Service Cost Estimations and Issues of Apron Flight Operation

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Abstract: Reviewing study airport apron cost, partly the percentage airport joint costs is not only unfairly reflected between airport and airline of the airport financial management issues, but it also influences reasonable airport facilities fees. Therefore, this study will make sure the allocation approach between airport and airline and propose a reasonable estimating approach for airport service costs. It proposes a suitable cost allocation approach and framework. By means of correlation coefficient and regression model, the research also tries to estimate and measure the relation between service activity and airport operation costs. The regression outcomes not only reveal a significant management issues concerning apron fee measuring, but also deals with depending on the airport physical activities cost driver to solve costs/revenue management.

Keywords: Apron Service Cost, Aircraft Activities, Regression

1. INTRODUCTION

Today, airports of all countries trend to increase air traffic charges and concession rents augment their revenue. However, a sound and reasonable airport cost management lies in an effective financial control and accounting procedures. This phenomenon will be faced with how to count the air navigation services costs and if the meteorological service costs are included in the basic costs of airport costs. Analysis tools play an important role in airport cost rationalization and standardization. The basic cost of the airport cost does not include the cost of air navigation services and the cost of meteorological services. Currently, airports are means to serve passengers and freight transportation, their general costs of include fixed facilities and recurrent expenditure as shown in past studies. In the past studies, researchers applied a given percentage to explore the joint costs of airport management, where my study tries to make up such a shortage by means of regression model. The estimation process of past studies is unable to clarify costing fairness between airport and airlines, because it hides airport financial management issues that may arise, which may also affect the airport to receive reasonable fees (such as landing fees). Particularly after privatization of airports that

used to be run by government, the airport cost management and cost-sharing issues have been gaining more and more attention and discussion.

For this reason, this study tries to define and clarify the cost activities for passengers, cargo and aircraft service activities necessary for the airport in order to further discuss the standards and principles for measuring joint costs and further addressed the joint cost-sharing formulation. Researching the airport service costs should be fairly assessed considering effective function of service activities and facilities at the airport. Therefore, this study intends to estimate apportionment of airport service costs in Taiwan, put forward more reasonable estimators of airport service costs and cost-sharing formulation. Literature related to previous studies of joint costs (Pirttila Timo, Hautaniemi Petri 1995; Wen-Hsien Tsai, Lopin Kuo, 2004) shows that cost-sharing varies a lot according to the characteristics of activities, such as the size of the space occupied by service activities, the number of employees the service activities required to serve, or the revenue from the service activities, joint cost-sharing principle. These sharing ways are too simple and arbitrary to set cost-sharing formulation, because they may cause the negligence of potential services, and equipment cost which is not measured, which misleads rather than optimize joint cost allocation and management

Therefore, this study intends to introduce activity-based costing to measure the joint costs of airport services, a new approach different from the traditional accounting measure of the cost of airport service activities. It will be analyzed to define the content of the joint cost of the project, review joint cost allocation theory, and build the appropriate costs estimation model, analysis of the applicability of various methods to build the appropriate cost-sharing formulation. It is easy to reflect the current allocation of airport cost-effective, because it not only reflects the activity ratio of the cost factors or correlation, and if the potential factors have been taken account of to adjust cost difference, but it also reflects the practical problems of the related units to be borne or paid. The research results may serve to assist the airport and airlines in searching the basis of cost burden and coordination; besides, it can further help the airport in matters regarding the cost of planning, management and analysis tools.

In this study, I first review and collect airport cost content as well as service classification; then I try to settle the definition of joint costs and measure the principles of cost sharing literature. Second, the measuring analysis framework of airport services activities of the joint cost factor building framework is divided by the characteristics of passenger activity, characteristics of cargos activity, characteristics of the aircraft, airport air traffic control facilities, and the dimension of the interaction between activity relationships. This study will involve the details of the definition of airport activities demand arising from the airport to provide products and services. The third part focusing on the cost of job-based approach used in this study will involve the details of the definition of airport activities demand arising from the airport to provide products and services. By means of regression method and activities based cost concepts, the study attempts to estimate and measure the relation between service

activity and operation costs. The fourth part, the empirical research collects information of the airport cost, which includes: survey of airport service activities, the operating costs of the airport project, airlines operating cost items, and data collected during the study period to the airport, so as to understand the actual airport accounting job situation and the cost related topics. Finally, the resource requirements of airport activity cost are estimated. Cost reasons or activities based on the use and the cost contribution of airport activities are emphasized in order to provide more accuracy estimator of airport service cost.

