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CASE STUDY

Building Cost Management: Case Study Using Costing Methods

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Abstract

There have been many significant changes in the construction sector recently: it is highly competitive market. In order to adapt to the new environment, it is important to improve the effectiveness of management for improved performance. Within the context, the objective of this analysis is to create a management tool according to the construction industry characteristics, specifically for buildings construction through the application of costing methods - Activity-based Costing, Production Effort Unit Method, Absorption Costing and Marginal Costing. This paper introduces the concept and defines steps within costing methods application, as well as proposing adaptation in order to apply them for construction and discussing the analysis of methods. Finally, after practical application based on case study, this paper provides as result, Activity-based costing and Marginal methods are appropriate for the application proposed.

Keywords: *Construction, Costs, Costing methods.*

Introduction

Competition in the construction sector is very strong. After Great Recession, the economic outlook calls for continued slow growth in several countries, some construction companies have gone away; most have just gotten leaner in order to survive a highly competitive, tight market [1]. It is important to research about cost reductions in construction industry and deployment financial management tools. Within the context, the goal is to develop a management tool. This is a study case; it presents four applied methods - ABC costing, Production Effort Unit Method, Absorption Costing and Marginal Costing - for a building, (four floors, with apartments and office space). Paper proposes adjustment for adapting methods for Construction and results. Firstly, it defines steps within costing methods application.

Costing Methods

Absorption Costing

Procedure called absorption or full costing, it is costing system, which treat all costs including fixed and variable costs as product cost. To calculate it, it is needed to identify the direct costs (direct materials, direct labor) and the indirect costs (indirect materials, indirect labor and indirect expenses). Direct costs are those costs that can be directly identified with a product. Indirect costs cannot be directly identified with a specific cost unit or cost center. The allocation of the overheads (indirect costs) was not as precise, but the absorption school advocated and promoted the use of supplementary managerial tools [2]. Cost allocation is the process by which overhead costs are charged directly to a cost center. Cost apportionment is the process of splitting a common cost between two or more costs centers in proportion to the estimated benefits received. Implementation steps:

- Identification of cost centers and apportion all overheads to cost center.It involves the allocation and apportionment of overhead costs to each cost center identified.

- Identify the support or service cost centers, and re-apportion the costs of these to the cost centers involved in producing the products or services. There are departments, as administration, which cannot be related to any income producing activity. To find the full cost of a cost unit these department costs should also be absorbed into the unit cost.

- Calculate the overhead absorption rate (OAR) for each cost center involved in producing products, using the most appropriate base. The calculation of an overhead absorption rate requires two variables: The total overhead attributable to a cost center by the absorption base.

- Use the OAR to establish the overhead cost per unit.

Marginal Costing

Marginal Costing may defined as the ascertainment by differentiating between fixed cost and variable cost of marginal cost and of the effect on profit of changes in volume or type of output [3]. The accounting system in which variable costs are charged to cost units and fixed costs of the period are written off in full against the aggregate contribution. Its special value is in recognizing cost behavior, and hence assisting in decision-making. It is a costing system, which treat only the variable cost as product cost. The fixed overheads are regarded as period cost. Costing method separates fixed costs and variable costs. It determines the contribution that each product brings the company but does not reach a value of the product cost. Steps for application:

- Separating the fixed costs and variables costs;
- Allocating variable costs in the products;
- Calculating the contribution margin of product;
- The total contribution margin for the company subtracts fixed costs, resulting in profit.

The contribution margin per unit generated by the difference between the selling price of the product and variable cost associated with each product .The contribution that each unit brings to the company to cover fixed costs and generate profit. The index is as an indicator of the viability of production of the product when positive: viable: if negative: unfeasible.

Activity-based Cost

Activity-based costing (ABC) is a relatively new approach in full absorption costing. This latest approach allocates overhead costs more fairly[4]. While ABC system are rather complex and costly, all industries are adopting ABC system [5]. ABC application process was to define the following steps [4]:

- Identify activities and identify the company's processes, activities and tasks, and create process flowcharts.
- Assign resource costs to activities: determine cost drivers for each activity and use output measures to calculate activity recovery rates.
- Trace all secondary activities to primary activities, so that the combined activity rates include all support costs.
- Identify which cost objects are to be priced.
- Multiply the activity recovery rates by the quantity of output consumed as specified in the bill of activities.
- Direct costs and non-traceable costs should be added to the cost to give the total cost of the cost object.

