International Journal of Database Theory and Application
Vol.9, No.4 (2016), pp.267-276
http://dx.doi.org/10.14257/ijdta.2016.9.4.25

Performance Evaluation of Regional Logistics Network Operation Based on Reverse Logistics Mode

Qiuping Ni[1,*] and Yuanxiang Tang[2]

[1]*School of Economy and Management, Yibin University, Yibin644007, Sichuan, China*
[2]*School of Computer and Information Engineering,Yibin University, Yibin644007, Sichuan, China*
[*]*qiuping2581500@126.com*

Abstract

With the development of social economy, the life cycle of the product is becoming shorter and shorter. Online shopping provides more convenient channels, but also produces the problem such as the return, when the returned products in the reverse logistics chain flow, how to calculate the logistics cost and improve customer satisfaction is very important. In this paper, the author analyzes the operation mode and the characteristics of the reverse logistics network, and makes an evaluation of the performance of the reverse logistics network in 24 provinces of China by using DEA model. The results show that the technical efficiency and scale efficiency in 8 provinces is equals as 1, and that means reverse logistics network is DEA effective. At the same time, we put forward the corresponding improvement measures for the situation of reverse logistics network in Sichuan province.

Keywords*: Reverse logistics, network performance, value chain, DEA model*

1. Introduction

With the development of social economy, the life cycle of the products becomes shorter and shorter, the new products and upgrading products to the market faster and faster, prompting consumers to purchase more frequently. This trend has inevitably led to the use of more and more consumers do not need products, but also bring more packaging and return and other issues [1]. In addition, the new distribution channels for consumers to buy goods to provide more convenient channels, online shopping into a new direct sales of goods into a popular marketing, and direct products also have the possibility of return. A more important point is that many countries have increased environmental legislation, requiring companies to be responsible for the entire life cycle of their products, when the product is abandoned; the company is responsible for the recovery of their treatment. Under the influence of these factors, the research of reverse logistics has been paid more and more attention.

Reverse logistics in the western developed countries started early, rapid development, and the government and the relevant departments of the strong support, has developed more complete. Xerox company will open EOL electronic products into new products and parts beginning in the early 1990's, formed a comprehensive process to recover the EOL products from consumers, construction of remanufacturing and reusing parts of project; CellStar is the United States of Texas, North Carrollton, a mobile phone logistics service provider a suit, is designed for mobile phone return processing design, determine whether the product is still in the warranty period [2-3]. At the same time, when the returned product flow in the reverse logistics chain, it can also calculate the cost of labor, which not only bring down costs and raise the level of customer service, but also enable enterprises to obtain more information; reverse logistics management of Toshiba

ISSN: 2005-4270 IJDTA

computer there are different problems between logistics and repair services between Toshiba, more filling Heavy logistics, because the Toshiba believes repair skill to learn, improve, and logistics model to imitate; Sony Ericsson mobile phone reverse logistics using the UPS has shown the reverse logistics skills, the ups supply chain solutions scheme and Mexico maintenance projects [4], Sony Ericsson's customer satisfaction level improve the double, inventory control, improve the ability of and improve the visibility of the supply chain and the whole process of management.

2. Literature Review

2.1. Reverse Logistics

Scholars use the reverse flow of logistics, reverse logistics, reverse distribution of different terms to describe the same event or part of the reverse logistics activities, we are now talking about. Samiee (2008) pointed out reverse distribution is the commodity in the distribution channels from the customer to the manufacturing enterprise flow [5]. Deniss (2014) pointed out reverse distribution defined as "a commodity or material because reuse, recycling or disposing of occurrence of returns, from downstream to upstream movement", they will further the reverse logistics is defined as the reverse distribution and resources to reduce the sum [6]. Rogers (1998) pointed out reverse logistics definition as in order to seize the useful value or handle correctly the goods from the final destination of moving back the process [7].

