

## Chapter 2 Literature Review

In this chapter, previous related studies are reviewed. In section 2.1, the main purpose is to distinguish logistics and reverse logistics. Four forms of reuse are mentioned in section 2.2, which contain direct reuse, repair, recycling, and remanufacturing. Afterward, in section 2.3, address the purpose of the logistics integration in this study. Then, review literature about Multiple Objective Decision Making and the weighting method, respectively, in section 2.4 and 2.5. Next, introduce briefly the development of IT industry in Taiwan in section 2.6. Besides, a brief review will be provided to represent models about demand and return in section 2.7 and green marketing in section 2.8. Finally, the original ideas in this thesis will be described explicitly in section 2.9.

### 2.1 Logistics [4]

Logistics is defined by the Council of Logistics Management (CLM) as:

*The process of planning, implementing, and controlling the efficient, cost effective flow of raw material, in-process inventory, finished goods and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. (Rogers and Tibben-Lembke, 1999)*

Reverse logistics includes all of the activities that are mentioned in the definition above. The difference is that reverse logistics encompasses all of these activities as they operate in reverse. Therefore, reverse logistics is defined by the CLM as:

*The process of planning, implementing, and controlling the efficient, cost effective flow of raw material, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the*

*purpose of recapturing value or proper disposal. (Rogers and Tibben-Lembke, 1999)*

More precisely, reverse logistics is the process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal.

As aforementioned description, there is quite different between logistics and reverse logistics. In order to distinguish logistics and reverse logistics more clearly, “logistics” will be replaced by “business logistics” utilized in this thesis.

## **2.2 Forms of Reuse**

For the different forms of reuse many authors have adapted the categorization given by Thierry et al. [5], which contain direct reuse, repair, recycling, and remanufacturing. Examples of items that may be ‘reused directly’ without prior repair operations (though possibly after cleaning and minor maintenance) are reusable packages such as bottles, pallets, or containers. The goal of ‘repair’ is to restore failed products to working order, though possibly with a loss of quality. Examples are numerous and include a.o. durable products, such as domestic appliances, industrial machines, and electronic equipment. ‘Recycling’ denotes material recovery without conserving any product structure. Examples are metal recycling from scrap, glass, and paper recycling, but also plastic recycling. By contrast ‘remanufacturing’ conserves the product identity and seeks to bring the product back into an ‘as new’ condition by carrying out the necessary disassembly, overhaul, and replacement operations. Traditional examples for remanufacturing are mechanical assemblies such as aircraft engines and machine tools. A more recent example is remanufactured copy machines.

According to aforementioned description, there are also four forms of reuse proposed in this study for demanded products after being utilized. They are, described specifically and respectively in section 1.3.2, reused products, repaired products, remanufactured products, and useless products. By the way, scrap products proposed

in this study is to describe products, which are abandoned but not flow into remanufacturers or RN.

### **2.3 Integrated Logistics**

Stock, et al. [6] proposed that, basically, the integrated logistics management concept refers to administering the various activities as an integrated system. Slats, et al., [7] considered that an integrated logistic chain is composed of several logistic sub-chains, each consisting of a large number of different, usually autonomously acting, companies. Integrating the several processes and partners may lead to advantages for each partner, thus providing a win-win situation. This is the reason why integrated logistic management has gained much attention in recent years.

In this study, the ILS is composed of BLS and RLS. However, the primary purpose of integration is to optimize the trade-off between BLS and RLS, not to seek maximum advantages for individual.

### **2.4 Multiple Objective Decision Making [8,9]**

Multiple Objective Decision Making (MODM) developed from the single criteria game theory is a method of Multiple Criteria Decision Making (MCDM). MCDM can be divided into two categories: Multiple Attribute Decision Making (MADM) and MODM. MADM puts emphasis on selecting a plan; prioritize the given alternatives by their attributes for decision maker to pick up. MODM is a process to find the noninferior solutions in the decision space constrained by the multiple objective functions under decision maker's preference. In this thesis, the objectives might conflict with each other in the ILS. In order to provide a coordinated plan rather than select a plan to eliminate conflicts between the BLS and the RLS, so MODM is utilized to enhance the performances in the ILS.

