

Cost Control and Budget's Errors Minimized in Construction with Use of Softwares

Raphael Lúcio Reis dos Santos¹, Rogério Cabral de Azevedo², Conrado de Souza Rodrigues³ and Vinícius Antônio Florentino Camargo⁴

^{1,2,3}Centro Federal de Educação Tecnológica de Minas Gerais (CEFET-MG)

⁴Universidade Federal de Minas Gerais (UFMG)

¹raphaelreisantos@hotmail.com

Abstract– The aim of this paper is identify and list the most common errors in budgets and cost control in construction, as well as assessing how the use of specific software for the cost estimating process helps to minimize these errors. It is an exploratory research study based on a case study for the implementation of the budget's software in a Brazilian construction company. The literature review discusses the concept for budgeting in the projects, the most frequent errors and the use of specific software for budget and cost control in construction. The developed case study describes, through verbal interviews with professionals, the main trivial errors that occurred in budgets. It comparative study between budgets performed before and after the implementation of the program, identifying the factors that cause errors, in order to verify that the use of specific software for budget contributed to eliminate or minimize the budgeting errors and cost control.

Keywords– Budget and Cost Control, Cost Estimating Process Softwares, Errors in Budgets Minimizing Errors in Budgets and Use of Technology in Construction

I. INTRODUCTION

According to [1], the construction industry is one of the most deficient in the use of new technologies. However, due to the expansion of the information technology sector, the number of companies seeking computational tools to improve and automate their processes has been growing in recent years [2].

The construction management processes (planning, budgeting and cost control) of the civil construction sector have been improved with the use of computational tools developed specifically for these purposes [3].

According to [4], the elaboration of budgets through softwares, in general, boosted the budgeting process in construction. With the use of the same it is possible to integrate the whole company during the process, facilitating the exchange of information and the decision making. In addition, with the database generated with each new budget made, the company will have up-to-date and reliable information.

In order to contribute to this evolving context, it is hoped

that this article will help in the knowledge of the common mistakes made to the budgets made without the use of specific software for this purpose and in the understanding of how the programs can be used to reduce errors in budgets in construction projects.

II. BIBLIOGRAPHIC REFERENCE

A) *Enterprises in the construction*

Enterprises in the construction sector present singularities, since each product represents a new project, terrain and study [5]. According to [6], the enterprise encompasses four stages in its life cycle: design, planning, implementation and finalization.

The improvement of the life cycle processes of the ventures can be obtained through the development of a general plan, which defines the main activities to be carried out, their precedence relations, the roles and responsibilities of the process participants, the flow information tools and feedback tools within the process [7].

[8] states that such structuring should enable the integration and interconnection of information, bringing greater reliability and usability to the budget to control costs.

B) *Budget concept*

Budget is the division of the work into services that, well characterized, generate a cost. The total cost of the work is the result of the sum of the costs of these services [9].

According to [10], the budget should be well executed and based on criteria, rules, rules and the use of reliable information; (labor costs, materials and equipment), indirect costs (supervision and support teams, construction site expenses and fees) and sale price (taxes and operating profit) added to direct and indirect costs).

[11] lists the activities obtained through the budgeting process: list materials and services used; analyze financial feasibility, as well as elaborate physical-financial schedule of the work; to systematically monitor the application of the inputs in each service and to issue a labor histogram for each activity.

TABLE I
MAIN CAUSES OF BUDGET INEFFICIENCIES

Item	Description	Causes
1	Absence of detail of items	The lack of description and detailing for the services regarding the errors provoke and can generate duplicity of items in the budgeting process [15]. According to [10], it is necessary to perform an activity of describing the items contemplated in the exercise of a work, since it explains the materials, a workforce to be used and as solutions adopted in the project.
2	Budgeting with incomplete data	[10] argues that in large part of companies, the education sector is overwhelmed due to the large number of projects, contributing to the study and analysis of incorrect projects. [13] Complement of omission of information and data of projects collaborates for errors in budget.
3	Difficulty in updating data (composition indices and prices of inputs)	It is emphasized that dossiers are related to the information generated throughout the design process that often as the sources needed for the process are not informed at the appropriate time, and the fact occurs over time as all steps of the project [7]. According to [12], large companies have indexes and compositions of magazines in magazines and specialized websites, and they may not be consistent with the value, leaving the budget differing with reality. Larger companies may err with the error of using existing data.
4	Access to budget updates for various business sectors	The sectors of a company, such as purchases, budget, investment and supplies, must be in the process of projects to obtain the results: greater predictability of the work; possibility of meeting deadlines; more effective control of the work, materials and activities; administration of the purchase of materials and hiring of labor; greater possibility of evaluation of the constructive methods; support for decision making [12].
5	Errors in the quantitative survey	The raising of amounts, besides being subject to human error and propagating inaccuracies, is also time-consuming and may require 50% to 80% of the contribution time to forecast the cost of a project [18]. Second, the main budgeting points are generated by the collection of quantitative data of the projects, there are no longer the main misunderstandings regarding the reading of duplicate and / or incomplete projects, series, projects and projects.

