ANALYSIS OF ACTIVITY BASED COSTING (ABC) IN OUTBOUND LOGISTICS COST OF MANUFACTURING COMPANIES IN A DEVELOPING ECONOMY

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ABSRACT

Attempts to reduce the cost of individual logistics activities in isolation often lead to greater total logistics costs. This could be attributed to the fact that traditional accounting systems that tend to focus around understanding product costs rather than customer costs. It is in this regard that at the level of the firm, attempts must be made to integrate outbound logistics system so as to holistically minimize total logistics costs within the context of Activity-Based Costing (ABC). The paper adopted a case study approach, utilising detailed and sectionalized questionnaires as data collection instrument from twenty manufacturing companies located in southwest of Nigeria based on multistage techniques. The questionnaire elicited primary data on components of outbound logistics that were related to cost for the period of 2002-2006 and were analysed using a software application that was packaged and designed for the study. The paper revealed that the cost model is highly trustworthy and the accuracy corresponds to the purpose with the cost model, which it can facilitate estimation of cost, rationalities and restructuring principles, benchmarking with competitors, pricing and appropriate supply of resources. The model allocates resources and costs down to each profit centre where available and then down to the cost per order on an annual basis. The findings further revealed that the most important consideration in any organization is how much insight a company has in its cost and that profit can be maximized and customers' requirements met, if the cost bill of manufacturing company is controlled.

1.0 Introduction

Total logistics cost analysis has been proven to be the key to managing the logistics functions. More often, controls are expected to be instituted to minimize the total costs of logistics rather than to minimize the cost of each component. However, determining which component of logistics costs to reduce can be problematic, since there is a trade-off between costs components. Attempts to reduce the cost of individual logistics activities in isolation often lead to greater total logistics costs. This could be attributed to the fact that traditional accounting systems that tend to focus around understanding product costs rather than customer costs (Somuyiwa and Sangosanya 2007and Somuyiwa, 2009). The success of these attempts depends on the ability of the cost analysis system to identify the resources consumed for specific product. Similarly, according to Franceshin and Rafele (2000) total logistics cost analysis has been proven to be the key to managing the logistics functions, consequently, it is important that management considers the total of all logistics costs. Controls are expected to be instituted to minimize the total costs of logistics rather than to minimize the cost of each component. However, determining which component of logistics costs to reduce can be problematic, since there is a trade-off between costs components. In fact, attempts to reduce the cost of individual logistics activities in isolation may even lead to greater Total logistics costs. It is in this regard that at the level of the firm, attempts are often be made to integrate outbound logistics system so as to holistically minimize total logistics costs within the context of Activity-Based Costing (ABC).

This type of system assigns fixed costs to individual segments or products and therefore does not provide the management with adequate decision support. The costs common in multiple segments may, according to Stock and Lambert (2001) be allocated to segments according to an arbitrary measure of activities. If this is the case, vital cost information about the controllability and behaviours of segments are lost. Kaplan (1988) earlier refers to this dilemma that the identified costs usually have no relation to the true resources utilization that is consumed to design, produce, market, and deliver the product or service. Careful cost analysis have shown that these non-related cost allocations within companies product lines have been considered to break even, when they actually have been among the companies most profitable area. This distortion within product costs has in many cases led management to incorporate a strategy that may result in losing their competitive edge. The strategy can result in overpricing products that are profitable and incorrectly focusing on handling issues within non-profitable products. This is a situation that will lead the companies into losing customers and their competitiveness will not be enhanced. Ironically, most manufacturing companies in developing economies in general and in the study area in particular do not have knowledge of their cost for individual logistics functions, as well as resources utilization of these activities.

The traditional standard cost system focuses on accounting process and tracing cost to cost centres using the traditional cost drivers such as labour and machine hours. Kaplan and Cooper (1998) argued that those systems do not have the capability to accurately provide costs of resources used by activities, business processes, products and customers. This traditional system does not provide accurate, timely, operational, process focused, and team-based measurements. These failures and lack of measurements prevent

the essentials ingredients for continuous improvement and learning that are crucial for the business today with changing prerequisites and business environment.

Furthermore, it has been observed that the general financial accounting methods are insufficient to provide the accurate cost information and consequently Johnson and Kaplan (1987) introduced an approach that challenged this dilemma called Activity-Based Costing (ABC). This approach is expected to reveal the true cost to businesses by allocating costs to the activities that actually consume resources to produce the product or service from organization. Thereby the knowledge of the cost and profitability of individual processes, products, services, customers, and operating units can be revealed. It is against this backdrop that this paper attempts to apply the concept of ABC.

The common theme that links these points is that companies seem to suffer in business from a lack of visibility of costs as they are incurred through the logistics pipeline. Ideally what logistics management requires is a means of capturing costs as products and order flow towards the customer (Griful-Miquela, 2001).In an attempt to overcome this problem, attention should be shifted away from the notion that all expenses must be allocated (often on an arbitrary basis) to individual units (such as products) and, instead, to separate the expenses and match them to the activities that consume the resources. One approach that can help overcome this problem is Activity-Based Costing (Griful-Miquela, 2001).

