Comparative analysis for principled function and expense structure of logistic packaging systems

Peter Borocz[1], Akos Mojzes[2]

Abstract: **Two main types of the packaging systems can be distinguished in the logistic supply chains, depending on which routs the packaging spreads according to its function and its role, whether it is a device or a product. Today by means of their system-organization and continuous development, the companies get into a decision dependence situation in order to get optimal logistic-packaging expenses.**
Keywords: **logistic, packaging, structure**

Motto: „The decision of what kind of packaging structure we should select only can be expedient with a system-based analysis (P. Borocz)

I. INTRODUCTION

In the past 15-20 years the cost effectiveness has played a significant role in the practice of corporate activity. In the field of logistic packaging (whether it is industrial-transportation or even consumer packaging) the companies get into decision dependence in order to determine the technically optimal packaging expenses. This decision situation means the one-way and returnable (disposable or returnable) decision mechanism between packaging systems. Although more international studies deal with the difference between these two systems and their unique peculiarities in detail, unfortunately only industrial branch specific analyses are provided [1] [2]. Universally accepted models do not exist yet. This study deals with the theoretical function processes between these two systems, and furthermore an expense structure, which belongs to the given system.

This decision between the two systems does not provide a primary or definitive solution; moreover it puts pressure on operative specialists. The detailed analysis of the all alternative opportunities has become their task to organize a structured one-way and returnable mixed operation that suitable for corporate requirements.

It is necessary to set up a requirement system before making a final decision about which system to apply. The following content requirements are taken into account (quantitative indicators are not listed here):

a) Further development potentials of present common systems (participation opportunity in actual protocol);
b) Opportunity to harmonize and standardize together with the new system;
c) Choosing technically adequate devices;
d) Logistic organizational tasks in connection with returning the device;
e) Management, assortment and cleaning tasks of returnable devices;
f) In some cases: when the system is outsourced

Environmental regulations of the last few years increased the importance of the development of packaging systems, and this way also the decision making between systems. Namely, it would be vital for the environment, to increase the reuse of packaging or its recycling and this way decrease harmful environmental effects. These state regulations [3] are also the generators for R+D+I activity in the logistics packaging systems, regarding technology and operation.

Unfortunately in industrial practice the companies have hardly enough informational bases to introduce an optimal packaging system. We can observe that the priority of corporate packaging systems based on one-way devices (mostly which are from recyclable materials) is on the rise [4]. In accordance with this, specialists are watching curiously the absolute irregular headway of returnable systems [5]. This may be the reason why the companies in such decisive situations have only sketches about the requirement system and cost functions of the introduction of the different packaging systems. This schematic information does not give a precise picture of the theoretical and organizational structure of the convertibility of the processes, and the total costs.

The protective environmental limitations mentioned previously are going to increase the expenses in case of using not returnable and not recyclable devices. So it can be predicted, that in the immediate future more and more companies will be interested in the application of returnable devices meaning more cost effective packaging system.

II. THEORETICAL STRUCTURE

In the logistic systems two packaging systems can be distinguished (figure 1.) depending on the rout of the packaging based on its function, or its role as a product in a given supply chain. The packaging device is delivered to the customer by the manufacturer or the distributor, after that it is delivered to the consumer. Practically the packaging becomes waste at this point, since the end user handles it like a waste. I call this process the *linear packaging structure* shown on *Figure 1*.

This linear structure can be replaced with a system, in which the reusing of the device extends the life cycle of its supply processes. The *cyclic packaging structure* is significantly different from the above mentioned, because the manufacturer of the device or the first user (supplier) is the responsible for handling the devices as a waste or recycling.

[1]Peter Borocz & [2]Akos Mojzes, Department of Logistic and Forwarding, Szechenyi Istvan Universtiy, Gyor, Hungary

