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Case Study on the Calculation of the Earned Value Using the Planned Physical Advancement of Projects

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Abstract: The cost knowledge area is one of the pillars of project management, and its control process is fundamental to the success of an enterprise, with the Earned Value Management methodology as one of the most important techniques for project cost management. The Earned Value is the main indicator and variable of the Earned Value Management methodology technique, which aims to enable the integrated understanding of the correlation between cost and physical advancement of projects. The problem identified is that the result of the calculation of the through the ratio between The Planned Cost and Physical Advancement Realized is not always adherent to the reality of the project, being directly influenced by the correlation between the Planned Physical Advance and the Planned Value. The non-use of Planned Physical Advancement with variable for is understood with the gap of systematics, being the basis for meeting the objective of this article, which is to propose a model for calculating the using an Alternative Equation of Earned Value. The methodology used for the work will be case study referring to a basic project of deliveries of technical engineering documentation to an oil rig in Brazil controlled in 2018 and 2019. This research is justified by bringing an important point in the project management literature, being relevant for presenting a scientifically proven alternative equation model for the calculation of Earned Value using Planned Physical Advancement. The method employed contributes to the cost management of projects, since the correct calculation of the Earned Value provides assertive results for decision-making of project managers.

Key words: cost, project, earned value, physical advancement
JEL codes: C, C3

1. Introduction

Earned Value Management methodology (EVM) is a project control methodology originated in the U.S. Department of Defense (Colin, Martens, Vanhoucke, Wauters, 2015). The U.S. Department of Defense released in 1967 its first official list of "Cost Control Systems/Schedules Criteria" establishing the formal start of value-Earned analysis, which the Department said represented the best chance management would measure the progress of a project in an integrated manner. According to Cleland, Ireland (2007) EVM was widespread in Brazil from the 21st century.

Cioffi (2006) notes that value-Earned analysis initiated a paradigm shift in project management implying the non-acceptance of separate budget or schedule views. The author emphasized that the actual progress of any project

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has not changed, however, measurement techniques have changed due to this new perspective.

The Guide to the Project Management Body of Knowledge (PMBOK®) developed by the Project Management Institute (PMI, 2017) that presents the best practices addressed in project management, guides that Earned value (EV) is the main variable of the indicators that make up the EVM technique and provides project managers with information for decision-making aimed at meeting the planned costs and deadlines.

The literature presents in general that the EV should be calculated through the ratio between Planned Cost (PV) and Physical Advancement Realized (PA_R), referring to the objective of this article that is to investigate whether this calculation can be performed for any type of project control, having an oil company from Brazil as the organization chosen for the case study.

The research is justified by bringing a little discussed point in the project management literature, being relevant for presenting a scientifically proven alternative for the calculation of EV using Physical Advancement Planned (PA_P).

2. Literature Review

Cioffi (2006) indicates that EVM is a project management methodology widely used for project control, integrating three critical elements for control: scope, time and costs under the same structure, "using cost as the common exchange".

Mendes, Valle, Fabra (2014) understand that EVM is a comparative technique of project performance with what was planned.

Colin et al. (2015) explain that EVM records the progress of individual activities at a higher level of the Work Breakdown Structure (WBS) and provides the project manager with an indication of the overall health of the project.

Mishakovaa, Vakhrushkinaa, Murgula and Sazonova (2016) deduce that the use of the EVM method can provide accurate evaluation of the project at the date of its implementation compared to the initial plan.

The PMI (2017) considers EVM as the method used to control project costs by verifying variations and trends of a project, composed of a basket of indicators.

EVM directs the use of the value of accumulated planned work (PV), with the premise that accumulating direct costs consistent with the way the related work was planned and budgeted facilitates the comparison between the cost of work performed or actual cost (AC) and the budgeted cost of the work performed (EV) for performance analysis and variations of projects (ANSI, 2018).

EVM is shown to be a necessary technique for controlling the costs of a project, taking into account that it is essential for a successful project that the cost on any deadline does not exceed the estimated cost for that date, taking into account the delivery on time and within the budget to the customer (Zohoori et al., 2019).

