EARNED DURATION MANAGEMENT FOR A STUDENT ASSOCIATION PROJECT

By Mario Vanhoucke, Annelien Boelens, Hendrik D'hondt, Eline Hoornaert, Evelyn Mareels, Jens Martens and Tom Servranckx

INTRODUCTION

Earned Duration Management (EDM) is a state-of-the-art project control technique for the time dimension. Introduced by Khamooshi and Golafshani in 2014, this technique has the purpose to decouple the schedule performance and cost measures. Due to the novelty of the EDM approach, there clearly is a need to demonstrate the potential of this technique.

This paper is based on a project executed by five master students Business Engineering with a focus on Operations Management at Ghent University - Annelien Boelens, Hendrik D'hondt, Eline Hoornaert, Evelyn Mareels and Jens Martens – for the course module entitled "Project Management". This project, called 'Illustration of EDM by students", was selected as one of the best contributions by an external jury that included prof. dr. Mario Vanhoucke, research assistant Tom Servranckx and local consultants from PMI Belgium. In this project, the students applied the EDM technique upon a project in their everyday environment, i.e. the real-time follow-up of a student association event to control and compare the actual and the scheduled performance. During periodic meetings with the board members of the student association, the students discussed the project progress and recommended corrective actions in order to improve the performance.

In this paper, the starting event of Capitant, a famous student association in Belgium, is used as a case study to demonstrate the benefits and drawbacks of the EDM methodology. Since the main objective of a project from a student association is to meet the pre-defined deadline (i.e. the start of the event) and all board members are students, who are working on a voluntary and non-paid basis, the time dimension is the most important dimension to control the performance of the project. Therefore, this student association event is a relevant project to illustrate the potential of EDM.

Capitant is the largest student organization with a focus on finance in Belgium. Their main goal is to be the student's gateway to the financial market. This is made possible by organizing lectures and workshops about international finance in all its aspects. Their network of partner companies offers students an extra-curricular forum to contact these companies and to apply for an internship or a job. Capitant is active in Antwerp, Leuven, Brussels and Ghent. Capitant Ghent has more than 400 registered members a year that are participating in different lectures, workshops and events in order to get certified. Each year, more than 700 students are attending the starting event of Capitant Ghent, which is the subject of this case study.

FOREWORD BY MARIO VANHOUCKE

Before you read the remainder of this paper, it might be useful to clarify how this work has begun and how it finally resulted in – in my view – an exiting search for better control done by young students from our university. In my course module "Project Management" (PM) at the Faculty of Economics and Business Administration, I give my master students a full overview on how to manage a project using scheduling techniques, risk analysis methodologies and control methods such as Earned Value Management (EVM) and its time-based extension Earned Schedule (ES). Part of the evaluation of this course module is based on a written exam containing exercises and questions to test their understanding on the topic. However, another important part of the final evaluation consists of a group assignment in which I ask my students to rely on the PM concepts discussed in class and apply them in a real and critical way. Rather than giving my students a well-defined task to solve, I give them full freedom to explore the exiting world of PM, and ask them to apply and criticize concepts, improve them, tell me why some concepts work, and other fail, and any theme is good, as long as it is related to the course content. The best group assignments are nominated for the PMI Belgium University Contest and the winner is then invited to present their findings to professional project managers.

Students are not used to receiving such a task. Most of the tasks are well defined and have a clear goal, while mine is rather vaguely described, and it is up to the students to exactly define what they want to do. The students of the manuscript have chosen to apply the EVM/ES methodology for their own real projects (at Capitant) but quickly came up with a paper found at the International Journal of Project Management that discusses a new technique, Earned Duration Management (EDM), which is not discussed in my class. They asked me whether they could rely on this technique since it fit, in their opinion, better to what they needed. "It's your work, so you choose", was my immediate response, and I left them in the dark. Below you find an overview of what they did.

