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Strategic Reverse Logistics Planning with Interactive Planning

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Abstract:
The importance of building efficient reverse logistics system has been increased by rapidly changing environmental factors including customers' demand and governmental regulations, while the network causes the organizational system to be more complex. Also, reverse logisticshas been recognized as one of company's important strategies in order to generate additional financial benefits and to increase the customer satisfaction. However, the building of reverse logistics network is more difficult than forward logistics one. To build the efficient and effective reverse logistics system, interactive planningwith pluralistic perspectiveand flexibility would provide appropriate way.
In this paper, (1) interactive planning is applied to establish ideal reverse logistics system, and (2) how and why suppliersand retailers including those in secondary market in reverse logistics system can be constructed in the view of interactive planning aresuggested with several propositionsfor improvable reverse logistics planning.

Keywords: Reverse logistics, interactive planning, systematic approach, and sustainability

1. Introduction

From company's strategic perspective, the additional establishment of revere logistics to forward logistics has been recognized to be important as the closed loop system to entirely control from the production of a product to disposal of it, in order to create additional benefits either visible such as financial outcomes or invisible such as the achievement of information of customer requirements. However, the establishment of RL is added the complexity to existing processes. For instance, governmental regulations for environmental issues on products sold or to be sold, customer dissatisfaction in quality for products, even if products do not have any problem in quality have increase of necessity of RL and complexity to overall supply chain network.

In the ideal supply chain, the return of product would be zero. However, it is just dream even in the best supply chain (Malone, 2004).It is current phenomenon in the market that, even when products do not have any problem, customers sometimes return the products. Under such process, RL is one of more important means to keep and attract customers.

However, returned product is different from virgin one in customer and manufacturer's perspectives. For instance, the value of returned product is rapidly decreased rather than virgin one, and manufacturers in RL network might loss financial benefits when effective response such as reselling for the product is not conducted. Under such risky environments, what drives RL as strategic business means?Álvarez et al (2007) provide three driving forces of RL as motivations for RL: economic, corporate citizenship, and legislation. Through RL, a company reuses some parts and resells the product either as new or as refurbished. Throughout such process, company can get economic benefits as well as the increase of corporate citizenship indirectly showing that the company has conducted the responsibility toward community and environment. And, RL is occasionally dependent on government legislation such as requirement of collection of products for environmental issue. As examples of such legislation, Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) can be listed. Such legislations have forced RL to handle not only repairable product returned, but also a wider range of low cost parts which are previously scrapped (Cope, 2006).

According to Rogers and Tibben-Lembke (1998), the size of reverse logistics in the U.S. amounted to about $35 billion in 1997. The amount has been increased along with one or mix of RL drivers. To satisfy such changes in RL, most third party logistics companies have provide their specialized reserve logistics services and they also have recognized the RL system as an opportunity in market. Many studies have conducted to contribute in forming effective network for increase the efficiency of reverse logistics. For instance, Blackburn et al (2004) suggest that either centralized or decentralized reverse supply chain can be used by the

change of value or returned product over time. Although the studies have contributed on the development on RL, most of them have focused on unitary participants such as the application of operations researches or dynamic system methodologies. However, RL network is needed to be considered in pluralist participants since the process of RL includes various participants such as operation, financial or account department. Even supplier and retailer's role can be importantly considered for RL process to be synergetic. Furthermore, stricter regulations and increasing demand of community and customer about environment issues cause current RL network and policies to be continuously changed to stricter. Under such perspectives, interactive planning in RL would be proper one of various pluralistic methodologies with holistic view.

This paper is organized as follows: 1) what is the RL arepresented,2) what is interactive planning and why it is appropriate for building of RL network are discussed, and 3) along with the application of interactive planning to RL, several propositions are suggested for building of effective RL network.

2. Reverse Logistics

Rogers and Tibben-Lembke(1998) defined reverse logistics (RL) as "The process of planning, implementation, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value of proper disposal". Although many researchers differently define RL, their based thought for RL is in making profits either tangible or intangible from returned products with environmentally consciousness. RL and FL have significant differences as presented in Table1.

