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Activity Based Costing in Manufacturing Facilities and Electrical Power Distribution Systems Equipment Manufacturing

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ABSTRACT

Manufacturing processes are critical to the success of the nation's economy. Due to availability of raw materials and labour in certain economies lead to large scale establishment of manufacturing facilities. Depending on global supply chain, many industries procure raw materials from a broader geography. One such example is petroleum industry the relies on cross-country pipelines for inflow of crude for refining and marketing purposes. The project managers must take care of the internal decision by proper use of the accounting figures available with the internal environment. Especially in a large manufacturing unit with low and high-volume products and services are delivered the accounting of the overhead costs incurred needs to be allocated so that an optimal pricing decision is made. Traditional costing allows undifferentiated allocation of the overheads to all types of the products irrespective of the volume. However, the activity-based costing has a greater significance when a literature review was performed to study the advantages of activity-based costing (ABC) and its success. Later on, a comparison of two hypothetical products "X" and "Y" distinguished based on the volume was performed against following the traditional methodology and activity-based methodology to understand how it would impact the pricing strategy been followed. The steps followed in the ABC were enumerated and presented in a manner to be able to understand by a person with non-business background. A general analysis has provided an insight in application of ABC for the management in taking the right decisions for the betterment of the company. In electrical power systems industry there are many equipment manufactured. The majority of them comprises of copper and aluminium conductors. The respective manufacturing facilities require attaining high energy efficiency, optimized processes, leverage of new technologies at the same time allocate the appropriate pricing strategy to promote both company profits and recover costs for research and innovations.

Keywords: manufacturing; project accounting; electrical equipment manufacturing.

1. Introduction

The activity-based costing is applicable to the manufacturing facility businesses which require a most reliable data for the costs for including the true costs borne by the entire process of the production within the industry [1]. This guides the management accountants in helping the decision-making processes in pricing the products and services [2].

In this methodology the costs related to the overhead and the indirect headers are applied to the services and the offered products by the company [3]. The entire purpose of managerial accounting is to include all the accounting figures related to the internal operations of the company for the evaluation purposes for the management staff in decision making process [1]. Hence, for a manufacturing industry the key areas of the focus for the accountants includes raw materials costs, production costs, labour and wages costs, repair, and maintenance costs and so on [4]. The raw material includes the inflow and outflow of the materials from the facility [3]. For instance, for a cement industry the inflow includes the sand and gravel, coal, gypsum and so on [3]. The outflow includes the fly ash and other waste materials to be treated for recycling. Production costs include the electrical energy consumption, bills, machinery, technology and so on [4]. The labour and wages are standard wages paid to the staff and the shift operators and so on [3]. Additionally, the maintenance and repair for the equipment have another cost component [1]. In manufacturing facilities, the critical areas to improve the efficiency of production includes: (a) implementing high energy efficient products for production, (b) improving the energy efficiency of existing equipment, (c) optimizing the processes, (d) technological advancements in current manufacturing processes, (e) utilizing economies of scope and scale. Raw materials are often an excellent place where the input cost may be reduced. Certain types of waste management practices or recycling the by-products as input raw materials and waste heat re-utilization can help with efficiencies improvement.

A company needs to know the areas where they must improve the processes and at the same time determine the pricing of the products so that they can reasonably make profits. A large portion of the product pricing contributes to the research and technological innovation of the products. To gain competitive advantage, the best practices is to keep working on strategizing best innovative practices both in equipment and processes. For example, many businesses are able to scale their businesses just from scaling the user applications. Similarly, for a company manufacturing wide variety of products do share same processes and sometimes working in multi-dimensional processing industry leads to resiliency from market forces which can diminish the need of the products due to other forces. Market in food processing industry sees a sharp trend in dropping sales from increased pricing. For example, essential commodities are often prone to decline in sales resulting from price rise from either the inflation or reduction in raw materials availability. Although many supply chain problems come into picture such as transportation costs, import and export duties, and distribution network in determining the optimal price, solutions with ABC do govern the effective strategy for pricing.