MODM can be divided into Multiobjective Programming Problems and Goal Programming Problems. The most difference between them is most goals established

in advance in many objective functions in Goal Programming Problems but in Multiobjective Programming Problems. In this thesis, the performances are not regulated in the integrated logistics system, so it is a Multiobjective Programming Problem.

The general model in MODM can be presented as:

$$\text{Objective : } \text{Max}(\text{Min}) \ Z = [Z_1, Z_2, \dots, Z_k] \quad (2.4-1)$$

$$Z_j = Z_j(X_1, X_2, \dots, X_n) \quad j = 1, 2, \dots, m \quad (2.4-2)$$

$$\begin{aligned} \text{Subject to : } G_k(X_1, X_2, \dots, X_n) &\leq b_k \quad i = 1, 2, \dots, l \\ X_i &\geq 0 \quad i = 1, 2, \dots, n \end{aligned} \quad (2.4-3)$$

$Z$  : multiobjective function

$Z_j$  : the  $j$ th objective function,  $j = 1, 2, \dots, m$

$X_i$  : the  $i$ th decision variable,  $i = 1, 2, \dots, n$

$G_k$  : the  $k$ th constraint function,  $k = 1, 2, \dots, l$

$b_k$  : the  $k$ th resource constraint,  $k = 1, 2, \dots, l$

Since there are conflicts between objectives, each objective cannot be maximized simultaneously when finding a solution by MODM. In the mathematical process, multiobjectives can be transformed into a single objective to find out the solution. There are three major methods to transform multiobjectives into a single objective presented as follow:

1. Weighing all objective functions, then summarizing them into a new objective function to find out the solution.
2. Choosing the most important objective as the objective function, then transforming other objectives into constraint functions to find out the solution.
3. Require the minimum summarized deviation of each objective based on a selected level to find out the solution.

## 2.5 The Weighting Method [10]

In this study, the weighting method will be utilized to solve the problem about the trade-off between the BLS and the RLS, because the weighting method is simple and clear for executives to operate the ILM. Besides, the weights of assignment could depend on decision maker's preference or the societal values.

The basic idea of assigning weights to the various objective functions, combining these into a single-objective function, and parametrically varying the weights to generate the nondominated set was first proposed by Zadeh. [11] It can be shown that the weighting method follows directly from the Kuhn-Tucker conditions for a nondominated solution.

Mathematically, the weighting method can be stated as follows:

$$\begin{aligned} \max \quad & z(x) = w_1 z_1(x) + w_2 z_2(x) + \cdots + w_p z_p(x) \\ \text{subject to} \quad & x \in X \end{aligned} \tag{2.5-1}$$

which can be thought of as an operational form of the formulation

$$\begin{aligned} \text{max-dominate} \quad & z(x) = [z_1(x), z_2(x), \cdots, z_p(x)] \\ \text{subject to} \quad & x \in X \end{aligned} \tag{2.5-2}$$

In other words, a multiobjective problem has been transformed into a single optimization problem for which solution methods exist. The coefficient  $w_i$  operating on the  $i$ th objective function,  $z_i(x)$ , is called a weight and can be interpreted as “the relative weight or worth” of that objective when compared to the other objectives.

If the weights of the various objectives are interpreted as representing the relative preferences of some decision makers, then the solution to eq. (2.5-1) is equivalent to the best-compromise solution, that is, the optimal solution relative to a particular structure. Moreover, the optimal solution to eq. (2.5-1) is a nondominated solution provided all the weights are positive. The reasoning behind the nonnegativity requirement is as follows. Allowing negative weights would be equivalent to

transforming the maximization problem to a minimization one, for which a different set of nondominated solutions will exist. The trivial case where all the weights are zero will simply identify every  $x \in X$  as an optimal solution, and will not distinguish between dominated and nondominated solutions.

## **2.6 Information Technology Industry in Taiwan [12,13]**

The days of purely contract PC (Personal Computer), scanner, and keyboard production are long gone from Taiwan. While companies in Taiwan are still actively engaged in these areas, Taiwan today is much, much more. Whether developing the latest IA (Information Appliance) platform, or pushing the IC (Integrated Circuit) industry to adapt the latest fabrication technologies, Taiwan has moved to the cutting edge of the information technology industry.