Forward	Reverse
• Forecasting relatively straightforward	• Forecasting more difficult
• One to many transportation	• Many to one transportation
• Product quality uniform	• Product quality not uniform
• Product packaging uniform	• Product packing often damaged
• Destination/routing clear	• Destination/routing unclear
• Standardized channel	• Excepting driven
• Disposition options clear	• Disposition not clear
• Pricing relatively uniform	• Pricing dependent on many factors
• Importance of speed recognized	• Speed often not considered a priority
• Forward distribution costs closely monitored by accounting systems	• Reverse costs less directly visible
• Inventory management consistent	• Inventory management not consistent
• Product lifecycle manageable	• Product lifecycle issues more complex
• Negotiation between parties straightforward	• Negotiation complicated by additional considerations
• Marketing methods well-known	• Marketing complicated by several factors
• Real-time information readily available to track product	• Visible of process less transparent

Table 1: The difference between FL and RL (Tibben-Lembke& Rogers, 2002)

The Table1 shows that the control or planning of RL is more difficult than one of forward logistics. For example, in the reverse logistics, how much products will be returned is more unpredictable than how amount will be sold to customers. Under such conditions, the effective response for returned products is critical for customers to be satisfied and for smooth overall logistics flow to be available.

Firms' policies for products to be returnable can be categorized as either liberal or restrictive (Richey et al 2005). Under a liberal policy, authorization for return is easy, whereas the burden of customers become higher, under a restrictive policy, by such requirement as the considerable documents, pre-authorization and a limit on payment or amount returned. Reversely, under a restrictive policy, customers have more limitations to return products. By such policies, the RL processes have 8 different disposition options: Direct reuse/ resale, Repair, Refurbishing, Remanufacturing, Cannibalization, Recycling, Incineration, and Landfilling. The disposition is dependent on the location of FL process and the condition of returned product.

As well as just returning of products from customers with defects during manufacturing, the returning of the product is sometimes caused by customers' or retailers' mistakes such as the loss of a part in returned product and misunderstanding of delivery policy; the increased complexity by customers and retailers. RL activities include information intensive and labor-intensive process filled with exception (Retzlaff-Roberts & Frolick, 1997). During returning process, the condition of a product which decides disposition option is mainly checked by certain worker(s) since many returned products have different reasons including incorrect packaging. During the process of credit issue on returned product, the flow of information such as what item is returned, who did return, what is the reason for returning, and whether or not the return policy is met etc. is flowed. These features from information- and labor intensive process would provide manufacturers to create additional costs along with more complicate processes.

Under complicate situations, for RL to be effective and to achieve strategic benefits, an initial step begins with the building of effective network with the relevant value measurement of the returned product, based on the analysis of the product life cycle. As OEM products entering the mature stage in product life cycle, remanufactured products are lately appeared in product life cycle with low sales (Prahinski and Kocabasoglu, 2006). Two products' different life cycle is shown in Figure 1.
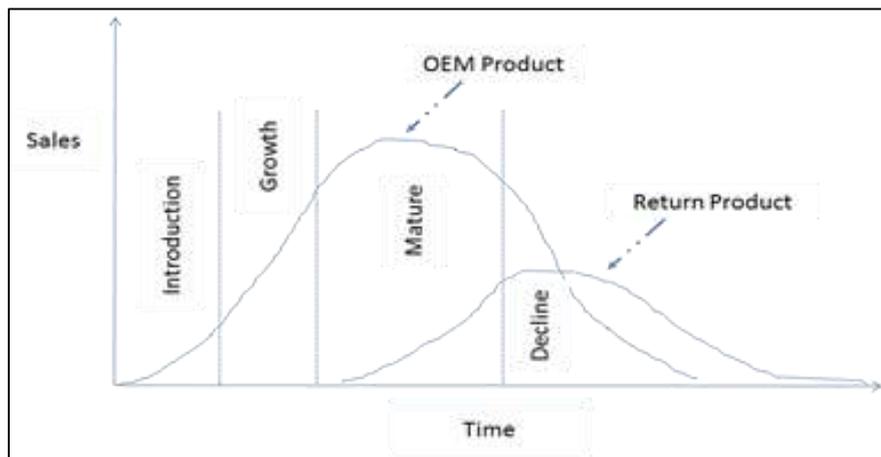
Figure 1: Product Life Cycle Comparison (Prahinski & Kocabasoglu, 2006)

The Figure 1presents two facts: one is that RL causes additional financial benefits by selling products or reusing parts, and another is that if effective RL system is not constructed, company might lose additional economic opportunities in use of returned products. In order to sell returned products along with the lengthening of product life cycle, the role of secondary market as well as primary one is important. For returned products, it shows that speedy value measurement of the product with the analysis of the product life cycle is important for the product to provide firms reduced losses in financial outcomes (Blackburn et al, 2004). When effective value measurement is conducted, the quality of returned product can be measured and speedy process is available to decide what next step is.

