

	Case Name: Wind Farm	Sector	Construction (Industrial)	
	OR-AS Operations Research - Applications and Solutions www.or-as.be info@or-as.be	Baseline Schedule	Schedule with resources	
		Risk Analysis	Schedule with costs	
			Random simulation	
Submitted by	N/A		One of nine std. scenarios	
Date	December 21, 2011		User defined distributions	
File Name	C2011-13 Wind Farm.p2x	Project Control	Automatic tracking	
			Tracking based on user input	

1. Project description

Project authenticity

The construction of a wind farm of moderate size. The project also includes the preliminary application for permits and study phase.

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	134
Planned Duration (PD)	525 days*
Budget At Completion (BAC)	21,369,836 €
Renewable Resources	-
Consumable Resources	-

* standard eight-hour working days

Network topology	
Serial/Parallel (SP)	27%
Activity Distribution (AD)	36%
Length of Arcs (LA)	0%
Topological Float (TF)	48%

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	7.2	9.5	2.6
CRI-rho	24.4	19.8	0.4
CRI-tau	41.9	41.8	0.6

	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	2.2	14.6	6.6
SI	5.9	16.4	4.9
SSI	1.1	8.6	9.0
CRI-r	7.9	10.2	4.1
CRI-rho	18.1	18.7	1.2
CRI-tau	31.0	36.6	1.2

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			Simulated EAC accuracy		
method - PF	MAPE [%]	MPE [%]	method (PF)	MAPE [%]	MPE [%]
PV - 1	73.8	64.7	1	0.3	0.0
PV - SPI	97.3	97.3	CPI	0.3	0.0
PV - SCI	97.4	97.4	SPI	18.2	18.2
ED - 1	3,830.9	3,830.9	SPI(t)	15.5	15.5
ED - SPI	97.3	97.3	SCI	18.2	18.2
ED - SCI	97.2	97.2	SCI(t)	15.5	15.5
ES - 1	32.9	32.1	0.8 CPI + 0.2 SPI	17.5	17.5
ES - SPI(t)	42.0	41.3	0.8 CPI + 0.2 SPI(t)	10.4	10.4
ES - SCI(t)	42.1	41.3			

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 120 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	-1,212,377	-1,362,871	-60.74	0.88	0.73	0.79	0.96
std dev	1,662,289	2,079,884	58.21	0.14	0.22	0.22	0.07
final	-4,707,924	0	-75.00	0.82	1.00	0.88	1.00

2.3.3.2. Time forecasting

PD	525 days
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Real Duration	600 days
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Late	14.29%
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EAC(t)			Real Accuracy	
method - PF	avg [d]	std dev [d]	MAPE [%]	MPE [%]
PV - 1	558.47	51.10	10.3	-6.9
PV - SPI	825.00	382.25	44.5	37.5
PV - SCI	1000.22	550.11	70.9	66.7
ED - 1	623.35	84.51	11.3	3.9
ED - SPI	830.07	378.66	43.7	38.3
ED - SCI	928.38	485.02	59.7	54.7
ES - 1	585.74	58.21	8.4	-2.4
ES - SPI(t)	746.01	303.24	32.4	24.3
ES - SCI(t)	776.94	302.46	35.6	29.5

2.3.3.3. Cost forecasting

BAC	21,369,836 €
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Real Cost	26,077,765 €
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Over Budget	22.03%
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EAC			Real Accuracy	
method (PF)	avg [€]	std dev [€]	MAPE [%]	MPE [%]
1	22,582,199	1,662,288	13.4	-13.4
CPI	25,235,928	5,194,968	16.2	-3.2
SPI	33,431,001	14,843,602	34.9	28.2
SPI(t)	31,021,181	11,800,454	29.1	19.0
SCI	38,812,898	20,889,201	55.1	48.8
SCI(t)	34,115,094	11,979,936	38.3	30.8
0.8 CPI + 0.2 SPI	26,147,863	5,326,868	14.9	0.3
0.8 CPI + 0.2 SPI(t)	25,491,463	3,739,957	11.2	-2.3