C) Importance of the budget

The budgeting of a work is not only a description of the costs of the services performed in it. It should seek to predict how the work will be executed, aiming at reducing the time and cost [3]. According to [10], through the budget we obtain indices of productivity (labor) and indices of consumption (material and equipment), with the function of comparing the budgeted with the one realized in the work.

According to [12], the budget provides support for other sectors of the company, such as planning and supplies, responsible for physical-financial follow-up and acquisition of materials and equipment, respectively. Therefore, the lack of discipline in monitoring the costs necessary to implement a project may make it uneconomic, since there may be no funds available for the execution of certain services [13]. This makes it necessary to seek quality in the estimates and cost control of critical activities [14].

D) Stages of the budget

At the beginning of the budget, basic knowledge is needed, such as the structure needed to organize the budget (constructive cell, stage, sub-step and activity), the quantity of each service, the value of Indirect Benefits and Expenses (IBE) and labor costs [11].

According to [15], the use of the Project Analytical Framework (PAF) is fundamental for the realization of a budget. The PAF tool makes it possible to discriminate the activities of the project, relating them to levels of detail that allow the planning to verify the predecessor and succession of the same. In addition to this advantage, there is also the possibility of verifying the omission of services.

E) Major budget errors

Construction budgets have many variables, details, and problems that can cause inaccuracies. However, through careful work and detailed considerations, the inaccuracies can be minimized [16]. According to [17], contingency funds are included in budgets to provide flexibility to project managers due to uncertainties and errors in budgeting. The main causes of this inefficiency in budgets are presented in Table I.

III. METHODOLOGY

III.1. Identification of the most relevant errors

In order to obtain a better understanding of the study, verbal interviews with all the professionals and managers belonging to the budgets sector of company A. were carried out in an initial stage. To these 22 (twenty-two) respondents, free, of the main mistakes verified in the execution of budgets without the use of specific software for this activity. Each error quotation present in the budgeting was counted with 1 (one) point, so that the most common errors pointed out by the professionals interviewed were demonstrated. Errors were reported in budgets that obtained at least 6 (six) points, or approximately 28%, of the maximum possible number of 22 (twenty-two) quotes.

Table II presents the number of points and the percentage relevance in relation to the maximum number of citations, of the errors in the budgeting indicated by the interviewees as being the most common in the budgets already made by company A.

It is noted that items 1-2-4-6-7 cited have correlations with budget activities. Items 3-5 are related to accessing,

integrating and using budget information for other company activities. There are errors that have near conceptualization, such as pairs items 1-2 and 3-5, although they represent divergent activities.

TABLE II
RELEVANCE OF THE ITEMS CITED IN INTERVIEWS

Item	Description	Numbers of citations	Relevance (%)
1	Integration with management software	21	95,45
2	Absence of detail of items	20	90,91
3	Budgeting with incomplete data	18	81,82
4	Difficulty in updating data (composition indices and prices of inputs, labor and taxes)	16	72,73
5	Access to budget updates for various business sectors	15	68,18
6	Limitations and short deadlines for reporting	13	59,09
7	Errors in the quantitative survey	8	36,36

After the analogy between the relevant points, a comparative study was carried out between budgets carried out without and with the use of software.

III.2. Identification of the most relevant errors Comparative study carried out during the software implementation phase

From the survey of the main errors in the budgeting indicated by the interviewees in the previous stage, a comparative study between budgets carried out without and with the use of softwares was developed.