Under RL, companies have more complicated processes, and would not be sure whether the building of RL provides potential benefits or not. If so, what drives the RL to be established? Álvarez, et al (2007) present three drivers as motivations for RL: economic, corporate citizenship, and legislation. As external factors to affect RL network, Carter &Ellram (1998) listed following 4 factors: Regulatory, Output, Input, and Competitive. The combinations of four factors cause RL system to be necessary to gain strategic benefits.

Although such benefits can be achieved, all companies cannot achieve such benefits. In the case of RL, many barriers can be appeared. As barriers for RL, Rogers and Tibben-Lembke (1998) listed eight items as barriers for RL: 1) Importance of reverse logistics relative to other issues, 2) Company policies, 3) Lack of system, 4) Competitive issues, 5) Management inattention, 6) Financial resources, 7) Personal resources, and 8) Legal issues. The results of them indicate that most respondents did not still recognize the importance of RL relative to other business activities as well as the insufficient policies and system against RL.

2.1. RL with Suppliers, Retailer and Secondary Market

In RL, suppliers' role is also important as well as in FL. Along with the expected financial achievement, the selection of suppliers to be seen to customers as "green company image" is important. For instance, when a product is packaged, used box would be reusable and when the box is needed to be incinerated, environmental impact should be considered to avoid the violations of government regulations. As conditions to avoid those side effects, the flow of all processed initiated from original suppliers would positively affect the RL system.

RL often requires processes to be shared between suppliers and retailers. For instance, Soosay et al (2008) found from case study that one company has shared their process on recycling by the collaboration. The cased company offers the discounts on the future service charges for pallet returns and other incentives are provided for customers returning damaged products requiring refurbishment or minor rework. This incentive enables customers to return products in saleable conditions. Also, in another case, when return product arrives at collection site, reusable parts moves to remanufacturing stages. Reusable parts with new parts are assembled and resold to primary or secondary market. Under this process, the role of suppliers can decide reusable parts to be another new or refurbished product saleable in the market. If the cooperation with suppliers did not accomplished, the value of the reusable parts would be zero and the effects of RL process would be diminished. Integration with suppliers can play a critical role for returned products to have longer life cycle (Fernández & Kekäle, 2005). Also, if the cooperation with suppliers was accomplished from product design stage, the remanufacturing process would be speedy.

Many returned products have been resold in secondary market as well as primary one as "Refurbished" product, indicating that secondary market can play a role in recovering the financial benefits which might be loss when product is returned. Also, the satisfaction level of refurbished products from customers would be directly related to the brand image as much as virgin product with the creation of new customers.

Despite the fact that reverse logistics would help company to survive, the achievement of efficient reverse logistics is not easy. Many previous studies have been conducted in unitary approach, leading the understanding of overall RL process to be relatively underestimated.

Such previous research has contributed to improve RL process. However, such hard system approaches generally ignore the characteristics of changing environments. Thus, although hard system approach is obviously important, more holistic approaches should be recommended by understanding overall processes as well as the considerations of the involvement of other participants such as retailers and suppliers in RL. Throughout such holistic approach, all threats and opportunities which have not been considered could be figured out along with the finding of the effective solutions.

3. Interactive Planning

As types of planning to cope with changing environment, four different planning can be listed as "Reactive", "Inactive", "Proactive", and "Interactive" planning(Ackoff, 1981).Their significant differences are shown in Table2:

Orientation	Past	Present	Future
Reactive (Reactivist)	+	-	-
Inactive (Inactivist)	-	+	-
Proactive (Proactivist)	-	-	+
Interactive (Interactivist)	+/-	+/-	+/-
+ : Favorable attitude , - : Unfavorable attitude			

Table 2: Comparison of Planning (Ackoff, 1981)

By Ackoff (1981), the simple characteristics related to different planning are following:

1) Reactive: By assumption of "technology is the principal cause of change", technology is considered to hostile factor. The management mostly depends on experience and history. The plan is the bottom up while the style of rule is the top down. The problem is dealt with separately, not systematically, causing that the essential properties of the whole and many of the important properties of the individual part are missed.

