Production Cost Estimation in Food and Drink Industry
(A Case Study of a Soft Drink Company in Lagos, Nigeria)

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Abstract
A cost data were collected from a soft drink company in Lagos, Nigeria and used to develop a manual costing model for a 35cl package size for flavor, with special consideration for weight and size. Other cost parameters like; raw materials, labour, transportation, water and electricity were also considered and analyzed using mathematical methods. An effective cost estimate of N18.42k for flavor was made which is then compared with the management’s target cost of between N18.00 to N20.00 for the same product. This shows that the cost estimation is still within the range with no deviation from management’s target cost. However, adequate awareness should be given to manufacturing industries on the importance of having production cost estimation before the product is manufactured. To this end, this paper recommended the use of cost estimation for use in any food and drink manufacturing company here in Nigeria, developing and developed countries in world in general.

Keywords: production cost, estimation, food and drinks and industry

INTRODUCTION
Adejuyigbe (2002) defines management as the act of planning, organizing, staffing, controlling, coordinating and directing of human resources to achieve the enterprise objective. He went further to see management as the process by which a cooperative group directs action of others towards common goal. Management also involves getting a job done through people. (Fashina, 1974) offers what is termed a management definition, which in the traditional sense, among management writers means stimulating people to action to accomplish desired goals.

Cost Estimation is defined by (Sharma, 2006) as the process of forecasting the expenses that must be incurred to manufacture a product. Knowledge of how cost behaves under various conditions is important if managers are to make intelligent use of techniques present for budgeting, decision making and performance evaluation. However, Cost Estimation as being defined by (Kajola and Emmanuel, 1999) is the attempt to measure historical costs for the ultimate purpose of facilitating the prediction of expected future costs for decision-making purposes. According to guide to project management book, Cost Estimation involves developing an approximation (estimate) of the costs of the resources needed to complete project/manufacturing activities. (Blocher et al, 2005) defined Cost estimation as the development of a well defined relationship between a cost object and its cost object and its cost drivers for the purpose of predicting the cost. Cost estimation facilitates strategic management in two ways thus:

- It helps to predict future costs using previously identified activity- based, volume based, structural, or executional cost drivers.
- Helps identify the key cost drivers for a cost object and which of these cost drivers are most useful in predicting cost.

(Ulrich and Eppinger, 1995) said that the cost of a standard components are estimated by

- Comparing each part to a substantially similar part the firm is already producing or purchasing in the comparable volumes or;
- Soliciting price quotes from vendors or suppliers.

(Hilton et al, 2000) said that cost estimation is the process of estimating the relationship between costs and the cost drivers that cause those costs. Companies estimates costs for three purposes thus;

- To manage cost;
- To make decisions; and
- To plan and set standards
They also said that when the custom component is a single part we estimate its cost by adding up the costs of raw materials, processing, and tooling. Manual assemble costs can be estimated by summing the estimated time of each assemble operation and multiplying by a labour rate.

Cost is the background of almost every decision the tool engineer makes in organizing manufacturing operations and in selecting materials, methods, tooling and facilities. An understanding of cost determination is essential to ensure that these decisions are based on sound and dependable estimates of cost. Estimates of cost must be reasonably accurate if a venture is to be successful. If a job is overpriced, it is lost to a competitor. If it is underestimated, it results in financial loss.

According to (Nwachukwu, 2006) Costing is quite different from estimating. He enumerated the difference in table 1, thus:

<table>
<thead>
<tr>
<th>ESTIMATING</th>
<th>COSTING</th>
</tr>
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<tbody>
<tr>
<td>It predetermine of the PROBABLE cost of the proposed product or process.</td>
<td>The systematic and accurate recording of the details and operations of manufacturing processing or supply no of services so as to show the ACTUAL cost of each individual price of work or process.</td>
</tr>
<tr>
<td>Has regard to the market prices and the wage rates ruling at the time of estimating</td>
<td>Is concerned with ACTUAL cost of materials subsequently used and wages eventually paid.</td>
</tr>
<tr>
<td>The possibility of rising or falling prices must be considered.</td>
<td>Only ACTUAL costs should be taken into account.</td>
</tr>
<tr>
<td>To secure orders, certain expenses may be wholly or partially disregarded.</td>
<td>All expenses must be fairly charged and each individual item prices are considered independently of all others.</td>
</tr>
<tr>
<td>Estimates may be prepared with the aid of previous cost account which serves as a guide.</td>
<td>Costs should be prepared in such a way that they assist in the preparation of future estimates.</td>
</tr>
</tbody>
</table>