Over the past two decades, Taiwan has emerged as a key global technology hub, moving from low-end products manufactured on an original equipment manufacturing (OEM) basis, to today's high-end production and design of semiconductors, flat panel displays, notebooks, communications and information appliances (IAs). Taiwan has created an entirely new industry in made-to-order semiconductor fabrication services, enabling the establishment of hundreds of global "fables" IC design houses.

In fact, Taiwan is the second-largest designer of chips behind the United States. Besides, Taiwan is currently the world's third largest manufacturer of IT hardware, IT hardware has grown to become Taiwan's leading export. Table 2.6-1 shows the value, the quantity, and the growth rate of IT hardware in 2000. In Table 2.6-2, it shows that Taiwan itself manufactured some US\$47 billion in IT hardware and the growth rate was 19.9% in 2000.

Becoming a truly global player, Taiwan is moving production facilities offshore to improve competitiveness and prolong product lifecycles. The majority of

scanners, keyboards, sound cards, modems, and many other devices are now manufactured offshore in Mainland China or Southeast Asia.

Table 2.6-1 Taiwan IT Hardware in 2000

<b>Product</b>	<b>Value (US\$ million)</b>	<b>Growth (%)</b>	<b>Quantity (k pcs)</b>	<b>Growth (%)</b>
<b>Notebook PC</b>	13,548	23.8	12,707	32.2
<b>Monitor</b>	10,392	12.5	62,365	18.0
<b>Desktop PC</b>	7,797	8.1	27,660	44.7
<b>Motherboard</b>	5,674	16.9	84,372	31.1
<b>CD/DVD/RW</b>	2,605	66.8	67,579	46.4
<b>SPS</b>	1,879	7.7	98,895	23.3
<b>Case</b>	1,580	13.8	91,345	18.7
<b>Scanner</b>	1,089	14.9	27,135	11.7
<b>Digital Cameras</b>	569	311.1	5,635	247.4

Source: MIC

Table 2.6-2 Taiwan IT Hardware Production

<b>Indicator</b>	1995	1996	1997	1998	1999	2000
<b>Production value (US\$ billion)</b>	19,543	25,035	30,174	33,776	39,881	47,019
<b>Growth rate (%)</b>	34.0	28.1	20.5	11.9	18.1	19.9

Source : MIC/III; ITIS; IDB , Jan. 2001

At the same time, R&D, marketing, and global logistics functions are headquartered in Taiwan, with subsidiaries in Europe, Japan, and the United States.

Taiwan's success in IT hardware is now leveraged in other industries including

IAs, software and services, communications, flat panel displays, and the semiconductor industry. Taiwan has become the global platform for information industry manufacturing.

## **2.7 Demands and Returns [14,15]**

The models mainly differ with respect to assumptions on demand and return processes and on the recovery process. A first major classification, can be made into deterministic versus stochastic models, will be described, respectively, in section 2.7.1 and 2.7.2. Finally, section 2.7.3 will propose the direction of researching.

### **2.7.1 Deterministic Models**

Demands and returns are known in advance for every point in time. A first model of this type was proposed by Schrady. [16] He assumes constant demand and return rates and fixed lead-times for external orders and recovery.

More recently some extensions to the model of Schrady have been proposed by Mabini et al. [17] They consider stockout service level constraints and a multi-item system where items share the same repair facility.

A model equivalent to the one by Schrady but with a different control policy has been proposed by Richter [18, 19]. For this policy he gives expressions for the optimal control parameter values and discusses their dependence on the return rate.

All these models share the drawback of optimizing the parameters of a predetermined control policy, without studying optimality of the policy itself. To Fleischmann et al.'s knowledge there are no results regarding the structure of optimal policies.

### **2.7.2 Stochastic Models**

Many models assume demands and returns to be independent stochastic processes. However, in principle, any joint probability distribution for demands and returns is admissible. Next, it follows the traditional classification of stochastic



models into periodic versus continuous review models.

*Periodic review models.* Attention has been focused mainly on deriving optimal control policies under various assumptions, minimizing expected costs over a finite planning horizon.

