e.g. the number of packages loaded into a truck, to the input activity, e.g. the labor and forklift time required. Most logistical productivity studies center around better utilization of *inputs*, particularly labor, work harder. On the other hand, packaging initiatives like unitization and size reduction can easily increase the *output* of logistical activities. A good example is palletization, which dramatically improves the productivity of most material handling operations compared to break-bulk handling. Unitization enables a single person and a forklift to handle thousands of kilograms in an hour.

Almost all logistical productivity measures are described in terms of number of packages. Some examples include the number of cartons loaded per hour into a trailer, the number of packages picked per hour at a distribution center, the number of packages that fit into a cubic metre (*cube utilization*) of vehicle or warehouse space, the time to stock retail shelves and the cost of waste disposal. Packaging configuration directly affects the number that can be handled per hour or the number that fit into a vehicle.

Ergonomics is also a utility issue because healthy workers are more productive than employees engaged in personal injury lawsuits. Most injuries in physical distribution activities involve shipping containers. There are two types: accidents, usually involving an unstable package falling on a person, and chronic stress injuries due to manual handling of goods. Routine manual handling of packages has always been taken for granted, but it has a reputation for causing chronic back injuries. Many retail and warehouse workers are hurt by packages that are heavy, bulky, or must be lifted to a top shelf. In order to protect workers, the US Occupational Safety and Health Administration (OSHA) has issued guidelines for maximum weight of manually handled packages and appropriate handholds, and the EU has set ergonomic standards in Directive 90/269/EEC. The recommended package weight is related to how far and how often a package is lifted, how far the worker's hands are

extended, how far he/she must twist and the adequacy of the hand grip. For most routine material handling jobs, the recommended weight limit is between 20 and 30 lb (9–14 kg).

4.2.3 Communication

The third packaging function, communication, is becoming more important as logistical information systems become more comprehensive. Electronic data interchange (EDI) and control has been key to the development of effective and integrated management of material flow, inventory, transportation and warehousing. For EDI to succeed, accurate timely information on the status of the packaged product is required. For all practical purposes, the package symbolizes the product throughout the distribution. Every time that a product changes status, for example when it is picked for a warehouse order, information about the status change is registered in various logistics records.

The information systems that record a status change include inventory records, shipping records, bills-of-lading, order picking lists, order receiving verification, accounting payables and receivables, manufacturing and logistics system tracking, and retail pricing. Packaging codes are also sometimes used for sorting products to various destinations in a factory, warehouse or transport terminal. International shipments additionally require the language of shipping origin, destination and intermediate stops, as well as international markings for handling instructions.

Correct identification of stock-keeping units (SKU) including SKU number, name, brand, size, color, lot, code dates, weight and number in the package are critical for good information management. Every logistical activity entails reading the package and recording/changing its status in an information system. Accuracy is essential. SKU information must be clearly legible. Workers must be able to quickly recognize a package from its label.

The most popular trend for reducing errors and increasing the efficiency of the information movement is to use automatic identification. Barcodes and radio frequency identification (RFID) enable a systems approach to managing information where every input is standardized, thus reducing errors. Bar codes require a line of sight to be read by a scanner. RFID enables packages to *call home* from a distance when prompted via radio frequency. Furthermore, new information can be added to RFID tags as they move through the supply chain. RFID promises to revolutionize package identification, since in theory the packages could be linked directly to a supply chain's information management system. The readability of these automatic identification forms depends on technological and symbolic compatibility of the package's label with every reader in the system. If automatic identification is intended to be used throughout a logistical system, it is necessary to use a common symbology. A number of standards-setting organizations exist for this purpose.