PROJECT

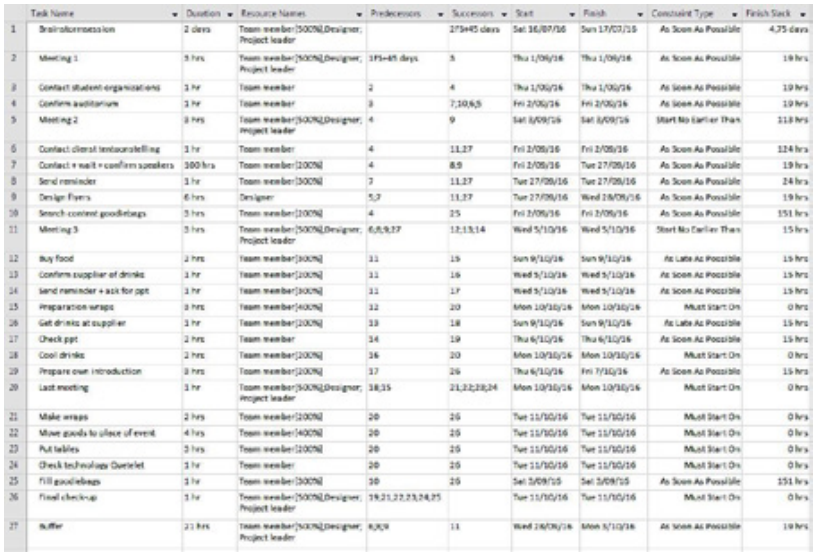
The network representation of the project investigated in this paper is given below. The critical path is marked in blue. The activity durations are indicated above the nodes (expressed in hours) and the resource requirements of each activity are displayed below the nodes. A distinction was made between three different types of resources: project leader, designer and team member. Even though in reality the students work for free, we assigned costs to the different resources in order to compare EDM with EVM/ES. We assumed for the project leader, designer and team member a cost of respectively 5, 3 and 1 euro. These costs are used to express the level of experience rather than real costs of the different resource types and are, therefore, assigned based on the relative difference in experience and expertise levels of these resources.

Figure1: The Capitant event project network.

The following resource constraints should be considered in order to obtain the baseline schedule presented in figure 2.

- The resource constraint is equal to 7, since Capitant Ghent counts 14 members of which 7 were assigned to this project. There are 5 team members, 1 team leader and 1 graphical designer.
- The team members of Capitant are students, so they cannot work 8 hours a day on a project. Therefore, we restricted a working day to a maximum of 4 hours a day. Only on the day of the event, we relaxed this constraint to 8 hours.
- One of the main requirements of this project is that it should be finished on October 11th. Neither later, nor earlier. That is why the constraint "Must Start On" was added to the final check-up activity. We also added this constraint to some other activities, as they had to be done on the day of the event: Making wraps, Move goods to place of the event, Put tables and Check technology Quetelet.