Cho and Parlar [20] surveyed the literature related to optimal maintenance and replacement models for multi-unit systems. Cohen et al. [21] studied a system where recoverable and serviceable inventory coincide because returned products can be reused directly. They assumed that a fixed share of the products issued in a given period is returned after a fixed lead-time. The model is an extension of a simple stochastic inventory model with proportional costs only, to a situation with reusable items. Later, their system was modified to the system with random returns by Kelly and Silver [22].

Simpson [23] proved that the optimum solution structure for n-period repairable inventory problem is completely defined by three period dependent values and proposed a solution methodology. Recently, the work of Simpson has been pursued by Inderfurth [24, 25] by considering the effects of non-zero leadtimes for orders and recovery. He shows that a decisive factor for the complexity of the system is the difference between the two leadtimes. For identical leadtimes his model is the same as Simpson's. For different leadtimes the growing dimensionality of the underlying Markov model prohibits simple optimal control rules.

*Continuous review models.* In these models the time axis is modeled continuously and the objective is to find optimal static control policies minimizing the long-run average costs per unit of time.

Heyman [26] analyses disposal policies to optimize the trade-off between additional inventory holding costs and production cost savings. He discussed a model with independent demand and return occurrences with generally distributed quantities

and inter-occurrences time. Remanufacturing and outside procurement are instantaneous, resulting in perfect service and only one inventory to be considered. Furthermore, no fixed costs are taken into account. The system is controlled by a single parameter disposal level strategy: coming remanufacturables exceeding this level are disposed of. Heyman shows the equivalence of this model to a single server queuing model. For the case of Poisson distributed demands and returns he derives an explicit expression for the optimality of the parameter policy in this case. For generally distributed demands and returns an approximation is given.

Muchstadt and Issac [27] considered a continuous review model with explicit modeling of a remanufacturing facility with non-zero lead times. In their research the demand and return occurrences were assumed to be of unit quantity following a Poisson distribution. Later, van der Laan et al. [28] presented more general model that has four control parameters and they [29] developed two approximations for the average cost an  $(s, Q)$  remanufacturable inventory model. Recently, van der Laan and Salomon [30, 31] and van der laan et al. [32] studied various manufacturing/ Remanufacturing systems with PUSH and PULL disposal strategies. Especially, the related researches are well classified in the last article van der Laan et al. [30]

### **2.7.3 Comments**

Since demands and returns are not considered independent variables in this study, return ratio ( ) and waste ratio ( ) will be proposed to describe the relationship between demands and returns. In other words, returns are determined by the return ratio, waste ratio, and demands. On the other hand, demands and returns will be supposed to distribute as Poisson distribution in this study.

### **2.8 Green Marketing [33]**

Concern for the environment has become one of the most important issues of the 1990s. Both in Europe and the United States, companies have discovered that

consumers will buy products, or avoid their purchase, based upon environmental considerations. This phenomena, referred to as Green Marketing, involves the marketing response to the design, production, packaging, use and disposal of products. It traces the evolution of green business, and the societal catalysts and pressures that resulted in green marketing. Finally, key green marketing issues and activities, both in Europe and the United States, are discussed.

### **2.8.1 The Evolution of Green Business**

In the late 1960s the United States began the modern environmental movement and became the world leader for environmental reform. At that time European countries were still engaged in completing post-World War economic recovery. [34] In the US the ecology movement of the 1960s raised public awareness and concern. This movement led to the creation of the Council on Environmental Quality (CEQ) and the Environmental Protection Agency (EPA) in 1970, and the passage of numerous environmental laws during the decade of the 1970s. [35] This early, strong regulatory response in the US, was partially based upon the ‘bad reputation’ of American industry in respect to the environment. Industry is seen as less of a bad guy in Europe. [36] Unlike Europeans, the American public ‘chose to blame industry for the nation’s environmental problems’. [37] America’s consumption ethic, 5% of the world’s population using 30% of the world’s resources, also drew early attention to the issue in the US. For years The Continent was the ‘dirty man of the West’ lagging behind the US in environmental regulation. Environmental concerns eventually emerged in West Germany, the Netherlands and Scandinavia, but these countries were the exception until recently. [38]

