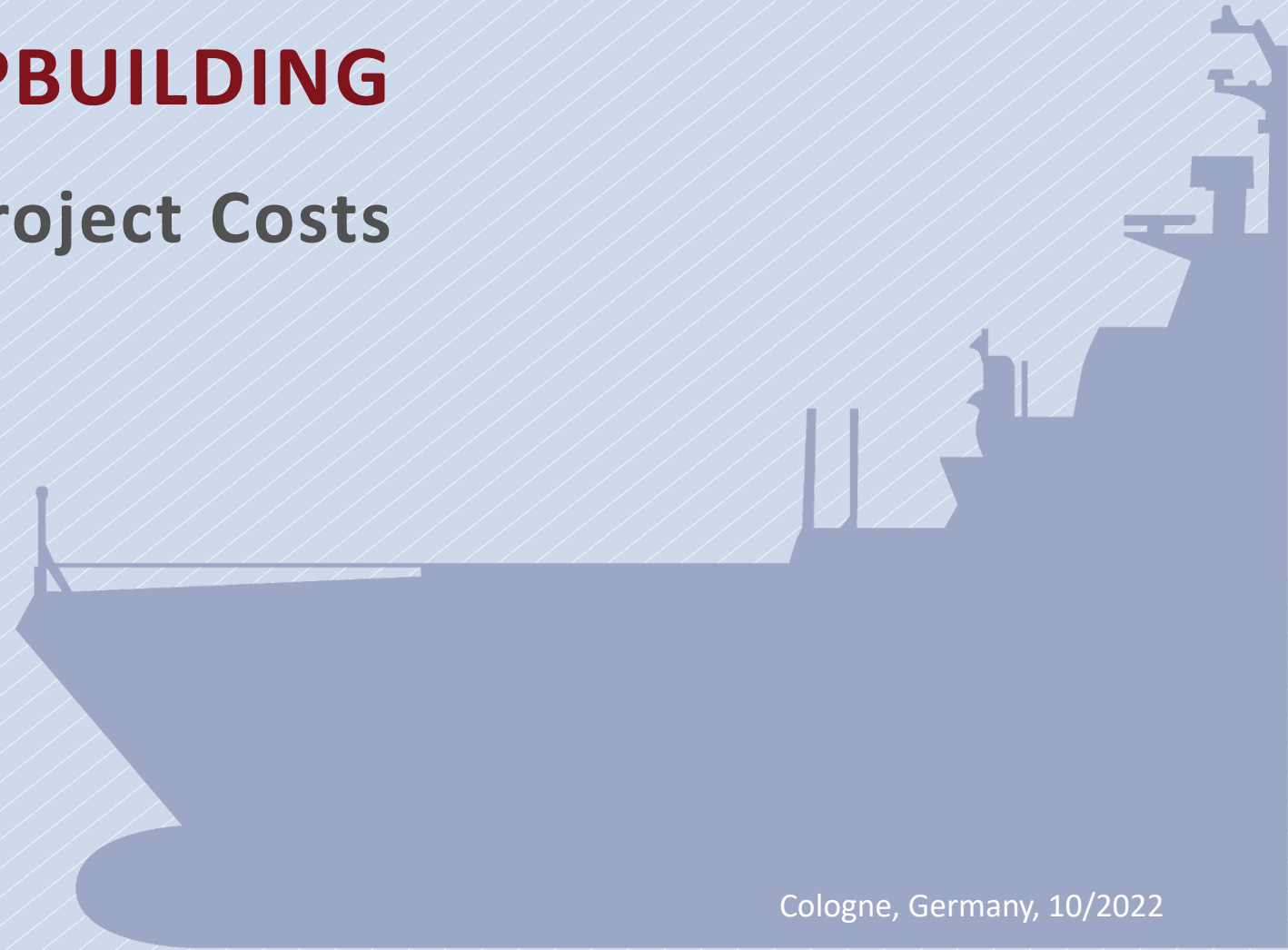


COST ESTIMATION IN SHIPBUILDING

Estimating and Optimizing Project Costs



Cologne, Germany, 10/2022

About CostFact

The cost estimation system “CostFact” is the number one in maritime specialized costing software. It was developed by the German company COSTFACT GmbH in close cooperation with several of the world’s leading shipyards, which means that a number of best-practice methods have been incorporated into the system, covering all of a shipyard’s estimation demands.

