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Time and Cost Controlling with Earned Value Technique – Yellow Pages Directory Case Study

1. Introduction

Managing a project as a unique, complex endeavour requires a lot of effort. This effort concerns equally initiating a project, defining its goals and constraints, careful planning and organizing, as well as monitoring and control in its development phases.

The goal of this paper is to present one of the best project management control practice – earned value technique (EV, also known as earned value management system, EVMS). EV will be presented not only from a theoretical point of view, but also with regard to its practical utilization in the website development project case study undertaken by a small software development company.

Since its beginning Earned Value has proven to be a very useful project control method which allows project managers to track project progress, identify its deviations from the baseline as well as to provide precise forecasts of the future course of the project. Widely recognized as a valuable tool EV is used by project managers across all industries: manufacturing, pharmaceutical, high-tech and IT alike.¹

¹ Larson E.W., Gray C.F., Project Management. The Managerial Process, Fifth Edition, McGraw-Hill 2011, p. 458

2. Earned Value as the best project management practice

Evaluation and control are a vital part of every project manager's job. Monitoring and control of performance of the entire project is crucial, as the performance gives results and allows reaching the overall outcome of any project. Individual task performance must be monitored with precision as budget, timing and coordination of each task is vital to project success. On the other hand, experience shows that control is one of the most neglected areas of project management.² Often found resistance to project control results from the lack of knowledge and understanding how to effectively monitor work and how to develop a single information system to collect data and report progress on cost, schedule and project scope.

The issue of project progress reporting has become a vital part of project management since the 1960's when the US Department of Defence (DoD) laid a foundation for what we know today as Earned Value. In 1967, the DoD established the Cost/Schedule Control Systems Criteria (C/SCSC) based on a set of 35 criteria used to control government financed military projects and programmes.³ Further development of this tool and its employment in subsequent government undertakings made EV in the late 1980's a commonly understood project management method used not only by accounting specialists, but also by managers and executives.

The reason for such popularity of the method is that it provides the following benefits:

- accurate display of project status
- early and accurate identification of trends
- early and accurate identification of problems
- basis for course corrections.⁴

In 1987 Earned Value was recognized as a best practice in project cost management and was enclosed to the first global project management standard – PMI: The Project Management Body of Knowledge.⁵ We can find reference to EV in the PRINCE2 project management methodology as well.⁶ Earned Value is a part of many

² Larson E.W., Gray C.F., *Project Management. The Managerial Process*, Fifth Edition, McGraw-Hill 2011, p. 453.

³ Bukłaha E., *Technika Earned Value*, Bizarre, Warszawa 2009.

⁴ Kerzner H., *Project Management. A Systems Approach to Planning, Scheduling and Controlling*, Ninth Edition, John Wiley and Sons 2006, p. 613.

⁵ PMI, *The Project Management Body of Knowledge*, Project Management Institute 1987.

⁶ OGC, *Managing Successful Projects with PRINCE2*, TSO, London 2009, p. 114.

industry standards like the US ANSI EIA 748-A, the Australian AS 4817–2003 and AS 4817–2006 as well as the British: “Earned Value Management APMG Guidelines”⁷

3. Fundamentals of Earned Value

According to Earned Value the status of any projects or any portion of it can be assessed by a common set of variables used in a detailed described way.⁸

The Earned Value method starts with the time-phased costs that sum up to the project budget baseline. The budget baseline shows in a cumulative way the value of work scheduled to be completed in a given period of time, in terms of agreed cost estimates: i.e. initial budget – what is planned to do and how much do we plan to pay for it. This measure is called BCWS – budgeted cost of work scheduled or shorter PV – planned value.⁹

As the project starts, work progress involves incurring costs and expenditures. The sum of all actual cost for all completed and started work packages (including direct and indirect costs) is aggregated to ACWP – actual cost of work performed, also known as AC – actual value.

The third measure is EV – earned value, also known under the older acronym BCWP – which explains its calculation: budgeted cost of work performed. EV can be found out by checking the amount of work performed so far (fully and partially) as well as the amount that work was supposed to cost as allocated in the original, initial budget. EV is the answer that project manager may give when asked: what have we done already? How much did we plan to pay for it?

Those three measures as a basis for further analysis as the project progresses through its life cycle.