Sidebar footnotes



	Task Name	Duration	Resource Names	Predecessors	Successors	Start	Finish	Constraint Type	Finish Slack
1	Brainstormsession	2 days	Team member[50%],Designer, Project leader		2FS+45 days	Sat 16/07/16	Sun 17/07/16	As Soon As Possible	4,75 days
2	Meeting 1	3 hrs	Team member[50%],Designer, Project leader	1FS+45 days	5	Thu 1/09/16	Thu 1/09/16	As Soon As Possible	19 hrs
3	Contact student organizations	1 hr	Team member	2	4	Thu 1/09/16	Thu 1/09/16	As Soon As Possible	19 hrs
4	Confirm auditorium	1 hr	Team member	3	7;10;6;5	Fri 2/09/16	Fri 2/09/16	As Soon As Possible	19 hrs
5	Meeting 2	3 hrs	Team member[50%],Designer, Project leader	4	9	Sat 3/09/16	Sat 3/09/16	Start No Earlier Than	113 hrs
6	Contact clerat tentoonstelling	1 hr	Team member	4	11;27	Fri 2/09/16	Fri 2/09/16	As Soon As Possible	124 hrs
7	Contact + mail + confirm speakers	100 hrs	Team member[100%]	4	8;9	Fri 2/09/16	Tue 27/09/16	As Soon As Possible	19 hrs
8	Send reminder	1 hr	Team member[300%]	7	11;27	Tue 27/09/16	Tue 27/09/16	As Soon As Possible	24 hrs
9	Design flyers	6 hrs	Designer	5;7	11;27	Tue 27/09/16	Wed 28/09/16	As Soon As Possible	19 hrs
10	Search content goodiebags	5 hrs	Team member[100%]	4	25	Fri 2/09/16	Fri 2/09/16	As Soon As Possible	151 hrs
11	Meeting 3	3 hrs	Team member[50%],Designer, Project leader	6;8;9;27	12;13;14	Wed 5/10/16	Wed 5/10/16	Start No Earlier Than	15 hrs
12	Buy food	2 hrs	Team member[300%]	11	15	Sun 9/10/16	Sun 9/10/16	As Late As Possible	15 hrs
13	Confirm supplier of drinks	1 hr	Team member[200%]	11	16	Wed 5/10/16	Wed 5/10/16	As Soon As Possible	15 hrs
14	Send reminder + ask for ppt	1 hr	Team member[300%]	11	17	Wed 5/10/16	Wed 5/10/16	As Soon As Possible	15 hrs
15	Preparation wraps	0 hrs	Team member[400%]	12	20	Mon 10/10/16	Mon 10/10/16	Must Start On	0 hrs
16	Get drinks at supplier	1 hr	Team member[200%]	13	18	Sun 9/10/16	Sun 9/10/16	As Late As Possible	15 hrs
17	Check ppt	2 hrs	Team member	14	19	Thu 6/10/16	Thu 6/10/16	As Soon As Possible	15 hrs
18	Cool drinks	2 hrs	Team member[200%]	16	20	Mon 10/10/16	Mon 10/10/16	Must Start On	0 hrs
19	Prepare own introduction	3 hrs	Team member[200%]	17	26	Thu 6/10/16	Fri 7/10/16	As Soon As Possible	15 hrs
20	Last meeting	1 hr	Team member[300%],Designer, Project leader	18;15	21;22;23;24	Mon 10/10/16	Mon 10/10/16	Must Start On	0 hrs
21	Make wraps	2 hrs	Team member[200%]	20	28	Tue 11/10/16	Tue 11/10/16	Must Start On	0 hrs
22	Move goods to place of event	4 hrs	Team member[400%]	20	28	Tue 11/10/16	Tue 11/10/16	Must Start On	0 hrs
23	Put tables	3 hrs	Team member[200%]	20	28	Tue 11/10/16	Tue 11/10/16	Must Start On	0 hrs
24	Check technology Oerlelet	1 hr	Team member	20	28	Tue 11/10/16	Tue 11/10/16	Must Start On	0 hrs
25	Fill goodiebags	1 hr	Team member[300%]	10	28	Sat 3/09/16	Sat 3/09/16	As Soon As Possible	151 hrs
26	Final check-up	1 hr	Team member[50%],Designer, Project leader	19;21;22;23;24;25		Tue 11/10/16	Tue 11/10/16	Must Start On	0 hrs
27	Buffer	21 hrs	Team member[50%],Designer, Project leader	8;9;9	11	Wed 28/09/16	Mon 3/10/16	As Soon As Possible	19 hrs

Figure 2: The baseline schedule of the Capitant event project

ANALYSIS WITH EDM

In order to measure the performance of projects with EDM, the following key metrics are required: Earned Duration (ED), Total Planned Duration (TPD), Actual Duration (AD) (this is similar to the Actual Time (AT) metric used in EVM/ES) and Total Earned Duration (TED). The used performance index is the Duration Performance Index (DPI), which is calculated as ED / AD. Since we want to focus in this article on the illustration of the EDM technique rather than providing a complete theoretical explanation, we would strongly advice the interested reader to consult the article "Introduction to Earned Duration" from The Measurable News (2015.02) written by Vanhoucke, Andrade, Salvaterra and Batselier. In the table below (figure 3) a summary of the metrics and performance measures that are used in our analysis is given. It also shows the correspondence between the EVM/ES and EDM metrics.