During the 1980s European environmental interest and action began to grow. Meanwhile, under Ronald Reagan’s policies of deregulation and lax enforcement, the US may have lost its leadership role. [34] In the late 1970s the Green Party was

created in Germany. The activities of this organization, including the election of its members to political offices throughout Europe, were a major factor in Europe's 'green revolution'. Today the environment has become an important issue in most European countries including formerly reluctant nations such as Great Britain and Italy. A Union Carbide executive summarizes the changes when he says: "in the past international health, safety and environmental standards always lagged behind the US. So if a US company was on top of the domestic situation it was automatically on top of the international one as well." Today with rising standards in Europe (and Asia) the gap is diminishing. [39] A European Environmental Agency, similar to the EPA, has been created with its headquarters being in Copenhagen, Denmark. Generally the US has tougher legal standards, stricter enforcement policies and a more developed infrastructure for public participation in environmental decision making (e.g. environmental impact statements, mandatory public hearing) than Europe. [34]

Individual European countries, of course, vary in their response to environmental issues. In October 1989, *The Economist* ranked the 12 European Community (EC) member countries in respect to national environmental policy. They found the most well-developed policies in The Netherlands, West Germany and Denmark. The middle tier included Britain, France and Belgium. Those countries having less developed environmental policies were Greece, Portugal, Spain, Ireland, and Italy which has made the most progress in the latter group. [40] The *Single European Act* (SEA) of 1987, which amended the European Community treaty, states that: "Economic growth is necessary but there is a fundamental realization that ecology is an absolutely essential component." [41] In 1988 the European Court of Justice issued a major decision regarding the ability of individual countries to set environmental standards which impact trade with other member nations. A Danish law might make it unprofitable for foreign manufacturers to do business in Denmark and

this could act as a trade barrier. The court upheld this law under the environmental provisions of the SEA. [40] This decision raised environmental standards in European nations in which they desire to do business.

As previously mentioned European business has historically had a better public image than US business in respect to the environment. The result has been a more amicable relationship among business, government and environmental groups, and less regulation. [36] By the beginning of the decade, American business had softened its approach to one of greater cooperation with the environmental community. To many, the change of heart was startling. [42] This turnaround in the US was based at least in part on the widespread perception that the 1990s would be the decade of the environment. [43] This perception had a bandwagon effect as companies in the US and Europe attempted to profit from the powerful trend through green marketing.

### **2.8.2 Catalysts and Pressures for Green Marketing**

Many of the same factors have influenced the greening of corporations on both sides of the Atlantic. The timing and degree to which particular factors have played a role has differed. As the movement has grown multiple factors have had an impact and it becomes increasingly difficult to assess cause and effect. This section discusses the most important catalysts and pressures that have result in green marketing.

*Environmental damage and the media.* A major catalyst of public opinion to preserve the environment has been environment damage or the threat of environmental harm. Theses events are usually carried to the public by the media. Europeans are particularly sensitive to these issues “by virtue of the size of the region (only one-fourth that of the United States) and the [population] density” which is much greater than in the US. [34] A relative scarcity of natural resources is another important factor in Europe. [41] Examples of disasters impacting Europeans include chemical spills on the Rhine River; the poisoning of North Sea seals; contamination

of Mediterranean beaches; the Chernobyl nuclear power meltdown; the revelations regarding the shocking mess in Eastern Europe; and the large oil spill off the Shetland Islands. Americans have been influenced by events such as Love Canal; Times Beach; the barge of New York garbage which couldn't find a dump; and the Valdez oil spill. Both Europeans and Americans have become particularly concerned about damage to the Earth's ozone layer; global warming; reaching the limits of landfills; and acid rain. The Michael Peters Group, an American marketing consulting firm, studied 'green' consumers in three European countries in 1989 and found that events and threats such as those previously mentioned 'strongly influence consumer behavior' and lead to green consumerism. [44]

*Public opinion and social concern for the environment.* Public opinion in both Europe and the US, as influenced by environmental damage, media coverage, and other factors has strongly favored action to protect the environment. "Due to varying perceptions and cultural backgrounds, the North American consumer responds to three issues differently than does the European consumer." [41]

*Social forces and the greening of business.* Public concerns have translated into potent forces for the environment including green political power, and green consumerism. These forces, and institutional pressures from investors and employees (including management), have been major catalysts for the greening of business, which, in turn, has given rise to the concept of green marketing.