2. THE DEFINITION OF AIRPORT SERVICES COST AND COST ALLOCATION MEASUREMENT

This section mainly separates literature reviews, the definition of airport service cost and measuring airport service cost for three subsections as follows to review:

2.1 Literature Review of Airport Service Costs

The first approach of activity-based costing in accordance with Cooper (1987) is traced to cost objective in a two-stage procedure and uses cost drivers. In the first stage, a company's overhead costs such as administrative salaries, insurance, rent and transportation are traced to activities. In the second stage, costs are traced from activities to cost objective such as customers, processes, products and services. Because of this two-stage methodology and the use of multiple cost drivers, it will be easier for us to measure the relation and improve between input and output of activity-based costing. The procedure of activity-based costing through the five steps evaluate, which are aggregating activities, reporting the cost of the activity, identifying the activity centers, selecting first-stage cost drivers, selecting second-stage cost drivers. Cooper considers the suitable cost drivers must include three cost factors to be associated with the degree of operation activity, measuring the cost and behavior influence. The allocation accuracy depends on the relation degree between operation execution and the consumption of operation drivers.

Thus, very few literatures regarding airport's cost allocation measurement can be found, if focus on the financial performance appraisal rating for the airport competitiveness project. The existing airport performance studies have failed to take full activities of airports into consideration, to thoroughly analyze the balance of between the revenue and cost expenditure, and objectively reflect the relationship between real airport activities and airport costs. This will make airport activities fail to reflect their contributions and shortage of input financial and manpower resources. In order to calculate the relation between the airport services and traditional cost accounting system, this paper intends to clarify the relationships between airport services and cost accounting system to propose an approach of cost allocation about

airport service activities, which mainly employs the concepts and principles of activity-based costing and airport service costs.

2.2 The Definition of Airport Service Costs and Measuring Approach

This study review a activity-based cost system to develop the content of the airport cost, service classification of airport and airline activities to take business analysis The airport activity-based cost system includes two input resources, one is airport, and the other is airline and airport activities. Output is airport service performance. The objectives of airport activity-based cost system can be use to evaluate system cost and efficiency.

Classified the airport counter activities, loading and unloading of baggage, cargo handling activities, the activities of the terminal and aircraft ground handling activities(runways, taxiway, apron). Airport cost items can be classified according to activity, the accounting system of personnel costs, capital costs, construction equipment and maintenance costs attributable to different activities and service costs. There are five classifications of service costs, such as counter activities, baggage loading and unloading, cargo handling activities, service in the terminal, aircraft ground handling activities. It is respectively described as follows:

First, counter activities service costs: the costs arising from the handling of passengers and luggage in the terminal building, including the rent of the counter, the size of the construction price, the number of rented equipment and service personnel.

Second, baggage loading and unloading of service costs: this activity including the number of rotations of the baggage carousel, the use of an area, the size of the construction expense and the number of service staff.

Third, cargo handling activity cost of service: for general cargo handling, this cost includes the rent of the freight station, size of construction prices, the number of rented equipment and service personnel.

Fourth, main service costs in the terminal includes the cleaning of the terminal building and surrounding area equipment maintenance, the use of common equipment, the size of the construction price, rented equipment and the number of service personnel.

Fifth, aircraft ground handling activities cost of service: this cost includes runway taxiing road and apron construction prices to use the size of the surface results, the number of the rental of the apron and ground crew.

