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CASE STUDY ON OPERATION MANAGEMENT PERFORMANCE IMPROVEMENT OF SCRAP IRON COMPANY

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ABSTRACT

The present study wants to improve the operation management performance, so as to increase the amount of revenue and improve the delivery cost of the case company. Therefore, the purpose of the present study, first, is to analyse the factors that affected the willingness to resupply of suppliers, and adopts the questionnaire survey method to collect data and uses statistical software to analyse the suppliers. Results shows the willingness to resupply of the suppliers. There are 92% suppliers will supply to case company again, and 88% suppliers would recommend peers to supply to case company. Second, use break-even analysis to analyse the delivery cost, compare the distance of the three major steel plants and the number of trips, and propose different delivery car options, which can save nearly NT$ 1.2 million per year for the case company.

Keywords: *Circular economy, Supplier management, Scrap iron, Break-even analysis.*

1. INTRODUCTION

Industrial development brings economic growth and employment opportunities, but also produces problems such as ecological damage, climate change, and deterioration of health and living environment. How to use the least amount of energy and resources to create the greatest economic benefits and reduce environmental impact has become an important issue in the post-industrial era [1]. Industrial ecology was first proposed by Frosch & Gallopoulous [2], aiming to make the industry like a natural ecosystem, it turns waste into new resources and joins a new round of production system in a circular way, reducing the negative impact of industrial systems on the environment. Industrial symbiosis is one of the most important strategies, which means that enterprises in the region promote the use of by-products of one enterprise as raw materials for another enterprise through the exchange of energy, resources, water resources, etc. [3].

Since the use of metal by human beings, it is the beginning of civilization. From the bronze age to the iron age, so as to today's high-tech age, most of the steel raw materials for manufacturing machinery and equipment, transportation, and housing structures are smelted from mineral resources. Mineral resources are non-renewable resources and will eventually be exhausted. Therefore, making good use of recycled resources is a topic that needs to be actively faced. Furthermore, the iron, one of the mineral resources, has an extraordinary influence on the economies of the world today: it affects two major industries in the market: the steel industry and the bulk industry. However, the usage of iron leads to the generation of large quantities of scrap iron, which is hazardous to health and causes environmental pollution [4]. Therefore, enhance the reuse of iron is an import issue for the industries and government. The main business of case company is major on the scrap iron recycling. The co-author is the CEO of the case company. Thus, the present study focus on the operation management improvement of the case company.

2. RESEARCH METHOD

The circular economy is an economic system that aims to eliminate wastes by reusing [5]. Rabbani & Zarfeshani [5] also indicated that the production companies currently face significant environmental concerns, which raised the circular economy. Due to global warming, geopolitical instabilities and rising raw material costs, recycling metal is increasingly important [6]. Onesmo et al. [7] call for a synchronized sustainable development and solid waste management system that connects product design, development manufacturing, and end-of-life products to improve the circular economy. The increased demand for secondary materials, particularly scrap metals, in cities due to development activities in both emerging economies and developing countries has increased the demand for recycling materials. It accelerated the growth of the circular economy and climate-smart development [7]. Achieving a zero-emission future depends greatly on how steel production is decarbonized within a limited time frame. Here we show that the production of zero-emission steel is possible but that the quantity and quality of steel may be limit by scrap down cycling [8].

For the case company, the stable supply of suppliers is the most basic key to maintain the operation of the case company. Therefore, there is needed to investigate the supplier management to increase the willingness to resupply of the suppliers. Suppler management (SM) is a new area of interest to scientists and industrial practitioners through which to maintain productivity, reduce costs, and enhance agility [9]. While services represent the largest sector of the global economy, most SM research is focused on product flows. Executives in manufacturing firms have benefited from frameworks created to implement SM processes, but this is not the case for their counterparts in service companies [10]. Figure 1 shows the scrap iron industry chain in Taiwan. The personal recyclers collect the scrap iron and then sold to small recycling yards or direct sold to recycling yards. The supply sources of case company have recycling yards, construction demolition, and import from oversea. Furthermore, the recycling yards are the most import supplier of case company. The case company purchase and then crop and compress the scrap iron, finally, deliver the compressed scrap iron to steel plant.