The first analysis may concern simple cost and schedule variances. Cost variance is the difference between the amount of money we budgeted for the work that has been performed up to date and the actual cost of that work:

$$CV = EV - AC = BCWP - ACWP$$

⁷ APMG, Earned Value Management, APMG Guidelines, London 2002.

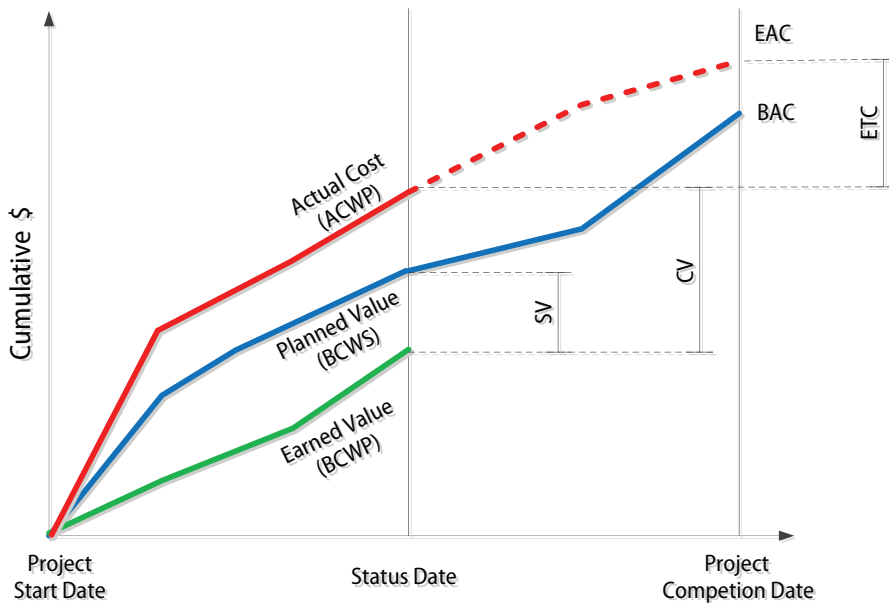
⁸ PMI, Practice Standard for Earned Value Management, Project Management Institute 2005.

⁹ As far as acronyms are concerned in recent years acronyms have been shortened to be more phonetically friendly (ACWP=>AC; BCWS=> PV; BCWP=>EV). In the article for readers convenience we use both. Their longer version can still be found in some project management software. Furthermore in Authors' opinion they give more information about their meaning and calculation [see: Mulcahy R., PMP Exam Prep, RMC Publications 2009, p. 243].

Schedule variance is calculated as a difference between earned value (budgeted cost of work performed) and the budgeted cost of the work we scheduled to be performed up to date (i.e. planned value).

$$SV = EV - PV = BCWP - BCWS$$

Figure 1. Earned Value chart



Source: Meredith J.R., Mantel S.J., Project Management. A Managerial Approach, Wiley & Sons 2006, p. 509

Results of calculations are interpreted as follows:

- zero means the project is progressing smoothly, according to plan, no cost and/or schedule deviation from the baseline
- negative value means the project is behind schedule and/or over cost
- positive value informs that work is performed faster and/or cheaper than planned.

In order to know how efficiently work is performed, apart from computing simple variances, the earned value technique gives a project manager formulas to calculate performance efficiency as a percentage of EV. The Cost Performance Index (CPI) is defined as a ratio of the earned value and actual value.

$$CPI = \frac{EV}{AC} = \frac{BCWP}{ACWP}$$

Similarly the Schedule Performance Index (SPI) is a ratio of the earned value and planned value.

$$SPI = EV/PV = BCWP/BCWS$$

Both ratios are always positive, but the tipping point in both cases is 1. If CPI / SPI equal 1 it means that the project is going according to plan, when is greater than 1 – progress is made faster / cheaper than planned, when lower – progress is made respectively slower / at a greater cost than forecasted.¹⁰

SPI and CPI are shown in ratios with regard to 1, whereas CV and SV are calculated in days and monetary units. H. Kerzner notices that it allows a company to show the current project status without disclosing hard, frequently sensitive financial figures.¹¹ It is beneficial for customer status reporting. It is also useful when comparing several, different projects in a company's portfolio, as SPI and CPI are normalized values independent from project scale or complexity.