Information on this stage of the case study was obtained and collected during the implementation of the budgeting program in company A, in which a comparative study of 10 (ten) budgets carried out in the conventional way, before implementation and without the use specific software for budgeting; and after installation and use of the software. The sample was defined by company A that considered it adequate for the study, since the projects contemplated all the followings of its performance.

The comparative study was based on quantifying the number of occurrences and the frequency of the presence of errors in budgeting, mentioned in the stage of verbal interviews, in budgets made without and with the use of software. The data were collected from the prepared documents and interviews with the budgets during the implementation phase of the software, generating an accurate verification of the contributions of the use of budgeting program for the minimization of errors in budgets and control of costs in civil construction. Based on the data obtained it is shown by means of graph the percentage reduction of the errors in the budgeting listed when comparing the budgets realized without and with the use of softwares.

Fig. 1 shows the number of occurrences and percentage of presence in the 10 (ten) budgets of the errors (listed in Table II) for budgets made without the use of software.

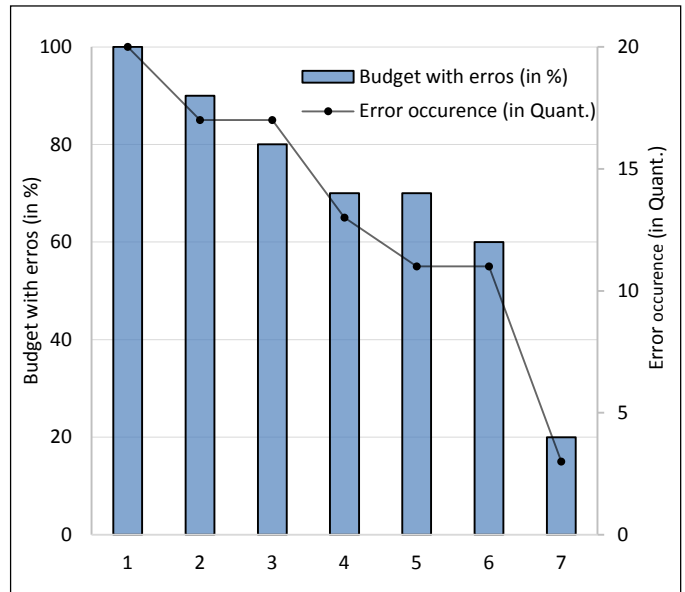


Fig. 1. Errors in budgeting verified in budgets made without use of software

Similar survey was carried out after the implementation of the software, with the same 10 (ten) budgets used in the database to calculate budgeting errors without the use of specific programs, this time making budgets using the software. Fig. 2 shows the number of occurrences and the percentage of presence of errors in budgeting in the 10 (ten) budgets made with the tool.