This paper attempts to integrate outbound logistics system with a view to holistically minimizing total logistics costs within the context of Activity-Based Costing (ABC) and Translog cost function at the level of the firm. The paper adopts a case study approach, utilising detailed and sectionalized questionnaires as data collection instrument from twenty manufacturing companies located in southwest of Nigeria based on multistage techniques. The components of outbound logistics that were related to cost for the period of 2002-2006 and were analysed using a software application that was packaged and designed for the study. Activity-Based Costing (ABC) framework formulae (Activity cost = Time x Labour cost + equipment cost + maintenance cost + service cost). Detailed analysis, using Translog cost function, was carried out on Inventory, Activity time, Labour, Equipment, Maintenance and service of all activity centres. How much insight a company has in its cost and how profit can be maximized and customers' requirements met, if the cost bill of manufacturing firms is controlled based on the cost model are discussed.

2.0 Methodology/Study Area

2.1 Study Area

South-Western part of Nigeria lies between latitude 6^0N and $8½^0$N of the equator and longitude 3^0E and 5^0E of Greenwich Meridian Time (GMT).The zone consists of Six States. These are Lagos State that stretches along the seaboard, Ogun, Oyo, Osun, Ondo and Ekiti State. The South-Western Geo-political Zone occupies an area of 79,048 Square Kilometres. The Zone covers about one-twelfth of Nigeria, and into it are packed almost 25 million or about one-fifth of the entire population of the Country.

The region remains a transportation node, an economic centre and a pole for financial and manufacturing development in the country. The region, particularly the Lagos zone,

accounted for 80% of international passenger traffic in the country in 2007, shared between 61% (in 1965) and 79% (in 2005) of seaport trade, and freight of between 69% (in 1965) and 96% (in 2005). Indeed, Lagos, the largest city in the country of estimated 12 million people is currently the most diversified economic centre in the country having the largest market with highest per capital income (Oyesiku, 2010). The region also recorded about 65% of the total number of wholesale in the country, 52% of total number of retail establishments and about 62% of the wholesale and retail employment by 2005. The role of the region in the national and international scene conferred on it a primate region within Nigeria and West Africa in 2005. It is in line with these local and international roles, that the region witnessed tremendous population growth that accompanied its rapid urbanization process in the past 20 years.

The economic development of the region is diversified due to factors that include; financial institutions allied institutions, provision of infrastructure facilities, availability of thriving market, reliable raw material base, available labour pool with right mix of skills and provision of serviced industrial and housing estates. The availability of effective and comprehensive industrial and agricultural policies generally, facilitates the rapid and interesting economic scenario of the region.

Modern manufacturing firms have experienced exponential growth between the late 1950s and the late 1980s. The region industrial policy aim at attaining an improved investment climate that attracts, promotes and sustains large, medium and small-scale industries with a view to encouraging private sector investments and generating employment in the state as a whole. More pertinent however, the industrial policy is also aimed at promoting regional and sectoral balance in the industrial and overall economic development of the region through the establishment of large and medium-scale industries, as well as propagation of cottage and small industries in all parts of the region. Among the industries include, agro-based, food processing, forest based, leather and rubber, mineral based, metallurgical based, engineering and chemical.

The economy of Lagos metropolis in particular forms the hub of Nigeria's national economy. It is also view as the "life wire" of the country owing to its relatively high level of industrial and economic development. Various commercial and business activities are heavily concentrated in metropolitan Lagos with Lagos Island and being the central Business District (CBD) as the most outstanding socio-political centre. Currently, metropolitan Lagos continues to provide, serve or support the: headquarters of most merchant, commercial and development banks as well as insurance companies; the Nigeria stock Exchange and allied institutions and the largest concentration of industrial and commercial establishment in the country together with the diversified activities allied to them. The range of buildings and allied infrastructure which the Federal administration and its parastatal have used hither to (and most of which they still use) further compliment the role of Lagos and indeed the region as being the economic nerve centre of the country. The developments of seaports, railway, road construction and establishment of industries make money to be injected into the economy *(Balogun et al 1999.)*

2.2 Methodology

The paper adopted a case study approach, utilising detailed and sectionalized questionnaires as data collection instrument from twenty manufacturing companies located in southwest of Nigeria based on multistage techniques. The questionnaire elicited primary data on components of outbound logistics that were related to cost for the period of 2002-2006 and were analysed using a software application that was packaged and designed for the study. Activity-Based Costing (ABC) framework formulae (Activity cost = Time x Labour cost + equipment cost + maintenance cost + service cost), was incorporated into this software and used to investigate resources that was traced to the respective activity centres, and then further down to the cost object (Product) where available. In other words, ABC distributes and structures both direct and indirect logistics activities and costs to various activities centres.

Detailed analysis, using ABC and Translog cost function, was carried out on Inventory, Activity time, Labour, Equipment, Maintenance and service of all activity centres.