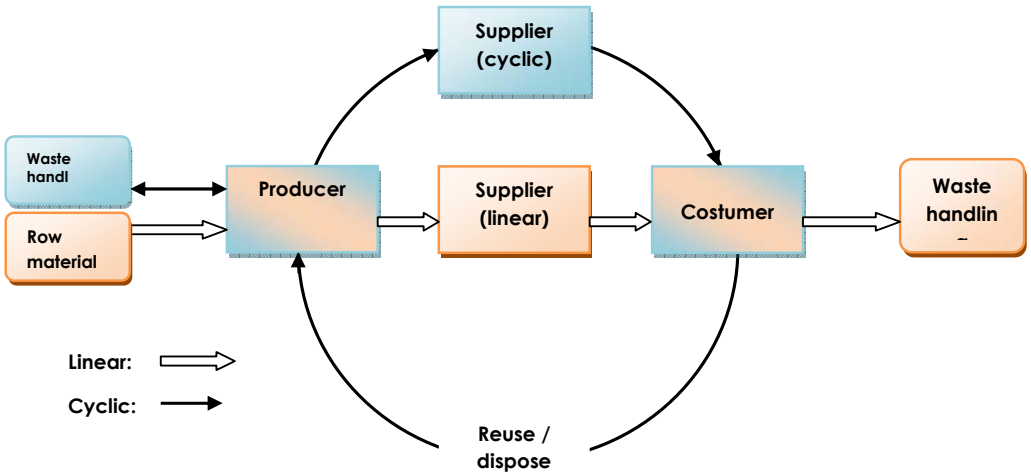

Figure 1: The theoretic structure of packaging systems

Consequently it is necessary to examine the packaging system types according to different viewpoints. We have to do an analysis setting out from the existed systems, and it is necessary to make the suitable comments considering the prescribed requirements and structural rules.

I need to draw the attention to the fact that the valuation of systems is not based only on the quantity of emerging waste material, but also on many other factors. This way the decision is not only on choosing between one-way or returnable packaging; it is on choosing between packaging systems, with their all advantages and disadvantages.

III. The appearance form of returnable packaging

As shown on *Figure 1* a simplified conceptual structure of the single systems can be relatively easily defined.

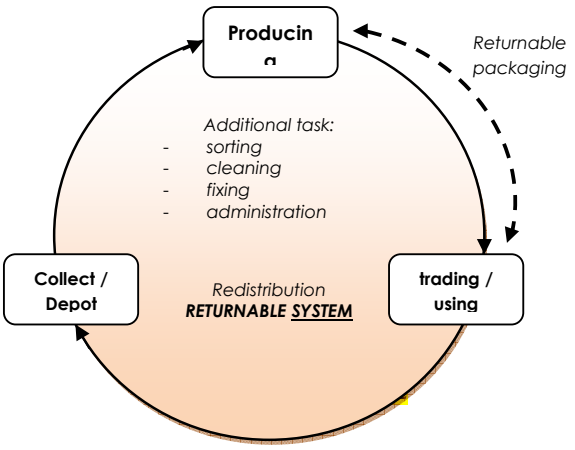

Figure 2: Organization of the returnable packaging in a system

This system is not getting more complicated in case of the application of one-way devices. However in case of cyclic system more form of appearance can be found. The reason is that the number of the participants of the system grows or surplus tasks emerge during operation. It can be seen on *Figure 2*, where we can observe the indirect return of the device, because of the insertion of a so-called depot.

Although we can found several appearance forms of returnable devices in practice, all their functions are built up on the same conceptual structure. The complexity of this system could be higher, if the number of participants on a given level (using/trading/collection levels) is multiplied, illustrated on the *Figure 3*.

As seen on *Figure 3*, the type of the device influences the degree of the possible level of organization. The organization of the returnable packaging with a higher degree can be achieved only with standardized devices. While developing a packaging system by involving only two companies is relatively simple, in case of direct or indirect contact among several companies the devices have to be prepared for installing in the system. Only those devices can be applied that meets these requirements. This has a significant role, because depending on the number of participants the costs grow, which has to be taken into account while establishing the decisive alternatives.

In a special case a – illustrated on *Figure 3.b* – when the consumer is a supplier at the same time and the other way around. There are such packaging devices that are not returned, but reused, or returned partly filled with product (e.g.: returning scrap or products to repair). The most typical example for this is the exchange system of EU pallets between companies that outgrew to a worldwide network. The participants operate the returnable system, with economic accounting among each other. The main point is that the cost of returning is basically zero.