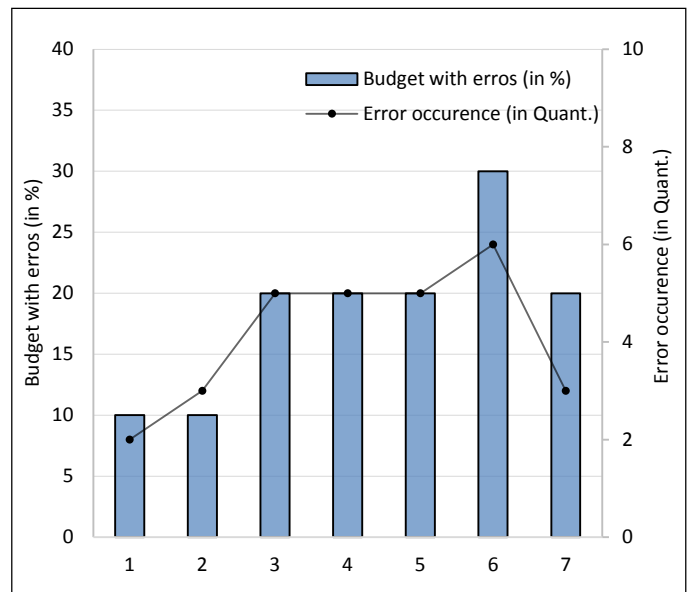


Fig. 2. Errors in budgeting verified in budgets made with use of software

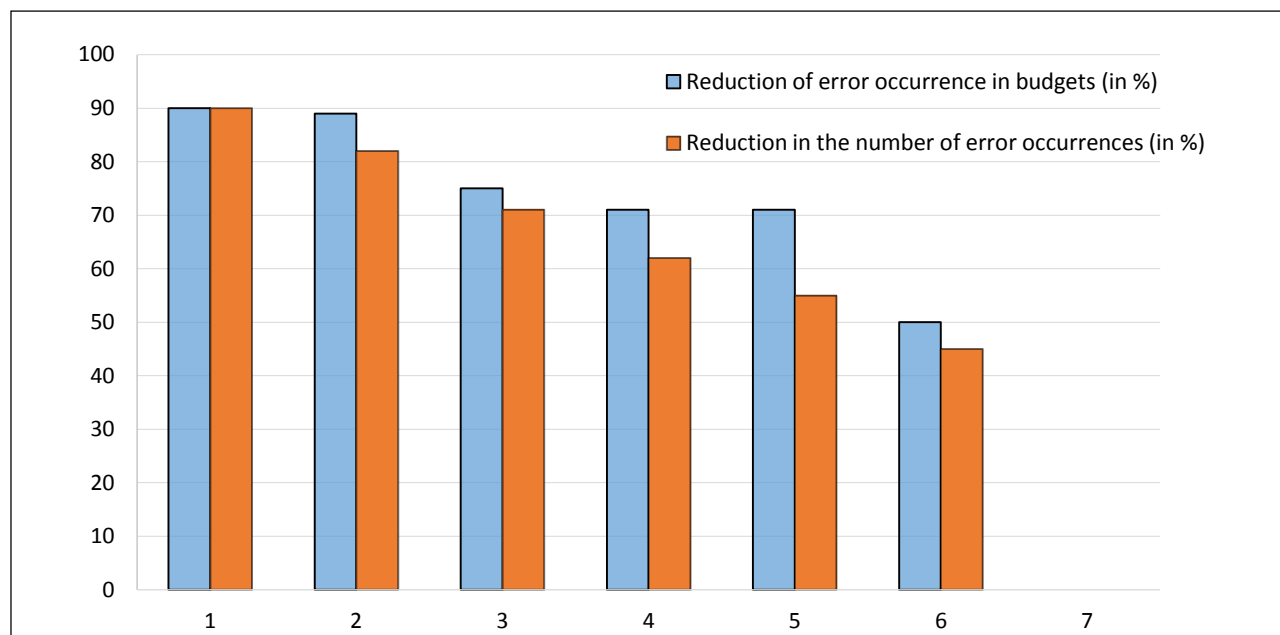


Fig. 3. Percentages reductions of errors occurring in budgeting after the use of the software

Based on the data collected, a comparative graph was generated showing the percentage reduction, when comparing budgets performed without and with the use of software, errors in budgets with the use of the software and the percentage reduction in the number of occurrences of the error with the use software. Fig. 3 shows the percentage reductions in budgeting errors found after the use of budgeting software.

The analysis of the graph shows that the errors in budgeting provoked by the integration of the budgets realized with software of management of the company were those that presented greater percentage reduction after being realized with specific programs. Next, the following budget errors were identified in order of relevance: the lack of detail of the items, the limitations in the access to the updates by the various sectors of the company, the budgeting with incomplete data, the difficulty in updating data, and limitations and short deadlines for reporting. Finally, it should be noted that there was no percentage reduction of budget errors related to the quantitative survey after the use of the software.

III.3. Evaluation of the use of software in budgeting

From the survey of the main errors in the budgeting indicated by the interviewees in the previous stage, a comparative study between budgets carried out without and with the use of softwares was developed.

Aiming to consolidate the results presented in the comparative study between budgets made without and with the use of software in company A, and to verify the acceptance and receptivity of the new budgeting methodology, it was requested that the employees involved in verbal interviews and in the implementation of the software filled a quiz. The questions used in the questionnaire were elaborated by the

managers of the budgets sector of company A.

The evaluation of the use of software in budgeting had the participation of 20 (twenty) employees of company A (number of participants divergent from the stage of verbal interviews due to the dismissal of 2 (two) company employees during this study).

The questionnaire developed was based on two stages. In the first one, it was requested the assignment of a grade to evaluate the degree of agreement, among the budget of company A, that the use of software in budgets contributed to the minimization of each error pointed out in verbal interviews. The grades followed the range from 0 to 5, with the minimum grade defined as "do not help minimize errors in budgeting", and the maximum grade defined as "are able to eliminate all errors in budgeting." Table III shows the settings of the assigned note ranges.

