Construct the Fur Input Mixed Model with Activity-Based Benefit Assessment Approach of Leather Industry

M. F. Wu, F. T. Cheng

Abstract—Leather industry is the most important traditional industry to provide the leather products in the world for thousand years. The fierce global competitive environment and common awareness of global carbon reduction make livestock supply quantities falling, salt and wet blue leather material reduces and the price skyrockets significantly. Exchange rate fluctuation led sales revenue decreasing which due to the differences of export exchanges and compresses the overall profitability of leather industry. This paper applies activity-based benefit assessment approach to build up fitness fur input mixed model, fur is Wet Blue, which concerned with four key factors: the output rate of wet blue, unit cost of wet blue, yield rate and grade level of Wet Blue to achieve the low cost strategy under given unit price of leather product condition of the company. The research findings indicate that applying this model may improve the input cost structure, decrease numbers of leather product inventories and to raise the competitive advantages of the enterprise in the future.

Keywords—Activity-Based Benefit Assessment Approach, Input mixed, Output Rate, Wet Blue.

I. INTRODUCTION

THE global fierce competition and environmental awareness make great challenge of leather industry in whole world, that will also include in Taiwan. Part of enterprises established Activity-Based Costing (ABC) database in the first operation stage in order to analyze and explore the benefit and advantage competition of all of the products in Taiwan. The ABC cost database is the most important infrastructure to provide cost information to assessment the each item of the products' benefit and production process efficiency of the leather industry.

The livestock supply quantities falling and price uprising because of the promoting and implementing energy saving and carbon reduction awareness. The soaring price upraises 25% each year since 2010 from US$70 to US$120 each cattle now a day. The Wet Blue (WB) is main material of the leather industry and the cost rate of WB is form 50% uprising to 80% of product cost that make operational profit decreasing tremendously of the leather industry in the worldwide.

Output quantity of the leather product will affect by four factors: output rate, grade level of WB, and unit cost of WB and table run. Therefore, the more precise WB input mixed that will make product inventory quantities and production cost under reasonable control and increase profitability as whole. The

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main purpose of this paper establishes the WB input mixed model of leather industry with ABC assessment approach [3], [5] which is based on ABC cost database to reduce production cost, product inventory and increase advantage competition.

The four factors that affect the product cost are:
1) Output Rate: This is important technology term uses by leather industry. The term indicates that average output square feet (SF) of each piece of WB. The way of measurement is output SF of each manufacturing order divided by number of input pieces of WB.
2) Grade Level of WB: The Company will categorize WB into various grades level which is based on surface quality, size and thickness of WB to meet the customers' leather product quality and table run (TR) requirements.
3) Unit Cost of WB: The way of measurement of unit cost of WB is total cost of WB purchased from supplier divided by all of the pieces of WB.
4) Yield Rate: The term represents that failure rate during manufacturing process of leather products that will cause less output quantities.

The company uses the WB input mixed model to provide the output quantities of leather products for customer needs under least WB input quantities precisely. Much precise input quantities make sure that reduces the leather product inventory decreasing and keeps input cost lowest.

II. LITERATURE REVIEW

There are three parts of the literature review: Leather industry introduction, leather product introduction and Activity-Based Costing and Management (ABC/M).

A. Leather Industry Introduction

The milestone of leather industry in Taiwan can be divided into three stages: infancy stage, before 1970; maturing stage, from 1970 to 1990; and recession stage, from 1990 till now a day [1]. The input leather material, Salt crust and Wet Blue (WB), need to import totally from foreign countries, such as USA, Australia and South American. Yield and Output value of leather industry in Taiwan occupies a pivotal position and great market share in the global.

The leather products supply to shoes industry as main material in Taiwan. Yet, the labor cost is increasing every year that drives footwear manufacturer move oversea to establish manufacturing bases for lower labor cost. According to the export and import data from Statistics Department of Economics Bureau in Taiwan indicates that import of leather

material and export of leather product change a lot in recent year. The summary of market supply and demand is shown in Table I.