In the above definition and discussion, the key elements of the reverse logistics is usually in the product after the planned use of all or part of it has been consumed from the terminal client to other activities or locations of mobile processes. Consumers as the main terminal in the product flow process, they began to reverse logistics flow in the using value of products consumed. Here, consumers not only refer to the household, including commercial purposes, research institutions, government agencies and all other users of the products [8]. Reverse flow can have many channels, the user will have to use or defective products returned to its source, also can transfer it to those who can dig out more use value of the user, or can be them as waste to dispose of. The above mentioned products include not only the terminal products, including packaging products. Based on the above analysis, we will the definition of reverse logistics network is to withdraw the product from the hands of consumers and transported to processing equipment for further processing, and then recycling products transported to the market network system. Compared with the forward logistics, reverse logistics has the following characteristics.

1) Reverse movement: in the reverse logistics channels, there are two important characteristics of the material are different from the forward flow of the sports. First, due to the morphological changes of consumption or its use value, materials in the reverse logistics value than forward logistics low[9]; second, in the reverse channel materials could have different morphology, mode of transport and storage characteristics, such as bulk jar can no longer be put in a box, with this type of vessel in the reverse channel gradually becomes empty, they will become more loose.
2) Uncertainty: forward logistics system generally refers only to the uncertainty of market demand, and in the reverse logistics system uncertainty is much higher, not only to consider the market demand for recycled products of uncertainty, but also consider the uncertainty of recycling supply, mainly including the back goods quantity, quality, time of arrival, *etc.*
3) Treatment scheme of complexity: reverse logistics is an important problem, recyclable items from the starting point of transported to disposal sites, further processing is more complex, with final destination and transportation routes are difficult to be determined and bring great difficulty of the management, which

requires maximum degree by means of information technology, the various possible demand and processing requirements of integration, and in the master on the basis of this information, providing a complete and reasonable solution.

4) Asymmetric information: to understand government logistics system, production enterprises, and consumers recycling of wastes and green technology is the serious information asymmetry, which caused the failure of price mechanism. Want to understand much of the negative social benefits produced by a waste, and green technology to create positive externalities have much, as the limited resources of enterprises especially individual consumers is almost no way to obtain such information, their understanding of the negative social benefits or positive externalities rely heavily on in government, and sometimes because of access to such information needs huge cost, making the government not to implement.

2.2. Logistics Network

Guiltinan define four main types of reverse channel. First class focused on traditional intermediary to achieve articles reuse, such as recycled bottle of yogurt; the second focused on secondary scrap processing business, such as scrap yards; the third is controlled by the manufacturer recycling center; fourth class built in resources development near the center, it will be separated from the total waste materials recycling, which need to use complex classification technology, in their view, this is future prospects for the development [10].

Grant (2014) analysis the existing cyclic channel, and find that kind of structure envisaged because of the emergence of market pressure and a channel in the new members, including the government [11], there have been in many different situations, they found that reverse logistics and distribution channels are very different, it may use any one, depending on its type, source material, and the market or other purposes related to the position and the channel members of the function, as well as their own complete specific tasks in the form. Mohamad (2012) refers to the early some describe the outcomes of distribution channels, from the number of layers (vertical dimension) and each layer points (horizontal dimension) two aspects described, these concepts are applied to municipal solid waste, and enumerating the five levels of the urban reverse channel: consumers, collection, transport, transfer, processing, terminal market [12]. Think each of the city's reverse logistics channels design depending on the characteristics of the local, a combination of these layers of material flows, and not necessarily through all five levels, and that early on the reverse channel description did not include all possible types, some channels than before to describe the complex. Jahre demonstrates the appliance of solid waste, including it can use the part of reverse flow indeed exhibit the characteristics of reverse channels, and that the reverse channel deepened our understanding of the process of the reverse flow, further introduces the concept of urban channel of reverse logistics operation delay

Reverse logistics is in an overall social environment, will be affected by four factors: social factors, environmental factors, regional factors and consumer factors. These factors constitute the four major systems: enterprise reverse logistics system, consumption system, regional reverse logistics system and environmental system. Regional reverse logistics network that is, a certain range of reverse logistics activities regarded as a system, according to the relationship between each node in the system, emphasizing the material flow, energy flow, information flow organic combine, overall planning, organization, implementation and coordination control, so that the whole system is gradually becoming the best state, regional reverse logistics to achieve a virtuous circle. Regional reverse logistics system can be decomposed into several interconnected subsystems, no matter how large it is. Regional reverse logistics system is connected with the inside and outside the region to multiple users, manufacturers, vendors and other nodes, and with the change of supply and demand, the main factor in the system will change. That is to say, the

cooperation between enterprises, the social and economic development, resource scarcity, and the changes of regional policy environment changes will lead to the change of regional reverse logistics system. Therefore, the regional reverse logistics system is a dynamic system which can meet the need of regional economic development and adapt to environmental change.