3.0 Conceptual Underpinning

3.1 Activity-Based Costing (ABC) Model

The key to Activity Based Costing (ABC) is to seek out the "Cost drivers" along the logistics pipeline that cause costs because they consume resources. ABC enables each customer's unique characteristics in terms of ordering behaviour and distribution requirements to be separately accounted for. This falls within the framework of principles of logistics costing, that it should be capable of identifying the cost that result from providing customer service in the market place. In addition, it should be capable of enabling separate cost and revenue analysis to be made by customer type and by market segment or distribution channel. This latter requirement emerges because of the danger inherent in dealing solely with averages, (the average cost per delivery), since they can often conceal substantial variations either side of the mean (Lin, Collings and Su, 2001).

Other rationales discussed in management accounting literature, for using ABC can be that it increases the visibility that management has into how products, customers, or supply channels consume work and resources. The non-financial information produced by the ABC model facilitates the development of performance measures and continuous process improvement (Pohlen and Londe, 1994). Griful-Miquela (2001) further argued that by using ABC it is possible to analyze costs by areas of management responsibility and customers. ABC helps to recognize the way in which customers directly affect the cost structure of the business and therefore helps to analyze customer profitability. In other words, it is possible to model logistics cost and customer service holistically within the context of ABC.

Pohlen and Londe (1994) further stressed that a reduction in uncertainty provided by ABC will ensure a more solid basis for strategic decisions. Consequently, the success of ABC might not depend only on the results of the analysis, but on the ability to provide a correct diagnosis of the situation that the company might be in at present. However,

ABC can be handicapped by, lack of perfect cost data; losses of customer focus and effect of internal politics Lin *et al.* (2001).

ABC as a model has been found applicable in upstream or inbound logistics as highlighted by Lin *et al.* (2001); Griful-Miquela (2001); Hansson and Ottossen (2003); Borgqvist and Hultkrantz (2005) and Bengtsson and Sjoblom (2006). However, it has not been used in downstream or outbound logistics that involves more resources and activities in the area of transportation, inventories, warehousing and Order processing/information. The application of this model to the outbound logistics developing economy is predicated on the model's strength to measure various activity centres' costs holistically, which in turn can be used to determine where and how costs are incurred, such that decision can be made on cost reduction and customer service. In view of this, ABC steps include: analysis of different functions within the company, breakdown of the processes into activities, identification of the resources that are consumed when performing the different activity, determination of the costs of the different activities and trace the costs to the cost objects, and evaluate and analyse (Lin *et al.,* 2001).Suffice it to stress that ABC can be used to model cost measurement at outbound logistics which has not been done at inbound logistics that ABC had been adopted.

Lin *et al*. (2001), further argued that when conducting ABC, focusing on just one area within logistics as an example might cause inefficiencies in other areas (trade-off). The cost savings realized by implementing a new warehousing technique may be more than offset by a corresponding increase in transportation costs or inventory holding costs. The management must know every feasible solution to reducing total logistics costs and consider the important tradeoffs that must be made between the costs of the separate activities.

It is becoming imperative, therefore for feasible comprehensive cost model that would assist in outbound logistics in a satisfying manner, such that the cost distribution to different logistics functions would not be inaccurate, and perhaps doubtful if the costs are reflecting the true resources consumption of each logistics service process performed. The fact that most companies in developing economy lack sufficient cost data to reveal the true cost of business and as such, do not utilise the possible true potential in profit maximization for their logistics services. It is in this regard that at the level of the firm, attempts must be made to integrate outbound logistics system so as to holistically minimize total logistics costs within the context of Activity-Based Costing (ABC)

ABC is a concept that identifies and traces the cost of the activity performed in the sense that all costs are regarded as indirect. This is in contradiction to traditional accounting where the direct or indirect costs are allocated to the product or service, using volume based measures such as direct labour, and machine hours (Johnson and Kaplan, 1987; Hicks, 1992 and Kaplan and Cooper, 1998)

According to Kaplan and Cooper (1998) a proper ABC model should address the following questions:

(1) What activities are being performed by the organizational resources?
(2) How much does it cost to perform organizational activities and business processes?
(3) Why does the organization need to perform activities and business processes

(4) How much of each activity is required for the organization's products, services and customers.

Pohlen and LaLonde (1994) argued that the assumption is that an activity causes costs, allows the ABC approach to be divided into two stages (see Figure 1.1) when allocating costs to the cost object/product or service.