SPI and CPI are as well most often used to show trends in project performance which provides a project manager with an early warning system and allows the taking of relevant corrective actions beforehand.

Earned Value technique provides the project manager not only with tools for assessing the current project status, but also to forecast its future performance. This can be achieved by using a few additional measures.

The first measure is ETC – estimated cost to complete the project. It is the amount of money that is needed to deliver the work remaining to complete, that have not yet been done.

$$ETC = (BAC - EV) / CPI$$

In this equation BAC is meant as budget at completion – project baseline, its original, total budget. It is worth noting that this formula is based on the assumption that the future cost performance will stay the same as the current CPI for the project. Some researchers indicate that in some cases it is more reliable to use the ETC from reviewed cost estimates using expert judgement.¹²

¹⁰ Bukłaha E., *Sterowanie projektem za pomocą metody wartości uzyskanej [w] Nowoczesne zarządzanie projektami*, red. M. Trocki, PWE, Warszawa 2012, s. 243–244.

¹¹ Kerzner H., *Project Management. A Systems Approach to Planning, Scheduling and Controlling, Ninth Edition*, John Wiley and Sons 2006, p. 618–619.

¹² Larson E.W., Gray C.F., *Project Management. Managerial Process Fifth Edition*, McGraw Hill 2011, p. 473.

If the project manager knows ETC, he is able to forecast the total budget at the completion of a project, which consists of total expenditures up to date plus what remains to be done:

$$EAC = AC + ETC$$

Additionally the project manager can calculate the difference between the planned total budget of a project and the forecasted total budget at completion. This difference is called VAC – variance at completion:

$$VAC = BAC - EAC$$

If variance is negative it means that the project is likely to end up with a cost overrun and the project manager should immediately initiate corrective actions.

Similarly the project manager can forecast the total project length and the expected project end date. The time at completion uses SPI for the forecast and can be expressed as follows:

$$EAT_t = \frac{\text{original projekt duration}}{SPI}$$

Knowledge about cost and schedule variance at completion, especially if the variance is a negative force posing a question how efficiently should remaining work be performed to get back on a right track? Earned Value technique can provide the answer to that question as well by using an additional index – called TCPI – to complete the performance index. It is calculated separately for the required cost and schedule performance:

$$\text{for cost performance: } TCPI_{AC} = \frac{BAC - EV}{BAC - AC},$$

$$\text{for schedule performance: } TCPI_{PV} = \frac{BAC - EV}{BAC - PV}$$

Both indexes have the same interpretation. An index value above 1 means that in order to meet budget constraint and/or deadline the remaining work has to be done faster and/or cheaper.

All the above mentioned measures recommended by the Earned Value technique give the project manager a solid and reliable piece of knowledge about the current state of the project and its forecasted future performance. Thanks to these measures,

according to the study of more than 700 projects carried out under US Department of Defence contracts after 15% of project completion the future state and course of the project can be assessed with a reasonable level of confidence.¹³ The following part of the article presents the practical value derived from the employment of Earned Value principles and measures in a real life software development project.

4. Yellow Pages Directory Case Study

The Company, which is the subject of this case study, specialized in the creation of web pages. The whole team consisted of two head owners: John Smith (CFO), and Jack Brown (CEO), three consultants involved in the sale of the Company's products and two web developers (Martin Cooper and Robert Allen).

Last year the Company had received an order from a Client to prepare a directory of companies located in the area, which belonged to him. It was the first so complicated project for this micro company, with a high level of innovation, which imposed an additional risk on its realization. The owners decided that, because of no previous experience in the implementation of such projects and the lack of any documentation related to the costs and time required to perform the various functions of websites, the Directory should be supported by the project management technique – Earned Value.

4.1. Planning a project's scope, schedule and budget

The planning process of the project started with creating WBS (Work Breakdown Structure) on the basis of customer specification. The directory was divided into 4 stages:

- a) UML (the concept of creating a web site)
- b) structure and admin panel (the creation of data bindings used by the web site and the management panel of its contents by Admin)
- c) site view and panel (the display of the selected data and profile management panel of the owner),
- d) graphic design and banner system (system for buying ads in the Directory).

Each stage ended with an internal test of its functionalities and the introduction of any necessary changes.

