OR-AS Operations Research Applications and Solutions	Case Name: **Office Finishing Works (4)**	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 User defined distributions
Submitted by	N/A		
Date	August 7, 2013	Project Control	Automatic tracking
File Name	C2013-16 Office Finishing Works (4).p2x		Tracking based on user input

1. Project description

Project authenticity

The finishing works inside an office building, mainly consisting of the placement of partition walls (also acoustic).

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	7
Planned Duration (PD)	196 days*
Budget At Completion (BAC)	248.204 €
Renewable Resources	-
Consumable Resources	-

Network topology	
Serial/Parallel (SP)	33%
Activity Distribution (AD)	62%
Length of Arcs (LA)	0%
Topological Float (TF)	75%

* 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	20.4	32.6	2.5
CRI-rho	34.9	31.3	1.3
CRI-tau	45.4	44.8	0.4

	Time sensitivity		
	avg [%]	std dev [%]	skew [-]
CI	42.9	49.5	0.4
SI	38.6	41.7	0.7
SSI	29.7	35.2	0.6
CRI-r	26.3	31.9	1.2
CRI-rho	40.7	27.4	0.3
CRI-tau	47.6	39.1	0.3

	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

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	26.5	-1.8
PV - SPI	45.1	17.9
PV - SCI	45.5	17.4
ED - 1	183.3	153.2
ED - SPI	45.1	17.9
ED - SCI	45.1	17.7
ES - 1	5.6	-4.8
ES - SPI(t)	19.2	18.4
ES - SCI(t)	19.0	18.2

Simulated EAC accuracy		
method (PF)	MAPE [%]	MPE [%]
1	0.9	0.1
CPI	0.2	0.0
SPI	15.1	15.1
SPI(t)	10.1	10.1
SCI	15.1	15.1
SCI(t)	10.1	10.1
0.8 CPI + 0.2 SPI	13.2	13.2
0.8 CPI + 0.2 SPI(t)	4.5	4.5

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 CPI-weighted method should yield the best results.

2.3.2. Tracking description

Tracking authenticity

Manual tracking was performed over 5 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	27.23	-6.295	28.45	1.12	0.96	1.23	0.98
std dev	25.94	8.372	39.02	0.20	0.04	0.35	0.02
final	49.637	556	65.00	1.25	1.00	1.50	1.00

2.3.3.2. Time forecasting

PD	196 days	Real Duration	131 days	Early	33.16%

EAC(t)			**Real Accuracy**	
method - PF	avg [d]	std dev [d]	MAPE [%]	MPE [%]
PV - 1	200.93	6.61	53.4	53.4
PV - SPI	204.30	8.90	56.0	56.0
PV - SCI	189.43	41.76	44.6	44.6
ED - 1	198.83	3.42	51.8	51.8
ED - SPI	204.30	8.90	56.0	56.0
ED - SCI	200.93	27.24	53.4	53.4
ES - 1	167.55	39.02	34.3	27.9
ES - SPI(t)	170.55	41.58	36.6	30.2
ES - SCI(t)	173.43	48.85	38.8	32.4

2.3.3.3. Cost forecasting

BAC	248.204 €	Real Cost	198.567 €	Under Budget	20.00%

EAC			**Real Accuracy**	
method (PF)	avg [€]	std dev [€]	MAPE [%]	MPE [%]
1	220.974	25.94	11.5	11.3
CPI	230.292	51.545	16.4	16.0
SPI	225.224	28.722	13.7	13.4
SPI(t)	223.064	26.86	12.6	12.3
SCI	234.485	53.651	18.3	18.1
SCI(t)	232.224	51.793	17.2	17.0
0.8 CPI + 0.2 SPI	228.461	45.362	15.3	15.1
0.8 CPI + 0.2 SPI(t)	228.021	44.924	15.1	14.8