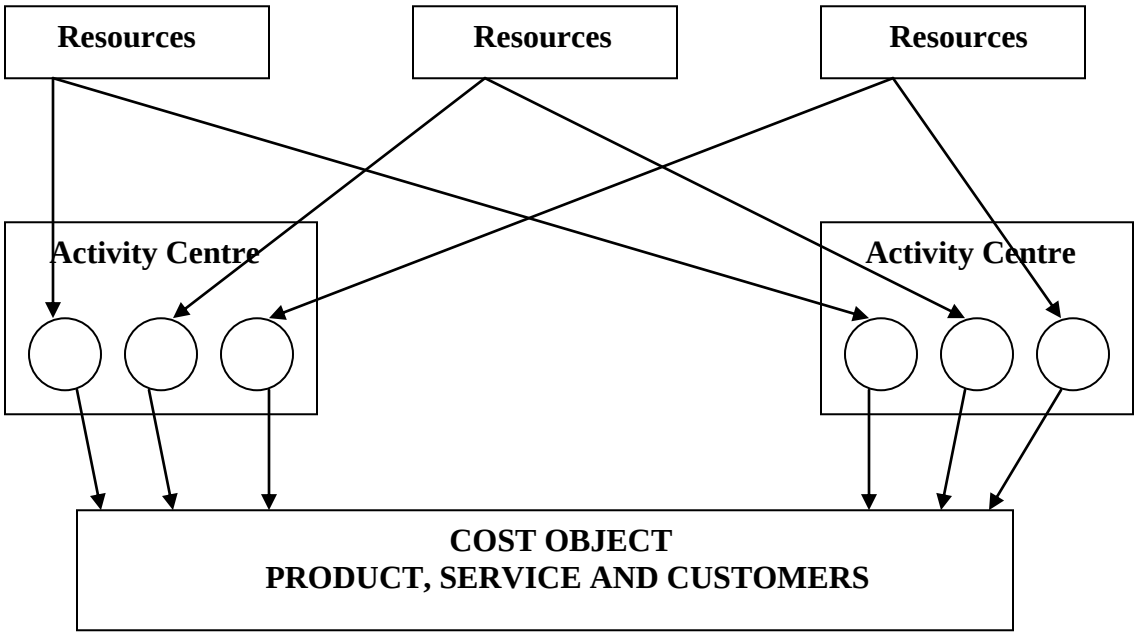

Figure 1.: **ABC Illustration of the distribution of Resources to Cost Objects**

***Source**: Adapted from Pohlen and LaLonde (1994) and Anderson (1997)*

First, the focus is to trace and determine the costs of resources to the activity within the organization. The resources drivers trace the consumption of resources by activities. It can be stated that the activities consume resources through the resources drivers or the work performed in the company. The costs of performing specific activities are then combined into cost centres at activity level. The second stage uses activity cost drivers to trace the activity to cost objects that consume the activities. The activity cost driver traces the activity costs to the products, or cost objects.

Cost within the framework of model can be defined as the tool that companies use in order to understand the cost which runs their business. This definition can be traced from Kaplan and Coopers (1998) discussion of the main functions for a cost model. These are:

(1) Valuation of inventory and measurement of the cost of the goods and services sold for financial purposes.
(2) Estimation of the cost of activities, products, services and customers.
(3) Provide economic feedback to managers and staff in general about process efficiency.

3.2 Benefit of the ABC model

The model can be utilized in different ways and thereby provide benefits depending on the nature of the required information for these manufacturing companies. The model is a tool that all these companies can use to understand the cost of their products. Through constant evaluation of the data acquired, an organization can be

improved. Several benefits that the model can provide these manufacturing companies are summarily identified in Figure 2.

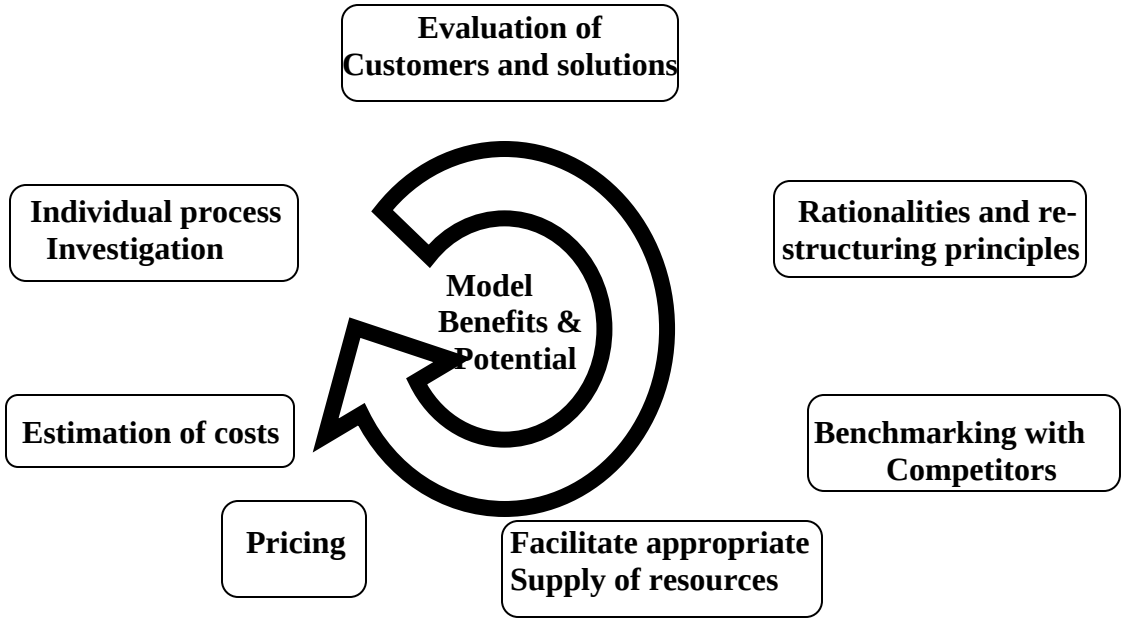

Figure 2: Framework of the Benefits of ABC model

Source: Bengtsson and Sjoblom (2006)