¹³ Flemming Q.W., Koppelman J.M., *Forecasting the Final Cost and Schedule Results*, PM Network, May 1996.

The next stage of the planning process was estimating the number of working hours necessary for each task. Since the Company had not had any documentation on past projects, it had to be estimated with the expert judgment technique.

The project coordinator also defined specific risks, from which the project could suffer during the development phase:

- a) developers did not know any common framework, which forced them to include some extra time in the estimations of task durations for the training partner
- b) it was the first major project for this Company, so the owners did not have any experience in managing this type of project,
- c) a high degree of innovation characterized the project due to the expected functionalities
- d) the Company had only two web developers, so the sudden absence of one of them could lead to deviations in the schedule of the project.

The developers divided tasks among themselves, depending on their skills. During numerous meetings with the owners the decision was made that employees would work 6 hours a day on the project, while the remaining two would be allocated for the usual line duties. Baseline predicted the end of the project after 98.25 working days.

Based on the schedule and the allocation of resources the project budget was developed, where both direct (cost of web developers) and indirect (fees for rent, electricity, internet, etc.) were taken into consideration. The estimated budget required to implement the project amounted to 36 296.96 zloty net.

Unfortunately it turned out that the price proposed by the Company to the Customer did not cover the projected costs (29 500 zloty net), so it was not economically feasible. Nevertheless, the owners decided that the project would be realized. The reason at that point of time was to develop a new product that could be sold to new customers and bring profit in the future. The fact of such a difference between the estimated budget and the proposed price caused a discussion on the existing process of pricing in the Company. As already mentioned, the owners did not have records of any expenses, so they really were not aware what the cost of the created functionalities would be. The prices offered to customers were determined by Jack Brown (CEO), however, were not supported by any specific process (cost of the web site plus indirect costs plus margin). The CEO compared the cost of a similar product in the competition's offer and offered a lower price so that the company seemed to be competitive, regardless if such conduct is even barely profitable. Such an approach prevented the effective management of the Company's products portfolio (making the decision which products should be developed and which should be withdrawn from the offer, which new functionalities to create). The implementation of the EV technique in this particular project could be the beginning of the process of introducing the best practice in the Company due

to the fact that it requires monitoring the actual cost and time performance of specific tasks. The after-project documentation would become the basis for estimating the costs and timing of completion of the Company's future projects.

Directory's planning phase lasted two weeks and was completed in mid-January, with a baseline acceptance.

4.2. Development and controlling of the project with the use of Earned Value technique.

The project couldn't immediately move to the development phase, as the owners had not completed the negotiation of the contract with the customer. The baseline had to be regularly moved, which meant that the final stage of implementation and completion date of the project overlapped the holiday season. This was related to the risk of prolongation of the project and renegotiating the terms of the contract before the start of implementation. However, the owners decided to wait for the latest amendments to the proposals sent by them.

While waiting for the contract, it was easy to note some interesting facts in the Company's daily work, which could have had an impact on the subsequent implementation of the project.

First, the company was characterized by an absolute lack of any fine organization. The tasks were listed on a spread sheet. In theory, this sheet was prepared so that the owners could have control over the web developers work – whether it was executed in the correct order or should be verified, etc., but the selective entry of tasks meant that the data was incomplete, so it was not possible to monitor the efficiency of employees.

What is more, Jack Brown (CEO) often commissioned additional tasks to developers that did not bring any benefits to the Company (such as inserting other buttons on the page, changing the font colour), which led to a two-hour argument between him and one of the developers on the merits of such changes. Constantly interrupted tasks resulted in a decrease in the efficiency of the project team, especially the developers.

Those obvious organizational problems may have had considerable influence on the future implementation of the Directory. Still the delayed project start resulted in a drop in the programmers motivation. Waiting for an amendment to the contract took longer than three weeks, and the owners did not share their findings on the planned project. On February 15 the project coordinator managed to convince Jack Brown (CEO) that because (as he said) negotiations with clients were at a very advanced phase, it would be possible to start the Directory. The official start date of the project was fixed for February 16 (Thursday).