Several authors conceptualize the EV as the budgeted cost of the work done, from the English Budgeted Cost Of Work Performed — BCWP, among them: Cioffi (2006); ST-Martin, Fannon (2010), Barcaui (2012), Meredith, Mantel (2013), Garza, Hernández (2014), PMI (2017), ANSI (2018) and Vargas (2018).

According to Pressman (2001), the EV is a measure of progress and each task receives a EV based on its estimated percentage of the total, a concept ratified by Zohoori et al. (2019), who explained that the EV is the budgeted value for the execution of the work performed at a given time. Garza Hernándéz (2017) sees the EV as the return value or progress of the project, which should be close to the planned value (PV) of the project.

The EV in projects is the measure of the work carried out expressed in terms of the authorized budget for such work (PMI, 2017).

The EV aims to indicate how much the physical progress made cost to the project, considering the budgeted cost, that is, whether the project is spending within the expected to be realized. It can be considered that the EV is an indicator that alone expresses how much physical advancement it cost for the project, providing the manager with an indication of the overall health of the project (Colin, Vanhoucke, 2015).

The EV offers a more complete picture of the reasons and consequences of overspending, under costs and problems such as early and late delivery (Bryde, Joby Unterhitzenberger, 2017)

It is worth mentioning that the result of the EV can also be used as a variable of other indicators of the EVM technique, whose purpose is to measure the performance of the project in relation to what was actually spent for the delivery obtained (Fleming, Koppelman, 1999).

Acebes et al. (2014) assess the need to measure the cost of tasks that have been completed at any intermediate time of the project, which is a requirement for the determination of EV. According to Vargas (2018), there is no EV measurement method that can meet all types of work.

Fleming, Koppelman (1999); Mendes et al. (2014) and Vargas (2018), prescribe some EV measurement techniques:

a) Fixed Formula: division of the project into two parts, based on the proportions between the parts 25/75, 50/50, 75/25 or 0/100, which are percentages of completion of the beginning and end of a task, the aggregate value will be found multiplying the percentage of delivery by the planned total cost.
b) Milestones with Weighted Values: percentage assignment (between 0 and 100%) for each milestone performed. The sum of the calculated costs of the milestones reached will be the Earned value.
c) Complete Percentage: Allocation of complete percentage of progress of large project deliveries (between 0 and 100%) to each control cycle.
d) Equivalent Units: Assignment of the complete percentage of the task in the measurements taken of basic individual elements of the project.

According to Vargas (2018), the most used models are the full percentage due to the ease of adoption (despite subjectivity) and, the model of equivalent units, used in projects that involve repetitive activities accounted for through their unit cost.

Although the EV is a project cost indicator, the main variable used in its calculation is the scope and time control indicator of a project: the percentage of physical advancement. Meredith, Mantel (2103) warn that it is not wise to make a complete percentage estimate without careful study and that there are several conditions to estimate the percentage of physical progress, such as knowledge of all process requirements; designers' knowledge of how to metrise processes; appropriateness to the customer's needs, among others.

The appendix of this article presents citations of authors researched about the variables used for the calculation of EV, where it can be observed that all academic indications directly or indirectly involve the relationship between the variables Planned Cost (PV) and Realized Physical Advancement Realized (PA_R) for the calculation of EV, and can be inferred the basic equation:

EV = Planned Value for activity (PV) x Percentage of Completed Activity Work or Physical Advancement Realized (PA_R), then $EV = PV \times PA_R$.

Another important point is that academic recommendations point to EV calculation for project tasks, activities, or deliveries and not to a managed project as a whole.

Vargas (2018) warns of the need to correctly choose how to measure the EV of the project because the complexity in data management and its difficulty of adoption may end up making monitoring the project impossible.

3. Case Study

This article is based on the single case study, by seeking the "how" the EV can be calculated, being empirical in order to investigate a contemporary phenomenon within its real-life context, noting that the "boundaries between phenomenon and context are not clearly evident". (Yin, 2005).

The database will be a project of deliveries of technical engineering documentation carried out in an oil company located in Rio de Janeiro, named in this article as Project "A". The project office of this company, carried out the cost control of this project based on EVM to monitor the physical and financial performance of the project as a whole. The steps described in Figure 1 describe the methodology adopted in this article.