CostFact has been field-tested for more than ten years. In 2018, the worth of ship newbuilding projects which were actively processed by the users in CostFact, exceeded the amount of 20 billion euros.

COSTFACT USERS



 **LÜRSSEN**


FERRETTIGROUP
PASSION. INNOVATION. EXCELLENCE.




thyssenkrupp
thyssenkrupp
Marine Systems



 **VT Halter Marine**
A company of VT Systems




LARSEN & TOUBRO



**GERMAN NAVAL
YARDS KIEL**

NOBISKRUG

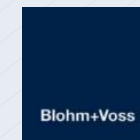
 **SHIPTEC**


ABE KING & RASMUSSEN



Shipyard Hermann
Barthel


AZIMUT
YACHTS

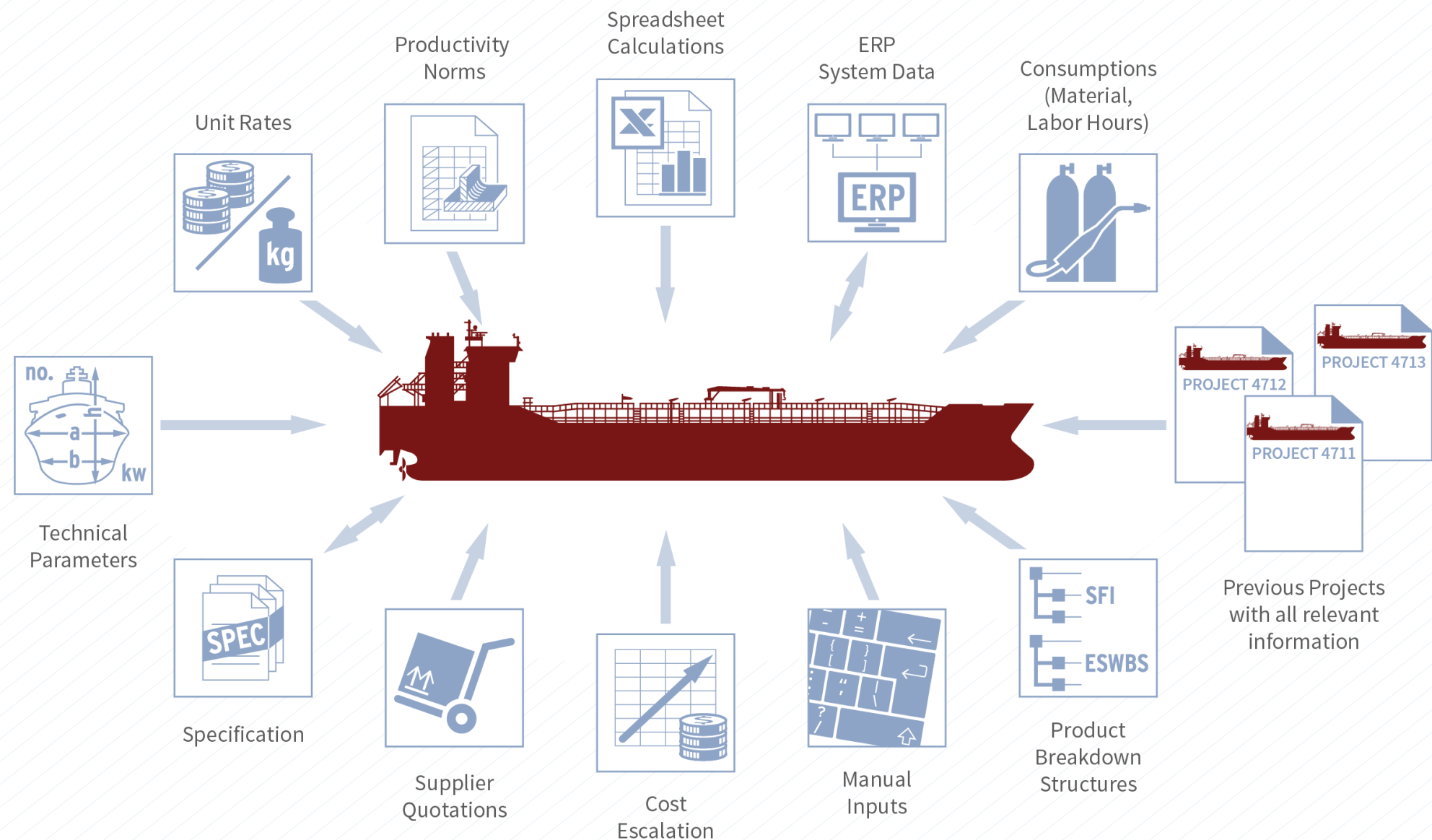



FLENSBURGER
SCHIFFBAU-GESELLSCHAFT

TURQUOISE
YACHTS

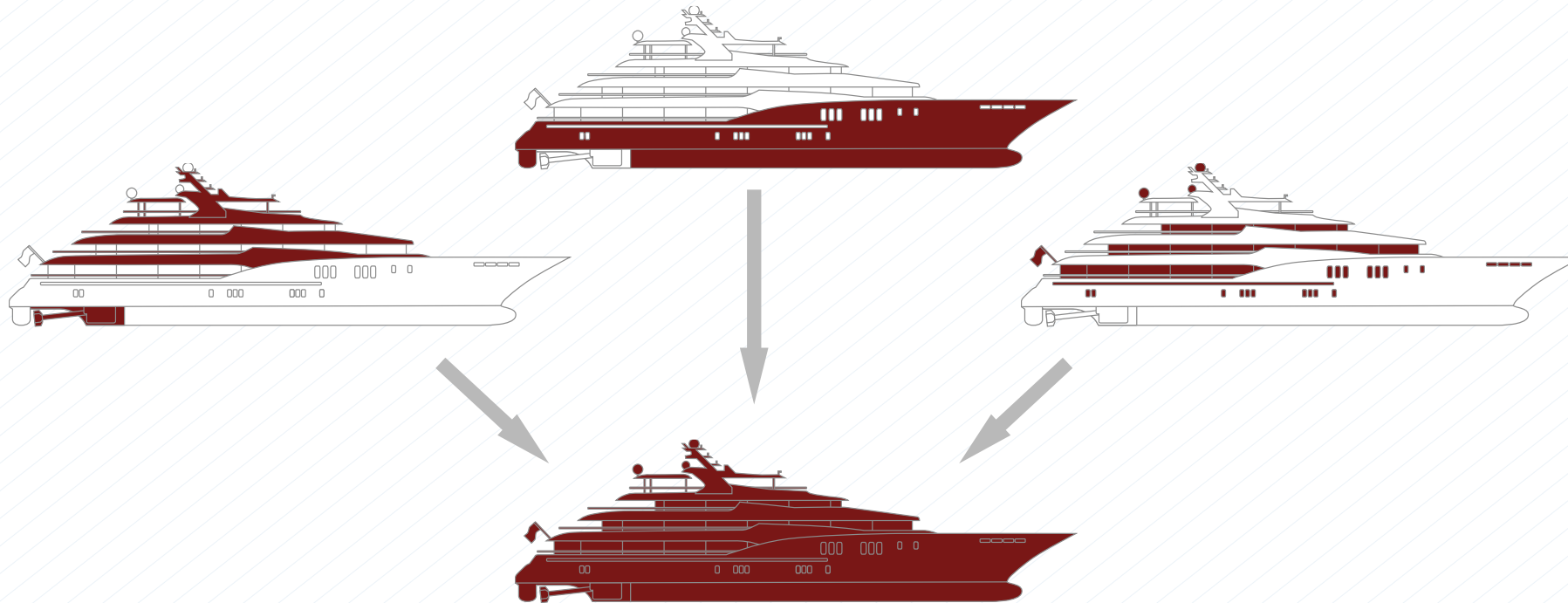

Alblasserdam Shipbuilding

CostFact: Integration of All Relevant Information



Create Estimates by Analogous Method

Cost estimations based on existing calculations (proposals, realized projects, uploads of estimates from spreadsheets) allow to generate reliable quotations very quickly.



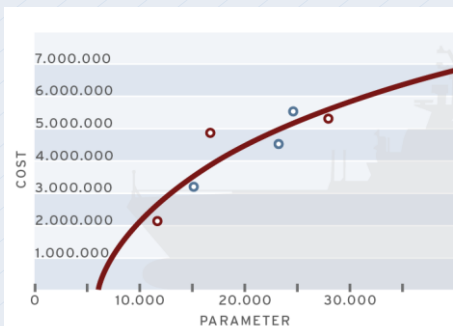
“CostFact reduces the time until a first cost indication is available from 14 days to 4 hours.”

