

	Case Name: Family home	Sector	Construction (residential building)
	OR-AS Operations Research - Applications and Solutions www.or-as.be info@or-as.be	Baseline Schedule	Schedule with resources
			Schedule with costs
		Risk Analysis	Random simulation
Submitted by	Stef Pauwels and Emile Van de Walle		One of nine std. scenarios
Date	June 2023		User defined distributions
File Name	C2023-08	Project Control	Automatic tracking
			Tracking based on user input

1. Project description

Project authenticity

This project consisted of constructing a three-story family home with accompanying practice space. At the moment of writing, 26th of May 2022, the building is still under construction. On this date, the project is two weeks behind schedule. The current cost is still within the expected budget. The "law of Breyne" was applicable here, as the contractor sold the building before construction. As a result, the contractor must pay a few tens of euros per day if the construction is late. The client also had the option to divide the final payment into several installments, which were to be paid upon completion of each building phase.

2. Project properties

2.1. Baseline Schedule

General	
# Activities	49
Planned Duration (PD)	382
Budget At Completion (BAC)	€438 622
Renewable Resources	-
Consumable Resources	-

* standard eight-hour working days

Network topology	
Serial/Parallel (SP)	53%
Activity Distribution (AD)	59%
Length of Arcs (LA)	6%
Topological Float (TF)	17%

2.2. Risk Analysis

Random simulation by ProTrack was performed using the default symmetric triangular risk distribution profiles.

	Cost sensitivity		
	avg [%]	std dev [%]	skew [-]
CRI-r	0	0	N/A
CRI-rho	1	0	N/A
CRI-tau	1	0	N/A

	Resource sensitivity		
	avg [%]	std dev [%]	skew [-]
CRI-r	N/A	N/A	N/A
CRI-rho	N/A	N/A	N/A
CRI-tau	N/A	N/A	N/A

	Time sensitivity		
	avg [%]	std dev [%]	skew [-]
CI	54.17	50.15	-17.27
SI	51.72	45.71	7.85
SSI	6.1	11.24	222.46
CRI-r	11.87	13.65	180.02
CRI-rho	13.09	14.2	160.17
CRI-tau	13.28	15.27	414.74

2.3. Project Control

2.3.1. Simulated forecasting accuracy

The accuracy of time and cost forecasting methods has been evaluated based on Monte Carlo simulation runs using the risk profiles described in section “2.2. Risk Analysis”. Based on these risk profiles, the Mean Absolute Percentage Error (MAPE) and Mean Percentage Error (MPE) has been calculated to evaluate the expected accuracy of the time and cost predictions, EAC(t) and EAC, respectively.

Simulated EAC(t) accuracy			Simulated EAC accuracy		
method - PF	MAPE [%]	MPE [%]	method (PF)	MAPE [%]	MPE [%]
PV - 1	38.03	-25.78	1	0	0
PV - SPI	37.66	-17.3	CPI	0	0
PV - SCI	37.66	-17.3	SPI	5.73	5.67
ED - 1	47.75	-11.39	SPI(t)	3.2	3.2
ED - SPI	37.66	-17.3	SCI	5.73	5.67
ED - SCI	37.66	-17.3	SCI(t)	3.2	3.2
ES - 1	46.33	-46.06	0.8 CPI + 0.2 SPI	1.69	1.68
ES - SPI(t)	44.53	-43.08	0.8 CPI + 0.2 SPI(t)	0.83	0.83
ES - SCI(t)	44.53	-43.08			

According to the MAPE values¹ the best performance for time forecasting can be expected from the unweighted Earned Schedule method. For cost forecasting the unweighted and CPI-weighted methods should yield the best results.

2.3.2. Tracking description

Tracking authenticity

Manual tracking was performed over 28 tracking periods with a length of approximately one week. The Real Duration and Real Cost mentioned in section “2.3.3. Earned Value Management” are based on manual user input.

The tracking information obtained from the project owner and introduced in ProTrack includes actual activity start dates, durations and costs.

¹ The MAPE gives the best indication for the forecast accuracy (the lower the MAPE, the more accurate the method) since all deviations from the targeted real duration (real cost) are cumulated, whereas for the MPE underestimates can be compensated by overestimates and vice versa, possibly leading to an overly positive evaluation of a certain method. However, the MPE can provide useful information about the nature of the deviations, i.e. does the method rather underestimate or overestimate the real duration (real cost)?

2.3.3. Earned Value Management

2.3.3.1. Performance metrics

	CV [€]	SV [€]	SV(t) [d]	CPI [-]	SPI [-]	SPI(t) [-]	p-factor [-]
avg	3500	-5687.5	-13.25	1.03	0.97	0.97	1
std dev	7000	10718.70	15.44	0.05	0.06	0.04	0
final	0	-1000	-29	1	0.99	0.93	1

2.3.3.2. Time forecasting

PD	273 days	Real Duration	302 days	Late	10,47%
----	----------	---------------	----------	------	--------

EAC(t)			Real Accuracy	
method - PF	avg [d]	std dev [d]	MAPE [%]	MPE [%]
PV - 1	440.31	11.07	-46.07	46.07
PV - SPI	449.92	29.46	-49.26	49.26
PV - SCI	439.21	8.16	-45.71	45.71
ED - 1	442.93	15.92	-46.94	46.94
ED - SPI	449.92	29.46	-49.26	49.26
ED - SCI	444.74	19.13	-47.54	47.54
ES - 1	444.26	11.84	-47.38	47.38
ES - SPI(t)	450.82	19.33	-49.56	49.56
ES - SCI(t)	446.02	15.86	-47.97	47.97

2.3.3.3. Cost forecasting

BAC	€438 622	Real Cost	€ 477 438	Over budget	8.85%
-----	----------	-----------	-----------	-------------	-------

EAC			Real Accuracy	
method (PF)	avg [€]	std dev [€]	MAPE [%]	MPE [%]
1	435122	7000	8.86	8.86
CPI	428902.37	19439.27	10.17	10.17
SPI	445138.16	12107.99	6.77	6.77
SPI(t)	445202.03	9089.12	6.75	6.75
SCI	438062.05	2167.63	8.25	8.25
SCI(t)	438515.93	15907.11	8.15	8.15
0.8 CPI + 0.2 SPI	431622.71	14186.91	9.6	9.6
0.8 CPI + 0.2 SPI(t)	431819.33	16120.55	9.55	9.55