3. Model Construction and Index

3.1 Evaluation System

Performance evaluation refers to the organization in accordance with predetermined standard and evaluation procedure, the use of scientific methods of evaluation, in accordance with the content and standard of the evaluation of evaluation objects work ability, working performance of regular and irregular assessment and evaluation. Performance evaluation is an important means to improve the management and improve the efficiency of decision makers. According to the purpose of supply chain management and supply chain performance evaluation system can be divided into six basic components, respectively: price method of the object of performance evaluation of supply chain, supply chain performance evaluation model, the performance evaluation index system of supply chain, supply chain performance evaluation criteria, supply chain performance evaluation, performance evaluation of supply chain organization. Reverse logistics network as a part of supply chain management, evaluation system composition and evaluation system for supply chain composition is the same, into six parts. Regional reverse logistics network performance evaluation object, involving to all members in the network, including suppliers, manufacturers, dealers, distributors and consumers in various network nodes, is the effect of the implementation of the reverse logistics strategy target. This effect is more abstract, it is difficult to measure directly, it needs to be decomposed and then measured, analyzed and integrated to get the overall performance of the reverse logistics network. The performance evaluation model of regional reverse logistics network is to show how to form the index system which can be used to measure the performance of the reverse logistics. In the commonly used model in the performance evaluation of supply chain supply chain operations reference model, logistics score card, the balanced scorecard model. Regional reverse logistics network performance evaluation index system, which is the basis of performance evaluation, through which the key index to reflect the performance of the reverse logistics network. It reflects the overall operation condition of the reverse logistics network, reflecting the operational relationship between nodes, rather than isolated to evaluate the performance of a certain node. Regional reverse logistics network performance evaluation method, is refers to the evaluation of each index value after appropriate calculation, and according to the evaluation standard, it is concluded that the means of comprehensive evaluation conclusion.

Regional reverse logistics network performance evaluation organization is responsible for the construction of performance evaluation system, including the selection of performance evaluation model, the establishment of evaluation index system, select the evaluation method, set the evaluation criteria of the organization. Because the cooperation among the members of the reverse logistics network is based on the common interests, there is not a right organization to lead the establishment of network performance evaluation system. This paper argues that, can the government do to the initiator, inviting the node enterprises in the network to share in a common and negotiate the establishment of performance evaluation system. In this paper, it is also the performance evaluation of the reverse logistics operation of the provinces in China from the perspective of the management decision maker.

3.2. Index Selection

The input and output in the DEA application must be measurable, but not in the same unit. In the initial determination of a factor as the input or output will be somewhat ambiguous, which depends on the specific circumstances, but the general principle is that the entry of the smaller the better, the bigger the better output. First, the selection of indicators and evaluation of the object of the strategic objectives, that is, the selection of indicators to reflect the strategic objectives of the evaluation object. Secondly, selected indicators to conform to the characteristics of the object of evaluation, according to the evaluation object to set specific targets and employee performance evaluation indicators that are different from the evaluation index of organizational performance, the performance evaluation index system of supply chain is different in enterprise performance evaluation index. Finally, the selection of indicators to be operable, the corresponding data is easy to collect, and has been widely recognized. Supply chain performance evaluation index system is composed of a number of interrelated, mutual complement, with hierarchical and structural indicators of the composition of the organic series. We can consider the following aspects of the input indicators:

1) Labor costs: the number of employees who collect and dispose of waste.
2) Financial costs: the collection and disposal of solid waste in cost, the annual recycling project cost management, annual recycling project of publicity and education costs, capital equipment costs annually, materials and supply costs, and so on.
3) Environmental costs: such as the annual waste of resources and recycling of waste materials, the amount of coal consumed in the processing industry, the amount of waste water generated and so on.
4) The scale of the reverse logistics channel: the channel size refers to the number of nodes in the reverse recovery network

When selecting the output indicators we can consider the following aspects: the number and percentage of recycled materials, the sales income of the recycling, the number of residents receiving services, and the scale of the total reverse logistics channels. The size of the reverse channel can be as input can also be used as output, because the efficiency of the most simple definition is the output input ratio, the output can be defined as its growth can cause the efficiency of growth, similar to the input can also defined as its reduction can cause the efficiency growth. If the scale of the reverse channel is regarded as the output, then the expansion of the scale will increase the efficiency of the channel without causing the increase of the cost.