Source: (Nwachukwu, 2006)

However, cost estimation is determining the anticipated or probable cost of a job much before the manufacturing of the job is undertaken, whereas cost accounting will be complete only after the job has been completed. Estimation as compared to costing is a higher technical job because an estimator must be familiar with factory methods and operation time etc., whereas cost accounting only consists of compiling data from various source by clerical staff. Cost estimation gives predicted or standard cost, whereas cost accounting gives actual or postmortem costs.

LITERATURE REVIEW

Good cost estimation has a direct bearing on the performance and effectiveness of a business enterprise because overestimation can result in loss of business and goodwill in the market, whereas underestimation may lead toward financial losses to the enterprise (Ben and Qian, 2003). Because of this sensitive and crucial role in an organization, cost estimation has been a focal point for design and operational strategies and a key agenda for managerial policies and business decisions. As a result, a substantial research effort has been expanded in exploring design implications, new techniques, and methods for producing accurate and consistent cost estimates not only to generate optimum design solutions but also to achieve the maximum customer satisfaction in terms of low-cost, high-quality, and in-time product delivery (Shehab and Abdalla, 2002). The published literature on product cost estimation (PCE) covers a wide variety of issues ranging from manufacturing cost estimation of standard mechanical components to cost analysis of highly customized assembled products, from process cost optimization techniques to specific methods for overhead costing, from unique approaches for estimation at the conceptual design stage to general costing rules designed for use at a later stage in the design cycle, and also from classical costing methods to highly novel cost estimation techniques (Cavalieri et al, 2004). A number of researchers have attempted to categorize the PCE techniques using certain criteria. (Zhang et al, 1996) categorized some techniques into traditional detailed breakdown, simplified-breakdown, group-technology-based, regression-based, and activity-based cost estimation techniques. (Ben and Qian, 2003), classified cost estimation methods into intuitive, analogical, parametric, and analytical methods. (Shehab and Abdalla, 2002), mentioned intuitive, parametric, variant-based, and generative cost estimating approaches without defining them clearly.

The same authors later classified cost modeling approaches at the design stage into knowledge-, feature-, function-, and operations-based approaches. (Cavalieri et al, 2004) identified three approaches for cost estimation: analogy-based, parametric, and engineering approaches. However, this paper has adopted production cost estimation in food and drink industry with a specific case study of a soft drink company in Lagos, Nigeria.

MATERIALS AND METHODS

Production cost estimation will involve any of the following cost:

- Direct and Indirect Cost

Direct Costs of a Cost Object – are costs that are related to the particular cost object and that can be traced to it in an economically feasible (cost effective) way.
Indirect Costs of a Cost Object – are costs that are related to the particular cost object but cannot be traced to it in an economically feasible (cost effective) way (Horngren et al, 1997)

- Cost Behavior

Management accounting systems record the costs of resources acquired and track their subsequent use.

The two basic types of cost behaviour patterns found in many of these systems are:
- Variable Cost – is a cost that changes in total in proportion to changes in a cost driver.
- Fixed Cost – is a cost that does not change in total despite changes in a cost driver. A cost driver (also called a cost generator or cost determinant) is any factor that affects total cost. Therefore, costs may simultaneously be:
  - Direct and variable cost
  - Fixed
  - Indirect and Variable
  - Indirect and Fixed

Accounting systems typically report both Total and Unit cost numbers. A Unit Cost (also called an average cost) is computed by dividing some total cost by some number of units, Horngren et al (1997).

\[ \text{Unit Cost} = \frac{\text{Total manufacturing Costs}}{\text{No of unit manufactured}} \] (1)

**Cost Structure**

Sharma (2006) says the element of cost can be combined to give following types of cost:

1. Prime cost. Prime cost or direct cost is given as:
   \[ \text{Prime cost} = \text{Direct material + Direct labour + Direct expenses} \] (2)

2. Factory cost: This cost is given as:
   \[ \text{Factory cost} = \text{Prime cost + Factory expenses} \] (3)

3. Manufacturing cost: Manufacturing cost or cost of production is given as:
   \[ \text{Manufacturing cost} = \text{Factory cost + Administrative expenses} \]

4. Total cost: is given as:
   \[ \text{Total cost} = \text{Prime cost + Factory cost + Manufacturing cost} \] (4)

5. Selling price: selling price is given as:
   \[ \text{Selling price} = \text{Total cost + profit} \] (5)

**Cost Hierarchies**

The driver of many costs in organizations is a unit of output (or variables that are a function of units of output). However, not all costs are driven by output units. This has led to the classification of costs into hierarchies. Therefore, a cost hierarchy is a categorization of cost into different cost pools on the basis on the basis of different classes of cost drivers or different degrees of difficulty in determining cause – and – effect (or benefit received) relationship, Horngren et al (1997).

**Cost Pools** – a grouping of individual cost items. Cost pools can range from the very broad (such as company wide cost pool for telephones and fax machines) to the very narrow (such as the cost of operating a car used by a traveling sales person).

The four levels of manufacturing costs we examine are:

- **Output Unit** – level Costs are resources sacrificed on activities performed on each individual unit of product or service.
- **Batch – Level Costs** – are resources sacrificed on activities that are related to a group of units of product(s) or service(s) rather than to each individual unit of product or service.
- **Product – Sustaining or Service – Sustaining Costs** are resources sacrificed on activities undertaken to support specific products or services. Product – sustaining Costs cannot be linked in any cause – and – effect way to individual units of product or to individual batches of products.
- **Facility – Sustaining Costs** are resources sacrificed on activities that cannot be traced to a specific products or services but support the organization as a whole. Examples of facility sustaining costs are the leasehold costs for a manufacturing plant and the plant manager’s salary.

**Manufacturing System**

Manufacturing is the transformation of raw materials into finished goods for sale, or intermediate processes involving the production or finishing of semi-manufactures.

Manufacturing is also defined as the mechanical, physical, or chemical transformation of materials or substances into new products. It is a large branch of industry and secondary production. The manufacturing thus consists of a series of interrelated activities and operations involving design, material selection, quality assurance etc (Sharma 2006).

According to Sharma (2006), system can be defined as the entire combination of hardware, information and people, necessary to accomplish some specified mission.

Sharma explains further that due to all this, manufacturing has grown to become a “System” with many components that interact in a dynamic manner. Based on Sharma’s definitions of manufacturing and System above he now gave the definition of Manufacturing system as a system organized to manufacture parts and products.

**Production System**

A production system according to Sharma (2006) helps a manufacturing system to produce the goods. He goes further to say that there are many types of manufacturing systems (Job shop, flow line etc.), but
all the manufacturing systems are derived by a production system and that a production system serves the manufacturing system/systems and the individual processes to manufacture goods, without itself manufacturing products.

Calculating Product Costs
Mogaji, (2005) said, “After estimating the costs of the different elements, the total costs of the product can be easily be determined. The total production costs can be determined by adding up the costs of every product element. The costs of a product element are a summation of the cost attributes. Thus, the total product cost can be determined by adding up all values of the cost attributes of all elements. For instance, the costs of a component are a summation of the costs of material (on component level), costs of process on component level and the costs of producing the features. An advantage of this method is that the costs can be related to the desired aggregation level”.

Manual Costing Of A Typical Soft Drink Used
The company used as a case study has its own Mixing Instruction, it is based on a basic formula which involves a lot of calculations that the workers always refer to.