Production Effort Unit Method

This method creates a common measure throughout the production process which can it be used in all costing, planning and comparison activities [6]. As well as Georges Perrin method uses for enterprise's activity measuring and costs determination a nonmonetary unit measure, represented by an index, an equivalent, a characteristic number etc.[7]. This costing method aims to transform a company that produces various products in a company that produce one, simplifying the physical and monetary control. The unification of the production done by the notion of production effort, transformed into a homogeneous unity, Production Effort Unit Method (PEU) or UVA means *Unités de Valeur Ajoutée* – Value Added Unit. The method provides a measure all products in a unit in which their sum represents the total produced by the company. Therefore, according Levant and La Villarmois [7] the method consists in a precise examination of each expense item and of each operation. An inventory taken of the different expense items and basic work operations. A basic operation corresponds to a workstation or to part of a workstation, whose costs can be spread over the production processes or manufactured items. Methods phases[8].

- Inventory and defining an entity for value measure. An enterprise is formed of labor posts, that represent an assembly of material and human means that suppose resources consumption. A UVA post represents a labor post that functions with precise determined resources consumption.
- UVA posts evaluation in units. Each UVA post will be expressed in units by comparison with the reference post expressed in monetary unit, respectively by comparing direct consumed resources UVA post will be.
- Resources evaluation. In this phase, the whole of enterprise's resources should be allocated to labor posts, separating the expenses in expenses with material, equipment, maintenance, staff expenses, material base usage expenses etc. For

every separate post will be established a normal activity volume, it resides that to each post a direct resources consumption on assignation unit will revert, named post rate.

- UVA posts cost will be determined in value added unit. The value added unit represents the resources consumption necessary for a post/process/product chosen as representative for the entire activity of the enterprise. This representative post/process/product is considered as basis rate. The sum between post rate of every posed used by UVA and post usage time allows the UVA operation manner evaluation. From here, the UVA post index can be established as report between its resources consumption and the one of base process (post rate/basis rate).

Adjustment Proposed for Adapting Methods for Construction

Methods were applied on the study object based on theoretical framework of costing methods. The study object is a building using traditional construction methods in Brazil (concrete), four floors, three apartments with three dorms and three apartments with two dorms, and office space located on the ground floor of the building. The considerations resulting from these applications more broadly conclusions about how each method fits the application in construction. The applications of the methods of costing incur in the recognition and classification of costs for centers.

- Cost Center Support: human resources, planning, scheduling and control, related to the maintenance of property services.

- Production Cost Center: the process steps of production, in this case: foundations, walls, window frames, flooring, floors …

- Cost Center Management financial and management cost.

- Cost Center Commercial: includes sales and product shipment.

Considering the objective of develop a management tool adapting for construction industry, specifically buildings. Management, commercial and support cost centers vary widely, depending on the company structure, they were disregarded in the calculation. Thus, it is clarified that the focus is to manage the costs of production; the construction of the building in order to measure them correctly, apportioning fixed costs respecting parameters, and finally recognizing the real cost of each product (the cost of each apartment, commercial space).Overheads in order industries tend be much higher than those in construction is relatively high. For this reason, careful management of direct cost is critical to success [9]. The following items were considered as indirect costs: overheads with process management, financial, maintenance cost, depreciation, operation and replacement and commercial cost. Besides items above, many authors in order to facilitate the calculation considered direct cost as indirect costs. According to Jungles and Avila [10] spending on paint, bathroom fixtures, windows and frames were completely classified as indirect costs. Surely, this classification is an error; it is possible to discern how much material spent in each apartment or office space in the building. Therefore, this paper proposes a different classification about direct and indirect costs, not the usual. Paper proposes using material as indirect cost in common use area. Following the same logic, it is known that facilities infrastructure and superstructure, as well as plumbing, electrical and other items that appear in the budget, as fixed costs are direct costs. However, they must be considered indirect cost, considering proration among the products of building.

In relation to the accounts plan, the structure that divides known costs:

- Equity: includes costs related to depreciation, property tax, property and vehicle insuranc

- Staffing: salaries, overtime, vacation, compensated vacation, paid training, food, transportation and all taxes and employee benefits about staffing (24 items based on Brazilian law).

- Administrative: expenses notary, mail, newspapers, magazines, taxes, social contributions, fines, advertisements, gifts, travel expenses and food, rent.

- Outsource service: labor, maintenance equipment, infrastructure, electricity, water, internet, consulting, auditing and fines.

- Overheads: spare parts of machinery and equipment.

The price database used for the cost of materials, labor and equipment, is based on Composition Table Prices for Budgets (TCPO - reference in construction price in Brazil). Finally, in order to develop the rates, when the costing method indicated an arbitrary choice, it is used NBR

12521:1991 (Brazilian standard), as it established criterion of proportionality: calculating the ratio equivalent to the area of total cost of stand-alone unit by area of the total cost of building area. The unit consists of dependencies and installations for private use and share dependencies and common use facilities of the building. The division of the land area follows the same rule.