The purpose of the research is to identify the optimal use of the ABC and devise proper tools in calculation of the costs to have an accounting done in fashion that provides more accurate results for development of a pricing strategy for the company management [2]. Firstly, the all the activities related the production are identified and tabulated in an orderly fashion [2]. Secondly, all the activities are categorized into various pools of cost which is then overhead for each header is obtained [2]. Thirdly, the assignment of the activities with respect to the pools or headers of costs is done based on the hours/ units [2]. Fourthly, the overheads are divided by the total costs of each drivers for each header or the pool [2]. Finally, the rate for the cost driver is obtained and then multiplied by the total number of the drivers of the cost [2]. There are advantages to adoption of this strategy allows the overhead to be included in the wide range of the pools [2]. Moreover, the activity-based allocation ensures activities been accounted rather than volume measures adopted traditionally [1]. This ensures the overhead are accounted to low volume services or products from the high-volume ones [2]. The basis of the accounting utilized the variance analysis and activity-based costing for identification of the production activities involved [1]. So, the objective of the overhead, labour costs and the costs of

raw materials to accounted in optimizing the operations for application in use of correct manpower, reduction of the waste products and the indirect cost accounting is achieved using the ABC [1]. The remainder of the manuscript has been organized to sections to include the literature review, practical application, discussion on electrical equipment manufacturing, and conclusion.

2. Review of Literature

Kaplan (1988) presented the traditional methods adopted in the costing which helped with pricing and mentioned some of the drawbacks which limit the proper accounting of the overhead costs and hence decision-making processes [5]. However, Knezevic and Mizdrakovic (2010) presents the difference between the traditional methods and ABC. Traditional methods have more cost drives based on the volume basis and overhead costs are included with products and services [6]. The research highlights the limitations in terms of the requirement of the more labour/machine work hours when costs are assigned to the products and the services [6]. However, with the ABC accounts the indirect costs properly to the production. There were examples quoted for the type of the activities such as cleaning and disinfection of the kitchen after food production is done for a food processing industry just to understand types of the activities. So, there was a definition of "activity" presented here which states that it is an action that is repeated and moves the operations in an orderly manner [7].

Moreover, the difference in number of stages with traditional approach is four whereas with activity based it is just two which simplifies a bit [8]. The phase one comprises of the allocating of the costs by determination of the indirect costs at a whole entity level of the industry [8]. The other phase is essentially the definition of the activity as discussed earlier and evaluate the overhead costs with respect to the same [8]. Work presented by some of experts such as Johnson and Kaplan (2007) have consistently highlighted the short comings of the classical approach. [9] presents effects on the productivity when taking about the activity-based pricing [3]. How effectively the activity-based costing improved the production efficiency was evaluated with respect to the fitness of the cost drivers, creditability of the information on the cost, accuracy and precision on cost calculations and usefulness of the reporting followed for the costs [8].

3. Practical Application

The concept of the ABC can be applied to practical application to the two products (X and Y) that are being manufactured at one company facility [3]. Say product "X" which is a small volume commodity and will need some technology, analysis with testing activities and machinery for the production [3]. This can be compared to an much similar product "Y" which is essentially a fast running and have greater volumes and moves through flow line smoothly [3]. The company would adopt traditional approach the overhead would be all the machine working hours evenly allocated [3]. The product "Y" will have huge amount of machine hours and thus the overhead as compared to "X" since it has lower hours related to machine operations being a low volume [3]. So, essentially of the overhead is distributed to all the activities such as technology implementation, new machinery application or testing related works then the cost would evenly distribute to both products "X" and "Y" based on activity assigned [3].

The formula of obtaining the ABC is mentioned below (Stover, 2020):

$$ABC = \frac{Total\ cost\ of\ the\ Pool}{Driver\ related\ to\ the\ cost}$$

And allocation of the overheads is given by (Stover, 2020):

$$Overhead\ Allocated = (Activites\ Number)(Per\ Activity\ Cost)$$

4. Discussion on Electrical Equipment Manufacturing

The electrical equipment in power industry at distribution level are comprised of power transformers, overhead and underground power conductors, insulators, splice kits, connectors, fuses, circuit breakers, relays, panelboards, switchboards, motor control centers, safety switches, and many heavy electrical motors and equivalent protective equipment [10-12]. Large electrical systems as depicted in figure 1 shows breakdown of a commercial electrical system with switchboard, sub-panelboards, and service entrance safety switches and metering devices. As per table 1, the majority of electrical system consists of larger volume of power conductors thereby requiring manufacturing processes to utilize economies of scale to gain cost effectiveness at large scale. Many large scales copper and aluminium manufacturing involves utilization of not just economies of scale but also ABC.