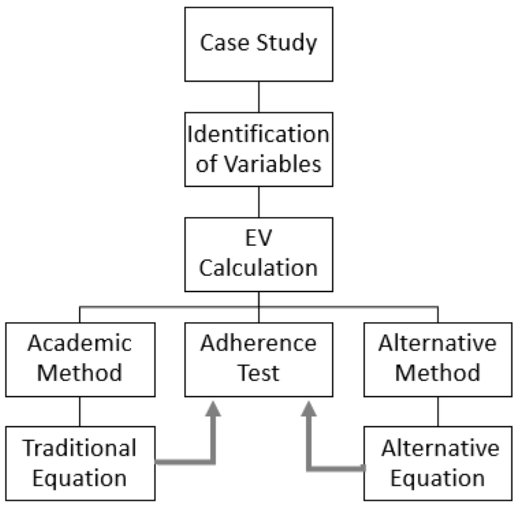

Figure 1 Steps for Calculating EV

The diagram described in Figure 01 demonstrates the items that will be addressed in the analysis in the results and discussions of this article.

In general, all projects of the researched energy company are managed following the methodology of Complete Percentage with integrated control of pmo, in view of the complexity and size of the projects managed in this company.

The project A researched was controlled according to Table 01. For the sake of corporate confidentiality, the costs of the project studied were minimized in decimal places of the actual amount and the monetary units used are not informed. Table 1 was prepared using accumulated values: planned value (PV) and actual cost (AC), besides the accumulated Physical Advancement Planned (PA_P) and Realized (PA_R) of the Project "A".

The survey was conducted in September/2019. It is observed that the beginning was used for the initiation work, with costs without influence on the physical progress of the project. The Project "A" variables for EV calculation with the measurement being performed in August 2019 are as follows:

- Planned Value (PV) = $30,000
- Actual Cost (AC) = $ 10,350

- Physical Advancement Planned (PA_P)= 8%
- Physical Advancement Realized (PA_R) = 12%

Table 1 Data on Planning and Realization of Physical and Financial Progress of the Project

Período	Accumulated Cost		Avanço Físico Acumulado	
	PV	AC	PA_P	PA_R
mar/19	$1.000	$900	0%	0%
apr/19	$2.500	$1.850	0%	0%
may/19	$5.000	$3.350	0%	1%
june/19	$7.000	$4.350	2%	4%
july/19	$10.500	$6.850	3%	6%
aug/19	$13.500	$10.350	8%	12%
sept/19	$16.000		16%	
oct/19	$20.500		31%	
nov/19	$21.700		47%	
dec/19	$26.500		81%	
jan/20	$28.500		96%	
feb/20	$30.000		100%	

Source: Energy Company (data extracted from the SAP system in 2019)

Only with these variables through EVM is it possible to evaluate that Project "A" is spending less and in advance on its physical realization.

EV of the Project "A" was calculated in two ways: by the traditional method, called Academic Method and by the proposed Alternative Method:

3.1 Academic Method

EV calculated using the traditional product equation of the planned total cost of the Project "A" by the accumulated realized physical advance ($EV = PV \times PA_R$).

Variables: PV = $ 30.000 and PA_R = 12%

If $EV = PV \times PA_R$ then simply EV = $30,000 × 12%, therefore EV of the Project "A" is **$3,600**.

3.2 Alternative Method

For the calculation of the EV, an equation will be developed with the planning variables PA_P and PV, hereinafter called Alternative Equation of Earned Value (EQEV), for which three steps will be necessary:

a) definition of the types of variables and ordered pairs (x,y);

b) analysis of the trend of the relationship between the variables PA_P (x) and PV (y);

c) development of the EQEV.

The PV (y) will be a function of PA_P (x) → PV = f (PA_P), making it possible to find the EV (y) at any point in the curve.

For a better understanding of the alternative, it is necessary to prepare a projection of the planned cost of the work performed, that is, of the VA (y) in a graph. For this, a graph was prepared in the MS Excel application of the type "X Y (Scatter)" with the option of trend line of polynomial regression of order 6.