TABLE I
MARKET DEMAND AND SUPPLY OF LEATHER PRODUCT, NTS100MILLION

	2006	2007	2008	2009	2010	2011	2012	2013
Output Value	290.47	273.88	243.21	258.94	258.94	258.94	258.94	258.94
Growth rate of Output Value	-7.70%	-5.71%	-11.20%	-15.89%	13.68%	-10.58%	-4.01%	-2.93%
Sales Value	290.33	278.73	251.00	266.37	296.91	261.25	252.75	244.94
Growth rate of Sales Value	-9.70%	-4.00%	-9.95%	-14.51%	11.47%	-12.01%	-3.25%	-3.09%
Export rate	40.84	44.5	45.25	52.43	52.47	50.5	53.74	55.26

Sources: Statistics Department of Economics Bureau in Taiwan

B. Leather Product Introduction

The category of leather product can be divided into various types which is based on manufacturing process, such as grain, pigmented, oily, emboss and milling. The leather product, Crazy horse needs to grain, coat oil, no emboss and milling. NBK needs to grain only. Nappa needs emboss, milling, toggling and costing.

The special characteristics of leather industry are various leather products with complicate manufacturing process. The main customers of the leather industry are footwear industry in Taiwan.

C. Activity-Based Costing and Management

The Activity-Based Costing divides manufacturing overhead into unit level, batch level, product level and facility level with various cause relation to product cost.

Kaplan and Cooper proposed One-Dimensional Model in 1998 [4], Turney proposed Two-Dimensional Model in 1991 [6]. The One-Dimensional Model establishes cause relationship between product cost and resources expired, allocate resources cost into activity cost pool with resources cost drivers in the first stage and allocate previous cost pool into activity item with activity cost driver secondly, calculate cost objective with activity cost driver rate by manufacturing process activity items finally. Two stage cost allocate flow is shown in Fig. 1 [2].
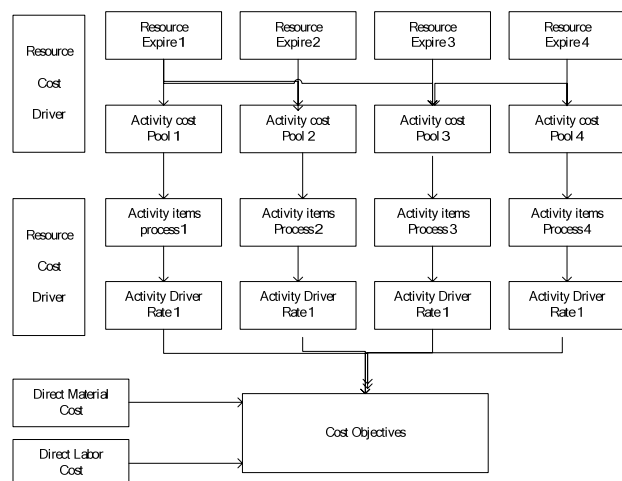

Fig. 1 Two Stage Cost Allocation Flow

Two-Dimensional includes two views in the model: Cost Assignment View and Process View. Cost Assignment View is continuation of Activity-Based Costing system concepts, Process view explores the concept of because relationship between resources expired and operation performance. The Two-Dimensional Model is shown in Fig. 2 [6].

After establishing the Activity-Based Costing database, the cause relationships between activity cost and resources expired can be explored and analyzed what value added the activity had provided. The company may introduce the Activity-Based Management (ABM) bases on ABC database and uses the skill of eliminate, combination, rearrangement and simplification (ECRS) to improve performance of operation activities continuously that will help increasing profitability for the company.
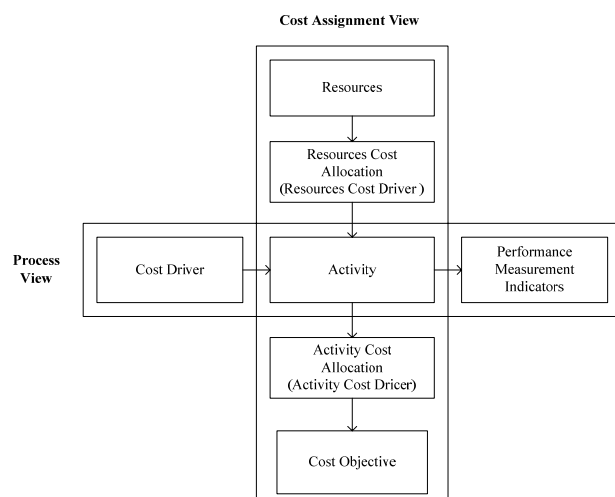

Fig. 2 Two Dimensional Activity-Based Costing Model

The fur input mixed model of this paper is based on systematic and dynamic concept to improve cost structure to achieve the low cost strategy and profitable operation goals.