2.3 Measuring Approach of Airport Service Costs

Airport cost may be allocated by the contribution approach, activities, standard allocation formulas, or a number of measurements. Airport cost measuring is based on activities analysis

and cost analysis methods to understand and find the real major appropriate cost drivers. In order to measure the relation between airport activities, cost driver factors and airport costs, this study will apply the grey analysis and correlation coefficients to measure the cost drivers/factors with the characteristics of the proportion, directly attributable, and causal attribution. Meanwhile, in order to measure the relation efficiency between airport activities, cost driver factors and airport costs, this study is also applied with the regression and data envelopment analysis from activity-based costing relation variables to measure airport services cost. These approaches are different from the traditional accounting cost of service activities. By means of appropriate cost estimation model, the research discusses the applicability of various methods to build the appropriate cost-sharing formula for each airport activity. These works can not only reflect the current allocation of airport cost-effective, and reflect the activity ratio of the cost factors or correlation, but it can also reflect the cost burden and coordination for airport. Besides, it can also provide further airport cost planning, cost management, process improvement and outcome/output analysis tools.

3. THE SERVICE COST ESTIMATION MODEL OF APRON SERVICE ACTIVITIES

This section can be separated into six parts that go as follows: First, it studies the related variables of cost allocation for airport service activities. Second, it chooses the suitable input/output variables of cost allocation performance for airport service by means of relation coefficients. Third, it tries to construct the regression models.

3.1 The Related Variables of Cost Allocation of Airport Service Activities

This study regards airport service cost as one output variable, and eleven input variables are selected, which are labor number, airport personnel expenses, airport apron area, airport cargo terminal area, airport passenger terminal area, scheduled flight number, passenger number, the number of arrival passengers, the number of departure passengers, passenger capacity of peak hour, and airport cargo amount. Because related data are difficult to collect, this study collects the yearly data of important variables from the statistics and survey of Magong Airport from 1991-2010.

In this study, the definition of the relation variables and independent variables can be defined as follow:

SC : Represent airport service cost of each year

LN : Represent airport labor number of each year

PE : Represent airport personnel expense of each year

AA : Represent airport apron area of each year

CTA: Represent airport cargo terminal area of each year
PTA: Represent airport passenger terminal area of each year
SFN : Represent flight scheduled number of each year
PCPH : Represent passenger number of each year
APN : Represent the number of arrival passengers of each year
DPN : Represent the number of departure passengers of each year
PCPH : Represent passenger capacity of peak hour
AAC : Represent the amount of airport cargo of each year

This study expects to select the suitable variables of influence airport service cost, such as the variables of labor number, airport personnel expenses, airport passenger terminal area, passenger capacity of peak hour, airport cargo terminal area, the number of departure passengers, passenger number, the number of arrival passengers, airport apron area, scheduled flight number, and airport cargo amount. Table 1 shows the higher correlated coefficient between airport service cost and related variables are labor number (0.940), airport personnel expenses (0.940), airport apron area (0.856), airport cargo terminal area (0.811), airport passenger terminal area (0.807), scheduled flight number (-0.804), passenger capacity of peak hour (0.770), and airport cargo amount (-0.653).The correlated coefficient between airport service cost and related variables are passengers number as well as the number of arrival passengers. The number of departure passengers, however, is not significant. The two variables, namely flight scheduled number (-0.804) and airport cargo amount (-0.653), reveal a negative relation as far as the variables of airport service cost are concerned.

Table 1 Correlation Coefficient of Cost Allocation of Airport Service Activities.