4. Empirical Analysis

4.1. DEA Model

Data envelopment analysis keep the input or output of a decision making unit, the mathematical programming is used to determine the relative efficiency of the production frontier, then each decision making unit (DMU) are projected to determine the production frontier. Through comparison of decision making units deviates from the frontier surface degree to evaluate their relative efficiency of. DEA method is in convex analysis and linear programming as the tool to measure the relative efficiency of a kind of evaluation method and applied mathematics model calculation relative efficiency of decision making units between, and make an evaluation to the evaluation of the object, it can give on decision making unit itself optimal planning of investment and output, to comprehensively reflect the evaluation object itself characteristic of information; at the same time it can also adapt to the complicated system input and output evaluation. In the DEA analysis, the DEA method is used to establish the model without the non dimensional treatment. The relative efficiency evaluation of the decision making unit is

independent of the dimension selection of the input and output parameters. With N decision making units, each decision making unit has M inputs and S outputs, respectively, using vector X_{ij} and Y_{rj} to represent the inputs and outputs of decision making units. CCR model is built on the basis of the comparison of the various decision making units, and they have the relative validity. The efficiency evaluation index of the element depends on its output synthesis and input synthesis ratio Z_j, as:

$$Z_j = \frac{\sum_{r=1}^{S} u_r y_{rj}}{\sum_{i=1}^{M} v_i x_{ij}} \tag{1}$$

In the formula, the molecule is the j DMU output is the sum of the denominator is the sum of input, efficiency evaluation index Z_j is relatively effective evaluation value.

To effectively evaluate the J_0 decision making unit (DMU), the evaluation model is its effective evaluation value as the objective function and seek the maximum value, in the effective evaluation of all decision making units value to all decision making units less than or equal to 1 as the constraint.

$$\max Z_0 = \frac{\sum_{r=1}^{S} u_r y_{r0}}{\sum_{i=1}^{M} v_i x_{i0}} \tag{2}$$

$$s.t. \quad \frac{\sum_{r=1}^{S} u_r y_{rj}}{\sum_{i=1}^{M} v_i x_{ij}} \le 1 \tag{3}$$

For the convenience of expression, we make:

$$X_j = \left(x_{1j}, x_{2j}, \cdots, x_{mj}\right)^T$$
$$Y_j = \left(y_{1j}, y_{2j}, \cdots, y_{sj}\right)^T$$
$$v' = \left(v_1, v_2, \cdots, v_M\right)^T$$
$$u' = \left(u_1, u_2, \cdots, u_S\right)^T$$

After the transformation, the introduction of a scalar θ and N x 1 constant vector lambda, get the model as follows:

$$s.t. \quad \begin{cases} -y_i + Y\lambda \ge 0 \\ \theta \cdot x_i - X\lambda \ge 0 \\ \lambda \ge 0 \end{cases} \tag{4}$$

The theta value is value of the i DMU's efficiency and θ is less than or equal to 1, when the value of 1 indicates that the change in the frontier; that is, the decision unit is effective. The slack variable is introduced; the CCR model is transformed into non Archimedes infinitesimal epsilon form:

$$Min\left[\theta - \varepsilon\left(es^- + es^+\right)\right] = V_D \tag{5}$$

$$s.t. \quad \begin{cases} \sum_{j=1}^{N} \lambda_j x_j + s^- = \theta \cdot x_0 \\ \sum_{j=1}^{N} \lambda_j y_j - s^+ = y_0 \\ \lambda_j \geq 0, s^- \geq 0, s^+ \geq 0 \end{cases} \tag{6}$$

If the optimal DEA model for the value θ*=1, a weak DEA effective decision-making unit.