Mixing Instruction = 1 unit of requires
203kg of Sugar
136 Litres of water
1 Unit of Concentrate

Note: 300 litres is Standard in the Mixing Instruction
H2O + Sugar + Concentrate = X volume Of Syrup,
that is,
1 Unit = 136 + 203 + 1 Unit Concentrate = 300 litres
So to get The Manufacturing Cost for flavor
A daily production report known as form 11.211 computed for 30th March 2012 was used

According to Sharma 2006,
Manufacturing Cost = Factory Cost + Administrative Expenses
While,
Factory Cost = Prime Cost + Factory Expenses
But,
Prime Cost = Direct Material Cost + Direct Labour Cost + Direct Expenses (if any)

A Direct Material
Concentrate, Sugar, Carbon dioxide, Caustic Soda, Treated Water, Package, Crown/Cork

(i) Concentrate
From form 11.211, 88,4111 Units was used for a day. While 1 Unit of concentrate cost N 8,600
Therefore,
88,4111 units = 8,600 x 88,4111
= N 760, 335.46k
On form 11.211, 14074 cases were produced that day

1 case contain 24 bottles of 35cl
Therefore,
14074 cases = 24 x 14074
= 337776 bottles
Cost on 1 bottle
= 760, 335.46
337776
= 2.25100 = N 2.25k

(ii) Sugar
50 kg of sugar = N 5,400
1 kg = 5,400
5
= N 108

From for 11.211, 17, 983.73 kg of Sugar was used for 30th day of March 2012
Since 1 kg of Sugar is N 108
17, 983.73 kg = 108 x 17, 983.73
= N 1, 942, 242.3k
14074 cases were produced which is equivalent to 337776 bottles
Therefore, for 1 bottle
Cost of Sugar is
1, 942, 242.3
337776
= 0.20231 = 0.20k
That is, the cost of Sugar on one bottle of Coca-Cola flavor is N 0.20k

(iii) Carbon Dioxide
25 kg of Carbon dioxide = 920
1 kg = 920
25
= 36.5
= N 36.5k
From form 11.211, 1,857 kg of Carbon dioxide was used for the day
Therefore,
1, 857 kg will cost
1,857 = 36.5 x 1, 857
= N 68, 337.6
Therefore, on 1 bottle,
Carbon dioxide = 68,337.6
337776
= 0.20231 = 0.20k
That is, the cost of Carbon dioxide on 1 bottle of Flavor is 0.20k

(iv) Caustic Soda
25 kg = 1,450
1 kg = 1,450
25
= N 58
From the daily production report, 630kg of caustic soda was used
If the cost of 1kg is N 58
Therefore,
630kg = 58 x 630
= N 36,540
For 1 bottle of Coca-Cola flavor the cost =
36,540
337776
= 0.10817 = 0.11k

(v) Treated Water
From the daily production report 88,4111 units of concentrate was used. While in working formula:
1 unit of concentrate = 136 litres of water
Therefore,
88.4111 units = $136 \times 88.4111 = 12023.91$ litres

But, 340 litres of water (treated) = $\text{N}10,877$
1 litre = $10.877$
$\frac{340}{1} = 31.99 = \text{N}32$

Therefore,
$12023.91$ litres $= \text{N}384,659.02$

Since 337776 bottles were produced for that day
1 bottle $= \frac{384,659.02}{337776} = \text{N}1.14$

(VI) Cost for a 35cl package/bottle $= \text{N}4,60k$

(VII) Cost per Crown Cork $= \text{N}1.20k$

B (i) Direct Labour

From form 11.211
Total Direct Labour = 562 man-hour
Salary for direct Labour / man for the month of March $= \text{N}188,168.50k$
Number of working days for the month = 27 days
Hours worked per day = 8 hours
Number of hours worked for a month (March) $= 8 \times 27$

Therefore, the amount paid per man-hour for direct labour $= 176.71$

i.e. $\text{N}176,71k$ is paid per man-hour for the month under review

Therefore,
For 562 man-hour of direct labour
$= 562 \times 176.71 = \text{N}99,308.78k$

i.e. for 337776 bottles produced
But for 1 bottle $= \frac{99,308.78}{337776} = 0.294 = 0.30k$

B (ii) For Indirect Labour

Form 11.211 shows that
Indirect labour = 238 man-hour
Salary for the month (March) $= \text{N}30,128.00$
Hours worked for the month (March) $= 8 \times 27$
$= 216$ hours

Therefore, Pay per man-hour
$= 30,128.00$
$\frac{216}{1} = \text{N}139.48k$

Total pay for 238 man-hour = $139.48 \times 238$
$\text{N}33,196.59$

Cost of indirect labour per bottle therefore
$= \frac{33,196.59}{337776}$
$= 0.098 = 0.10k$

C. Direct Expenses

FUEL USAGE

From form 11.211
Net production = 14, 074 cases
1,576 litres of diesel was used
1 litre of diesel = $\text{N}85$

Therefore,
1,576 litres $= 85 \times 1,576 = 133960$
1 bottle $= 133960$

D. Factory Expenses

For the month under review $7,220,000$ was spent by different departments in the production unit as running expenses.

