

	Case Name: Wine storage expansion	Sector	Construction (industrial)
	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	C2023-09	Project Control	Automatic tracking
			Tracking based on user input

1. Project description

Project authenticity

A private-sector construction group led this project near Frankfurt. The project progressed remarkably well, with minimal additional costs and successful adherence to the predetermined deadline. However, there was a budget reallocation due to an unforeseen expense caused by the need for an extra in-house team. This supplementary cost primarily pertained to the roof installation on May 31st. This cost was deducted from the project-specific miscellaneous expenses, which had not yet been allocated to any specific activities or secured by a contractor. As a result, the final cost amounted to 464.187,00 euros, exceeding budget by 1,19%, but ultimately aligning with the baseline schedule and its corresponding cost. The overall profit margin of the project remained at 15,23%, which was perceived as a success within the construction company.

2. Project properties

2.1. Baseline Schedule

General	
# Activities	28
Planned Duration (PD)	80 days*
Budget At Completion (BAC)	€ 458 688.44
Renewable Resources	-
Consumable Resources	-

* standard eight-hour working days

Network topology	
Serial/Parallel (SP)	61%
Activity Distribution (AD)	69%
Length of Arcs (LA)	0%
Topological Float (TF)	61

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	0	0	N/A
CRI-rho	0	0	N/A
CRI-tau	0	0	N/A

	Time sensitivity		
	avg [%]	std dev [%]	skew [-]
CI	36	48	0.61
SI	27	37	1.32
SSI	11	18	1.59
CRI-r	18	17	1.57
CRI-rho	20	18	1.43
CRI-tau	17	21	3.10

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	29.7	-2.8	1	0	0
PV - SPI	43.2	14.5	CPI	0	0.0
PV - SCI	43.2	14.5	SPI	11.0	11.0
ED - 1	36.0	-7.3	SPI(t)	10.8	10.8
ED - SPI	31.1	14.5	SCI	11.0	11.0
ED - SCI	31.1	14.5	SCI(t)	10.8	10.8
ES - 1	21.1	-20.9	0.8 CPI + 0.2 SPI	5.3	5.3
ES - SPI(t)	31.1	11.4	0.8 CPI + 0.2 SPI(t)	5.3	5.3
ES - SCI(t)	31.1	11.4			

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	931.78	729.73	-0.39	1.02	1	0.99	0.99
std dev	12878.33	1631	0.90	0.06	0	0.02	0.02
final	-5498.56	0	0	0.99	1	1	1

2.3.3.2. Time forecasting

PD	80 days	Real Duration	120 days	Late	50%
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EAC(t)	Real Accuracy			
method - PF	avg [d]	std dev [d]	MAPE [%]	MPE [%]
PV - 1	85.36	0.32	0.29	0.29
PV - SPI	85.36	0.32	0.29	0.29
PV - SCI	84.36	4.69	0.3	0.3
ED - 1	85.46	0.11	0.29	0.29
ED - SPI	85.36	0.32	0.29	0.29
ED - SCI	84.28	2.92	0.3	0.3
ES - 1	85.79	0.64	0.28	0.28
ES - SPI(t)	86.46	2.16	0.28	0.28
ES - SCI(t)	85.26	1.13	0.29	0.29

2.3.3.3. Cost forecasting

BAC	€ 458 688.44	Real Cost	€ 464 186.97	Over Budget	
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EAC	Real Accuracy			
method (PF)	avg [€]	std dev [€]	MAPE [%]	MPE [%]
1	457756.63	12878.34	0.02	0.01
CPI	452172.68	25588.37	0.03	0.03
SPI	457716.31	12830.33	0.02	0.01
SPI(t)	460469.72	7483.3	0.01	0.01
SCI	452131.31	25551.03	0.03	0.03
SCI(t)	454580.26	20300.91	0.03	0.02
0.8 CPI + 0.2 SPI	453173.77	23236.79	0.03	0.02
0.8 CPI + 0.2 SPI(t)	453610.92	22302.57	0.03	0.02