4.0 Analysis and Discussion

4.1 The Implementation of Activity Based Costing

As against the background of one of the objectives of this study, is to model in line with Activity Base Costing. The rationale behind the choice of this concept had been explained at the literature review section and need not be over flogged, but rather, the process of modelling would be explained. There are various approaches for designing and implementing a successful ABC system. There is no "one approach fits all" solution. Without a clearly stated purpose, the ABC system resulting from the project will not meet the needs of the organisation in a cost-effective manner. The implementation procedures are performed in seven major steps (Roztocki *et al.*, 1999) namely: review the company's financial information, establish objectives and requirements of the ABC system, identify main activities, trace overheads to activities, trace overhead to cost objects, calculate product cost of each cost object, and, use the ABC analysis for strategic decision-making and improvements

4.2 Model Building Processes

The empirical section provides the foundation for the cost model, which in turn is applied in the analysis section in order to construct the cost model. The cost model created clearly illustrates where the costs incur, and how the costs have been allocated

through, what according to ABC theory and analysis, are appropriate resources and cost drivers as identified thus.

Labour cost: The cost is calculated as an average monthly salary which includes sick pays and labour contributions. The employees are working on the average for all the companies for 9 hours on a day and evening shifts each. Moreover, they have allocation time of 13% which are working hours that cannot be covered because of planning, toilet visits and so on. In order to determine activity time, the monthly salary has to be multiplied by the allocation time since only the effective time is used in the cost model. When calculating the labour cost, the employees' salary that covers both day and evening shifts have been multiplied with the total amount of employees by category in each shift of activity centre. This value is divided with the total amount of employees to get a mean value that is converted to hours.

Equipment cost: Various equipment used in the outbound logistics activities contribute to cost. For instance, vehicles used in distribution, forklift used at warehouse and other means of transport contribute to equipment costs. When calculating the equipment cost, their relative costs of hiring or acquisition per month have been divided by the amount available minutes to perform those activities.

Maintenance cost: These are the cost of things that are broken down but need to be repaired. Maintenance cost per year is based on equipment maintenance cost per year divided by average available time of the equipment per year.

Service costs: These are costs on equipment, regularly performed to avoid wears. Average service costs for the year divided by the available time (both day and evening shifts) for the equipment is used in the model.

Total Activity Cost: The total cost for each activity is the activity time multiplied with each of the resources costs and then adding these costs together that result to total cost. The costs for the activities are used as a basis when conducting the total cost of logistics.

During this step, the direct and overhead costs of each cost object are added together, in order to obtain the product cost. Once the product cost is calculated, for example it can be used to judge profitability, make well-founded pricing decisions, and identify opportunities for cost savings, introduce a new product line, or drop an existing one (Roztocki, 2001b).

Against the background of the objectives of the paper; to model logistics cost within the framework of ABC Activity Based Costing (ABC). The ABC methodology as incorporated in the software are shown in the Tables 4.1, 4.2 and 4.3 for Transport, warehousing/Inventory and Order processing/Information activity centres respectively.

Table 1: Activity Cost for Transport Activity centre.

(A) Activity Cost (Transport) = (Transport Time x Labour cost) + Equipment Cost + Maintenance Cost + Service Cost

Companies	Transport Time	Labour Cost	Equipment Cost	Maintenance Cost	Service Cost	Activity Cost
1	2510	85	76500	5510	900	296260
2	2700	117	88450	6950	1010	412310
3	2550	84	78200	7200	810	300410
4	2900	145	90035	7150	2950	520635
5	2540	82	75102	5620	725	289727
6	2785	133	89841	6250	2708	469204
7	2800	135	87650	5560	1980	473190
8	2510	85	75100	5600	710	294760
9	2550	90	77800	4100	650	312050
10	2550	92	78850	6200	1000	302650
11	2660	92	78850	6310	1200	331080
12	2800	105	87115	5125	1670	387910
13	2610	80	75100	5600	850	290350
14	2650	82	75400	5650	870	299220
15	2850	130	90610	4710	1385	467205
16	2900	135	91710	4755	1445	489410
17	2730	82	76100	6005	1025	306990
18	2680	92	79120	6400	1250	333330
19	2780	125	86450	5250	2450	441650
20	2850	140	88760	6000	2650	496410
Total						7,514,751

Source: Output of ABC Results in the Software developed based on field survey (2009)

Table 2: Activity Cost for Warehousing and Inventory

(B)Activity Cost (Warehousing) = (Warehousing Time x Labour cost) + Equipment Cost + Maintenance Cost + Service Cost