Since there are 27 days in that month therefore for a day the running expenses
$= \frac{7,220,000}{27} = \text{N}267,407.41k$

337776 bottles were produced
Cost per bottle $= \frac{267,407.41}{337776}$
$= 0.7916 = 0.80k$

E. Administrative Expenses

A sum of $\text{N}12.5$ million was spent as Administrative Expenses for the plant in the month under review

Since there are 27 days in the month of March, it means that averagely for a day, the plant spent
i.e. 1 day $= \frac{12,500,000}{27} = \text{N}462,962.96k$

Cost per bottle $= \frac{462,962.96}{337776}$
$= 0.137 = \text{N}1.37k$

F. Machine Hour Rate (MHR)

MHR $=$Charges Applied to a Machine over a Period/Number of Hrs. of Operation of the Machine during the Same Period

Charges Applied In a Month $= \text{N}1,800,000$
For a day $= \frac{1,800,000}{27} = \text{N}66,666.67k$

In One Hour $= \frac{66,666.67}{16} = \text{N}4,166.67k$

From Form 11.211
Number of Cases per day was given to be 14074 cases

Therefore, To Change from Cases Per day to Bottles Per Hour equals The Number of Bottles Per Case Multiplied By The Number of Cases Per Hour

Facts:
Package Size $= 35cl$
Bottles Per Case $= 24$ Bottles
Cases Per Day $= 14074$ Cases

Therefore,
Cases Per Hour $= 14074$
$\frac{16}{1} = 879.63 \text{ Cases / Hr}$

Line Speed = Number of Bottles/Case $\times$ Number of Case / Hour
$= 24 \times 879.63 = 21,111 \text{ bottles/Case}$

That is,
The Charges applied to
21,111 Bottles / Hour $= \text{N}4,166.67k$

Therefore,
1 Bottle $= \frac{4,166.67}{21,111} = 0.1974 = 0.20k$

Manufacturing Cost = Factory Cost + Administrative Expenses
While,
Factory Cost = Prime Cost + Factory Expenses
But,
Prime Cost = Direct Material Cost + Direct Labour Cost + Direct Expenses (if any)

= ₹2.25 + ₹5.75 + ₹0.20 + ₹0.11 + ₹1.14 + ₹4.60 + ₹1.20 + ₹0.30 + ₹0.10 + ₹0.40 + ₹0.80 + ₹1.37 + ₹0.20
= ₹18.42k

Therefore, the manufacturing Cost for one bottle (35cl) of flavor is ₹18.42k. This shows that the cost estimation is still within range with no deviation from management’s target cost of between ₹18.00 to ₹20.00 for the same product which is the target of the company to be viable.

CONCLUSION
The aim of this study has been to investigate the current state of cost estimation in a typical manufacturing outfit in food and drink company using a typical food and drink industry located in Lagos, Nigeria as a case study. It is heartwarming to note that the afore-mentioned company utilized the cost estimation method to the benefit of the company. A manual costing model for a 35cl package size for flavor, with special consideration for weight and size was developed and utilized in this study. Other cost parameters like; raw materials, labour, transportation, water and electricity were also considered and analyzed using mathematical methods.

An effective cost estimate of ₹18.42k for flavor was made which is then compared with the management’s target cost of between ₹18.00 to ₹20.00 for the same product. This shows that the cost estimation is still within range with no deviation from management’s target cost which is the target of any company to be viable.

Therefore, this research recommends the use of cost estimation for use in any food and drink manufacturing company in both developing country like Nigeria and developed country.

REFERENCE