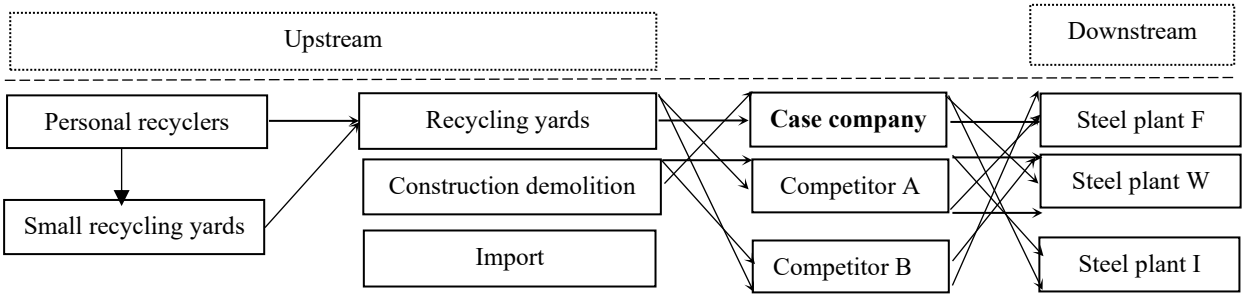

Figure 1. Scrap iron industry chain in Taiwan

Break-even analysis is basically concerned with the exact ascertainment of profit thresholds (the break-even points), the requisite data preparation and further related analysis [11].

Morano & Tajani [12] indicated that the break-even analysis is an important tool of financial management, and the break-even point is the amount that a corporation must bring in to cover costs and operate the business. There are many models for break-even analysis, such as simple model (Figure 2), ladder cost model (Figure 3), and multiple break-even points model (Figure 4).

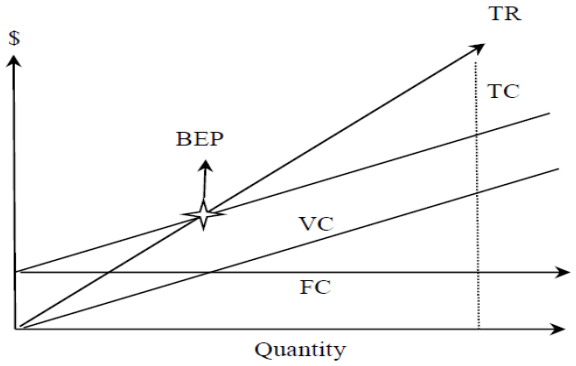

Figure 2. Simple model

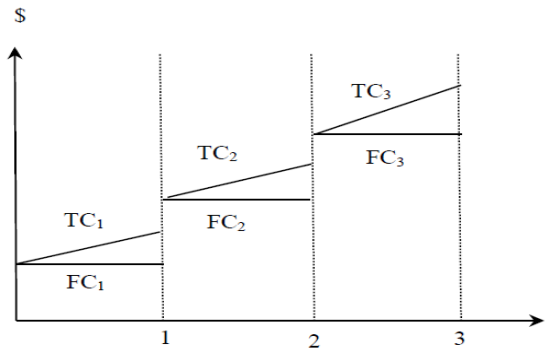

Figure 3. Ladder cost model

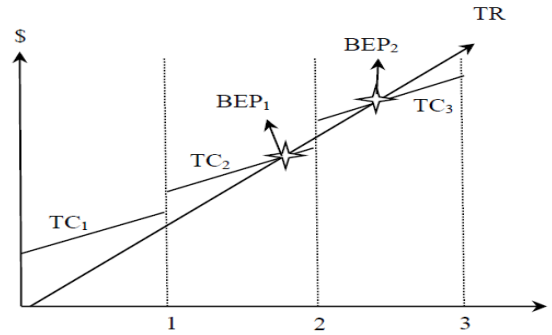

Figure 4. Multiple break-even points model

In Figure 2 to Figure 4, the FC means fixed cost, VC means variable cost, TC means total cost, TR means total revenue, and BEP means break-even points. Case company was established in 2012, and its registered business items include resource recycling and wholesale of recycled materials, etc. It is the only environmental protection company specializing in scrap iron recycling in Rende, Tainan. In addition to the equipment of the case company including large trucks, weighbridge, excavator, and gripper tools. The company also purchased high-unit-priced equipment such as automatic cutting machines and packing machines. The automatic cutting machine is used to deal with a large amount of incoming materials, and can automatically cut the incoming materials into sections, so that the subsequent production line process and transportation can increase the efficiency. The packing machine is to use strong force to condense materials into a cube state, which can not only save storage space, but also be easy to stack and store.