It is observed that the relationship between PA_P (x) and PV (y) is not linear, and therefore it is necessary to develop an equation to relate the two variables.

The polynomial equation of the points PA_P (x) and PV (y) obtained in the MS Excel trend chart was as follows:

$$\mathbf{y = -1E{+}06x^6 \ + 4E{+}06x^5 \ + -5e{+}06x^4 + -1e{+}06x^2 {+} 207678x + 3241.4}$$

The EV found with this equation **was $19,735,** which was not faithful to the established curve, since it is possible to identify in Figure 2 that for a physical advance of 12%, the EV, is situated close to $ 15,000. Microsoft ® that the equation generated for a trendline on a scatter plot may sometimes be inconsistent (Microsoft Support, 2018).

Table 2 Ordered Pairs

PA_P (x)	PV (y)	Ordered Pair (x,y)
0%	$1.000	(0.00, 1.000)
0%	$2.500	(0.00, 2.500)
0%	$5.000	(0.00, 5.000)
2%	$7.000	(0.02, 7.000)
3%	$10.500	(0.03, 10.500)
8%	$13.500	(0.08, 13.500)
16%	$16.000	(0.16, 16.000)
31%	$20.500	(0.31, 20.500)
47%	$21.700	(0.47, 21.700)
81%	$26.500	(0.81, 26.500)
96%	$28.500	(0.96, 28.500)
100%	$30.000	(1.00, 30.000)

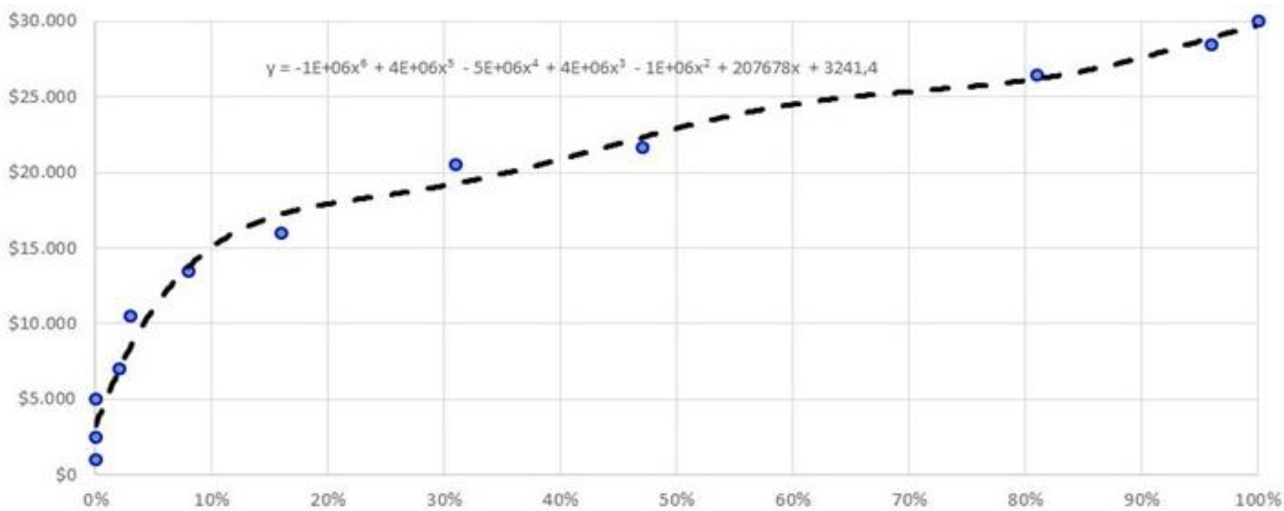

Figure 2 Graph with Relationship PA_P(x) and PV(y).