	EVM	ES	EDM
Key Metrics	Planned Value (PV) Actual Cost (AC) Earned Value (EV)	Earned Schedule (ES)	Total Planned Duration (TPD) Total Actual Duration (TAD) Total Earned Duration (TED) Earned Duration (ED)
Performance Measures	Schedule Performance Index (SPI)	Schedule Performance Index (SPI(t))	Duration Performance Index (DPI)

Figure 3: Key and performance metrics used in this analysis

Figure 4 provides a plot of the TPD and TED over the entire project horizon. This indicates the periods in which the project suffers from a delay (TPD > TED) or is ahead of schedule (TPD < TED).

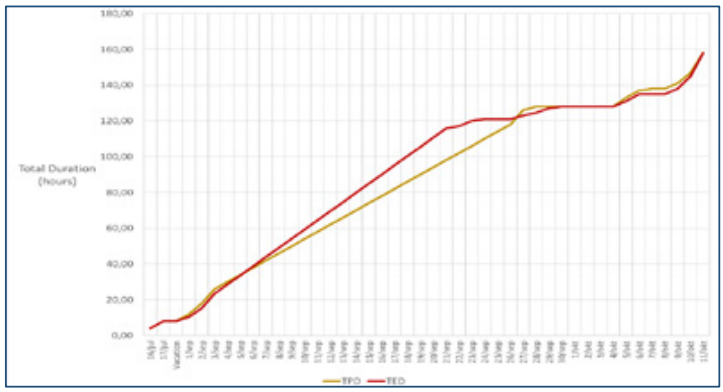


Figure 4: Evolution of the EDM Key metrics for the Capitant project

Some conclusions can be drawn, based on this graph:

- The Total Duration at Completion (TDC) is equal to 158 days.
- In general, the student association performed very well according to the baseline schedule as no significant delays could be identified throughout the project progress.
- From September 5th till September 26th, Capitant accomplished to stay ahead of schedule as the event speakers were much faster contacted than originally planned. A detailed discussion with the project members of Capitant taught us that this good schedule performance could be achieved thanks to the extensive professional network of the Capitant members.
- However, when we take a closer look, the performance of the project dropped towards its deadline on the 11th of October.

In the remainder of this section, we will provide a more in-depth analysis of the project performance towards the project completion. The period from September 20th till October 2nd is represented in the first part of figure 5. In order to better understand the drop in project performance, the key EDM metrics for this period are provided below:

- September 20th: **DPI = 119%**
  The time dimension is expressed in hours. Since we allocate 4 hours per day, September 20th corresponds to 88 hours (AD). The Earned Duration (ED) at September 20th can be computed exactly and is equal to 104,59 hours. A graphical estimation is shown on the graph in figure 5 (a).

  DPI = 104,59 hours / 88 hours = 1,19.
- September 29th: **DPI = 95%**
  September 29th corresponds to 124 hours (AD) and the equivalent ED level equals to 118 hours.

  DPI = 118 hours / 124 hours = 0,95.

Indeed, the performance has dropped with 24 percentage points in only 9 days. The strength of the EDM project control technique is that the project managers of Capitant can identify the cause(s) of the problems in that particular period of time in order to identify important lessons learned for the future. We immediately noticed delays in activity 8 and activity 9.

- Activity 8 "*Send reminder to the speakers*": This delay was caused by a negligence of the team members, who forgot to start this activity on time. Based on this observation, we decided to build in some safety checks to avoid that this problem would occur in future projects.
- Activity 9 "*Design the flyers*": We already mentioned that Capitant has a brand new designer this year. We would strongly recommend Capitant to have a talk with this board member in order to get to know the reason for the delay. Either we scheduled this task too sharp or the learning curve of the inexperienced designer will allow us to finish the task on time in future projects.

We used "meeting 3" to discuss these findings with the board members of the student association.