Management team of case company has always adhered to the spirit of risk management, focus on financial stability and strengthen the characteristics of customer service. To enable shareholders

and employees to receive appropriate remuneration, also based on the principle of integrity and stable operation, to ensure long-term sustainable operation. The company itself upholds corporate social responsibility and cares for employees and their families. In addition to providing employees with opportunities for self-growth, the company also organizes activities from time to time to allow employees and their families to participate in the fun and gather solidarity. The case company maintains a good partnership with suppliers and forms a win-win situation with customers and maintains a competitive position in the market with quality and flexible service capabilities. In the future, it will develop towards the mode of expanding production capacity, improving automation efficiency, reducing costs and increasing profits.

In purchase phase, basically, the suppliers need to line up one by one to enter the site in order. At the beginning, the two parties will first inspect the quality of scrap iron, then go to the weighbridge to measure and get the weight list, and then go to the unloading area to prepare for unloading. The process will be accompanied by 1-2 inspectors, mainly for the type and quality of the unloaded scrap iron, etc., conduct a more rigorous inspection stage, and finally notify the amount and record the acceptance completion on the list, and then get the payment at the accounting window and sign for receipt, and then complete the entire process.

The research framework of the present study is shows in Figure 5.

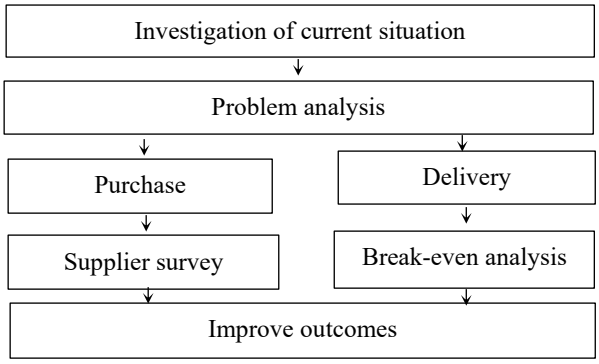

Figure 5. Research framework of the present study

The research framework of supplier survey is shows in Figure 6.

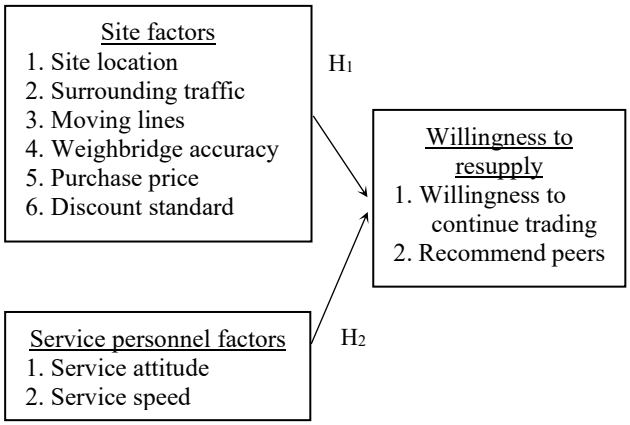

Figure 6. Framework of supplier survey

And the hypotheses awe shows below.

H1: Site factors has a significant positive impact on willingness to resupply

H2: Service personnel factors has a significant positive impact on willingness to resupply

After the entire process, the on-site processing personnel will move the scrap iron from the unloading area to the feeding area. And then the scrap iron were crop and compress into cube. During the moving process, preliminary classification must be made: manual processing, shearing table processing, and compression processing. After the crop and compress processing are completed, according to the customer's different materials, the requirements are loaded and transported to the client separately, and the discharge process is completed. The major issue in the purchase process is ensure continuous supply from suppliers. Therefore, how to maintain and improve the willingness to resupply of the suppliers is needed to investigate. The major issue in the delivery process is how to cost down the delivery cost. Therefore, the break-even analysis of owned car and outsourcing was conducted.