2) Inactive: The purpose of this planning is "survival" and "stability". But, this management style satisfies current conditions. It is not believed that the current condition is the best, but believed that it is enough until any threats against stability and survival appear. Inactive organization successes when current environments are favorable to organization.

3) Proactive: This planning initiates from the belief that the future is better than the current or past. The critical issue in this planning comes from forecasting. Based on forecasting, this tries to optimize the system to respond future changes. The assumption of this planning is that the organization can identify possible futures and assign probability to futures.

4) Interactive: This planning is simply the combinations of other planning. The aim of this is to maximize organization's ability to learn and adapt to develop. This is an approach to analyze and improve current process between realistic and idealistic views.

Ackoff (1981) presented the relationship between the type of planning and the planning posture. The relationship is presented following Table3.

Type of planning	Means	Goals	Objectives	Ideals	Associated with
Operational	Choose	Given	Given	Given	**Inactive**
Tactical	Choose	Choose	Given	Given	**Reactive**
Strategic	Choose	Choose	Choose	Given	**Proactive**
Normative	Choose	Choose	Choose	Choose	**Interactive**

Table 3: Planning Characteristics (Ackoff, 1981)

Strategic and normative seem to be very similar. But, Ackoff (1981) presented their difference as follows: in strategic planning, "both internal relationships and those between the organization as a whole and its transactional environment with longer-range view", while, in interactive one, "the considered time range is indefinite and the relationship of all internal and external relationship including those between the organization and its contextual environment which has no influence over but which influences it". If the organization wants to overcome its competitors and requirements from external environments, strategic or operational planning through normative planning, interactive, is more appropriate.

The methodology of interactive planning is supported by three principles: participative, continuity, and holistic principles (Ackoff, 1981& 1999).

1) Participative principle: The participation encourages involved members to achieve an understanding of processes within an organization and help to approach the ideal results of an organization effectively.

2) Continuity: The effect and used assumptions of planning should be reviewed continuously, while other planning has a planning period having ending and start again by implementation, periodically. Under such continuous planning, the planning process generating knowledge, understanding, and wisdom is achieved.

3) Holistic principle: Interactive planning is all-over-at-once planning rather than sequential planning such as top-down and bottom-up. This principle includes two parts: coordination and integration. The principle of coordination indicates that the planning should be conducted along with all units at the same level, simultaneously and interdependently. The principle of integration states that planning should be interdependently conducted with at all level of a system or organization. When two principles are combined, planning becomes holistic approach.

By three principles, the interactive planning is conducted in following processes: 1) Mess Formulation, 2) Ends Planning, 3) Means Planning, 4) Resource Planning, and 5) Implementation and Control Planning.

4. Reverse Logistics in Interactive Planning

Firms need to look further to search out their vision to continuously survive and be better than competitors. There active or proactive planning has own limited characteristics (Ackoff, 2001). In the case of reactive planning, this is tactically oriented and bottom-up planning. One of focuses of RL is for firms to pursue "green image". In order to approach to such image of a firm,

most RL planning has been based on reactive planning (Walton, et al 1998). As such reasons, they state that studied corporations only want to avoid penalties without the realization of competitive implications. Reversely, in the case of proactive planning, this is strategically oriented and top-down approach. For RL to be effectively processed, the involvement of other departments is required to manage marketing, accounting, financing, and product development. Each participant would have different understanding of RL process and different views. To establish effective RL, for instance, all external environments should be considered such as the change of regulations and the changing of RL policies or the features of products on other industries. When all participants are involved, participants can understand overall processes and create effective solutions on the horizontal view by analyzing current RL system along with the generation of effective information and knowledge. External or internal environment has been and will always change. The governmental regulations for environmental issues have been and will be stricter than now. Rather than simply satisfying such regulations and customer requirements, it is better for a firm to have more competitive power than other companies focusing just their strategy by continuously reviewing and re-implementing changed or more-improved planning.

Again, strategic planning has ending. However, interactive planning encourages participants to create effective knowledge by continuously reviewing its planning rather than having ended planning. The external pressure for RL policies or processes to be upgraded is not stoppable. Thus, continuous planning would help such external pressures to be mitigated or already satisfied against such changing requirements.