	SC	LN	PE	AA	CTA	PTA	SFN	PN	APN	DPN	PCPH	AAC
SC	1	.940(**)	.940(**)	.856(**)	.811(**)	.807(**)	-.804(**)	-0.303	-0.308	-0.298	.770(**)	-.653(**)
LN	.940(**)	1	1.000(**)	.759(**)	.786(**)	.742(**)	-.732(**)	-0.161	-0.165	-0.156	.710(**)	-.764(**)
PE	.940(**)	1.000(**)	1	.759(**)	.786(**)	.741(**)	-.735(**)	-0.162	-0.167	-0.158	.708(**)	-.762(**)
AA	.856(**)	.759(**)	.759(**)	1	.807(**)	.944(**)	-.732(**)	-.481(*)	-.482(*)	-.479(*)	.916(**)	-0.353
CTA	.811(**)	.786(**)	.786(**)	.807(**)	1	.855(**)	-.711(**)	-0.437	-0.438	-0.434	.844(**)	-.530(*)
PTA	.807(**)	.742(**)	.741(**)	.944(**)	.855(**)	1	-.654(**)	-.511(*)	-.514(*)	-.508(*)	.997(**)	-.455(*)
SFN	-.804(**)	-.732(**)	-.735(**)	-.732(**)	-.711(**)	-.654(**)	1	.622(**)	.623(**)	.619(**)	-.614(**)	.490(*)
PN	-0.303	-0.161	-0.162	-.481(*)	-0.437	-.511(*)	.622(**)	1	.999(**)	.999(**)	-.513(*)	-0.065
APN	-0.308	-0.165	-0.167	-.482(*)	-0.438	-.514(*)	.623(**)	.999(**)	1	.997(**)	-.516(*)	-0.065
DPN	-0.298	-0.156	-0.158	-.479(*)	-0.434	-.508(*)	.619(**)	.999(**)	.997(**)	1	-.509(*)	-0.065
PCPH	.770(**)	.710(**)	.708(**)	.916(**)	.844(**)	.997(**)	-.614(**)	-.513(*)	-.516(*)	-.509(*)	1	-.453(*)
AAC	-.653(**)	-.764(**)	-.762(**)	-0.353	-.530(*)	-.455(*)	.490(*)	-0.065	-0.065	-0.065	-.453(*)	1

* Represents under the level of significance is α =0.05(two tails), we accept Pearson correlation coefficient

** Represents under the level of significance is α =0.01(two tails), we accept Pearson correlation coefficient

3.2 The Estimation of Service Cost Regression

This study collects the data of important variables from the yearly statistics and survey data of Magong Airport from 1991-2010. According to the relation coefficients between airport service costs and 11 important variables larger than 0.8, this study focuses on such factors as labor number, airport apron area, cargo terminal area, passenger terminal area, flight scheduled number, and personnel expense as input variables, which are further separated into two groups. The first group tries to explain variables such as labor number, airport apron area, cargo terminal area, passenger terminal area, and flight scheduled number. Variables discussed in the second group include personnel expenses, airport apron area, cargo terminal area, passenger terminal area, and flight scheduled number.

The above explained variables of influence airport's service costs are regarded as essential elements of the regression model so as to predict the airport's service costs and allocation, which are shown in the following functions. Function (1) represents the estimator of airport's service costs for group 1. Function (2) represents the estimator of airport's service costs for group 2. Thus, these regression models satisfy goodness of fit. One outcome shows that adding per labor number, airport authority has to spend NT$3,367,064 more for airport service costs per year, that is say, adding per labor number, airport authority has to spend NT$9,225 more per day for airport service costs. The second regression shows that per year personnel expenses will increase airport service costs by 2.6 times. However, the variable influence of passenger number, arrival passenger number and departure passenger number to airport service cost are not significant.

$$SC = 3367064LN + 4227AA + 77CTA - 701PTA - 2698SFN \quad (1)$$
$$\text{(t=5.576)} \quad (2.368) \quad (0.001) \quad (-0.470) \quad (-3.191)$$
$$R^2 = 0.984, F = 189.045, N = 20$$

$$SC = 2.6PE + 4168.8AA - 327.5CTA - 626.7PTA - 2662.2SFN \quad (2)$$
$$\text{(t=5.476)} \quad (2.300) \quad (-0.006) \quad (-0.414) \quad (-3.100)$$
$$R^2 = 0.984, F = 184.409, N = 20$$