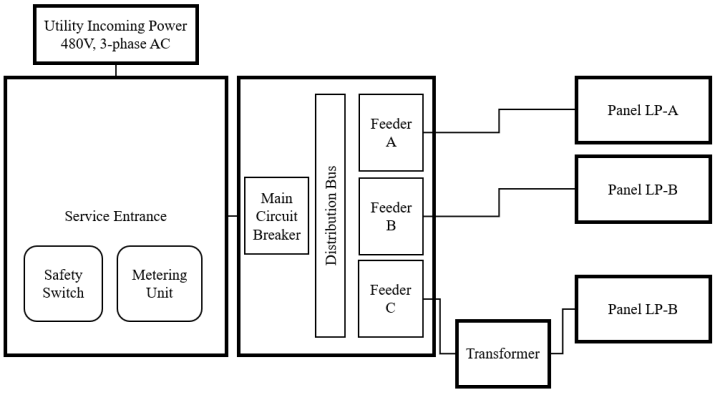
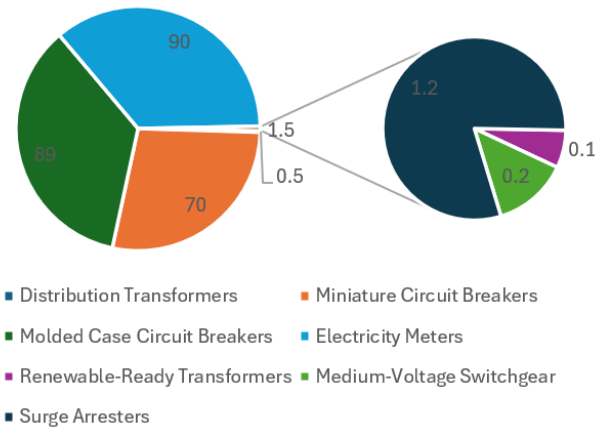


Figure 1. Power Distribution System

Table 1. Power Distribution System Components

Component Name	Estimated Annual Qty (Million Units)
Distribution Transformers	0.5
Miniature Circuit Breakers (MCB)	70
Molded Case Circuit Breakers (MCCB)	89
Electricity Meters (Smart Meters)	90
Renewable-Ready Transformers	0.1
Medium-Voltage Switchgear	0.2
Surge Arresters	1.2



The raw materials for both copper and aluminium conductors are not only the respective ores but also the insulation material. For example, the epoxy raisin utilized for coating the conductors are made of several ratings matching the requirements of international standards. For the copper conductors jacketing, figure 2 presented how the plastic pellets were moulded onto the cable to prepare a jacketed cable. The large circular runs of the conductors often require cooling before jacketed. Based on the types of conductors such as single or three core the types of rolling processes differ. However, for optimization of the process the economies of scale comes into picture. Both alumimum and copper conductors have similar process.

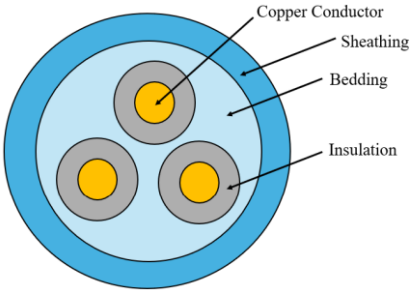


Figure 2. Conductor cross section (3-core cable)