TABLE III
BANDS OF NOTES FOR EVALUATING THE USE OF SOFTWARE IN BUDGET

Description	Note
Do not help to minimize deviations in budgeting	0
Can eliminate small part of the deviations in budgeting	1
Can eliminate part of the deviations in budgeting	2
Can eliminate much of the deviations in budgeting	3
Can eliminate most of the deviations in budgeting	4
Can eliminate all deviations in budgeting	5

Table IV presents the results of the first stage of the questionnaire, in order to list the notes filled by the employees and the percentage equivalent to the sum of the notes.

TABLE IV
RESULTS ON THE EVALUATION OF THE USE OF SOFTWARE FOR THE MINIMIZATION OF BUDGET ERRORS

Description	Note (Number of respondents)						Σ
	0	1	2	3	4	5	
Integration with management software	-	-	-	1	10	9	20
Absence of detail of items	-	-	-	-	13	7	20
Budgeting with incomplete data	-	-	1	2	11	6	20
Difficulty in updating data (composition indices and prices of inputs, labor and taxes)	-	-	-	2	11	7	20
Access to budget updates for various business sectors	-	-	1	2	11	6	20
Limitations and short deadlines for reporting	-	-	1	3	12	4	20
Errors in the quantitative survey	8	4	3	2	3	-	20
Percentage (%)	5,71	2,86	4,29	8,57	50,71	27,86	100,00

The second stage of the research aimed to identify the main initial difficulties noted by budgeting in software during budgets made during the implementation phase. Table V shows the data collected from the questionnaires.

TABLE V
MAIN INITIAL DIFFICULTIES IN THE USE OF SOFTWARE

Description	Relevance (by number of respondents)	Percentage of the number of respondents
Lack of tools in quantitative survey software	8	40 %
Unaware of all software functions	5	25 %
Need for rapid adaptation to the new budgeting methodology	4	20 %
Reduced number of employees to help with software inquiries	3	15 %

The results of the first stage of the questionnaire reaffirmed the importance of the use of budgeting programs to minimize errors in budgets and cost control, already mentioned during the development of this work, since the section 4 denominated "are able to eliminate the greater part of the errors in budgeting" was pointed out as the one with the greatest incidence in the results of the questionnaire.

However, the difficulties observed in the use of budgeting software during the implementation phase, for the most part, do not indicate limitations of the program, but rather initial difficulties in the adequacy of their use, since part of the budgeting team had the first contact with the software during the implementation phase. Only the absence of a tool for carrying out the quantitative survey in the program demonstrates a limitation of its use.

These questionnaire results served as a basis for improvements in budgeting processes with the use of softwares and in the qualification of the budgets of company A.

IV. CONCLUSION

According to a bibliographical review, it is worth noting the need for good communication and integration among the various sectors of the company involved in the budgeting process. It is impractical to think of a complete and reliable budget, if there is no good communication between budgeting and those responsible for the supply, project management and business administration sectors.

In this way, it is shown the need for a company to have the strategic use of modern and functional technological tools to remain competitive in the construction market. However, it is necessary to have the necessary knowledge of such tools to use all the resources that they provide, making the activities effective.

It should be noted that the use of technological resources does not eliminate the responsibility of the budget to verify and analyze the results obtained with the use of the software. Therefore, it is recommended to critically analyze the budget and cost control processes in order to obtain improvements in this important stage of the construction process.

It is concluded, therefore, that the use of programs focused on budgeting and cost control in civil construction contributes to greater integration among the company's sectors, reducing the execution time of budgeting activities, and, above all, helps to minimize errors in implementation. However, one should have complete knowledge of the tool used and carry out constant checks with the objective of eliminating possible inconsistencies in the software.

Another important factor is the need for there to be constant checks on the databases used in the budgeting processes so that possible errors are not propagated. Of course, this action represents a useful managerial tool, and that makes the base used more reliable.

Among the possible future works that can be developed from the discussion presented in this research, which addressed the minimization of errors in budgeting and cost control in civil construction with the use of softwares, the

following stand out: the improvement of a computational tool capable of meeting the needs of all stages of the budgeting activity; and the availability of automatic database update feature.

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