Companies	Warehousing Time	Labour Cost	Equipment Cost	Maintenance Cost	Service Cost	Activity Cost
1	455	110	50560	750	310	101670
2	480	130	58350	1000	560	122310
3	450	95	55330	950	450	99480
4	350	115	70120	3000	900	114270
5	450	100	50110	1100	460	96670
6	356	105	68961	2778	850	109969
7	370	120	70000	2750	880	118030
8	455	105	50000	1080	450	99305
9	460	85	58500	1120	760	99480
10	370	125	62310	2000	920	111480
11	380	128	61250	1980	900	112770
12	375	133	65560	2670	890	118995
13	430	90	50110	1550	900	91260
14	450	95	50120	1500	920	95290
15	350	130	70110	2600	885	119095
16	345	135	72100	2760	890	122325
17	485	85	49200	1000	780	92205
18	480	100	51350	1200	1110	101660
19	380	130	68120	2550	800	120870
20	380	125	65700	2510	835	116545
Total						2,163,679

Source: Output of ABC Results in the Software developed based on field survey (2009)

Table 3: Activity Cost for Order Processing and Information

(C) Activity Cost (Order/Information) = (Order Time x Labour cost) + Equipment Cost + Maintenance Cost + Service Cost

Companies	Order Time	Labour Cost	Equipment Cost	Maintenance Cost	Service Cost	Activity Cost
1	400	155	50120	1800	500	114420
2	480	150	55145	2000	650	129795
3	420	155	50750	1750	510	118110
4	610	140	71790	3100	950	161240
5	400	160	50980	1890	600	117470
6	580	142	70127	3009	926	156422
7	530	145	68455	3300	1000	149605
8	380	150	50080	1732	530	109342
9	430	120	50335	2500	980	105415
10	470	135	57125	2100	850	123525
11	480	138	58145	2300	870	127555
12	510	140	60765	2800	900	135865
13	400	120	53550	1780	800	104130
14	440	125	54140	2100	850	112090
15	590	135	70550	3100	950	154250
16	600	138	71110	3200	1000	158110
17	400	133	50000	1200	450	104850
18	430	128	55330	1500	600	112470
19	520	130	60300	3000	990	131890
20	530	133	61200	3200	1000	135890
Total						2,562,444

Total Activity Cost = 7,514,751 +2,163,679 +2,562,444 =12,240,874

Source: *Output of ABC Results in the Software developed based on field survey (2009)*

Based on the Tables 1, 2 and 3, it is obvious that transport activity centre consumes more cost especially time, equipment, maintenance and service. Similarly, at warehousing activity centre, maintenance cost and equipment cost consume substantial amount. Similarly, at order processing/ information activity centre, it is only maintenance and equipment that has higher values, coupled with the fact that the activity Cost of this Activity Centre is greater than that of Warehousing. This might be as a result of training, based on the fact that this activity centre (Order Processing /Information) is gaining prominence in manufacturing companies in the developing economy in order to satisfy customers as initially discussed.

Translog cost function was further adopted to reveal technical and economic interrelationships present in Activity Centre of manufacturing companies. It is assumed that ABC attempts to minimize the cost at each Activity centre with the incorporation of cost function. The cost function can be written as a function of output levels (Y) and

input cost (r), or C = f(Y, r). Mathematically, the translog cost function can be written for this study as:

$$InC=Ina_0+ \sum_{i=1}^{3} a_1 InP_i + \frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3} b_{ij} InP_i InP_j + \sum_{k=1}^{4} c_k InQ_k + \frac{1}{2}\sum_{k=1}^{4}\sum_{I=1}^{4} d_{kI} InQ_k InQ_i + \frac{1}{2}\sum_{i=1}^{3}\sum_{k=I}^{4} e_{ik} InP_i InQ_k + \varepsilon$$

Where C is Activity cost of each activity centre, Q_k (k = 1, 2, 3, 4) stands for the sub grouping of these companies that is,. Agriculture/agro allied, Breweries/Soft drinks, foods and other group; P_i (1, 2, 3) represents the cost of resources, that is, Time, labour, equipment, maintenance, and service and a_0, a_i, b_{ij}, c_k, d_{kl}, and c_{ik} are parameters to be estimated. In addition, potential technological relationship, jointness-in-inputs, implies that all inputs are required to produce all outputs, while non-jointness in inputs implies that the output of any single product depends only on the inputs used in the production of that product and not on the inputs or outputs used in any other production process. The cost structure of multiproduct firm can provide useful information with respect to regulation that is imposed to promote economic efficiency. . For example, in the case of jointness-in-inputs, many groups might need to carry out their logistics activities by the same gear at the same time, so that it is costly to exclude particular groups.

The results of Translog are presented in tables 4 and 5. For the analysis, the models variables label, and definitions are presented in Table 4 while the results are reported in Table 5.

Table 4: Variables labels and Definitions

Variables	Description
TAc	Total Activity Cost
AAAg	Agric/Agro Allied Group
BSDg	Breweries/soft drink group
FDg	Food group
Others g	others group
Time	Time
Labour	Labour
Equip	Equipment
Matce	Maintenance
Service	Service.