*Green political power.* "Once thought of as little more than business-bashing cranks, the Greens have moved from the political fringe to the center." [45] In 1981, Belgium became the first country to elect Greens to Parliament. In addition to Belgium and Germany. Green parties were represented in the 1990 national legislatures of Italy, Portugal, the Netherlands, Luxembourg, Austria, Switzerland, Sweden and Finland. Green Party representatives in the 1990 European Parliament

were elected from Belgium, Germany, Netherlands, France, Italy, Spain and Portugal. The British Green Party won strong support (15% of votes cast in 1989), but gained no seats in the European Parliament because of the electoral system. [34] Political leaders including the previously reluctant UK Prime Minister Margaret Thatcher promoted the environmental cause. Even royalty including Queen Beatrix of Netherlands, and the UK's Queen Elizabeth and her son Prince Charles made pleas for the environment. [45] In the late 1980s environmentalists had become "Europe's most formidable and best organized pressure-group". [46]

*Environmental law.* Green political power has resulted in the proliferation of environmental laws. As previously discussed, the US "still (has) more stringent, comprehensive pollution control laws than Europeans and enforcement is often even spottier overseas than in the US". [34] "The EC has been setting green rules, yet its members increasingly disregard them." [47] American environmental laws and regulations exceed 11,000 pages, which surpasses the US tax code in sheer mass. [48] US laws such as the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, also commonly known as 'Superfund') are making it difficult and expensive for some businesses to get financing or insurance. This is because of the potential liability or penalties for environmental accidents or violations. By contrast, European liability standards are not as onerous as those in the US. EC legislation tends to require certain results while allowing member nations discretion in implementation. In most European countries regulations are not as extensive, specific or rigid as in the US, and as a result there is less litigation over liability. [49] European governments increasingly favor economic "incentives to encourage consumers and industry to behave in ways that do little harm to the environment". [50] Examples include taxes in several countries on ozone depleting chemicals [50], and tax concessions in Germany to stimulate manufacture and sales of less polluting cars.

[46]

*Consumer attitudes and green purchasing.* Europe's green consumerism has strongly entwined with green politics and the Green Party. Environmental groups in both Europe and the US have educated and pressured consumers through boycotts and other campaigns.

*Institutional pressures — investors and employees.* In addition to the forces of politics, law and consumers, pressures on business to protect the environment emanate from investors and employees including all levels of management. In the US, socially responsible investing is a growing trend. An increasing number of mutual funds offer investments screened on environmental criteria. Individual and institutional investors may avoid companies with a poor environmental record, or seek those with a positive environmental performance. Such choices are made for both ethical and financial reasons. Stockholders are offering an increasing number of environmental resolutions at annual meetings, such as initiatives for adoption of the *Valdez Principles*. [42]

The greening of business. Business has been profoundly influenced by the social, political and legal pressures for environmental protection. "Rather than duke it out with environmentalists in court, companies both large and small now figure that cooperation will win them more battles for public opinion in the 'Green Nineties'." [42] Richard J. Mahoney, Chairman of Monsanto said : "Corporations like ours are experiencing what can only be called a revolution in environmental stewardship." This statement was made at a National Wildlife Federation dinner honoring the chemical maker's cleanup efforts. [42] The "Business Council for a Sustainable Environment," a group of 48 chief executives from companies such as Minnesota Mining and Manufacturing Co., Nippon Steel Corp. and the Royal Dutch/Shell Group. launched a 'green business' manifesto. They called upon their colleagues to take the



initiative on saving the environment by promoting a brand of market led environmentalism. London-based Greenpeace criticized the effort as a “veiled attempt to minimize environmental controls on big business”. [51] This skepticism is shared by the American public. In a 1991 survey 91% of those polled felt that business is not concerned enough about the environment. [52] According to a 1990 report in *The Economist*: “Probably no more than 100-200 companies worldwide have made environment performance one of their top concerns.” [53]

### **2.8.3 Green Marketing Activities and Issues**

Green marketing is defined as the marketing response to the environmental effects of the design, production, packaging, labeling, use, and disposal of good or services. Green marketing in Europe and the US has primarily centered on the areas of product (including packaging and labeling) and promotional strategies. There is considerably less information and emphasis on the other major areas of marketing — pricing and distribution. However, an analysis in each of these four areas will be made to provide an overall perspective of green marketing activities.