Week 1 – Lack of time

The first day of project realization showed already that the company was not ready to implement the Directory according to the initial time assumptions. Some tasks required the attention of both developers at the same time, so any involvement of at least one of them in other tasks could result in the project's downtime. Jack Brown (CEO) ordered Robert Allen additional tasks which occupied him for the next two days. In order to not delay the project start date again Martin Cooper decided to perform tasks assigned to him in Stage 2 After two days (and thus the first week) of realization the Earned Value indicators were as follows:

Table 1. Earned Value indicators after the first week of the Directory realization

SV	CV	SPI	CPI	EAC _t	EAC
59,20 zł	326,19 zł	1,08	1,65	91,20	21 945,72 zł
ETC	VAC	TCPI _t	TCPI	BAC	T _c
21 44 6,88 zł	14 350,24 zł	99,8%	99,1%	36 295,96 zł	98,25

Source: own study.

The variances (SV and CV) were positive, which meant that if the project performance stayed at the same level the project would be completed ahead of schedule and below the planned budget. The SPI suggested that the project would be realized with the effectiveness of 108%, while the CPI showed that with every zloty invested in the project the company generates 1.65 zloty of value for the project. The EAC forecast brought very good news for the Company – the estimated total cost of the project was to reach 21 945.72 zloty (approximately 14 350.24 zloty less than originally assumed by the budget). For the owners, this meant that the project would not only be cost-effective due to the Directory's progressive realization, but also would generate profit, which wasn't at all taken into account when planning the budget. The way to achieve it was to keep the similar pace of work (108% efficiency) for the remaining duration of the project. The value of the EAC_t showed that the project would be completed before the scheduled completion date (after 91.2 working days). The TCPI_t indicator provided the project coordinator with information that to complete the project within the schedule the web developers should work with efficiency = 99.8%, while the cost TCPI (efficiency necessary to complete it within the budget) equaled 99.1%.

Based on these data, it appeared that on the one hand the Earned Value technique provides reliable and very clear information about the course of the project, but on the other hand a holistic approach to the results of the project (not to each task or

project member) may cover some risks that arise in during the project realization (here he dealt with the deployment of one employee to tasks not related to the project).

Week 2 – The contract and communication problems

The second week of the project began with a discussion and amendments to the contract. It raised a lot of controversy, as it was significantly different from that sent by the Company. In the text appeared lines concerning new fines, changes related to the duration of the project and copyright law. Considering those new Client’s proposals, which were not acceptable for the Company, it was necessary to organize a discussion with the whole project team and introduce a number of amendments, which took most of the Monday. The revised agreement was to be transferred to John Smith (CFO) for approval and then sent back to the Client.

The second week of the project also showed another problem in the Company’s organization. By chance, it turned out that John Smith (CFO) did not know that the developers had been carrying out the project for almost a week. Jack Brown (CEO) decided to start a project on his own without consulting it with him. This situation revealed some communication traffic problems in the Company (taking into account the fact that the owners were sitting opposite each other, and between them were merely computer monitors you would think that they should not have had major problems with the transmission of the information). From the perspective of the project coordinator, this meant that it must be ensured that the information concerning the project reached both owners in the future

Table 2. Earned Value indicators after second week of Directory realization

SV	CV	SPI	CPI	EAC _t	EAC
-67,07 zł	1 655,97 zł	0,98	2,47	100,62	14 674,28 zł
ETC	VAC	TCPI _t	TCPI	BAC	T _c
13 550,40 zł	21 621,68 zł	100,2%	95,3%	36 295,96 zł	98,25

Source: own study.

Based on the results of the Earned Value results in the second week, it can be seen that it ran very smoothly. Robert Allen finished his work last week and was able to devote his time to training in the new framework and the realization of the tasks of Stage 1.

During the second week all scheduled tasks for Stage 1 were finished. The developers decided to change the assumptions about the creation of the concept, which allowed them to save a lot of time and thus reduce the actual cost of the work.

Unfortunately, they failed to do all the work planned for this period, so this is why on the chart the EV line at the end of the week is slightly below the PV.

Looking at the Earned Value indicators in the first place we should pay attention to the negative value of SV. It means that if the project should be implemented with the current efficiency (98%) it would be completed before the scheduled time. Growing positive CV showed that current actual costs generated by the project were much lower than expected. For this week, it resulted directly from the mentioned changes in assumptions. Despite a decline in the efficiency of developers from 108% to 98% they managed to achieve a very high rate of CPI, which was reflected in the low EAC. The project's savings reached a level of 21 621.68 zł in relation to the proposed budget, which gave an opportunity to develop a final profit of 15 000 zlotys.