Using specific software for non linear analytical function tuning, the Project EQAV will be as follows:

$$\mathbf{y = 5{,}038 + 152{,}348*(x) + -766{,}025*(x)^2 + 2.15106e{+}006*(x)^3 + -3.16746e{+}006*(x)^4 + 2.31416e{+}006*(x)^5 + -659438*(x)^6}$$

Using this deducted EQEV, when the AF_R(x) is equivalent to 12% the PV(y), that is, the EV (planned cost of the work performed) found is $ **15,405.**

3.3 Alternative Method

For a critical analysis of the situation of Project "A", a test of adherence to the EV results found in the methods used was carried out, using the EVM indicators: Cost Variance (CV) and Schedule Variance (SV) which are fundamental basic metrics of EVM (Cleland and Ireland, 2007) detailed in Table 3.

Table 3 Definition of EVM Indicators

Indicator EVM	Calculation	Analysis
Cost Variance (CV)	Difference between the Earned Value (EV) and the Actual Cost (AC) CV = EV - AC	CV > 0 → Cost below budget CV = 0 → Cost within budget CV < 0 → Cost over budget
Schedule Variance (SV)	Difference between the Earned Value (EV) and the Planned Value (PV) SV = EV - PV	SV > 0 → Project advanced SV = 0 → Project on time SV < 0 → Project delayed

Source: adapted from Cleland, Ireland (2007) and PMI (2017).

Table 4 consolidates the results of Project "A" in the period of August/19 and demonstrates the evaluation of EVM indicators, based on the Fixed Variables: PV = \$ 13.500 and AC = \$ 10.350 for the method used.

Table 4 Adhesion Test Using EVM Technique

Method	EV	Cost Variance (CV= EV – AC)	Schedule Variance (SV = EV - PV)
Academic Method ($PV \times PA_R$)	\$3.600	\$3.600 - \$10.350 = - \$6.750	\$3.600 - \$13.500 = - \$9.900
		CV < 0: Cost over budget.	SV < 0: Project delayed
Alternative Method (EQEV)	\$15.405	\$15.405 - \$10.350 = \$5.055	\$15.405 - \$13.500 = \$1.905
		CV > 0: Cost below budget	SV > 0: Project advanced

According to the GVA results, Method 2 (EQEV) presents adherence to the curve and the situation of the Project "A", unlike the traditional Method 1 ($PV \times PA_R$), which brought different information from the reality of the project, taking into account that project A is spending less and in advance on its physical realization, with the EV close to \$ 15,000.

These results confirmed the need for EQAV for the cost control of Project "A", and it is essential to use the variable Physical Advancement Planned (PA_P) for the development of this equation.

4. Conclusion

The EV is so fundamental for project cost analysis that it gives the name to the EVM technique that involves other project cost indicators and deadlines, so it should be calculated to obtain results with the highest possible accuracy.

According to the academic publications researched, at first it should be simple to calculate the EV of a project, simply carry out the financial planning based on the same packages used for the measurement of the physical advancement performed, therefore to calculate the EV through the product between the PV and PA_R, it is necessary that the budget and control of the PA_R be carried out at least for each work package of the Work Breakdown Structure (WBS).

Some situations impair the calculation of the EV in this way: impossibility or difficulty apportionment of indirect costs in the work packages or activities of the project up to the last level of the WBS; sometimes it is not possible or necessary to budget the cost or physical advancement of each work element; costs charged in activities that do not generate physical progress (for example, one can consider costs of mobilization or construction of a construction site, as elements in which there is expenditure, however, generate indirect value for the project, not being incorporated into the final product); difficulty of detailed cost control and/or physical advancement, especially in large projects.

The central point found in this research is that the academic guidelines on the calculation of THE do not take into account the PA and consequently its relationship with the Planned Value (PV), which constitutes a problem for projects controlled globally and use the traditional method, since, when there is no linearity in the relationship between the variables described, inconsistent results from the project EV will be generated.

With this it can be concluded that the traditional methodology ($PV \times PA_R$) should not be used to calculate the EV of projects when the relationship between the two variables (planned cost and predicted physical advance) is not linear, while the EQEV deduced from the relationship (PV, PA_P) can be used inany situations. Therefore, the need for analytical and in-depth calculation of the EV is confirmed with the definition of an EQEV relating.

PV and PA_P to EVM, in order to increase the reliability of the cost projection and consequently the physical and financial management of projects.

