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Detailed Budget, the Key to Project Management

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Abstract- The situation of Brazil's economy in recent years has required that construction companies look for management tools in order to endure in current circumstances. Part of a company's success is based on cost management. The goal of this article is to present a broad vision of the importance of formulating a detailed budget, oriented by scientific literature and by experiences in the building sector. In order to explain the planning and controlling phases of a project, it is proposed the use of systems, tools and techniques produced in the making of a detailed budget. The main methodological procedures adopted were data collecting, field observation, bibliographic research and the analysis of detailed budget related documents. Therefore, this is an exploratory and qualitative research, in which a practical and simplified model, with the main processes generated in the development of an analytical budget, is presented. The results show that in utilizing these processes, uncertainty in decision making is reduced, strategies are improved and there is material for better planning, which increases the chances for a company to achieve its goals and beat competition.

Keywords-*Budget, Costs, Planning, Management*

I. INTRODUCTION

The economic and political crisis that has been striking Brazil in recent years makes up for a terrible scenario for the building sector companies. The lack of governmental and private investments rendered scarce opportunities and a more intense competition, forcing entrepreneurs to adopt measures to make their companies stand out, like focusing on knowledge, techniques and tools related to construction planning in order to have a safe enterprise management.

A detailed and coherent budget provides a constructor with many advantages - it guarantees the achievement of expected results, anticipates the necessary costs of implementing the business, allows efficient decision making and putting together an adequate team, besides controlling material consumption. An inefficient budget can provide incomplete information and generate big losses to companies.

According to Segundo, the price proposed by a constructor, in order to be competitive, shall not be so low to the point that it doesn't generate profit, nor so high that it cannot be competitive in the market. Thus, a detailed analytical budget must be very coherent, and making one requires experience and sober judgment.

The budget will allow the enterprise's economic feasibility to be analyzed, and thus all materials, services and all necessary manpower in each step of the construction will be identified, as asserted by [2]. The elaboration of a schedule allows a systematic inspection of the enterprise's occurrences.

Thereby, every time a budget is not correctly made, there will be unavoidable imprecision and possible costs and deadlines frustrations. Efficient budgeting is one of the fundamental factors for lucrative results and a constructor's success. A detailed budget, along with a physical financial schedule assists future expenditures predictions and decision making.

The purpose of this research is to present, through a simple and practical project model, the systems, processes, tools and techniques that emerge from detail budgeting in the building sector; and present the sequential advantages as key to a good project management.

The current economic scenario pushes company to resort to techniques and knowledge in order to overcome obstacles, which justifies the budgeting and control methodology implementation.

All systems, processes, tools and techniques that come out of a budget development will be presented, including the project study, the analysis of technical documents, service contracting, productivity index analysis of operational teams, material consumption, direct and indirect costs, taxes, profit, input histogram, ABC input curve and the physical-financial schedule.

It is emphasized that planning and monitoring projects require a well elaborated budget, because it influences managers' actions in achieving organizational goals. Therefore, the companies that adopt such measures will present a competitive advantage in relation to the others.

A. Analytical budget

Elaborating an analytical budget well is the more precise way to predict the costs of a construction work. There is the scope decomposition into service packages, chronologically organized; the costs composition and the extensive research of input prices. Based on that, it is possible to predict all materials and services needed, anticipate the necessary labor, elaborate the construction

execution schedule, as well as the physical financial schedule, which will allow the monitoring and systematic control of input, time and cost.

The budget must include all services to be executed, taking into consideration the project's quantitative data and the unitary cost of each service, the social laws and complementary custom, presented in table [5].

B. Technical documentation analysis

In order to initiate the budgeting process, the technical documentation, which is composed by the following, must be analyzed: project specifications, as well as the technical specification and the bidding notice. In order to extract all the elements from the project - the technical particularities, the practices and procedures, the material choosing criteria, the technological tests, the dimensional tolerance, the quality, the prices, sanctions, measuring criteria, payment and readjustments - the technical documentation analysis is fundamental.

C. Services identification

Identifying the necessary services is directly related to the concept of Work Breakdown Structure (WBS), through which will occur the subdivision of the project's works into more easily manageable components, and thus the division of the project in a chronological structure.

It is very important that all services and quantitative data be identified so that no difficulties occur during the project's execution, since a poorly defined scope results in unsatisfied clients. Description and quantification of services and materials help the constructor plan purchases, identify suppliers, study payment methods and executive methodologies.