At this point, it should be of no surprise that, even though both developers working on the project were able to perform almost all the tasks below the scheduled time, they failed to make the EV exceed the PV. This was due to the Jack Brown's (CEO) practice to "throw" developers additional current operations and service tasks during project working hours. There were even situations when they were distracted 3–4 times from one project task. These actions greatly reduced the working efficiency and time savings from already completed tasks being used for additional orders, which were not recorded on the spread sheet used by the Company. The resulting situation called for immediate discussion with whole project team concerning the dropping efficiency and lack of priorities. Setting those priorities would increase the efficiency and growth of the SPI of the project. John Smith (CFO) promised to discuss it with Jack Brown (CEO) and convince him that the introduction of such working rules would serve both developers and improve the quality of their work.

Week 3 – The discussion results and contract misunderstanding

The third week brought visible effects of the discussion with John Smith (CFO). Jack Brown (CEO) limited his visits to the developers, so developers could devote most of their time working on the Directory.

Table 3. Earned Value indicators after the third week of the Directory realization

SV	CV	SPI	CPI	EAC _t	EAC
63,49 zł	2 902,96 zł	1,01	2,73	96,89	13 277,78 zł
ETC	VAC	TCPI _t	TCPI	BAC	T _c
11 603,24 zł	23 018,18 zł	99,8%	91,6%	36 295,96 zł	98,25

Source: own study.

On the basis of these data, it appears that the developers were able to improve the efficiency of their work. Some of the tasks could be performed below the scheduled time which resulted in a CV increase in favour of the Company. Robert Allen and Martin Cooper spent the last week catching up on delayed tasks, so the project had developed an EV over the PV. Decreasing estimated at completion cost (EAC) increased the likelihood of a profit from the project for the Company.

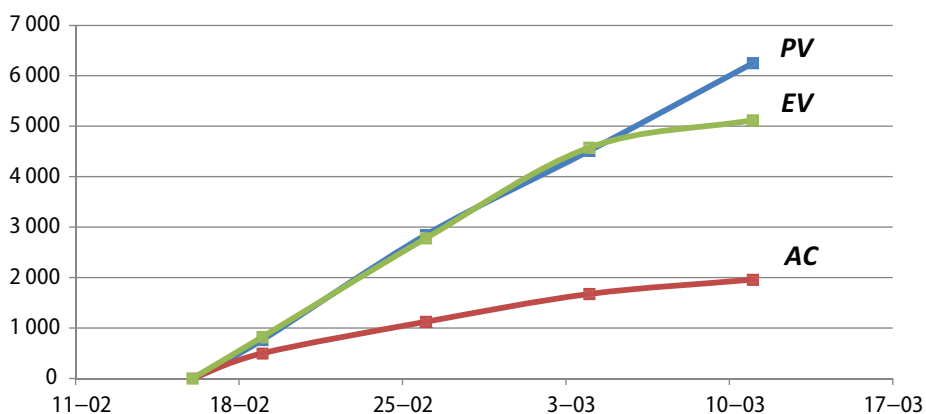
Although the results show that project could be finished with undoubted success, the developers' morale was very low, as it turned out that the revised agreement had not yet left the Company. It seemed that the developers were wasting their time on a project that may not come to official realization due to the lack of a signed contract. John Smith (CFO) said that he first wanted to see if the project progresses before deciding to sign a contract that contains penalties for exceeding the time limit. Also he wished to save extra time for a project to reduce the risk of those penalties. However, this strategy was not communicated to the developers, causing a morale drop. This situation showed that the communication problems in the company destroyed the working atmosphere and caused misunderstandings in the relationship between employees – owners.

After acknowledging the results of the EV analysis, John Smith (CFO) decided that the project should still be realized according to plan and the contract would be sent to the customer within the next week.

Week 4 – Altering the Company's website

The fourth week came with a breakthrough for the project, but not in a positive sense. Observing the curves in the graph below, a drastic change in the EV curve cannot be unnoticed.