Source: Author's field survey (2009)

The test of overall model significance that all model coefficients were 12.332 (model F-value = 73.251), indicating that the estimated model was significant in describing cost relationships in the logistics resources of manufacturing companies. In other words, there is relationship between total activity cost and outbound logistics resources based on the above results. In addition, a large proportion of the variation in the dependent variable (log(total cost)) was explained by the estimated model (R-squared = 0.6867 or 68.7%) of the 52 estimated model parameters, 32 were statistically significant at the 0.05 percent level of significant, with 14 additional coefficients significant at 0.01 level of significance. Specifically, highly significant variables were resources cost (Equipment, labour, maintenance and service), other group; interactions between input resources, and most of the interaction terms associated with Breweries/soft drink group and food group. The implication of these is that companies have potentials of benefiting in complementary and jointness in the distribution of their products, especially if handled by logistics service provider. This will not only enhance customer satisfaction but accelerate competitive advantage.

The negative sign associated with the output interaction coefficients suggests that a cost reduction might be possible if resources are harnessed. In the translog function, however, the many interaction terms make the individual estimated coefficients difficult to interpret directly. As an alternative, these coefficients can be used to determine own – and cross-cost elasticities of input demand, cost elasticities and economies of scope and scale which are not within the ambit of this write-up. In all the findings can be represented diagrammatically as shown in fig.3

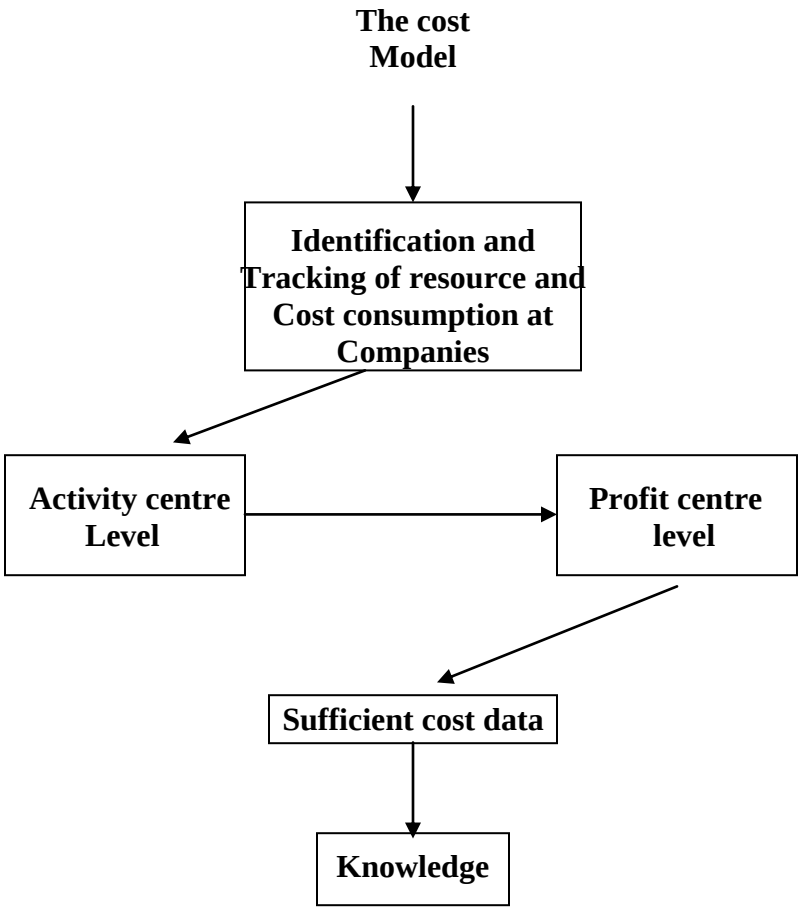

Figure 3 Conclusion Framework of the cost model

Source: field survey (2009)

Table: 5. Estimated Coefficients and associated statistics of the unrestricted Translog cost function for Total Activity Cost.

Variable	Parameter Estimate	Standard Error	T.Value	Pr>/t/
TAc	1.14647	0.06191	3.11**	0.005
AAAg	-2.83061	0.38897	-2.14*	0.034
BSDg	1.31766	0.37827	4.84**	0.002
Fdg	1.91427	0.25387	0.06	0.955
Others g	2.03200	0.43978	3.17**	0.004
Time	17.71765	4.12651	3.07**	0.009
Labour	3.94854	0.92792	2.81**	0.001
Equip	6.72490	0.66402	2.24**	0.006
Matce	1.13689	0.00562	6.56**	0.000
Service	-2.10032	0.00311	-2.10*	0.001
(AAAg)^2	-3.00902	0.00235	-1.83	0.512
AAAg*BSDg	-1.12368	0.00479	-4.94**	0.000
AAAg*FDg	2.11001	0.00611	1.64	0.104
AAAg*othersg	-3.01185	0.00268	-4.32*	0.005
(BSDg)^2	-2.09955	0.00304	-0.18	0.858
BSDg*FDg	1.02287	0.00392	5.83**	0.000
BSDg*others	-3.01845	0.00260	-3.25*	0.001
(FDg)^2	2.91705	0.00515	3.31**	0.001
FDg*others	4.00239	1.55691	3.11*	0.000
(Others)^2	-5.04647	0.17059	-3.27*	0.000
(Time)^2	-6.40928	0.31022	-2.32*	0.008
Time*Labour	-4.19657	0.4942	-2.95*	0.004
Time*Equip	-5.11570	0.02210	-5.23**	0.000
Time*Mtce	3.16464	0.02461	2.63**	0.009
Time*Service	4.22792	0.06989	3.26**	0.001
(Labour)^2	-3.03653	0.01636	-2.23*	0.002
Labour*Equip	2.01217	0.00929	4.23*	0.008