Table I represents the identification of the proposed model project quantitative (200 m² of masonry sealing).

TABLE I. QUANTITIES

Item	Input Description	Unity	Amount
1	Wall	m²	200
1.1	Masonry	m²	200
1.2	Coarse mortar	m²	400
1.3	Plaster	m²	400
1.4	Painting	m²	400

D. Unitary costs composition

The composition of unitary costs corresponds to the process of establishing costs for services or activities' executions, listing all inputs included in said executions, covering quantities, unitary and total costs.

According to [5], the composition of unitary costs can be defined by the material quantity needed and equipment and personnel hours spent in each unit's execution, respectively multiplied by the material cost, by the equipments' rent time and by worker's hourly wage (plus social charges).

In its elaboration, besides the budget planner's experience and practical knowledge, auxiliary composition tables must be used as initial reference: TCPO (table of price composition for budgeting), SICRO (the national terrestrial infrastructure projects referential system), SINAP (national research system of index and costs of Caixa Economica Federal's building sector), SETOP (Minas Gerais transports and public buildings secretary), among others, so that the planner is able to compare productivity data with the information they collect.

Based on the index of labor, equipments and materials index, a constructor can compare the budget predictions and what is effectively taking place, which works as a control, monitoring and performance tool for the involved teams.

As stated by [5], even though there are fixed indexes, some items can vary according to location, company, and also depending on factors such as local culture or bad habits, training, supervision and even motivation. Because of these factors, the possibility of creating a variable productivity index is being studied.

Companies must develop its own cost compositions through observing its team's field productivity, which enables the identification of indexes that represent reality. The cost composition table must include the technically specified materials and the prices quoted from the suppliers. In relation to labor, the category's basic wage table must be consulted, and all social and complementary charges shall be included.

Table II presents the unitary cost composition for the 200 m² masonry sealing project model in June 2018 ($ 1,00 US Dollar = R$3,83 Brazilian Real).

E. Direct Costs

Direct costs are the ones connected to the services that one intends to execute, including costs with inputs, labor, equipments and the supporting infrastructure needed in order to make the construction happen [5].

The evaluation obtained from the project's predicted quantities is directly connected to the executed service [7].

[8] Describes direct cost as the consequence of the sum of all unitary costs of the construction's fundamental services, acquired by applying input consumption over the market price, multiplied by their respective quantities, plus the costs of needed infrastructure.

Table III presents the direct costs for the proposed model (200 m² of masonry sealing).

TABLE II. UNITARY COSTS COMPOSITION

Masonry						
Quantity: 200,00 m²						
Input description	Unit	Unitary cost	TCPO index	Total cost	Quantity in budget	Cost in budget
Mortar	m³	49,64	0,015	0,75	200	148,92
Bricklayer	h	2,85	0,72	2,05	200	410,85
Assistant	h	1,86	0,72	1,34	200	268,27
Brick	un	0,16	17	2,74	200	549,26
Total						$ 1.377,30
Unitary price						$ 6,89
Coarse Mortar						
Quantity: 400,00 m²						
Input description	Unit	Unitary Cost	TCPO index	Total Cost	Quantity in budget	Cost in budget
Mortar	m³	74,99	0,005	0,38	400	149,98
Bricklayer	h	2,85	0,12	0,34	400	136,95
Assistant	h	1,86	0,12	0,22	400	89,42
Total						$ 376,36
Unitary price						$ 0,94
Plaster						
Quantity: 400,00 m²						
Input description	Unit	Unitary Cost	TCPO Index	Total Cost	Quantity in budget	Cost in budget
Mortar	m³	49,64	0,022	0,75	400	436,82
Bricklayer	h	2,85	0,75	2,05	400	855,94
Assistant	h	1,86	0,75	1,34	400	558,90
Total						$ 1.851,66
Unitary price						$ 4,63
Painting						
Quantidade: 400,00 m²						
Input description	Unit	Unitary cost	TCPO Index	Total cost	Quantity in budget	Cost in budget
Assistant	h	1,86	0,25	0,47	400	186,30
Painter	h	2,85	0,3	0,86	400	342,38
Sandpaper	un	0,11	0,21	0,02	400	8,97
Paint	l	2,80	0,17	0,47	400	190,11
Total						$ 727,76
Unitary price						$ 1,82

TABLE III. DIRECT COSTS

Item	Description	Unit	Quant.	Unitary Cost	Total Cost
1	Parede				
1.1	Masonry	m²	200	6,89	1377,30
1.2	Coarse mortar	m²	400	0,94	376,36
1.3	Plaster	m²	400	4,63	1851,66
1.4	Paint	m²	400	1,82	727,76
Total					$ 4.333,08

F. Custos Indiretos

The indirect costs correspond to those that are not directly connected to the field, but are essential for the project's success, such as: technical and administrative teams, mobilization, demobilization, equipments, tools, housing, office, general expenses, and construction site [1]. For [3], a cost is indirect when it is not considered direct.