In order to understand sufficiently RL processes, holistic approach is appropriate rather than looking at certain processes within RL system. For all participants to understand overall RL system on all levels, they need to simultaneously and interdependently coordinate and integrate their planning. When holistic planning is conducted, the considerations from all participants are involved and effective combination of information and knowledge can be conducted for planning for RL to be successful. These are indicating that interactive planning would provide more effective way for the establishment of RL system rather than proactive and reactive planning.

The ideal purpose of RL is to satisfy people including customers and employee, planet and profits. Through return policies, a company satisfies the requirements of customers, reuses or reduces materials to be landfill causing environmental pollution to be increased, and efficiently use its own material to increase profits through various RL activities. The reuse of the resource with the reduction of resource rather than other options is more close to the ideal RL processes. To approach the ideal RL processes, a firm needs to recognize its objectives and goals and select proper means. In order to approach such ideal RL, Carter and Ellram (1998) provides the RL hierarchy guiding how a company to focus on RL. If ideal supply chain hoping both zero inventory and zero return with satisfaction of customers cannot be fully accomplished, a firm should prepare the efficient and effective system to cope with the environment of un-ideal supply chain network.

The policy of RL is affected by mixed factors as mentioned before. And, such factors will be continuously changed. Thus, to cope with such changes, RL also need to be continuously improved to meet changing environments. For such improvement, considerations from various aspects for retailers, customers and supplier would be critical.

In RL research, most studies have focused on only two participants either supplier and manufacturers or manufacturer and customers. However, such dyad participants have limitations to analyze overall RL process to generate more synergic effects. Overall RL needs to be considered as a system. Thus, three participants need to be involved for construction of the ideal RL network.

In this section, interactive planning is applied to construct RL system, and for the effective RL through interactive planning, several propositions are suggested. For the establishment of ideal RL through interactive planning, five steps are presented with propositions as follows.

4.1. Step 1: Formulate the Mess

In RL, main problems needed to start from how, when, and where return products should be handled. In order to solve such problems, company's current systems and policies should be considered to figure out threats and opportunities. And then, involved participants together need to formulate for future ideal processes. As participants in RL, along with considered departments within a corporation, the involvement of its suppliers and retailers would be better for the establishment of both ideal and reality view in following some reasons.

4.1.1. With Retailers

In RL process, the level of uncertainty is generally higher than one in the forward process. To handle such uncertainty, the collaboration with supplier and retailer is more required to achieve extensive information exchanges between suppliers, manufactures, and retailers in the logistics network (Van et al., 2001). Information about customers is achieved from retailers when retailers receive the product to be return from customers. Information sharing helps manufactures to research about end-customers for better product and services. In the research of the relationship between information sharing and financial outputs, Kulp et al (2004) show that information sharing with retailer has positive effects in an increase of the profit margin to retailer and manufacturer. Although information sharing with retailer affects positive financial outcomes (Kulp et al, 2004), the result of the research represents that when RL is applied, manufacturers have a greater possibility in stock-outs which cause sales to be missed. In the perspective of retailers, RL is an insurance policy given by a manufacturer. When retailers hold excess inventories, retailers by applying the insurance send back products to manufacturer, transferring the problems of the excess inventory of retailers to manufacturers. To reduce high possibility of such stock-outs, the relationship with retailers would be critical as well as information sharing. Thus, for the improvement of RL in interactive planning, the involvement of retailers would create better formulations to solve given problems. Retailers need to recognize the positive effects of RL.

Retailer influences the effect of overall RL under the condition where retailers collect returned products with the collection of information from customers. Most RL policies are conducted under the liberal policy which most products can be returned by

customers. And, retailers play a critical role on their proximity to customers. The purpose of the liberal return policy is to satisfy customers and be more competitive than other competitors. Smooth RL processes would support the improvement of customer satisfaction, and this would affect positively the performance of manufacturers and retailers, again.

When products arrive at retailer, customers would show their information. Such information would include the direction of what customers want. Then, such information encourages both FL and RL process to be improved. Within such process of the achievement of information about customers, the trust with retailer needs to be based on. And, the role of secondary market is to facilitate the recycling and reuse of materials by extending the life of the materials as well as the contribution of environmental impact (Sarkis et al, 2004). That is, the relationship with retailers or secondary market participants provides initial step for effective RL to be processed.