3. RESULTS AND DISCUSSIONS

There are about 38 recycling yards and 12 construction demolition companies supply the scrap iron to case company. Table 1 shows the respondents basic data.

Table 1. Basic data of the respondents

Items	Range	Number	%
Age	20-30	1	2
	31~40	16	32
	41~50	29	58
	51~60	3	6
	Above 61	1	2
Education	Junior high School	6	12
	High school	27	54
	College	17	34
Upstream	Recycling yards	38	76
	Construction demolition	12	24
Job title	Sales	39	78
	Owner	11	22
How to know the case company	Peer introduction	49	98
	Internet search	1	2

Table 2 to Table 4 results of the questionnaire. Table 2 shows the “The site location of case company is convenience of delivery” and “The surrounding traffic conditions is convenient for large vehicle to drive” are the two most important concern of the suppliers. Others items are slight important concern of the suppliers

Table 2. Rating scores of site factors

Factor	Items	Mean	S.D.
Site	The site location of case company is convenience of delivery.	4.12	0.799
	The surrounding traffic conditions is convenient for large vehicle to drive.	4.16	0.792
	In-site moving lines planning.	4.00	0.881
	Weighbridge accuracy.	3.94	0.793
	Purchase price.	3.98	1.000
	Discount standard.	4.00	1.069

Table 3 shows the service personnel factor is slight important concern of the suppliers.

Table 3. Rating scores of service personnel factors

Factor	Items	Mean	S.D.
Service personnel	Service attitude of case company' staff.	3.90	0.931
	Service speed of case company' staff.	3.88	1.003

Table 4 shows the willingness to resupply of the suppliers. There are 92% suppliers will supply to case company again, and 88% suppliers would recommend peers to supply to case company.

Table 4. Results of willingness to resupply

Factor	Items	Yes	No
Willingness to resupply	Will you supply to case company again?	46	4
	Would you recommend peers to supply to case company?	44	6

Table 5 shows the correlation matrix among factors. The recommend peers and willingness to supply again has the highest correlation with 0.799, follow by service personnel and site factor with 0.704, recommend peers and service personnel with 0.545, recommend peers and site factor with 0.474, supply again and service personnel with 0.471, and supply again and site factor with 0.374.

Table 5. Correlation matrix among factors

Factor	Site	Service personnel	Supply again
Site	-		
Service personnel	0.704**	-	
Supply again	0.374**	0.471**	-
Recommend peers	0.487**	0.545**	0.799**

* p <0.05； ** p <0.01； *** p <0.001； n=50

Table 6 shows the regression analysis of H1. Results shows the site factors has a significant positive impact on willingness to resupply.

Table 6. Regression analysis of H_1

Variable	B	S.D.	Beta	t	VIF
Constant	1.873	0.329		5.687	
Site	0.501	0.112	0.620***	4.460	2.062
Adj. R^2	0.541				
F-value	20.264***				

* p <0.05； ** p <0.01； *** p <0.001； n=50

Table 7 shows the regression analysis of H1. Results shows the site factors has a significant positive impact on willingness to resupply.

Table 7. Regression analysis of H_2

Variable	B	S.D.	Beta	t	VIF
Constant	2.000	.313		6.393	
Service personnel	1.290	0.452	0.481	2.851**	2.760
Adj. R^2	0.494				
F-value	24.965***				

* p <0.05； ** p <0.01； *** p <0.001； n=50

Table 8 shows the results of the hypotheses. The two hypotheses were all supported.

Table 8. Regression analysis of H_2

	Hypotheses	Result
H1	Site factors has a significant positive impact on willingness to resupply.	Supported
H2	Service personnel factors has a significant positive impact on willingness to resupply.	Supported

Table 9 shows the outsourcing costs of delivery to Steel plant F, W, and I.

Table 9. Outsourcing costs of delivery

Variables \ Destination	Steel plant F	Steel plant W	Steel plant I
Delivery cost	X+2,750	X-1000	X
Average trips per month	Y-52	Y+26	Y
Total costs	Z-110,500	Z+195,00	Z

For business secrets reason, the X, Y, and Z means the cost baseline. Furthermore, X: means delivery cost of steel plant I; Y: means average runs per month of steel plant I; and Z: means total outsourcing costs of steel plant I.

