

	Case Name: Pumping Station Jabbeke	Sector	Construction (Civil)
	OR-AS Operations Research - Applications and Solutions www.or-as.be info@or-as.be	Baseline Schedule Schedule with resources Schedule with costs	
Submitted by	Niels Crommen	Risk Analysis Random simulation One of nine std. scenarios User defined distributions	
Date	December 20, 2012		
File Name	C2012-13 Pumping Station Jabbeke.p2x	Project Control Automatic tracking Tracking based on user input	

1. Project description

Project authenticity

The renovation of three pumps used to prevent creeks from overflowing by removing the water from the polder and pumping it into the nearby canal. All main activities are controlled by a general low voltage panel, which also has to be installed. The pumping station is situated in Jabbeke (Belgium).

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	74
Planned Duration (PD)	125 days*
Budget At Completion (BAC)	336,410 €
Renewable Resources	2
Consumable Resources	-

* standard eight-hour working days

Network topology	
Serial/Parallel (SP)	64%
Activity Distribution (AD)	59%
Length of Arcs (LA)	3%
Topological Float (TF)	27%

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	10.2	10.6	2.8
CRI-rho	15.2	14.9	1.6
CRI-tau	32.4	24.8	1.3

	Resource sensitivity		
	avg [%]	std dev [%]	skew [-]
CRI-r	54.0	44.0	N/A
CRI-rho	55.0	43.0	N/A
CRI-tau	43.0	43.0	N/A

	Time sensitivity		
	avg [%]	std dev [%]	skew [-]
CI	58.5	48.6	-0.3
SI	64.1	42.6	-0.5
SSI	4.5	10.7	6.0
CRI-r	10.1	12.4	3.8
CRI-rho	14.1	16.1	2.2
CRI-tau	34.7	24.2	1.3

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	14.3	-14.3	1	0.3	-0.2
PV - SPI	21.2	4.0	CPI	0.3	0.0
PV - SCI	21.2	4.3	SPI	12.2	12.2
ED - 1	21.2	-21.2	SPI(t)	14.6	14.5
ED - SPI	21.2	4.0	SCI	12.3	12.2
ED - SCI	21.2	4.1	SCI(t)	14.6	14.6
ES - 1	12.4	-11.4	0.8 CPI + 0.2 SPI	4.0	3.9
ES - SPI(t)	18.6	15.4	0.8 CPI + 0.2 SPI(t)	5.5	5.5
ES - SCI(t)	18.7	15.5			

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	-5,717	6,471	-6.01	0.98	1.00	0.97	0.98
std dev	5,381	17,755	8.89	0.02	0.10	0.12	0.04
final	-14,101	0	-15.00	0.96	1.00	0.89	1.00

2.3.3.2. Time forecasting

PD	125 days
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Real Duration	140 days
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Late	12.00%
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EAC(t)		Real Accuracy		
method - PF	avg [d]	std dev [d]	MAPE [%]	MPE [%]
PV - 1	127.41	6.60	9.0	-9.0
PV - SPI	125.72	11.14	10.5	-10.2
PV - SCI	128.47	13.46	9.6	-8.2
ED - 1	128.50	7.48	8.5	-8.2
ED - SPI	126.83	12.03	10.0	-9.4
ED - SCI	127.46	12.59	9.7	-9.0
ES - 1	131.01	8.89	7.7	-6.4
ES - SPI(t)	130.16	15.09	10.2	-7.0
ES - SCI(t)	130.90	15.73	10.3	-6.5

2.3.3.3. Cost forecasting

BAC	336,410 €
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Real Cost	350,511 €
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Over Budget	4.19%
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EAC		Real Accuracy		
method (PF)	avg [€]	std dev [€]	MAPE [%]	MPE [%]
1	342,127	5,381	2.4	-2.4
CPI	343,266	6,632	2.1	-2.1
SPI	337,585	18,034	4.1	-3.7
SPI(t)	338,319	21,039	4.7	-3.5
SCI	338,86	19,596	4.1	-3.3
SCI(t)	339,646	22,476	5.0	-3.1
0.8 CPI + 0.2 SPI	341,966	9,025	2.5	2.4
0.8 CPI + 0.2 SPI(t)	342,046	9,433	2.5	-2.4