As one of green issues related to RL, Vachon and Klassen (2006) in the study of the green project partnership with suppliers or customers, retailers, reveal that the partnership with customers is positively related to quality, environment and system flexibility in green project partnership. Although their study is limited to specific industry, the package printing industry, the role of retailers is one of important factors in reverse logistics focus on environmental issues.

Thus, for the effective analysis of current policies and for ideal future plan, following propositions are suggest.

- Proposition 1: The strong involvement of the retailer leads the reduction of uncertainty in the future.
- Proposition 2: The strong involvement of the participants comes from the trust between participants.

For smooth flow of information and products, manufacturers with retailers and suppliers should analyze current process, and when they together plan for future policy, programs, and plans, the uncertainty from current and future changing environments would be reduced. During this step, each participants need to re-recognize the purpose of establishment of RL. From such recognitions of participants, ideal plan for overall logistics network can be achieved.

4.1.2. With Suppliers

The market value of returned product would be decreased from the initiation of selling of virgin product. For the value of return product to be maintained as much as possible, the modular architecture in the product design process would be helpful (Fernández & Kekäle, 2005). They addressed that modular architecture of product is appropriate to recovery, refurbishing, or reuse of product.

Also, along with the consolidation of regulations for environmental issues, importance of the selection of supplier has been increased. Van (1999) proposed that, for RL to be one of green supply chain activities, the disassembly stage needs to be favorably designed with the assembly stage along with the environmentally consciousness in transportation and packaging. This implies that the forward and reverse flow of the product from the product design to customers, or reversely, depends on the level of the collaboration with supplier. Thus, following proposition is suggested.

- Proposition 3: The involvement from the product design in initial stage increases the efficiency of return process. The product manufactured with modularity helps the smooth of return process.

An initial focus on barriers and constraints for reverse logistics should be avoided (Sinn, 1998). The initial focus prevents participants from being creative. During the execution of this step in interactive planning, participants should need to trust between them. After the relation specific assets such as trust are based on logistics network, participants would devote to make their appropriate scenarios for future plan.

4.2. Step 2: Ends Planning

After formulating the mess, the participants determine their final plans with the analysis of gaps between the ideal plan and the reference scenario. Step 1 and 2are ideal view, and then participants need to look at under realistic view from Step 3.

4.3. Step 3: Means Planning

Now, participants determine "what should be done" to reduce the gap originating from step1 and 2. They evaluate and select means to approach the ideal RL network by reducing the gap. As example of such means, the establishment of improved information system or the use of third party logistics partner could be listed.

4.4. Step 4: Resources Planning

When planning ended and means for planning are determined, what, when, how, and where the resources are necessary is determined. Facilities, any necessary material and machine, information, and knowledge, etc., can be listed as resources for RL. Such resources would be some limitations based on time and cost. The resource gap between time and cost is identified and how the gap can be reduced is determined. If the modification is required, the planning process goes back to the stage of ends planning.

4.5. Step 5: Design of Implementation and Controls

When planning is finished and who should do "what, when and where process should be executed "are determined with demanded resource planning, the plan is implemented along with the establishment of control. From the implementation of planning, feedbacks are provided to make learning and adaptation for process.

After these steps, the feedback is achieved. The feedback would encourage RL to be double loop learning to create improved satisfaction of customers. These overall stages are shown in Figure 2.