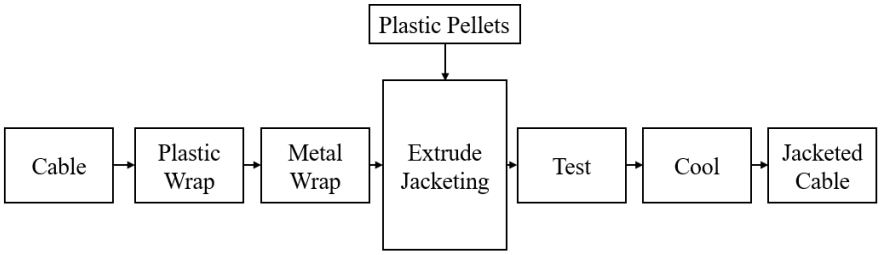


Figure 3. Manufacturing Jacketed Cable

Ansoff matrix is often known as market expansion grid, and it is defined as a tool for analysing and planning of the growth of the firm [13-15]. The matrix has namely four strategies which is mentioned as: market penetration, product development, market development and diversification. Let us consider a product such as mobile phones and analyse the Ansoff matrix for design strategies. The market penetration can be improved for the mobile phones by providing at low prices, by increased number of promotions and advertisements or by just merging other competitors. For instance, Facebook merged several social media platforms such as Instagram and WhatsApp. Similarly, for mobile phones some of the smaller firms can be merged into one giant company for increasing the production capacity and earn brand name from other companies. For instance, AT&T and BellSouth merged in 2007 and hence helped AT&T gain a significant market share. The advertisements on media networks such as TV and radio improves the reach to its customers. However, high promotion is expensive to have, and it can help with initial launch until it establishes itself as a brand image. Moreover, for cell phones price sensitive customers often look for more features in cheaper price and hence a reduced price with similar features as competitors such as camera quality, sound quality and visual display the market penetration can be significantly improved.

Product development phase is crucial phase wherein the firm establishes a new product line or new innovated product for meeting the rising customer need for change. This is often within the existing market of the customers that the company holds. The key areas involved expenditure in research and development of new product and services. For instance, a mobile phone company must understand the customer need for camera quality and then manufacture phone meeting the needs of the customers in terms of camera quality at affordable prices. But this involves a dedicated team

for carrying out R&D for market study and understand customer need and also to develop technology and innovation in new product development. Easier approach could be just merging a competitor which has a superior quality of products. For instance, Tata Motors acquired Jaguar, a luxury brand to offer the superior luxury cars to the customers. Also, formation of partnerships also helps in product development. For instance, Tesla jointly started business with Panasonic for manufacturing lithium-ion batteries for its electric cars. For mobile phones, a strategic merger could be with battery manufacturing companies for improving battery life or merging with camera manufacturing companies for improving the camera quality [14].

Market development of the product involves increasing the product penetration to a wide customer segment or multiple customer segments. This could either be achieved by introducing new products for each type of customer segment but with same brand name. For instance, young people will like features such as apps, camera quality and so on in their phones whereas old people may like easy to browse features with voice support features. Hence, a product development to cater these audience would help in increasing the company business and profits. The businesses can often expand globally and take advantage of the currency exchange value. Some of the multinational companies have manufacturing units in developing countries where land is cheap and so is the manpower. So, mobile phones can be manufactured in these countries but marketed globally and taken advantage of cheaper costs of manufacturing and increase the company profit.

Diversification is another strategy that is been followed by the companies in improving the customer base and company profitability. There are namely two types of diversification deployed: one that is related and the other that is nonrelated. Related strategy would include diversifying into similar product line such as for mobile phone it could be wireless handheld radios, wireless paging devices and so on. Unrelated strategies would include diversifying into electric fans making business. This could help reuse the brand image in marketing the new diversified product with is totally unrelated to the original product line.

5. Conclusion

The shortcomings of the traditional methodology in cost allocation were discussed for a manufacturing industry and the need for activity-based costing in improvement of the allocation of the costs was discussed with respect to accounting management. There is a significant improvement in defining the activities and then allocating the costs for the low vs high volume products and services. The formulas presented in this study were helpful in greater understanding to the readers in calculation of the activity-based costing for product “X” and “Y” and allocating the overheads to each activity for preparation of the accounting entries. Moreover, the advantages presented with this study for activity-based approach in simplification of the stages just limited two rather than four adopted in traditional approach is presented and discussed using the literature review available. A discussion on the electrical power distribution systems components manufacturing revealed that the various project management practices can lead to reduced costs and improved efficiencies in production. Based on the types of electrical equipment the majority of them fits into the conductors and insulators therefore requiring the focus to shift into these respective manufacturing processes.

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