In the second part of figure 5, the project performance during the last week (i.e. October 3rd till October 11th) before the event is represented. We can conclude that the performance during this period (see figure 5 (b)) was below the average performance during the entire project (TPD > TED). The most considerable activities with delays are activity 13 (*Confirm the supplier of drinks*), activity 14 (*Send reminder to the speaker + Ask and check for their PowerPoint presentation*) and activity 19 (*Prepare own introduction*).

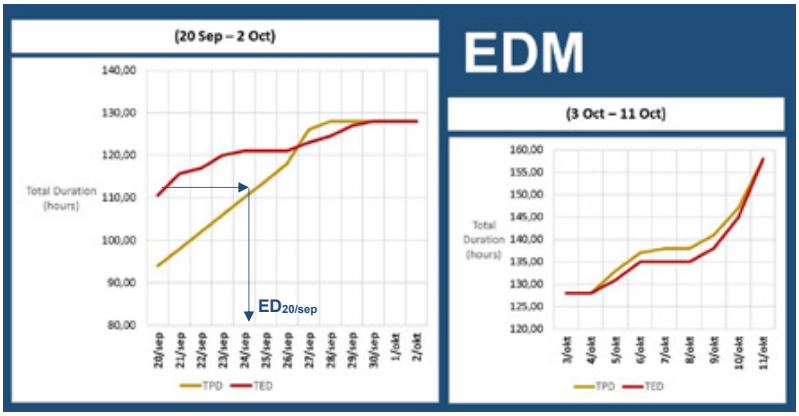


Figure 5(a,b): EDM Key metrics for the Capitant project

ANALYSIS COMPARED TO EVM/ES

Given the available data to control the performance of the project, the EVM/ES technique can also be used. The evolution of the Planned Value (PV) and the Earned Value (EV) of the last two weeks of this project are represented in figure 6.

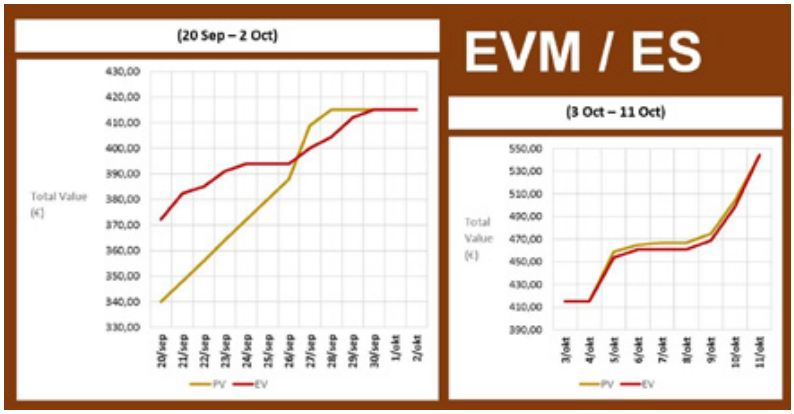


Figure 6: EVM/ES Key metrics

When we compare the graphs on figure 6 with the evolutions of the TPD and TED (see figure 5), there are no major differences detected between both techniques at first sight. But in order to thoroughly compare the two project control techniques, it might be useful to plot the evolution of DPI and SPI(t) over time on the same graph. This comparison is presented in figure 7.

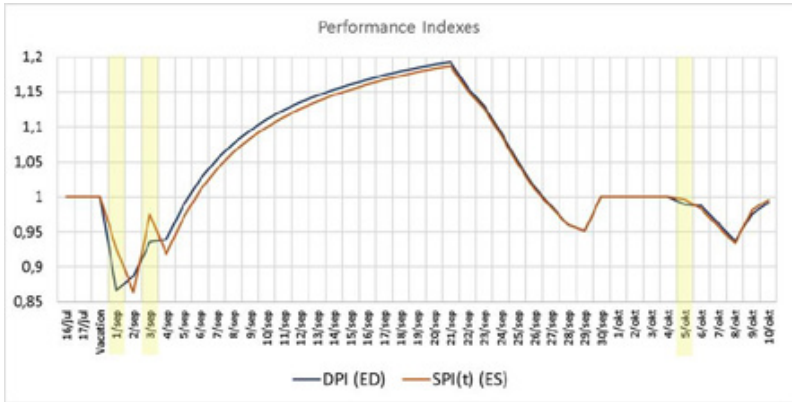


Figure 7: evolutions of the schedule performance indexes

We can conclude that DPI and SPI(t) are in general following the same trend. Nevertheless, there are some differences that might indicate that the EDM project control technique is more accurate than EVM/ES for the time dimension in this case study. At three particular