In Figure2, the participants of suppliers and manufacturers would be more critical factor to decide the success of RL rather than the one of retailer. This does not indicate that the role of retailer is not important. Also, within all stages, the inflow of data, information, knowledge, and understanding are constituted. The proper management of inflow of them would play in critical role of the success of RL planning.
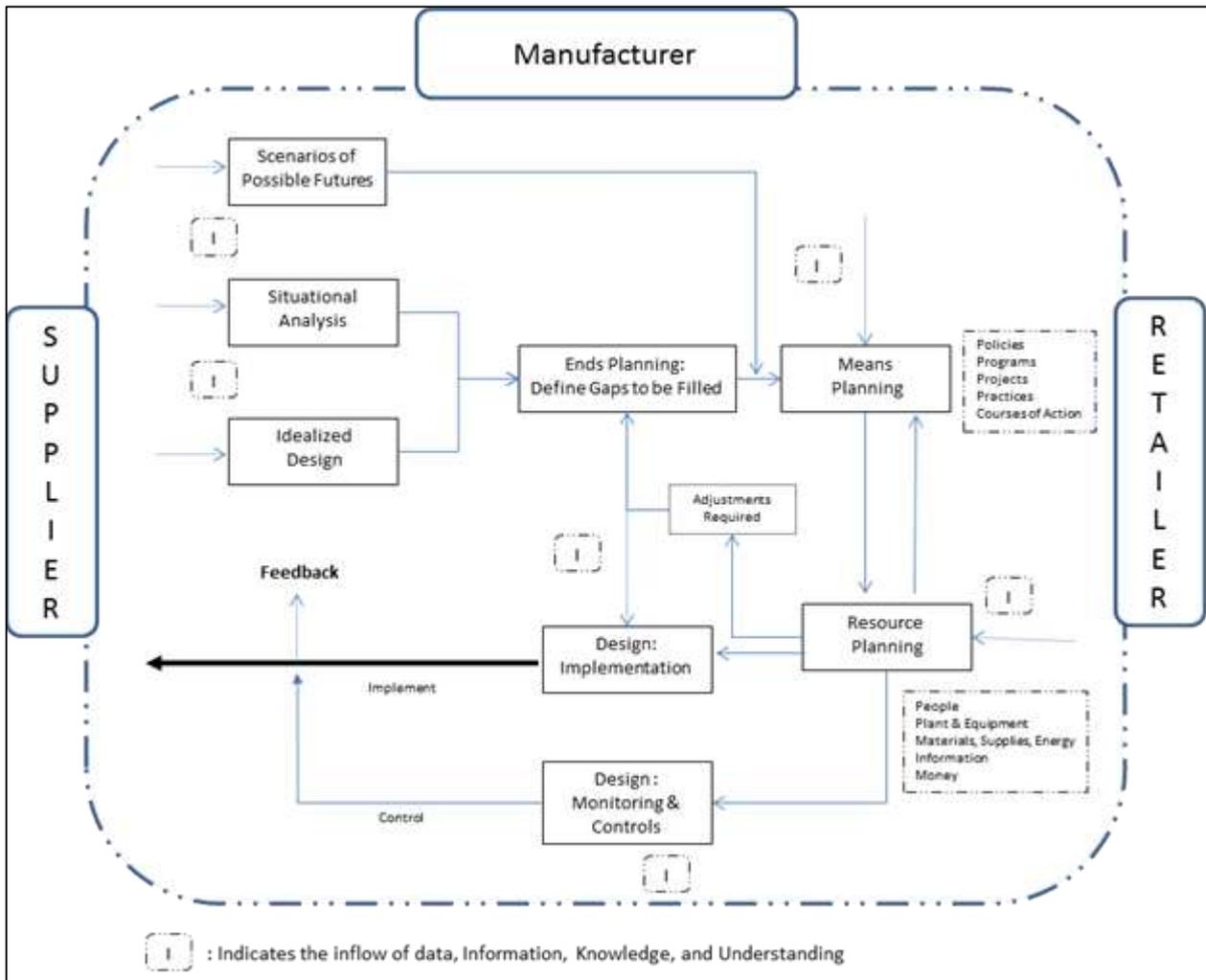
Figure 2: Interactive Planning with RL (Adapted from Ackoff, 1999)

5. Conclusion

The process of RL will be continually changed by various factors such as the change of regulations or customers' satisfaction. Although RL programs have been handled by proactive or reactive actions, each planning has its own limitations. In order to overcome such limitations, interactive planning would provide more appropriate way for company to pursue. Also, many companies have focused on RL as strategic perspective. However, with only strategic perspective on RL, a firm would not expect effective outcomes. A firm needs to consider reactive and proactive planning, simultaneously. To effectively balance and create synergetic outcomes among planning, interactive planning would be effective tool.

In this paper, RL is applied to interactive planning. However, to show the appropriateness of the application, there would be many limitations. Also, as many companies have focused on just strategic perspective, the example of interactive planning in supply chain studies including RL is very scarce. However, most critical importance of the interactive planning allows coping with future change along with the finding of the creative solutions from participants to approach ideal world. The approach of ideal world would be impossible. However, people and companies want to be in ideal world. Interactive planning would effectively help them to move toward ideal world where No inventory and No return products or the maximization of benefits from returned products through the involvement of markets and suppliers.

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