OR-AS Operations Research Applications and Solutions	Case Name: **Office Finishing Works (3)**	Sector	Construction (Commercial 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	■
			One of nine std. scenarios	
Submitted by	N/A		User defined distributions	
Date	August 7, 2013	Project Control	Automatic tracking	
File Name	C2013-15 Office Finishing Works (3).p2x		Tracking based on user input	■

1. Project description

Project authenticity

The finishing works inside an office building, comprising the interior joinery and the placement of plaster walls, partition walls (also acoustic) and suspended ceilings.

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

2. Project properties

2.1. Baseline Schedule

General	
# Activities	17
Planned Duration (PD)	171 days*
Budget At Completion (BAC)	341.468 €
Renewable Resources	-
Consumable Resources	-

Network topology	
Serial/Parallel (SP)	25%
Activity Distribution (AD)	43%
Length of Arcs (LA)	21%
Topological Float (TF)	35%

* standard eight-hour working days

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	17.8	14.9	0.6
CRI-rho	20.1	15.7	0.6
CRI-tau	16.4	22.7	3.1

	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	11.8	32.2	2.6
SI	26.8	29.3	1.8
SSI	7.8	22.0	2.9
CRI-r	13.9	22.4	2.5
CRI-rho	16.1	23.5	2.0
CRI-tau	17.6	25.9	2.4

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		
method - PF	MAPE [%]	MPE [%]
PV - 1	10.0	6.9
PV - SPI	35.3	33.0
PV - SCI	35.6	33.5
ED - 1	122.5	119.6
ED - SPI	35.3	32.9
ED - SCI	35.3	33.0
ES - 1	5.5	4.4
ES - SPI(t)	19.3	19.0
ES - SCI(t)	19.5	19.3

Simulated EAC accuracy		
method (PF)	MAPE [%]	MPE [%]
1	1.2	-0.4
CPI	1.7	0.1
SPI	24.4	24.3
SPI(t)	15.2	15.2
SCI	24.5	24.5
SCI(t)	15.5	15.4
0.8 CPI + 0.2 SPI	16.0	15.8
0.8 CPI + 0.2 SPI(t)	5.8	5.5

According to the MAPE values[1] 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 6 tracking periods with a length of approximately one month. 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	19.684	103.589	51.92	0.98	14.81	2.03	0.81
std dev	23.866	73.156	25.90	0.24	26.91	0.54	0.22
final	33.124	46.108	51.00	1.11	1.16	1.42	1.00

2.3.3.2. Time forecasting

PD	171 days

Real Duration	120 days

Early	29.82%

EAC(t)			**Real Accuracy**	
method - PF	avg [d]	std dev [d]	MAPE [%]	MPE [%]
PV - 1	119.10	36.64	26.8	-0.7
PV - SPI	66.06	46.98	52.7	-44.9
PV - SCI	60.50	40.78	53.3	-49.6
ED - 1	61.92	52.73	57.4	-48.4
ED - SPI	66.06	46.98	52.7	-44.9
ED - SCI	65.67	46.54	52.3	-45.3
ES - 1	119.08	25.90	17.8	-0.8
ES - SPI(t)	89.23	20.13	25.6	-25.6
ES - SCI(t)	98.04	13.76	18.3	-18.3

2.3.3.3. Cost forecasting

BAC	341.468 €

Real Cost	308.344 €

Under Budget	9.70%

EAC			**Real Accuracy**	
method (PF)	avg [€]	std dev [€]	MAPE [%]	MPE [%]
1	321.784	23.866	6.4	4.4
CPI	384.872	151.623	28.2	24.8
SPI	215.859	101.104	30.0	-30.0
SPI(t)	253.339	60.327	17.8	-17.8
SCI	216.966	98.727	29.6	-29.6
SCI(t)	274.341	28.078	11.0	-11.0
0.8 CPI + 0.2 SPI	244.258	89.475	20.8	-20.8
0.8 CPI + 0.2 SPI(t)	313.41	24.644	6.4	1.6