Table IV presents a table of indirect costs for the proposed project model (200 m² of masonry sealing).

TABLE IV. INDIRECT COSTS

Number	Item	Unit	Quant.	Unitary Cost	Total Cost
1	Technical and administrative team	Vb.	1	911,96	911,96
2	Administrative equipment	Vb.	1	52,11	52,11
3	Construction equipments	Vb.	1	52,11	52,11
4	Tool	Vb.	1	130,28	130,28
5	Construction site	Vb.	1	260,56	260,56
6	Other	Vb.	1	260,56	260,56
Total					$ 1.537,30

G. Central administration and cost assessment

Usually, constructors have a headquarter, where the administrative work and the general directing of the company take place, and where the costs are apportioned among projects. According to [3], the valued assigned to the central administration is between 2 to 5% of the project's cost (over direct plus indirect costs). It is easy to notice that the bigger the central administration's rate, the less competitive is the company.

H. Contigencies

Even an extremely detailed budget cannot predict all chance occurrences that can take place during the life cycle of a construction. The considered percentage for contingencies will vary according to the type of contract and experience of the constructor in that field. According to [3], the usual applied percentage varies between 1 to 3% of the project's cost (direct plus indirect).

I. Financial cost

When contracts determine that the company must use its own resources in the project, the percentage of financial expenses must be calculated, as if the resource was applied in the financial institution with yield appointed by CDB (bank deposit certification), with a 1% monthly rate, over direct plus indirect costs. This happens because between the final measurement day and the project's revenue, there may be a 30 to 90-day space of time.

Table 5 presents the accessory costs for the proposed model (200 m² of masonry sealing).

TABLE V. ACCESSORY COSTS

Custos acessórios	%	Observation	Cost
Central administration	2,00%	Small company	117,41
Financial expenses	2,00%	1% (CDB) per month and 60 days to receive	117,41
Contigencies	1,00%	Company has expertise in executing the contracted services	58,70
Total	$ 293,52		

J. Taxes

Taxes charged over materials and labor were already taken into consideration in direct costs, but there are federal, state and municipal taxes like COFINS (contribution for financing social security), PIS (social integration project), ISSQN (taxes over services of any nature), CSLL (social contribution over net profit), IRPJ (corporate income tax), among others. For the proposed model, we will consider the company's regime as taxation of real profit, and we will consider that the construction takes place in Belo Horizonte, Minas Gerais, Brazil. IRPJ and CSLL will take effect on real profit and, for calculating purposes, this value will be included in this phase of budgeting.

Table VI presents the summary of taxes and table VII presents the taxes adopted for the proposed model (200 m² of masonry sealing).

TABLE VI. TAXES SUMMARY

Tax	Competence	Tax regime	
		Real profit	Presumed profit
COFINS	Federal	3,0% over selling price	3,0% over selling price
PIS	Federal	0,65% over selling price	0,65% over selling price
ISSQN	Municipal	Municipal aliquat varies from 3,0% to 5,0%	Municipal aliquat varies from 3,0% to 5,0%
IRPJ	Federal	15% over real profit(if <$5.211,20 per month) 25% over real profit (if> $5.211,20 per month)	1,2% over selling price
CSLL	Federal	9,0% over real profit	1,08% over selling price

Source: Adapted Mattos 2006

TABLE VII. ADOPTED TAXES FOR PROPOSED MODEL

Tax	Aliquat
COFINS	3,00%
PIS	0,65%
ISSQN	5,00%
Total	8,65%

K. Profit

The definition of profit is influenced by many conditions related to competitiveness, risks, complexity, economy, necessity of taking the project, getting clients, entering new markets, signing new contracts and as stated by [3], in normal conditions, its percentage varies from 5 to 20%.

The current model considers that the company is under a real taxation regime (real profit < $5.211,20 per month), and that it is looking to have an 8% net profit with the project.

