OR-AS Operations Research Applications and Solutions	Case Name: **Building a Dream**	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	
			One of nine std. scenarios	
Submitted by	Giel-Jan Triest		User defined distributions	
Date	December 19, 2012	Project Control	Automatic tracking	
File Name	C2012-17 Building a Dream.p2x		Tracking based on user input	

1. Project description

Project authenticity

A young family building the house of their dreams.

The project consists of activity, resource and cost data that were created by the user.

2. Project properties

2.1. Baseline Schedule

General	
# Activities	33
Planned Duration (PD)	145 days*
Budget At Completion (BAC)	241.015 €
Renewable Resources	10
Consumable Resources	-

Network topology	
Serial/Parallel (SP)	65%
Activity Distribution (AD)	61%
Length of Arcs (LA)	35%
Topological Float (TF)	19%

* standard eight-hour working days

2.2. Risk Analysis

Standard simulation was performed using one of the nine predefined scenarios available in ProTrack. In this case scenario 9 was chosen, which is a so-called true scenario[1].

	Cost sensitivity		
	avg [%]	std dev [%]	skew [-]
CRI-r	11.4	16.4	2.0
CRI-rho	26.6	20.8	0.3
CRI-tau	39.9	41.3	0.7

	Time sensitivity		
	avg [%]	std dev [%]	skew [-]
CI	60.7	46.8	-0.5
SI	17.8	29.6	1.7
SSI	10.7	12.6	1.3
CRI-r	15.2	14.1	1.7
CRI-rho	15.3	13.8	1.7
CRI-tau	12.1	12.3	1.6

	Resource sensitivity		
	avg [%]	std dev [%]	skew [-]
CRI-r	50.8	24.8	0.3
CRI-rho	49.5	24.8	0.3
CRI-tau	35.7	20.4	0.6

[1] On average a project delay is predicted and indeed the project finishes behind schedule. Moreover, in this scenario critical as well as non-critical activities can be delayed (worst case).

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) have 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	17.5	17.3
PV - SPI	16.8	5.3
PV - SCI	27.5	-24.6
ED - 1	14.8	12.9
ED - SPI	15.2	0.5
ED - SCI	22.3	-14.4
ES - 1	13.4	13.4
ES - SPI(t)	6.4	4.0
ES - SCI(t)	11.6	-9.6

Simulated EAC accuracy		
method (PF)	MAPE [%]	MPE [%]
1	7.3	7.3
CPI	5.4	-3.9
SPI	9.6	-5.6
SPI(t)	5.7	-2.8
SCI	21.8	-21.1
SCI(t)	18.0	-17.4
0.8 CPI + 0.2 SPI	5.2	-3.8
0.8 CPI + 0.2 SPI(t)	5.1	-3.6

According to the MAPE values[2] the best performance for time forecasting can be expected from the SPI(t)-weighted Earned Schedule method. For cost forecasting the CPI- and SPI(t)-weighted methods should yield good results, but using the composite performance factors may be even better.

2.3.2. Tracking description

Tracking authenticity

Automatic tracking by ProTrack was performed over 41 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 simulation results.

Authenticity assessment is not relevant here as it is not possible to introduce any kind of tracking information obtained from the actual project owner when performing automatic tracking. Activity durations and corresponding costs were generated using the simulation method described in section “2.2. Risk Analysis”.

[2] 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	-46.466	-32.887	-29.44	0.75	0.79	0.75	0.99
std dev	23.297	26.559	16.84	0.07	0.14	0.06	0.05
final	-73.841	0	-59.63	0.77	1.00	0.71	1.00

2.3.3.2. Time forecasting

PD	145 days

Real Duration	204 days

Late	40.69%

EAC(t)			**Real Accuracy**	
method - PF	avg [d]	std dev [d]	MAPE [%]	MPE [%]
PV - 1	164.49	15.95	19.5	-19.5
PV - SPI	189.39	34.88	14.9	-7.3
PV - SCI	255.99	54.07	28.8	25.3
ED - 1	174.92	26.55	16.9	-14.4
ED - SPI	200.87	36.55	14.8	-1.7
ED - SCI	232.96	54.27	22.8	14.0
ES - 1	172.77	17.64	15.5	-15.5
ES - SPI(t)	193.24	13.70	5.5	-5.5
ES - SCI(t)	222.48	23.78	11.9	8.9

2.3.3.3. Cost forecasting

BAC	241.015 €

Real Cost	314.856 €

Over Budget	30.64%

EAC			**Real Accuracy**	
method (PF)	avg [€]	std dev [€]	MAPE [%]	MPE [%]
1	287.481	23.297	8.7	-8.7
CPI	324.726	23.193	6.3	3.1
SPI	328.914	40.566	8.6	4.5
SPI(t)	322.248	20.997	5.2	2.4
SCI	380.93	75.443	23.3	21.0
SCI(t)	371.877	39.572	20.4	18.1
0.8 CPI + 0.2 SPI	324.703	22.827	6.0	3.1
0.8 CPI + 0.2 SPI(t)	324.053	21.839	5.9	2.9