4. ISSUES DISCUSSIONS AND APPLICATIONS

There are two issues covered in the discussion and applications of this section. The first issue is key impact factors regarding cost management for airport service cost regression. Regression (1) indicates that per staff employment will increase 3.4 million dollars of yearly airport service costs. This figure can in advance estimate that per staff employment will increase 9225 dollars of day airport service costs. If the daily airport working load is 8 hours, it also means that per staff employment will increase 1153 NT dollars of hourly-paid airport service costs. From regression (2), one can estimate that yearly personnel expenses will

increase by 2.6 times of yearly airport service cost. These two regressions show that positive contributions of scheduled flight to save airport service costs and increase landing fee revenue, which per scheduled flight will decrease 2662 NT dollars of yearly airport service cost. The figure also represents that per scheduled flight will decrease 7.29 NT dollars for daily airport service cost, which means that airport authority shall increase flights to save the airport service cost. Meanwhile, the airport authority shall encourage the airlines to use bigger aircraft such as ERJ-190 and MD-90 of Table 5 in order to increase revenues, or to increase the landing fee of aircraft ATR-72-500 and DASH-300.

Table 2 Landing Fees of Scheduled Flight for Magong Airport

Aircraft Characteristics	ERJ-190	ATR-72-500	MD-90	DASH-300
Seats	106	72	172	56
Maximum Take-off Weight (Kilogram)	50,300	22,000	70,760	18,642
The rate of Landing fees 50,001-150000 Kilogram(Per thousand kilograms/dollars)	99	None	99	None
Landing Fees (Dollars) depend on flight of Maximum Take-off Weight	4,950	None	6,930	None

The second issue regards which approach of area or weight should be applied to measure if aircraft apron staying fees is beneficial for activity cost management. Comparing the current physical fee of aircraft staying apron by aircraft take-off weight are as shown in Table 6. The apron expenses estimators of the regression are shown the apron per m^2 will increase 4169 NT dollars of yearly expenses for airport service cost. The figure of the apron per 1 m^2 will increase 11.42 dollars of day expenses for airport service cost and is therefore more effective and profitable than using the measuring of aircraft staying fee of weight. The second issue thus provides the apron fee measurement which leads us to explore the possibility of a new airport service cost management and application.

Table 3 Estimating Aircraft Staying Fees of Magong Airport Apron

Aircraft Characteristics	ERJ-190	ATR-72-500	MD-90	DASH-300
Maximum Take-off Weight	50,300	22,000	70,760	18,642
Length (Meter)	36.24	27.17	46.50	25.68
Wings Width (Meter)	28.72	27.05	32.87	27.43
Parking Apron Area(m^2)	1,040.8	734.9	1,528.4	704.4
Aircraft Staying Fees of Weight 1.Less than 20000 Kilogram (23 dollars per 1000 Kilogram) 2.More than 20001 Kilogram (10 dollars per 1000 Kilogram)	503	220	708	429
Aircraft Staying Fees of 14 Operational Hours (dollars /per hour per m^2)	854	603	1,253	578
Aircraft Staying Fees of 24 Hours (dollars /per hour per m^2)	495	350	727	335
Aircraft Staying Fees of Area 11.42 dollars per m^2	849	599	1,247	575

5. CONCLUSION

This paper employs the correlation coefficient and regression method to measure the service cost of airport activities. Meanwhile, this paper proposes new approaches to improve current airport service activities. The major findings of this study are summarized as follows:

The outcomes of correlation coefficient between influence variables and airport service costs show that the labor number, personnel expenses, cargo terminal area, passenger terminal area, apron area, flight number are high correlation coefficients. This means that labor number and personnel expenses are import cost driver variables of measuring airport service costs. Therefore, this study proposes and estimates that staff, expenses, facilities and activities are all factors which result in cost's addition add burden. The two regression outcomes not only reveal a significant management issues concerning apron fee measuring, but also deals with depending on the airport physical activities cost driver to solve costs/revenue management.

Finally, this paper proposes that regression not only can be employed to study airport cost allocation measuring and approach, used as references and tools to compare cost allocation of efficiency differences, but it can also help provide further airport cost planning, cost management, process improvement and outcome/output analysis tools and application. This study focuses mainly on the relation and yearly data of cost allocation between labor, facilities and activities and airport service cost based on second hand data. Later and future

researches can go other survey and measure the relation between individual operational activities and cost allocation regarding the management of an airport.

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