

 <b>OR-AS</b> Operations Research Applications and Solutions	Case Name: Steel industry- cleaning of the IC584	Sector	Engineering	
	<b>OR-AS</b> Operations Research - Applications and Solutions <a href="http://www.or-as.be">www.or-as.be</a> <a href="mailto:info@or-as.be">info@or-as.be</a>	Baseline Schedule	Schedule without resources	
			Schedule with costs	
		Risk Analysis	Random simulation	
Submitted by	Stef Pauwels and Emile Van de Walle		One of nine std. scenarios	
Date	June 4, 2023		User defined distributions	
File Name	C2023-06	Project Control	Automatic tracking	
			Tracking based on user input	

## 1. Project description

Project authenticity

The company, operating in the steel industry, has to annually perform a highly sensitive project of the IC584 (converter installation). The cleaning of this boiler necessitates a halt to all other activities surrounding it.

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	844
Planned Duration (PD)	10 days and 21 hours*
Budget At Completion (BAC)	94,825,504.00 €
Renewable Resources	-
Consumable Resources	-

\* standard 24-hours working days

Network topology	
Serial/Parallel (SP)	10%
Activity Distribution (AD)	54%
Length of Arcs (LA)	0%
Topological Float (TF)	77%

### 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	2.47	15.52	6.14
CRI-rho	100.00	0.0	-
CRI-tau	100.00	0.0	-

	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	0.36	2.29	8.79
SI	4.71	11.07	4.00
SSI	0.37	4.13	13.50
CRI-r	4.62	6.39	1.63
CRI-rho	27.38	20.86	0.07
CRI-tau	56.58	40.10	0.05

## 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	26.5	26.0	1	0.0	0.0
PV - SPI	29.2	28.7	CPI	0.0	0.0
PV - SCI	29.2	28.7	SPI	3.3	2.9
ED - 1	24.8	29.1	SPI(t)	3.9	3.5
ED - SPI	28.7	27.7	SCI	3.3	2.7
ED - SCI	28.7	27.7	SCI(t)	3.9	3.5
ES - 1	29.7	29.6	0.8 CPI + 0.2 SPI	2.1	1.8
ES - SPI(t)	40.6	40.4	0.8 CPI + 0.2 SPI(t)	2.3	2.0
ES - SCI(t)	40.6	40.4			

\*\*values are stated according on the figure

According to the MAPE values<sup>1</sup> the best performance for time forecasting can be expected from the unweighted Earned Duration method. For cost forecasting the unweighted and CPI-weighted methods should yield the best results.

Tracking authenticity

### 2.3.2. Tracking description

Manual tracking was performed over 17 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.

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<sup>1</sup> 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	4297440.06	-14967560.5	2.69	1.26	0.75	0.59	0.75
std dev	7479481.78	14453864.23	1.72	0.42	0.27	0.42	0.42
final	-684,208.00	0.0	3.38	0.99	0.01	0.76	0.01

#### 2.3.3.2. Time forecasting

PD	10.88 days	Real Duration	10.24 days	Ahead	-6%
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EAC(t)			Real Accuracy	
method - PF	avg [d]	std dev [d]	MAPE [%]	MPE [%]
PV - 1	9.04	1.19	14.39	11.70
PV - SPI	12.25	6.09	41.06	-19.62
PV - SCI	9.99	5.19	32.41	2.40
ED - 1	9.00	0.78	12.10	12.10
ED - SPI	12.66	5.80	36.99	-23.69
ED - SCI	10.81	4.98	27.94	-5.56
ES - 1	9.74	1.16	8.58	4.87
ES - SPI(t)	15.54	6.72	57.78	-51.82
ES - SCI(t)	12.73	3.96	32.67	-24.38

#### 2.3.3.3. Cost forecasting

BAC	94,825,504.0€	Real Cost	95,509,712.0€	Over Budget	1%
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EAC			Real Accuracy	
method (PF)	avg [€]	std dev [€]	MAPE [%]	MPE [%]
1	90,528,064.00	7,479,482.97	6.10	5.22
CPI	80,593,316.50	19,567,239.54	16.54	15.62
SPI	129,329,133.00	64,738,824.36	36.04	-35.41
SPI(t)	141,366,837.25	58,746,439.88	48.19	-48.01
SCI	110,430,616.50	59,382,762.07	27.26	-15.62
SCI(t)	115,467,608.25	39,245,096.97	25.07	-20.90
0.8 CPI + 0.2 SPI	84,034,631.50	18,237,242.54	13.67	12.01
0.8 CPI + 0.2 SPI(t)	84,321,488.00	17,833,739.73	12.99	11.71