

 OR-AS Operations Research Applications and Solutions	Case Name: House renovation	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 04, 2023		User defined distributions
File Name	C2023-01	Project Control	Automatic tracking
			Tracking based on user input

1. Project description

Project authenticity

The renovation of a house. The project's progression was somewhat similar to those of the building projects. Ultimately the project execution went very smoothly; the project was completed within time and budget.

The project consists of activity, resource and cost data that were obtained directly from the actual project owner.

2. Project properties

2.1. Baseline Schedule

General	
# Activities	29
Planned Duration (PD)	271 days*
Budget At Completion (BAC)	€ 756,647
Renewable Resources	1
Consumable Resources	-

* standard eight-hour working days

Network topology	
Serial/Parallel (SP)	46%
Activity Distribution (AD)	41%
Length of Arcs (LA)	51%
Topological Float (TF)	30%

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	27,59	45,49	1,06
CRI-rho	100	0	-
CRI-tau	100	0	-

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

	Time sensitivity		
	avg [%]	std dev [%]	skew [-]
CI	15,62	21,81	3,07
SI	23,07	17,55	2,66
SSI	3,48	16,46	5,37
CRI-r	6,03	17,78	5,30
CRI-rho	6,07	17,98	5,29
CRI-tau	5,41	17,18	5,25

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	-	-	1	-	-
PV - SPI	-	-	CPI	-	-
PV - SCI	-	-	SPI	-	-
ED - 1	-	-	SPI(t)	-	-
ED - SPI	-	-	SCI	-	-
ED - SCI	-	-	SCI(t)	-	-
ES - 1	-	-	0.8 CPI + 0.2 SPI	-	-
ES - SPI(t)	-	-	0.8 CPI + 0.2 SPI(t)	-	-
ES - SCI(t)	-	-			

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	17642,90	7621,65	19,20	2,73	0,9	1,08	0,99
std dev	14684,83	49032,29	29,18	3,43	0,33	0,20	0,01
final	0	50,00	65,00	1,00	1,00	1,32	1,00

2.3.3.2. Time forecasting

PD	271 days	Real Duration	203 days	Early	25,00%
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EAC(t)			Real Accuracy	
method - PF	avg [d]	std dev [d]	MAPE [%]	MPE [%]
PV - 1	200,60	92,013	0,37	0,02
PV - SPI	316,72	322,82	0,94	-0,55
PV - SCI	191,25	192,36	0,69	0,06
ED - 1	199,87	90,17	0,36	0,02
ED - SPI	316,72	322,82	0,94	-0,55
ED - SCI	194,99	192,81	0,69	0,04
ES - 1	184,19	113,13	0,41	0,10
ES - SPI(t)	190,70	124,19	0,45	0,06
ES - SCI(t)	114,62	92,36	0,44	0,44

2.3.3.3. Cost forecasting

BAC	€ 756,647	Real Cost	€ 756,647	Within Budget	0%
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EAC			Real Accuracy	
method (PF)	avg [€]	std dev [€]	MAPE [%]	MPE [%]
1	739.005,04	14684,83	2,33	2,33
CPI	546.061,72	287360,39	27,83	27,83
SPI	1.063.264,57	746153,64	46,23	-40,52
SPI(t)	760.861,53	77884,17	6,74	-0,56
SCI	733.186,76	467106,69	37,38	3,1
SCI(t)	555.957,64	277170,11	26,52	26,52
0.8 CPI + 0.2 SPI	565.509,97	273872,06	25,26	25,26
0.8 CPI + 0.2 SPI(t)	558.032,65	275237,54	26,25	26,25