III. METHODOLOGY

The basic ABC database includes unit cost of WB, chemical, direct labor, and machine, other manufacturing overhead, selling and administrative. More key factors of WB input mixed model are: grade level of WB, average output rate of WB, output rate of each grade level of WB and yield rate.

The overall profits are summarized from each one of leather

product which is based on selling price and product cost. This paper explores the lowest WB input mixed cost under given selling price of leather product assumptions. The unit cost of leather product is shown in (1):

$$TC_u = PC_u + OC_u \qquad (1)$$

$$PC_u = LC_u + DC_u + CC_u \qquad (2)$$

where,

TC$_u$: unit total cost
PC$_u$: unit production cost
OC$_u$: unit operation cost
LC$_u$: unit cost of WB
DC$_u$: unit cost of chemical material
CC$_u$: unit cost of conversion

Equation (1) transfer into (3) based on ABC database as following:

$$TC_u = LC_u + \sum_{j=1}^{n} CD_j \times CDR_j \qquad (3)$$

where,

CD$_j$: expired units of cost driver J.
CDR$_j$: cost driver rate of cost driver J.
J: each category of input cost, such as chemical material cost, fur material cost, conversion cost and operational cost..

The precise fur material input quantities need to consider with four of key factors, grade level of WB, unit cost of WB, output rate of WB and TR. The four formulas below present as:

Minimum output square feet (SF) of leather product is in (4), pieces of WB input is in (5), pieces of various grade level of WB input is in (6), expected output SF of leather product is in (7) and unit cost of WB is in (8).

$$TQ_{out\,(mini)} = [Q_s \times (1 + DR)] \qquad (4)$$

$$TQ_{in} = TQ_{out\,(mini)} \div (R_{ave} \times 2) \qquad (5)$$

$$Q_{in\,k} = TQ_{in} \times W_k \qquad (6)$$

$$TQ_{out} = [\sum_{k=1}^{m} Q_{in\,k} \times (R_k \times 2)] \qquad (7)$$

$$LC_u = [\sum_{k=1}^{m} Q_{in\,k} \times (C_k - C_s)] \div TQ_{out} \qquad (8)$$

where,

TQ$_{out\,(mini)}$: expected output SF of leather product.
DR: yield rate.
Q$_s$: sales SF
TQ$_{in}$: Total input pieces of WB.
R$_{ave}$: average output rate of WB.
Q$_{in\,k}$: input pieces of k grade level of WB
W$_k$: input ratio of k grade level of WB.
TQ$_{out}$: actual output SF of leather product.
R$_k$: output rate of k grade level of WB.
C$_k$: unit cost of WB
C$_s$: unit selling price of split WB
Combine (6) and (7) with (8) and transfer into (9) as

following:

$$LC_u = [\sum_{k=1}^{m} Q_{in\,k} \times (C_k - C_s)] \div [\sum_{k=1}^{m} (TQ_{in} \times W_k) \times (R_k \times 2)](9)$$

Finally, combine (3) with (9) into (10) in further step to establish the WB input mixed model of leather industry which is shown as following:

$$TC_u = [\sum_{k=1}^{m} Q_{in\,k} \times (C_k - C_s)] \div [\sum_{k=1}^{m} (TQ_{in} \times W_k) \times (R_k \times 2)] + \sum_{j=1}^{n} CD_j \times CDR_j \qquad (10)$$

One assumption in this model is actual output SF (TQ$_{out}$) should be greater than sales SF (Q$_s$). Two assumptions are proposed: (1) change key factor of unit cost of WB and other key factors are being equal; and (2) change key factor of output rate of WB and other key factors are being equal.

IV. Empirical Study and Findings

This paper collects operation data from Leather Company in Taiwan to verify the reproducibility and feasibility of WB input mixed model. There are two parts in this section to analyze and explore the cause relationships between output rate and unit cost of WB and production cost.

A. Effect of Changing Unit Cost of WB

Given WB input weight, average output of WB, actual output SF, no split WB and yield rate (DR), changes the unit cost of WB to explore the effect of production cost of Nappa product.