The most significant change from the previous week was the dramatic decrease of the schedule variation which resulted in an estimated delay of 22 working days. This situation arose due to the fact that during the fourth week Jack Brown (CEO) decided to start new off project work and to implement some improvements in the Company's existing website and e-store. He believed that the website was unintuitive and unreadable, and therefore the Company did not receive new orders, and thus did not generate profit. Martin Cooper and Robert Allen argued that these changes were not big enough to bring any benefits to the Company so it would be better to realize tasks from the Directory project, which showed significant profits in the future. However, given the inflexible attitude of the owner, he had made a decision to introduce the changes, which took almost the whole week and showed no signs of being completed in the nearest future.

Figure 2. PV, EV and AC curves during the Directory project development

Source: own study.

Table 4. Earned Value indicators after the fourth week of the Directory realization

SV	CV	SPI	CPI	EAC_t	EAC
-1 130,56 zł	3 160,00 zł	0,82	2,61	119,95	13 892,53 zł
ETC	VAC	$TCPI_t$	TCPI	BAC	T_c
11 932,99 zł	22 403,43 zł	103,8%	90,8%	36 295,96 zł	98,25

Source: own study.

John Smith's (CFO) earlier decision to focus the efforts of developers on the project fell due to Jack Brown's (CEO) decision. Only a glance at Earned Value results showed that the project was in danger of failure in terms of duration. When the project coordinator presented the current project condition to John Smith (CFO) it turned out that the decision to modernize the site had not only been consulted with him, but he had believed that during the previous week all efforts were focused on the Directory realization. None of the tasks assigned by Jack Brown (CEO) had been included in the Company's spreadsheet, so no documentation remained of the work done during this week. This situation resulted in serious argument between the two co-owners and in a decision to stop the current Directory project and start the other one which was to implement the CRM system (Customer Relationship Management), to improve communication and registration of all tasks performed in the Company.

Week 5 – Implementation of CRM

As John Smith (CFO) announced, all employees of the Company have been involved in the creation of new working procedures and CRM customization to the current needs of the owners.

During the first three weeks of project development, the Earned Value results were satisfactory. The EV curve oscillated around the PV curve and the positive CV, not only made the project initially considered unprofitable became a profitable one for the Company, but also announced a profit of more than 15 000 zł in relation to the price proposed to the Client. Previous results showed the potential of the project and that it could be successful, if only the initial assumptions were followed. The key to success was to allow the developers to work on project tasks without ordering additional tasks that are not making any visible image or financial benefits.

For these reasons, the project coordinator proposed to the owners a kind of experiment – with the beginning of the next week the project should be carried out in accordance with the assumptions (2 hours service tasks and 6 hours on the project). If, after this one week period, Earned Value analysis results showed that there had been a significant reduction of the current schedule variance the value the owners would decide to continue the project. They both agreed to that proposal, and the experiment was to begin on Monday as promised. Unfortunately, on Monday, the decision was cancelled without explanation, an attempt to rescue the challenged project overruled, and the project was definitely abandoned.

5. Conclusions and summary

These findings indicate an extremely important and useful role of Earned Value for the described case study. Unfortunately, due to communication problems and a very destructive attitude of one of the owners of the Company, it was decided to cease the project after 4 weeks of realization. Several factors can be named that had a significant impact on the failure of the Directory project.

- Firstly, the owners had not had a defined vision of their organization. One could get the impression that each of them saw it differently, which caused communication and organization problems.
- Secondly, Jack Brown's (CEO) decisions, which did not yield visible benefits to the Company, divert developers' attention from the task, which could bring concrete profits. He also did not accept any suggestions that could improve the quality of work due to the "not invented here" syndrome.

- Thirdly, the enormous trust that John Smith (CFO) had for his partner, caused his limited interference in his decisions. He blindly believed that Jack Brown (CEO) was properly managing his scope of work, which resulted in deep ignorance of this part of the business. The analysis has shown him that the company is not functioning as it should and drastic measures must take place.

What is more, a big mistake was to delay the signing of the project contract. On the one hand John Smith (CFO) delayed signing the contract with the Client to see if the project was implemented according to plan and on that basis made a final decision on closing the deal. Jack Brown (CEO) on the other hand thought that if a contract was not signed, it would not be worth spending time and attention on the Directory realization. If the contract was signed before or just at the beginning of the planning phase of the project, it would be most likely some kind of motivation for both owners to focus on the project tasks, because the crossing time would involve the threat of the enforcement of penalties.