*Product variety.* Although most of the green products are in the household cleaning and paper products areas, the variety of green products (goods or services) that are already being marketed is abundant. Following is a brief listing of some of these products sold with environmental themes or benefits: Eco-Warriors (ecological soldiers for children), Dating Services (to help find an environmentally friendly mate), Ice Cream (containing nuts from rain forests), Batteries (mercury free), Golf Tees (biodegradable), Toilet Paper (from recycled materials), Hollywood Films (with ecological themes), and Stock Mutual Funds (investing in green oriented companies). Given this list one wonders whether just any product can be a green product. Simon Williams, the CEO of The Michael Peter Group, indicates that there are four areas that help to define a product as being green: (1) content (2) structure and packaging (3)

message and (4) positioning. [54] It is precisely in these areas where much of the controversy about green products and marketing has taken place.

*Labeling.* A very important area of consideration has been the area of eco-labels, labeling which certifies that a given product is environmentally safe or friendly. A key consideration is whether this labeling should be done by a private, independent, and presumably impartial organization, or whether it should be done by a government entity. Another consideration is whether there should be a single primary label which is government backed. As previously discussed, the EC ministers have adopted a common green labeling system for its members. This EC eco-label is a voluntary program. In June of 1993 the first two European eco-label products were introduced — a washing machine and a dishwasher. The US has several private labels. [55]

*Packaging.* An important part of the total product for many companies is the packaging which not only provides information but also serve as a type of promotion for the product. The packaging also is a major source of environmental waste. Much of the green marketing discussion, both in Europe and the US, is over excessive packaging and the material that the packaging is made of. The demand for recycled or recyclable materials shows it is important to consumers.

*Pricing.* The pricing of green oriented products has typically been higher in both Europe and the US to reflect the added costs of modifying the production process, the packaging or disposal process. An additional reason for higher prices was the perception that consumers would pay more for green products. Surveys indicate that consumers say that they will pay from 7 to 20% more for environmentally friendly products. [56]

*Promotion.* It has been suggested that “catering to environmental worries might be the hottest sales strategy since advertising agencies discovered sex in the

1950s". [57] In 1991, 13% of all new products sold in the US made some sort of environmental claim. [58] But the recession and other problems may be changing this trend. A major problem for marketers, and consumers, has been the confusion with many of the environmental terms used in promoting products. Terms such as biodegradable, recyclable, and environmentally friendly, have come under harsh criticism and now, in many cases, are being avoided by companies because of the difficulty in defining and documenting them. What began as positive promotion has turned into negative publicity in some cases.

*Distribution.* An important part of the distribution process for green products is through retailers who sell the goods to the end consumer. In many instances they share the responsibility of the claims as an aid to the consumer. [59]

*Implications for other areas of business.* In the 1990s, managers throughout a company must consider the environmental impact of their products. In addition to the marketing function, green marketing has implications for areas such as production, finance and accounting. Production must develop processes and products that minimize negative environmental impacts. This may entail significant start-up costs. Financial managers need to consider the difficulty in raising capital that a company's poor environmental record could create, and the potential advantages in attracting investors and lenders that result from producing environmentally friendly products. Accountants should find new ways to measure the environmental achievements of a company that go beyond the traditional focus on short-term profit indices. New developments in social accounting and social audits can be useful in this quest. [35]

## **2.9 Summary**

After reviewing related literatures, we find there are few studies about integrating business logistics and reverse logistics. However, it is getting more and more important to integrate them for individual, business, and governments. So, in

this thesis, we attempt to integrate business logistics and reverse logistics for IT industry, then propose advantages of the ILM. The original ideas in this thesis are as follows:

1. The ILS is an original system structure to describe the channels of IT industry.
2. The ILM is an innovative model to integrate the BLS and the RLS for the IT industry.
3. The optimal solution is for the ILS but for individual. So the conflicts among those objectives must be considered in the whole system to achieve the maximum profit.