Table 10 to Table 12 showed the results of the break-even analysis to deliver steel plant F to I, respectively.

Table 10. Break-even analysis to deliver steel plant F

	Items		cost/month/car	Total
Owned car costs	Fixed cost	Car depreciation	A	Q + 85,811
		Car insurance	B	
		Car tax	C	
		Driver salary	D	
		Insurance	E	
		Driver food	F	
	Variable costs	Maintainance	G	
		Fuel and tolls	P + 18,512	
Outsourcing cost	cost*trips/month		(X+2,750) * (Y-52)	R - 110,500

Table 11. Break-even analysis to deliver steel plant W

	Items		cost/month/car	Total
Owned car costs	Fixed cost	Car depreciation	A	Q + 76,555
		Car insurance	B	
		Car tax	C	
		Driver salary	D	
		Insurance	E	
		Driver food	F	
	Variable costs	Maintainance	G	
		Fuel and tolls	P - 9,256	
Outsourcing cost	cost*trips/month		(X-1000) * (Y+26)	R+ 195,000

Table 12. Break-even analysis to deliver steel plant I

Items			cost/month/car	Total
Owned car costs	Fixed cost	Car depreciation	A	Q
		Car insurance	B	
		Car tax	C	
		Driver salary	D	
		Insurance	E	
		Driver food	F	
	Variable costs	Maintenance	G	
		Fuel and tolls	P	
Outsourcing cost	cost*trips/month		X * Y	R

From Table 10 to Table 12, it can be known that for deliver to steel plant F, the cost of owned car is greater than the cost of outsourcing; for deliver to steel plant W, the cost of owned car is less than the cost of outsourcing; For deliver to steel plant I, the cost of owned car is less than the cost of outsourcing.

Therefore, it can be concluded that if deliver to steel plant F, the company should choose an outsourced vehicle; if deliver to steel plant W and I, the company should choose owned car.
If the case company chooses all use owned car to delivery, the annual transportation cost will be about NT$ 8.26 million. If the case company choose according to the analysis result, the annual transportation cost is about NT$ 7.07 million. About NT$ 1.2 million can be saved a year. For case company, the overall profit has been greatly improved.

4. CONCLUSIONS AND SUGGESTIONS

As far as the company's increase the purchase source of scrap iron is concerned, so it is inevitable to improve the supplier's supply satisfaction. According to the analysis results of the questionnaire survey, it is pointed out that the surrounding traffic conditions is convenient for large vehicle to drive and the d site location of case company is convenience of delivery are the two most important factors affecting the satisfaction of supply.

Surrounding traffic conditions refer to whether the traffic roads outside the site are convenient for large-scale transport vehicles to drive. From this we can know that in the selection of the location of the scrap iron yard, if it can have the convenience of large-scale transport vehicles entering and exiting the road, and is far away from densely populated, in order to greatly improve the priority of case company in suppliers, the advantages of security and other advantages in the area can be greatly improved. Site location refers the location of case company whether the convenience of delivery. And the case company all had those two advantage.

As far as the company's cost reduction is concerned, it is best to save inefficient operating costs. However, in scrap iron yards, transportation costs have always been high, no more than because the price of the transportation vehicles themselves is very high. High, and the amount of vehicle maintenance consumables and vehicle depreciation extended by it is also amazing.

Owned cars have the advantage of flexibility in transportation scheduling, but they also have the cost of idle non-operation time. Outsourced cars have the advantage of fixed costs that are priced by train trips, but they also have the uncertainty of delaying shipments. According to the aforementioned transportation profit and loss balance analysis, taking the three main sales steel

plants of the case company as an example, the monthly average supply volume of the three major steel plant is converted into the average monthly trips, and the distances between the steel plants to the case company are converted into fuel oil fee.

According to the break-even analysis, if delivery to steel plant F, it is more cost-effective to choose an outsourced cars; if delivery to steel plant W and steel plant W, it is more cost-effective to choose owned cars.

If the case company chooses all use owned car to delivery, the annual transportation cost will be about NT$ 8.26 million. If the case company choose according to the analysis result, the annual transportation cost is about NT$ 7.07 million. About NT$ 1.2 million can be saved a year.

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