The calculations below represent the net profit transformation with IRPJ and CSLL taxes, to obtain the operational profit, which will be included in the budget.

$$OP = \frac{NP}{(1-CIT-SCNP} = \frac{8{,}0\%}{(1-0{,}15-0{,}09)} = \frac{8{,}0\%}{0{,}76} = 10{,}5\%$$

Where:

OP = Operational profit

NP = Net profit

CIT= Corporate income tax

SCNP = Social contribution over net profit

Therefore, in order to get an 8% net profit, the operational profit must be 10,5%.

L. Selling price calculus

According to [3], the selling price corresponds to the total value agreed in the contract, value which incorporates all costs, profits and taxes, and matches the final value in the budget.

Costs include:

Direct costs

Indirect costs

Accessory costs

As stated by [3], there is the following equation:

$$PV = \frac{CUSTO}{1-i\%} = \frac{CD+CI+AC+CF+IC}{1-(LO\%+IMP\%)}$$

$$PV = \frac{4.333{,}08+1.537{,}30+293{,}52}{1-(10{,}5\%+8{,}65\%)} = \$6.163{,}86$$

SP: selling price in $

DC: direct cost

IC: indirect cost

CA: central administration in $

FC: financial cost in $

C: contingencies in $

OP%: operational profit in %

T%: taxes in %

M. Selling price calculation

In practical terms, BDI is the multiplier (in percentage) that must be applied on the direct cost of the items listed in the project's items table, in order to obtain the selling price, and the following formula must be used:

$$BDI = \frac{PV}{CD} - 1 = \frac{6.163{,}86}{4.333{,}08} - 1 = 0{,}4225 = 42{,}25\%$$

In which:

BIE: bonus plus indirect expenses in %;

SP: selling price in $;

DC: direct cost in $.

The selling cost of each service will correspond to its direct cost increased in 42,25%. This percentage represents the effect of indirect expenses, central administration, financial costs, contingencies, profits and taxes on the direct cost of the service.

Table VIII presents the price table for the presented project model (200 m² of masonry sealing).

TABLE VIII. SEILLING PRICE

Item	Description	Unit	Quant	Unitary Cost	BDI	Unitary Price	Total price
1	Wall						
1.1	Masonry	m²	200	6,89	42,25%	9,80	1.959,22
1.2	Coarse mortar	m²	400	0,94	42,25%	1,34	535,37
1.3	Plaster	m²	400	4,63	42,25%	6,58	2.634,01
1.4	Paint	m²	400	1,82	42,25%	2,59	1.035,25
Total							$ 6.163,86

II. HISTOGRAMS AND RESOURCES

The resources histogram graphically portrays the labor, materials and equipments distributed during the duration of the construction, and is used by the purchase and human resources departments in acquisition planning, and also in hiring and dismissing.

Figure 1 presents the resources histogram for the presented project model (200 m² of masonry sealing) considering the 10 business day deadline for its completion.

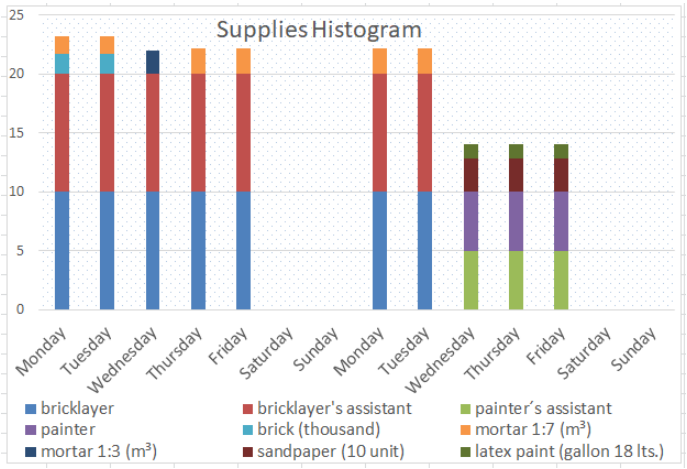

Figure 1. Supplies Histogram

III. ABC INPUT CURVE

The ABC input curve is an extremely important tool for the professional that is responsible for managing the project's execution, because it indicates the total inputs that will be used, pointing key items so that proper focus and attention be directed towards them.

The name curve comes from the drawing traced in the graphic, which represents the accumulated percentage of each input in the final cost of the construction. The ABC curve, though, is more commonly presented in a tabular form.