4.2. Performance Evaluation of Reverse Logistics

The performance of the reverse logistics network in 24 provinces of China was evaluated and the results were shown in Table 1.From the above calculation results Table 1 can see, Beijing, Heilongjiang, Guangdong, Guangxi, Chongqing, Guizhou, Yunnan, Gansu provinces of the eight technical efficiency and scale efficiency scores were 1.000 and $S^-=0$, $S^+=0$, that reverse logistics network of the eight regions are DEA effective, that is to say, the eight provinces the current production status in the best state. The most prominent is the Guangdong, whether it is waste of resources and waste material recycling processing industry a total number of employees or in Guangdong Province and the total population of are most, and is much higher than other provinces, in such a large population base, Guangdong Province of waste recycling or reach the DEA effective, we believe that the above scale enterprises. Above all, the in the new network path analysis, only when large quantities of processing, achieve the scale efficiency value, and waste of resources and waste material recycling processing industry the new road size recycling network, specialized recycling center is the biggest reason. The eight provinces in Heilongjiang, Guangxi, Guizhou, Yunnan, Gansu from the perspective of economic development do not belong to the developed areas, but their reverse logistics network operation reached DEA effective, through analysis, we found that the operation of these provinces do have worth learning place, that is their output cost ratio is very high.

Liaoning, Jiangsu, Zhejiang, Anhui, Shandong, Hubei, Hunan, Henan, Shaanxi ten provinces in the variable returns to scale (VRS model) efficiency scores to 1.000 and $S^-=0$, $S^+=0$, that reverse logistics network of the ten provinces in VRS is effective, and DEA invalid in the scale of fixed income model, that they currently are not in the optimal scale of operation, scale and input and output is not matching, if it is to maintain the output constant, merely the reduction of investment is not feasible, should be in size adjusted to the effectiveness. DEA also gives the countermeasures, the ten provinces should be reduced in size, that is, in the case of all input and output ratio unchanged, the scale will make more efficient. Their output cost ratio is not low, even in Sichuan and Shaanxi than Chongqing, Beijing is higher, and Zhejiang, Jiangsu Province, above scale waste resources and waste materials recycling processing industry, a number second only to Guangdong, and far ahead of other provinces in the country. Also output had a total population, which is unable to change in short-term. Therefore, from the point of view of data envelopment analysis (DEA) analysis, DEA and failed to give them short-term improvements. So here, we also identified their reverse logistics operation is effective.

Table 1. Empirical Results of DEA Method

province	crste	vrste	scale		S_1^+	S_2^+	S_3^+	S_1^-	S_2^-
Beijing	1.000	1.000	1.000	-	0.000	0.000	0.000	0.000	0.000
Hebei	0.810	0.896	0.904	drs	0.000	6.576	0.000	0.000	0.000
Shanxi	0.905	0.951	0.952	drs	0.000	1.401	0.058	0.000	0.000
Neimenggu	0.810	0.816	0.992	drs	364.09	0.000	0.000	0.000	0.000

Liaoning	0.916	1.000	0.916	drs	0.000	0.000	0.000	0.000	0.000
Jilin	0.797	0.805	0.990	drs	0.000	7.987	0.000	0.000	0.000
Heilongjiang	1.000	1.000	1.000	-	0.000	0.000	0.000	0.000	0.000
Shanghai	0.727	0.747	0.973	drs	2416.79	0.000	0.000	0.000	0.000
Jiangsu	0.801	1.000	0.801	drs	0.000	0.000	0.000	0.000	0.000
Zhejiang	0.786	1.000	0.786	drs	0.000	0.000	0.000	0.000	0.000
Anhui	0.951	1.000	0.951	drs	0.000	0.000	0.000	0.000	0.000
Jiangxi	0.828	0.843	0.982	drs	101.063	0.000	0.000	76.170	0.000
Shandong	0.789	1.000	0.789	drs	0.000	0.000	0.000	0.000	0.000
Henan	0.777	1.000	0.777	drs	0.000	0.000	0.000	0.000	0.000
Hubei	0.950	1.000	0.950	drs	0.000	0.000	0.000	0.000	0.000
Hunan	0.812	1.000	0.812	drs	0.000	0.000	0.000	0.000	0.000
Guangdong	1.000	1.000	1.000	-	0.000	0.000	0.000	0.000	0.000
Guangxi	1.000	1.000	1.000	-	0.000	0.000	0.000	0.000	0.000
Sichuan	0.913	0.896	0.913	drs	0.000	1.281	0.043	0.000	0.000
Chongqing	1.000	1.000	1.000	-	0.000	0.000	0.000	0.000	0.000
Guizhou	1.000	1.000	1.000	--	0.000	0.000	0.000	0.000	0.000
Yunnan	1.000	1.000	1.000		0.000	0.000	0.000	0.000	0.000
Shaanxi	0.950	1.000	0.950	drs	0.000	0.000	0.000	0.000	0.000
Gansu	1.000	1.000	1.000	-	0.000	0.000	0.000	0.000	0.000
mean	0.897	0.961	0.935		120.081	0.665	0.002	3.174	0.000