Analysis of Methods

Absorption Costing

Absorption method by cost centers required support center information for the redistribution of costs, which made it unfeasible to apply completely. As one of the goals is to reach the amount invested in the construction of each property (each apartment and office space), the structure of the building (beams, slab, columns) and the amount spent for common use areas, was considered fixed so they could be redistributed. Thus, this redistribution occurred according parameters - respecting criteria of a widely used management tool: square meter built would become parameter for apportionment of fixed costs. Based on this parameters it is approached all costs involved in the production process, without this adaptation all cost are not considered. Even after adaptation without center of support, results are not coherent. Interesting factor is that it considers several products and proration of indirect costs could be added to the cost of each product. Therefore, it becomes valid considering structure and costs common area as fixed costs. Finally, it should be clarified that absorption method by cost centers was not performed because it is based in the center of support and the proposal is to create just the production center via market prices, other items vary with the structure of each company

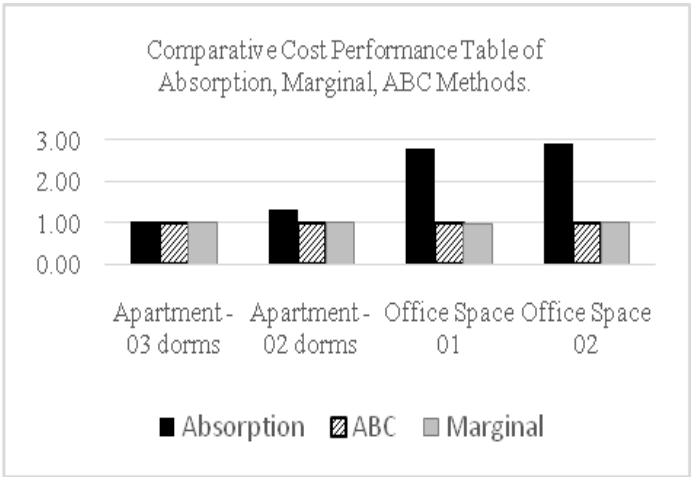
Production Effort Unit Method

The UEP costing is difficult to apply in construction. The problem of adaptation is at the core of theory; standard time is related to the activities (productive efforts). There are exogenous factors that may change the schedule by activity, or in sequential order of activities in construction. There is also difficulty in seeking another parameter that replaces the time. Therefore, it becomes difficult to create a unit of effort.

Activity-based Cost

This method has its methodology based on the proration of indirect costs, assigning costs to activities and then allocate activity costs to the products. Results of applied method : relevant management information was involved; Less need for arbitrary proration, compared with other methods; Identifies where and which the items are consuming more resources; Identifies the cost of each activity in relation to the total costs of the entity; Non-value adding activities more visible, allowing managers to reduce or eliminate them.

Comparing an apartment and office space, the first property area is almost double the second, but variable costs are quite close. Through this analysis, it can be confirm that when analyzing a property for built area, common practice, the manager get a wrong result. The ABC costing method is easy to apply. Considering the intended purpose of identifying cost per product and redistribution of fixed costs among products, this method is efficient.



Marginal Method

The marginal costing is easy to apply to the construction, specifically for cost management in buildings. During the analysis, because of the peculiarities of construction, it is possible to note that different properties (apartments and office space) use the same structure, therefore the structure must be considered as a fixed cost. Moreover, it can be a sign that when indirect costs are calculated composition of the unit cost of each product, it allows the manager know how much each product and / or service contributed to the outcome of the entity through the contribution margin of each product. It allows evaluate the result of each individual unit.

Conclusion

Selecting appropriate method according to company activity is important in order to get a best manager tool. Considering UEP's costing applied on construction activity, the method runs into a problem that is the core of your application: "standard time". Time to relate cost is quite subjective in construction. Therefore, the UPE's cost method is impracticable in construction. Considering Absorption Costing, ABC costing and Marginal method, there is little variation between

the costs of the apartments. About the office space, there is a significant discrepancy between the costs allocated to the Absorption method in relation to others. Absorption method reaches a value almost three times higher. The adapted form makes the sum of the estimated cost exceeds the cost, which would be an inconsistency. No adaptation, the sum of the calculated costs are lower than the total cost. Therefore, method does not integrate completely fixed cost to product cost, thereby it is not efficient The ABC and Marginal methods are easier to apply for construction. The result of allocated costs for each property was very similar for both methods, variation are around 1%. Therefore, this paper concludes that the ABC costing and Marginal costing are the most appropriate methods for cost management in construction. Through these methods easily identifies the cost centers and more costly activities. It opens up the possibility of the company to seek alternative techniques to reduce costs. This paper proposed innovation about costs in construction. It proposed a new classification, all inputs used in common areas and infrastructure and superstructure are classified as fixed cost. Thus, costs are redistributed and results in coherent cost for each property of the building. In other words, it allocates costs that were actually spent effectively, thus contradicting the traditional method of market, which estimate the property value based on built area.

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