moments in time - that are highlighted in yellow in figure 7 - the project schedule performance indicated by DPI is lower than the schedule performance indicated by SPI(t). When we explore the real project data in more detail, we notice indeed a delay in the activities scheduled on September 1st, 2nd and October 5th. This delay in activities can be faster detected with the DPI schedule performance indicator. This is the main argument to prefer the EDM to the EVM/ES project control technique for this project. Obviously, these results cannot be generalized based on a single case study. Nevertheless, it was an important lesson to learn for the authors of this paper, particularly for the young master students with little to no real-life experience in managing projects.

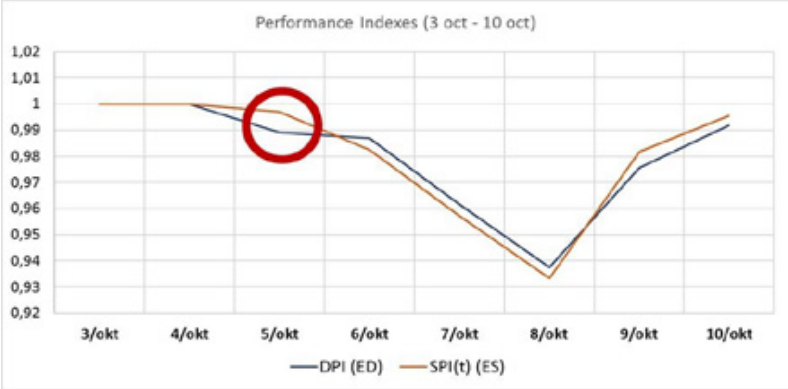


Figure 8: performance indexes from October 3 until October 10

For the sake of clarity, the observation of the schedule performance of the project around October 5th is explained in more detail. The conclusions for September 1st and 2nd can be drawn analogously. Figure 8 shows the evolutions of the DPI and SPI(t) performance indicators in more detail around October 5th. According to the project data of the baseline schedule (see figure 2), three activities are scheduled on October 5th: activity 11, 13 and 14. In reality, both activities 13 and 14 suffered from delays, which immediately resulted in a small drop of the DPI on October 5th. At the same time, the SPI(t)-indicator remained relatively constant on October 5th. However, the decline of the SPI(t) schedule performance is observed one day later, on October 6th. This delay can be explained as follows. When we explore the data of activities 11, 13 and 14, we notice that the delayed activities 13 and 14 have a relatively low cost rate per day compared to activity 11, which was executed on time:

- Activity 11: € 39,00/day
- Activity 13: € 2,00/day
- Activity 14: € 3,00/day.

As such, the contribution of activities 13 and 14 to the SPI(t) is relatively low compared to the contribution of activity 11. Because activity 11 was completed on time, the SPI(t)-value remained relatively high on October 5th despite the fact that there were two other activities delayed that day.

CONCLUSION

The purpose of this paper was not to investigate the advantages and disadvantages of EVM/ES/EDM techniques, but rather to illustrate that young students at Ghent University with a background in Operations Management and Project Management, but with little to no real-life experience, are able to rely on well established as well as novel project control methodologies to run their projects. It can be concluded that, during this specific case study, DPI was experienced to be a better performance controller for the time dimension than SPI(t). This is because EDM reacts more quickly than ES (at least, in this case study), so the delays are observed more in advance and a corrective action can be taken sooner. For projects where schedule performance is the main goal, we strongly recommend the use of EDM project control techniques as a valuable alternative for the time control methodology proposed by ES.

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