Among them, to crste list shown fixed returns to scale of the provincial technical efficiency value, vrste list shows variable returns to scale of the provincial technical efficiency value, scale list shown scale efficiency value, the scale efficiency value is 1 the decision-making unit in the current size of the inputs and outputs are effective, if the scale efficiency is less than 1, DEA in followed by a list of suggestions for improvement are given, the decision unit is reduced scale (DRS) or expanding the scale (INS).

4.3. Effective of Evaluation Index

In view of Sichuan Province, because of its non DEA effective, the analysis efficiency score, DEA gives the control group, as well as through the improvement may achieve the goal value. DEA gives an efficiency score for each decision making unit, which reflects the ratio of the total output to the total input data. The data show that Sichuan's score is 0.896, which is 95.2% of the area on the front face. In other words, it can reduce the cost of all inputs consumption by 4.8% in the case of keeping output constant. DEA software analysis gives the efficient decision making units and make them and evaluation unit in the input and output as closely as possible, known as the "control group" set, the control group of efficient decision making units is in the frontier, and their synthesis of the target value is evaluated unit to improve the expected value. Because they are similar to the similarity of the decision making units, the parameters in the control group provide a good reference for decision makers to improve the non technology effective decision making units.

Table 2. DEA Operating Results in Sichuan Province

Variable	sort	original value	radial movement	slack movement	Project value
output	1	3574.000	0.000	0.000	3574.000
output	2	1.000	0.000	1.401	2.401
output	3	0.284	0.000	0.058	0.342
input	1	1328.000	-65.472	0.000	1262.528

input	2	0.278	-0.014	0.000	0.265

Table 3. Control Group DEA Evaluation

LISTING OF PEERS:	
peer	Lambda
22	0.067
23	0.078
21	0.855

Output 2 can be seen that there is insufficient 1.281, that in accordance with the existing population and GDP, *etc*., the number of above-scale enterprises should be one or two more; Output 3 (above-scale Waste Resources and Materials Recycling industrial output) have less than 0.043, that GDP there is room for improvement; have invested 65.472 redundancy that in order to achieve DEA effective, the total number of practitioners can be streamlined; 2 has invested 0.014 redundancy, that cost can be further reduced. By provinces DEA effective analysis, we see the scale of operation and cost control is the two most important aspects of the impact of reverse logistics operation efficiency. Gansu Province, for example, the economy is not developed, the number of recycling processing enterprises reached more than one size only, but its GDP ratio is far greater than the cost of other provinces, and other provinces, its output value can be very low compared to, which proves Gansu cost control has done very well, which is why less Gansu population, large-scale recycling of waste resources and waste materials plus the number of industrial enterprises are small, but can achieve DEA effective. Development Status of Reverse Logistics is waste resources and waste materials recycling many processing enterprises, above-scale but low proportion, the majority of small-scale enterprises, the strength is not strong, the low quality of the staff, the lack of standardized procedures and standardized.

5. Conclusion

The definition of reverse logistics network, the characteristic, the classification and the analysis of the current performance evaluation methods and defect based on the proposed using data envelopment analysis (DEA) to evaluate the efficiency of the reverse logistics network. It overcomes the past performance evaluation of subjective factors, and of different dimension in the standardization process may appear deviation, can be directly quickly calculated multiple decision making units efficiency between the relative effectiveness of, and to adapt to multi input multi output complex system structure, and can effectively and quickly for comprehensive evaluation of objective evaluation. And reverse logistics network based on the "benchmark" evaluation criteria are consistent, that is, it can give a decision making unit improvement objectives and reference objects. Through the analysis of the previous research data, evaluating the reverse channel of input and output indicators, of which some can be further decomposed, such as cost decomposition for more input index, subdivision management fees, promotional fees, education expenses and so on, these can be with the needs of decision makers and measurement to the actual data set. However, with the increase of input and output indicators, the efficiency frontier will be a lot more face recognition, DEA will decline.