TABLE II
GIVEN CONDITION FOR KEY FACTORS OF NAPPA PRODUCT

Grade level	Weight	Average output rate/piece	TQ$_{out}$/SF	TQ$_{in}$/piece	Q$_{in\,k}$/piece	Yield rate (DR)	ΣCD_j*CDR_j/SF
A	0.2				354.6		
B	0.6	26.24	93,047.04	1,773	1,064	5%	23.96
C	0.2				354.6		

TABLE III
EFFECT OF PRODUCTION COST OF NAPPA WITH UNIT COST OF WB CHANGING
DOLLAR: US$1

	Unit cost of WB/cattle			LC$_u$/SF	TC$_u$/SF
Data	Grade A	Grade B	Grade C		
1	91.36	87.86	82	1.6652	2.46386
2	91.36	87.86	82.69	1.6678	2.46646
3	91.36	87.86	83	1.6690	2.46766
4	91.36	87	82.69	1.6580	2.45666
5	91.36	87.86	82.69	1.6678	2.46646
6	91.36	88	82.69	1.6694	2.46806
7	91	87.86	82.69	1.6664	2.46506
8	91.36	87.86	82.69	1.6678	2.46646
9	92	87.86	82.69	1.6702	2.46886
10	91	87	82	1.6540	2.45266
11	91.36	87.86	82.69	1.6678	2.46646
12	92	88	83	1.6730	2.47166

B. Effect of Changing Output Rate of WB

Given WB input weight, cost of WB, actual output SF, no split WB and yield rate (DR), changes the output rate of WB to

explore the effect of production cost of Nappa product.

TABLE IV
GIVEN CONDITION FOR KEY FACTORS OF NAPPA PRODUCT
DOLLAR: US$1

Grade level	Weight	LC_u/cattle	TQ_{out}/SF	Yield rate (DR)	ΣCD_j*CDR_j/SF
A	0.2	91.36			
B	0.6	87.86	93,047.04	5%	23.96
C	0.2	82.69			

TABLE V
EFFECT OF PRODUCTION COST OF NAPPA PRODUCT WITH OUTPUT RATE OF WB CHANGING

Data	Average output rate/piece	TQ_{in}/piece	LC_u/SF	TC_u/SF
1	25	1,860.94	1.75052	2.549182033
2	25.5	1,824.45	1.716196078	2.514858112
3	26	1,789.37	1.683192308	2.481854341
4	26.5	1,755.60	1.651433962	2.450095996
5	27	1,723.09	1.620851852	2.419513885

The fur input mixed model provides concept and methodology for leather industry to explore the production cost under changing various value of key factors. The Excel VBA software is applied with sensitive analysis approach embedded and given data for key factors to simplify the testing process of feasibility of the model more easily. The research findings indicate that production cost rises when unit cost of WB uprising and decreases when output rate of WB increasing.

V. CONCLUSION AND DISCUSSION

Leather industry is unique and special because of diversity leather products and complicate manufacturing processes. In such special manufacturing environment, the vision of the leather company is pursuing the overall profits to keep survive in the fierce competition global environment.

A. Conclusion

Bases on low cost strategy, the ways to maintain core competencies are handling all of the key factors of production cost firstly. Those key factors are: output rate and unit cost of WB, yield rate of manufacturing process, WB input mixed weight of grade level, unit cost of chemical material and conversion. This paper simulates only two factors: output rate and unit cost of WB using with Excel VBA software and WB input mixed model with Activity-Based Assessment approach with Activity-Based Costing database to explore and analyze the effect of production cost of leather product.

Under assumptions of key factors of production cost is being equal: WB input mixed weight of grade level, yield rate of manufacturing process, cost of chemical material and conversion are given. The research findings of this paper are: (1) higher unit cost of WB increase the production cost of Nappa. The relationship between unit cost of WB and production is positive; and (2) more output rate of WB decreases the production cost of Nappa. The relationship between output rate of WB and production cost is negative.

B. Discussion

The research stimulates two key factors of production cost, output rate and unit cost of WB only. There is more research topics can be explored such as: influences of production cost by changing yield rate of manufacturing process and WB input weight of grade level. More than the research of production cost issue, the research of operational profit topic is important to the leather industry too.

The key factors that will influence the profitability are unit selling price, rate of sales returns and allowance, table run (TR), sales SF and production SF, etc.,. More key factors include in the model, more contributions to leather industry will be. The research issues of leather industry are various and will never stop because of leather products are necessities and so much important to the humankinds' living.

The concepts of earth protection, energy saving, or carbon reducing issues might interfere the development of the leather industry in the future. Yet, leather industry helps to resolve the recycling problems of cattle fur that are great contributions for the cattle industry. Through continuous research of operational issues that will help to increase the core competencies for the leather industry.

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