A point of attention for the proposed alternative method is that any change from the predefined optimized logical sequence to the planning of physical and financial advancement at the beginning of the project may impair the results of the EQEV, and the team responsible for controlling costs of the project is responsible for reviewing the deducted equation, in order to allow adherence of the result obtained from the calculated EV to the replanning of the project.

It is expected that this article can contribute to more advanced research on this important theme for the project management community, with the performance of new tests, having as parameter the methodology used for project cost management.

References

Acebes Fernando, Pajares Javier, Galán José Manuel, and Paredes Adolfo López (2014). "A new approach for project control under uncertainty. Going back to the basics", *International Journal of Project Management,* Vol. 32, pp. 423-434, accessed on 25 de agosto de 2019, available online at: https://doi.org/10.1016/j.ijproman.2013.08.003.

ANSI, The American National Standards Institute (2018). "Earned value management systems (EVMS)", accessed on 15 de novembro de 2019, available online at: http://acqnotes.com/wp-content/uploads/2014/09/DoD-Earned-Value-Management-Interpretation-Guide-Jan-2018.pdf.

Barcaui André B. (2012). *PMO- Project, Program and Portfolio Offices Inpractice*. Rio de Janeiro: Brasport.

Bryde David, Unterhitzenberger Christine and Joby Roger (2018*).* "Conditions of success for earned value analysis in projects", *International Journal of Project Management*, Vol. 36, pp. 474-484, accessed on 10 de setembro de 2019, available online at: https://doi.org/10.1016/j.ijproman.2017.12.002.

Cioffi Denis F. (2006). "Designing project management: A scientific notation and an improved formalism for earned value calculations", *International Journal of Project Management*, Vol. 24, pp. 136-144, accessed in 05 de dezembro de 2019, available online at: http://dx.doi.org/10.1016/j.ijproman.2005.07.003.

Cleland David I. and Irland R. Lewis (2007). *Project Management*, Rio de Janeiro: LTC Editora.

Colin Jeroen and Vanhoucke Mario (2015*).* "A comparison of the performance of various project control methods using earned value management systems", *Expert Systems with Applications Journal*, Vol. 42, pp. 3159-3175, accessed on 08 de outubro de 2019, available online at: http://dx.doi.org/10.1016/j.eswa.2014.12.007.

Colin Jeroen, Martens Annelies, Vanhoucke Mario, and Wauters Mathieu (2018). "A mul-tivariate approach for top-down project control using earned value management", *Decision Support Systems Journal*, Vol. 79, pp. 65-76, accessed on 15 de dezembro de 2018, available online at: http://dx.doi.org/10.1016/j.dss.2015.08.002.

Fleming Quentin W. and Koppelman Joel M. (2000). *Earned Value — Project Management* (2nd ed.), Pennsylvania: PMI.

Garza Gerardo Espinosa and Hernández Imelda Loera. (2017). "Proposed model to improve the forecast of the planned value in the estimation of the final cost of the construction projects", *Procedia Manufacturing Journal*, Vol. 13, pp. 1011-1018, accessed on

17 de setembro de 2019, available online at: https://doi.org/10.1016/j.promfg.2017.09.103.

Gasparotti Carmen, Raileanu Alina, and Rusu Eugen. (2017). "The earned value management — A measurement technique of the performance of the costs and labor in the project", *University Danubius Journal*, accessed on 30 de julho de 2019, available online at: http://journals.univ-danubius.ro/index.php/oeconomica/article/view/4029/3995.

Grey David E. (2012). *Real World Search*, Porto Alegre: I think.

Kerkhove L. P. and Vanhoucke M. (2019). "Extensions of earned value management: using the earned incentive metric to improve signal quality", *International Journal of Project Management*, Vol. 35, pp. 148-168, accessed on 19 de dezembro de 2019, available online at: http://dx.doi.org/10.1016/j.ijproman.

Mendes João Ricardo Barroca, Valle André Bittencourt do and Fabra Marcantonio (2014). *Project Management* (2nd ed.), Rio de Janeiro: FGV Publishing House.

Meredith Jack R. and Mantel Samuel (2103). *Project Administration: A Management Approach*, Rio de Janeiro: LTC Publishing House.