Labour*Mtce	-1.16870	0.06884	-4.00*	0.003
Labour*Service	2.11078	0.01261	4.86**	0.003
(Equip)^2	1.10620	0.00862	1.26	0.981
Equip*Mtce	3.02761	0.04612	3.60**	0.005
Equip*Service	-2.10188	0.00959	-1.20	0.845
(Service)^2	3.06668	0.00489	-3.37**	0.004
AAAg*Time	4.02594	0.07446	3.35**	0.002
AAAg*Labour	1.90294	0.01253	4.23**	0.008
AAAg*Equipt	3.10422	0.01010	3.42**	0.006
AAAg*Service	-4.1904	0.01235	-2.84**	0.000
BSDg*Time	-5.62490	1.55301	2.42**	0.001
BSDg*Labour	-4.17193	0.15786	-3.13**	0.002
BSDg*Equip	4.03356	0.00272	4.8**	0.000
BSDg*Mtce	2.30614	0.21011	3.32**	0.000
BSDg*Service	3.33652	0.05776	3.16**	0.001
FDg*Time	1.11463	0.06335	4.45*	0.011
FDg*Labour	-3.00043	0.00221	-3.11**	0.000
FDg*Equip	-2.1458	0.00363	-3.75**	0.001
FDg*Mtce	1.62578	0.03386	7.64**	0.000
FDg*Service	3.03877	0.00306	6.15**	0.000
Others*Time	2.94954	0.25593	3.56**	0.000
Others*Labour	4.13227	0.00514	5.60**	0.000
Others*Equip	2.06873	0.02312	4.80**	0.004
Others*Mtce	-3.00316	0.00581	-2.45*	0.007
Others*Service	-2.14862	0.04310	-2.17*	0.001
Intercept	-17.6535	2.58096	-0.19	0.847

Model F-value = 73.251 **(Pr>F)** = 12.332 **R-Square** = 0.6867

** Significant @ 0.05 Level of significance * Significant @ 0.01 Level of significance

Source: Output of Translog analysis of the Software developed based on field survey (2009)

5.0 Conclusion

The paper finds the cost model is easy to use and understand, since it is based on time studies it also contain clear and specific costs that is easy to trace. Each market has its own particular logistic solution therefore the consumption between the profit centres differs. The resource consumption depends upon which activities/processes are required for a specific logistic solution which in turn is what the customer requires.

It is almost impossible to specify what determines the resource utilization at each profit centre on a general basis. This since the requirements for each profit centre is individual. To obtain the difference in resource utilization of each profit centre has to be carefully analysed. Through the ABC the consumption is illustrated for each profit centre, as the resources are allocated through cost drivers that affect the profit centres on a relatively equal basis. The users of the model can acquire information of how the costs are allocated that are required in order to run the everyday activities that are necessary. This is the significance as management, department managers and the staff members can be aware of how much resources the different activities consume. This creates consciousness throughout the organization.

The main goal of this paper, as initially stipulated, was to model logistics cost within the framework of ABC and interrelationships among logistics cost and resources of each activity centre by estimating a group distribution cost function. The paper , however revealed that logistics costs are characterized by a joint distribution process. The existence of jointness-in-inputs suggests that, to some degree, all inputs are required to produce all outputs. Thus, from distribution management perspective, individual regulation of components will affect the distribution process of the other components.

Hence, the model can act as a guide to prospective logistics service providers, which can facilitate benchmarking procedures that are necessary in order to obtain knowledge of the market position that they currently are in, while rendering some logistics services to these companies such that they have to be able to convince their customers that, they have the best the market has to offer.

The paper revealed that the cost model is highly trustworthy and the accuracy corresponds to the purpose with the cost model, which it can facilitate estimation of cost, rationalities and restructuring principles, benchmarking with competitors, pricing and appropriate supply of resources. The model allocates resources and costs down to each profit centre where available and then down to the cost per order on an annual basis. The different profit centres can be compared to each other and how much the consumption differs from resources. The findings further revealed that the most important consideration in any organization is how much insight a company has in its cost and that profit can be maximized and customers' requirements met, if the cost bill of manufacturing company is controlled. This is further illustrated in Fig.3.

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