Figure 2 presents the ABC input curve in the graphic form for the presented project model (200 m² of masonry sealing).

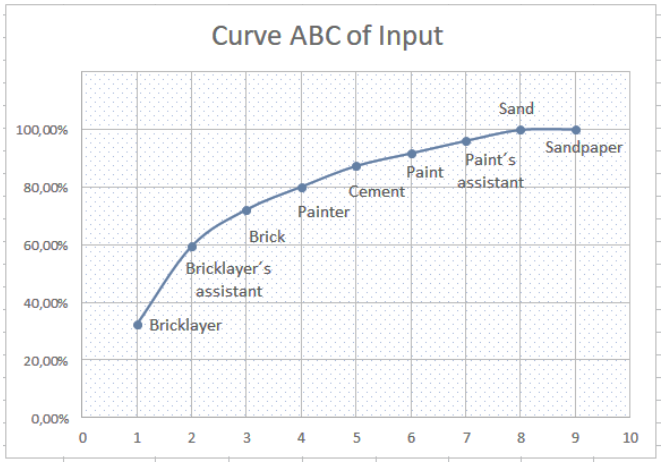

Figure 2. Curve ABC de Input

IV. PHYSICAL-FINANCIAL SCHEDULE

The physical-financial schedule visually represents the order of the activities to be carried out and the values that will be spend during each stage. This order, if properly planned, allows the constructor to purchase materials or hire personnel and equipments in the most correct moment.

The physical-financial schedule is a graphic representation of a project's execution, and indicates activities' deadlines, logically demonstrating those deadlines in order to guarantee that the project be finished in accordance to the previously established conditions.

A schedule development is an interactive process that involves the analysis of the activities' sequence, the activities' duration and the resources, in order to determine the starting and finishing date of each activity.

Projects, in their majority, have start and finishing dates previously defined, and it is the planner's responsibility to distribute tasks with their resources already determined, in order to meet the construction's deadline, utilizing the composition of unitary prices and productivity index as data base.

Figure III presents the physical-financial schedule form for the presented project model (200 m² of masonry sealing).

Item	Description	Total Partial	%	M	T	W	T	F	S	S	M	T	W	T	F	S	S
1.1	Masonry	1.963,26	31,79%	981,63	981,63												
1.2	Roughcast	536,48	8,69%			536,48											
1.3	Plaster	2.639,43	42,73%				659,86	659,86			659,86	659,86					
1.4	Paint	1.037,39	16,80%										345,80	345,80	345,80		
Total		6.176,55	100,00%	981,63	981,63	536,48	659,86	659,86	0	0	659,86	659,86	345,80	345,80	345,80		
Accumulated Value				981,63	1.963,26	2.499,73	3.159,59	3.819,45	3.819,45	3.819,45	4.479,31	5.139,17	5.484,96	5.830,76	6.176,55		
Accumulated Percentage				15,89%	31,79%	40,47%	51,15%	61,84%	61,84%	61,84%	72,52%	83,20%	88,80%	94,40%	100,00%		

Figure 3. Physical-financial schedule

V. METHODOLOGY

Applying the detailed budget used in civil construction, plus construction planning and monitoring. It is intended to present a simplified model with a budget making script that can be used as a base for the feasibility study, and also for planning and monitoring all stages of the project.

Exploratory research allowed familiarity with the topic through literature, and allowed the use of a simplified model, that exemplifies the applicability of a detailed budget's results in planning, monitoring and controlling civil construction projects.

VI. FINAL CONSIDERATIONS

An efficient cost management aims at maximizing resources and profits, and minimizing costs, which is the main competitive strategy for companies to get more projects and stay in the market.

It is very important to constantly strive for cost reduction while executing all services at once, considering that the budget is the first step to planning and also an indispensable control and management tool.

Thus, it is possible to conclude that detailed budgeting is fundamental, and can be considered the key to efficient civil projects management. It must be made before the beginning of the construction so that results can be predicted, contributing to planning, monitoring and managing all stages of the project.

Finally, the implementation and use of the proposed model can be considered as relatively simple, and this is a model through which it is possible to better the civil construction's planning and cost control system. However, it requires that the company adapts to the organization of cost management processes that shall interact with different sectors of the construction company. Presenting the model in this research was an attempt to show a way though which companies are able to plan and control the cost of projects over time, considering an uncertain, complex and highly dynamic context. It is the key to good project management.

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