The final factor was the fact that the project coordinator, as an outsider, did not have any influence on the course of the project. His job was mainly to observe and try to use the current controlling techniques on the project and propose solutions based on the results that could improve the health of the project in the case of negative variances. Unfortunately, the proposed suggestions were ignored by Jack Brown (CEO). Even when John Smith (CFO) tried to convince Jack Brown (CEO) repeatedly to change the approach, after a few days of improvement, Jack Brown (CEO) always returned to his usual way of working.

The conducted observations and interviews came out with one application for the company – it was facing financial difficulties due to low profitability. However, before applying the presented analysis techniques it was not entirely clear what was causing this. Jack Brown (CEO) reported that the developers had all their time occupied because of the assigned tasks, but no money (profit) could be seen in the financial statement. The implementation of Earned Value analysis on the newly adopted project showed why the company did not conduct a profitable business. It had significant work organization problems and had neither any after-project documentation to record the actual costs and time necessary to implement new functionalities, nor a clear communication plan.

For the Company and its owners the Earned Value technique was a chance to implement lacking management procedures in order to improve working and control efficiency. For the very first time in the Company's existence the planning stage was carried out, which resulted in a specific definition of project schedule and budget. Already at this stage it appeared that currently used time and price estimation methods did not provide the correct numbers. After-project documentation

of the Directory was designed to be a reference for future orders, as it provided information on the actual costs and time of implementation of the different types of functionalities. This would allow the owners to make more aware management decisions.

Moreover, the tools used in the Earned Value technique (indicators and PV, EV and AC curves) provided specific and clear data that could be understood even for those who had not had a contact with this technique before. For the person retrieving the data from the chart message seemed clear: if the EV is below the PV and / or AC is above the EV, the project is not realized as planned adjustments must be made. Of course, a thorough analysis of the indicators provided more detailed information, but the fact that at first glance, it can be concluded that the results vary from the plan, becomes a big advantage of the technique.

From the perspective of the project manager Earned Value is a technique of great help in the process of controlling the project. Although, like all techniques using the traditional approach to management, it requires a lot of work in the planning and on-going updates on the results of the project in terms of EV and AC of performed tasks, it provides a detailed insight into the progress of the project at every stage of realization. Such continuous monitoring of the work performed and possibility to relate the results to a baseline allows recording even small variations in the time of their appearance. Therefore, the technique can be used as an "early warning system" against emerging risks and changes that affect the initial objectives of the project.

On the other hand, from the perspective of time and observation of behaviour that occurred in this case, you may notice some imperfections of the technique. First of all, with a very holistic approach to the results of the analysis (the project as a whole rather than individual tasks or work packages) from the project coordinator point of view some important information (like the efficiency of individual workers) can be overlooked. However, this may occur as a problem in every complex project, involving a large project team.

In order to provide the most benefits earned value technique requires organization to be mature enough to have basic project management practices in place. Those practices are for example: documented and accepted project requirements, WBS with complete scope statement, integrated project plan, effective project change management process and precise cost collection system.¹⁴ Successful EV implementation demands a company to make some extra effort that includes: firm commitment from

¹⁴ Lukas J., *Earned Value Analysis – Why it Doesn't Work*, AACE International Transactions; 2008; pg. EV11.

stakeholders to implement EV, more structure and discipline compared to non-earned value approach as well as accept increasing report generation and data processing.¹⁵

To conclude, the Earned Value is a very useful technique of controlling time and cost of the project. It provides very precise and clear information and a graphical representation of the method shows at first glance the current condition of the project on both the expected date of completion of the project (before or after the schedule) and a budget (is it exceeded or shows additional savings). Depending upon which project aspect sponsor cares the most (maintaining the budget, completing within the schedule or maintaining the quality and scope) the coordinator can use a number of adjustment strategies. Earned Value is a very good early warning system, as it allows one to monitor any negative trends almost as soon as they occur (depending on how often during the project further indicators are calculated).

It must be highlighted that the application of technology is not a guarantee of success, which depends on many different factors. In the case described, these were the communication and organizational problems and too little power of the project coordinator in the Company.

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