Mishakova Anastasiia, Vakhrushkina Anna, Murgula Vera and Sazonova Tatiana (2016). "Project control based on a mutual application of pert and earned value management methods", *Procedia Engineering Journal*, Vol. 165, pp. 1812-1817, accessed on 15 de novembro de 2018, available online at: https://doi.org/10.1016/j.proeng.2016.11.927.

Moura Henrique (2013). *PMP Without Secrets*, Sao Paulo: Elsevier.

Pressman Roger S. (2001). "Software engineering: A practitioner's approach", accessed on November 4, 2018, available online at: http://www.qiau.ac.ir/teacher/files/911610/13-11-1387-17-31-03.pdf.

PMI (Project Management Institute) (2017). *Knowledge Guide in Project Management: PMBOK guide®* (6th ed.), USA: Project Mangement Institute.

ST-Martin Remi and Fannon David (2010). "Management of the earned value of work in progress", accessed on December 22, 2018, available online at: https://brasil.pmi.org/brazil/KnowledgeCenter/Articles/~/media/46DEF34C7B5346EE992DC015433E5402.ashx.

Microsoft Support (2018). "Chart trendline formula is inaccurate in Excel", accessed on January 12, 2019, available online at: https://support.microsoft.com/pt-br/help/211967/chart-trendline-formula-is-inaccurate-in-excel.

Microsoft Support (2016). "Value-Earned analysis for us", accessed on February 19, 2019, available online at: https://support.office.com/pt-br/article/an%C3%A1lise-de-valor-agregado-para-n%C3%B3s-6a49f56d-d7bc-44eb-8b56-2ff5526403cc#__toc321831422.

Vargas Ricardo (2018). *Value Earned Analysis* (7th ed.), Rio de Janeiro: Brasport.

Yin Robert K. (2005). *Case Study: Planning and Methods* (3rd ed.), Porto Alegre: Bookman (Original work published in 1984).

Zohoori Bahareh, Verbraeck Alexander, Bagherpour Morteza and Khakdaman (2018). "Masoud Monitoring production time and cost performance by combining earned value analysis and adaptive fuzzy control", *International Journal of Project Management*, Vol. 127, No. 821, accessed on 10 de agosto de 2019, available online at: https://doi.org/10.1016/j.cie.2018.11.019.

Appendix

Author	Year	Citations on the Variables for EV Calculation
Pressman	2001	The EV is a measure of progress being calculated based on the estimated percentage of the total tasks..
Barcaui	2012	It exemplifies the calculation of the EV by means of a rule of three for a job performed, based on the total of planned services, the planned costs (PV), and the costs performed of the work.
Meredith; Mentel	2013	Each work element of the Project Analytical Structure (WBS) must be evaluated according to its resource needs, and the cost of each resource type is then estimated. Therefore, to calculate the EV it would be enough to multiply the percentage of physical advancement of the elements of the EAP (AF_{R})to the value budgeted for these elements.
Moorish	2013	The EV is calculated by adding the budgeted cost of deliveries (PV) when they were completed (AF_{R}).
Acebes et al.	2014	The cumulative planned value (PV) of the tasks performed makes it possible to find the indicator of the development of the work, in this case the EV.
Kerkhove, Vanhoucke Hotels	2016	The EV can be calculated by multiplying the percentage of work completed by the planned value for these activities.
Microsoft Support	2016	In MS Project, the EV is calculated according to the percentage of expenditure of the total budget of each task.
PMI	2017	A good practice for calculating the EV, the sum of the planned value (PV) for each completed working group..
Gasparotti, Raileanu, Rahman.	2017	The EV can be calculated by adding the budgeted value of each project activity (PV) taking into account the percentage of completion of each activity..
Heron, Hernandez	2017	The EV can be calculated by equation: (PV) × % progress by deadline..
ANSI	2018	The EV is calculated by summing up budgets for completed work packages (PV) and completed working packages in progress (AF_{R})and can be expressed as a value for a specific or cumulative period up to the project measurement date.
Vargas	2018	The sum of the product of the completion percentages for the total planned cost (PV) of each large delivery will lead to the PROJECT EV.