In the empirical analysis, through access to large amounts of data, at the present stage in our country can be used as the index of the reverse logistics efficiency measure, this article is only for reverse logistics performance evaluation of selected two input indicators, waste resources and waste materials recovery and processing of number of employees, more than the size of waste resources and waste materials recycling processing owners business cost, three output index, total population, above scale waste resources and waste materials recycling and processing enterprises number, more than the

size of the abandoned resources and waste materials recycling industry total output value. With the data of provinces in 2015, by DEA software calculation results are given, to make an overall analysis on the efficiency of reverse logistics operation in the provinces, and focuses on the analysis of Sichuan province DEA improvement measures. Show that DEA is an effective tool can be used to measure the operating efficiency of reverse logistics channels, it can identify the effective measures, and to reveal the relative effectiveness of existing measures.

Acknowledgement

This research is supported by Yunnan Flower Auction Market based on Supply Logistics-in Kunming International Flower Auction Market (KIFA) Case(2011Q19); Sichuan Circulation System of Agricultural Research Mode in the Supply Chain Environment(12SB359); Yibin Port on the Development of Research and Regional Economic Interaction(SYJJ2013B07); Research on Yibin Port Logistics and Regional Economy(2012RY013).

References

[1] S. Djelassi and I. Decoopman, "Customers' participation in product development through crowd sourcing: Issues and implications", Industrial Marketing Management, vol. 42, no. 5, **(2013)**, pp. 683-692.
[2] A. D. Zaridis and T. Dimosthenis, "Entrepreneurship and SME's Organizational Structure. Elements of a Successful Business", Procedia - Social and Behavioral Sciences, vol. 148, **(2014)**, pp. 463-467.
[3] H. Gebauer, M. Paiola and B. Edvardsson, "A capability perspective on service business development in small and medium-sized suppliers", Scandinavian Journal of Management, vol. 28, no.4, **(2012)**, pp.321-339.
[4] M. Shoki, L. Yun and N. Zakuan, "Examining Dimensions of Electronic Service Quality for Internet Banking Services", Proceeding - Social and Behavioral Sciences, vol. 65, **(2012)**, pp. 854-859.
[5] S. Samiee, "Global marketing effectiveness via alliances and electronic commerce in business-to-business markets", Industrial Marketing Management, vol. 37, no. 1, **(2008)**, pp. 3-8.
[6] S. Deniss, "Impact of e-environment on SMEs Business Development", Proceeding - Social and Behavioral Sciences, vol. 156, **(2014)**, pp. 409-413.
[7] M. Savrul, "The Potential of E-commerce for SMEs in a Globalizing Business Environment", Proceeding - Social and Behavioral Sciences, vol. 150, **(2014)**, pp. 35-45.
[8] E. H. Sinem and Z. Kabadayı, "Innovation Orientation, Market Orientation and e-Loyalty: Evidence from Turkish e-Commerce Customers", Procedia - Social and Behavioral Sciences, vol. 99, **(2013)**, pp. 509-516.
[9] S. Manjit and V. Kristine, "Social Commerce: A Contingency Framework for Assessing Marketing Potential", Journal of Interactive Marketing, vol. 27, **(2013)**, pp. 311-323.
[10] I. Janita and W. Chong, "Barriers of B2B e-Business Adoption in Indonesian SMEs: A Literature Analysis", Proceeding Computer Science, vol. 17, **(2013)**, pp. 571-578.
[11] K. Grant and D. Edgar, "Risky business: Perceptions of e-business risk by UK small and medium sized enterprises (SMEs)," International Journal of Information Management, vol. 34, no. 2, **(2014)**, pp. 99-122.
[12] S. Mohamad and U. Ahmad, "The Attributes of Electronic Service Quality (e-SQ) among Academic Librarians", Proceeding - Social and Behavioral Sciences, vol. 65, **(2012)**, pp. 260-265.