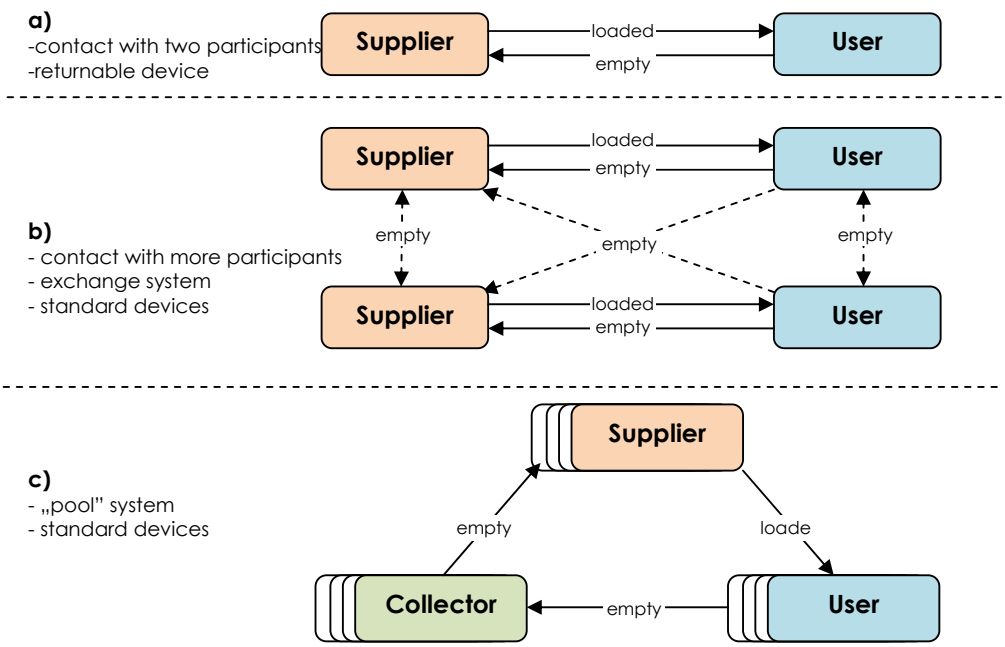

Figure 3: Organization levels of returnable system

Source: Dubiel [6], 1996

The "pooling" system (a repeatedly rental opportunity of packaging with standard devices) (*Figure 3.c*), in this case the user takes advantage of a rental service as the alternative of the purchasing/using of returnable packaging. In this case the device is purchased, but by the transaction a foreign asset is rented. With the usage of the system the fixed asset is reduced on the one hand, on the other hand it is possible to repair the efficiency of the logistic packaging processes by eliminating the hidden expenses, which has got a direct effect on packaging total costs.

It is necessary to add another thought. Although detailed analyses precede the decision on choosing packaging systems in the practice, but in most cases the different participants of the chain does not propose a common negotiation. The adjacent elements of the chain interpret the usage of the system in a different way. This way it may happen that one-way device is used as a returnable device, even serving with another function. This result in that the input parameters of the antecedent analyses are not necessary factors any more, so that the usefulness function does not give the expected result.

In this way the previously mentioned linear system turns into a cyclic system easily (*figure 4.*), without all preceding formal reasons. The level of the tactical decisions does not affect this phenomenon any more, but the specialist dealing with operative solutions. This task becomes important when the suitable feedbacks and checkpoints are claimed by the possible decision criteria and alternatives in the course of a decision process.

IV. THE COST AS THE MAIN FACTOR OF DEVELOPING DECISION ALTERNATIVES

Realizing the differences of these systems is so important, because the form of appearance of the expenses can be essentially different. So the comparison of the adequate application of systems will not be suitable at all.

The three phases of the decision mechanism could be determined with the followings:

- Realization of rising packaging costs;
- Determination of direct packaging costs;
- Allocation of packaging costs.

Corporate experiences indicate that there is not enough available information to measure the costs of the used packaging. It can be experienced because the packaging field is neglected, even inside the logistics. On the other hand packaging gets an emphasized importance when the product is damaged because of wrong packaging.

In the last few years the companies have not made analyses concerning only material costs, but also the recycling, making waste harmless and for other costs. This way an important problem stays unrevealed, that which packaging cost causes the bigger part of the total expense and how is it going to increase during the later processes. Contradictions setting back the detailed cost analysis and cost comparison are the followings:

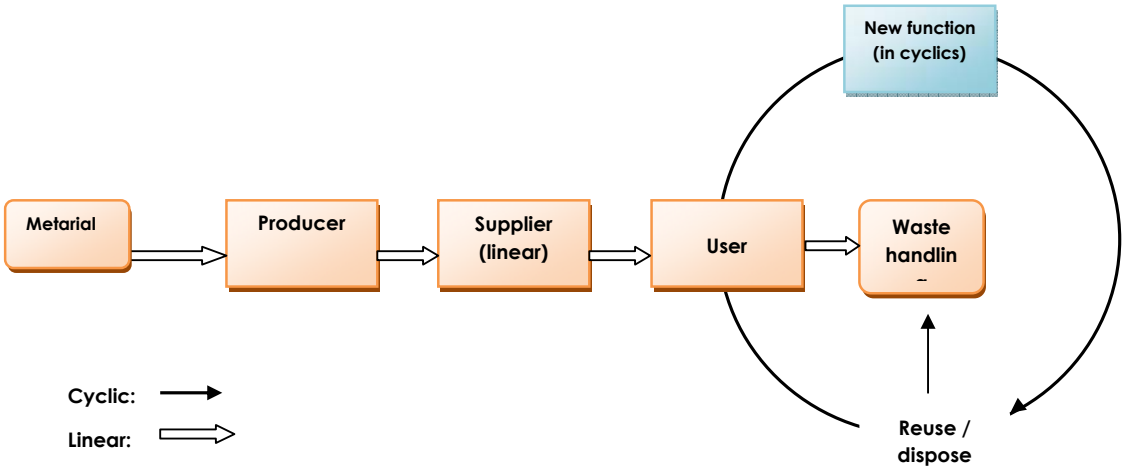

Figure 4: Organization of a one-way device in a returnable system

- Incomplete knowledge about packaging expenses;
- Limitation of costs of the packaging material, labour and rising of waste handling costs;
- The lack of knowledge, which is necessary for the analysis of the packaging expenses;
- The bigger part of the packaging expense is originating from the characteristics of the company or the product;
- The lack of information suggests participants to make wrong decisions that seem rational.

In order to analyze the cost structure of the chosen or applied packaging system, we have to divide the packaging procedure and the costs. So the cost types are put into groups, to decide whether they occur in the given system or not. For example these attributes can be the followings:

- *The data of the product: geometrical measures: (height* width* length) [mm], mass [kg];*
- *Data of the packaging geometrical measures:* (height* width* length) [mm], package mass[kg];
- *Life time of one-way and returnable device:* [year], [number of cycles], [cycle time];
- *Number and quantity of necessary packaging*: [pcs], [kg], [m^2], number of devices [pcs/pallet], weight of loaded package [kg], geometrical measures of loaded pallet [mm]
- *Transportation data:* number of loading units [pcs/vehicle], [pcs/year], distance of (return) rout[km], number of products on a pallet [pcs/pallet], total weight [kg],
- *Manufacturing data*: output performance [product/time], number of necessary packaging [pcs]
- *Storage data*: number of loading units [pcs], return time of device [day], unloaded packaging [pcs];
- *Waste material handling data*: by type [kg/year]

V. Conclusion

The practical experiences show that arguments based on individual lobbies cannot give adequate results for the introduction of a system with optimal costs. Establishing or changing the structure of a system can be efficiently carried out only with the common decision of the adjacent and non-adjacent participants of the logistic chain. To achieve this compliance the behavior of the participants has to be examined, and proposals for a global optimal solution are needed. However, we must not forget that the expense level is not constant in time, so it is necessary to verify experimental results continuously to maintain an efficient system; so a constant calculation is needed.

The parallel maintenance and combination of linear and cyclic systems may result that the system operation becomes erratic. It is a great challenge even for a logistic specialist to handle the elements of product-packaging systems in different structures. The planned or real structure changes – in case of both changing from linear to cyclic and the other way round – have to be established based on detailed plans. This is the only way to achieve cost effective structures in a decision-centered logistic process.

References

[1] Hilary Grimes-Casey, Thomas Seager, Thomas Thei, Susan Powers, - A game theory frameworks for cooperative management of refillable and disposable bottle liecycles, Journal of Cleaner Product 15, 1618-1627.o., 2007

[2] Gesellshaft für umfassende Analysen GmbH – Comparison of one-way and refillable packaging in Austria by analys of costs, ecological effects, employment and value added, Austria, january 2001

[3] Palmer K., Walls M. - Optimal policies for solid waste disposal Taxes, subsidies, and standards, Journal of Public Economics 65, 193-205, 1997

[4] RDCE Environment and Pira International - Evaluation of Costs and Benefits for the Achievement of Reuse and the Recycling Targets for the Different Packaging Materials in the Frame of the Packaging and Packaging Waste Directive 94/62/EC (Draft) Brussels: European Commission, 2001

[5] Rosenau, Wendee V, Twede, Diana, - Returnable/reusable logistical packaging: A capital budgeting investment decision framework, Journal of Business Logistics, 1996

[6] Martin Dubiel – Costing structures of reusable packaging systems, Pakcaging technology and Sciene VOL 9, 1996