Oliver Andresen, ThyssenKrupp Marine Systems (Hamburg, Germany)

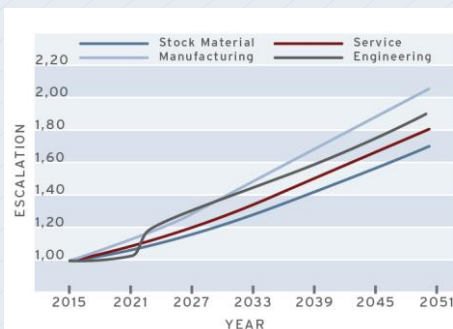
Data Re-Use and Update According to the Current Use Case



Cost Estimation Relationships

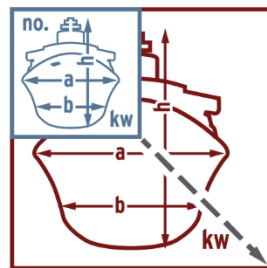


Price Escalation

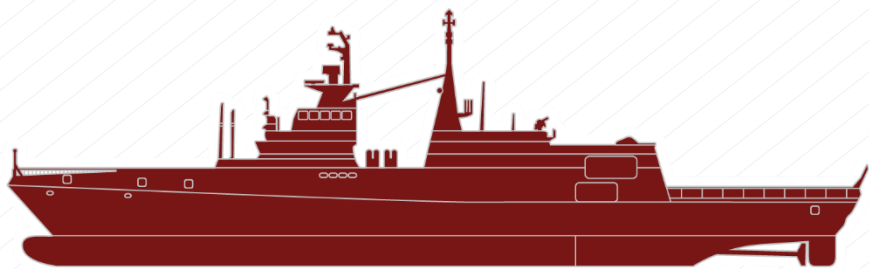
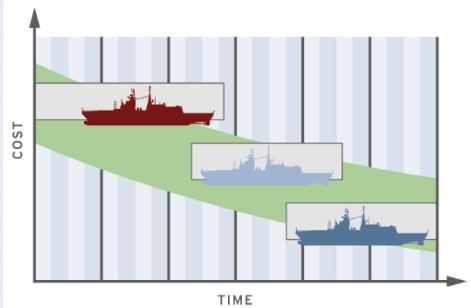


During importing, cost and hours
can be updated automatically,
under full user control.

Scaling and Parametrization

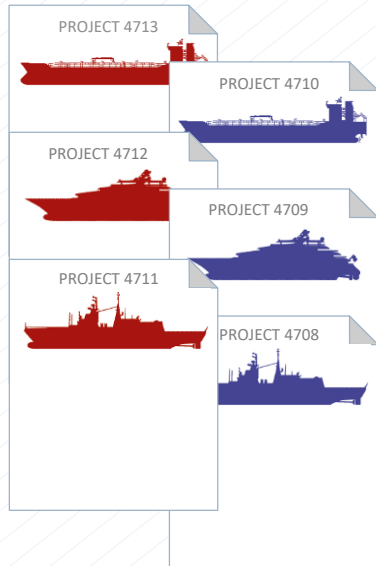


Learning curves in ship series

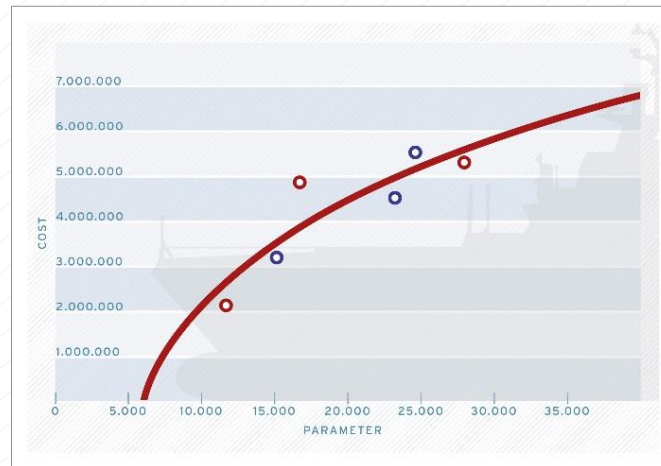


Incorporation of technical parameters for cost prognoses and project comparisons.

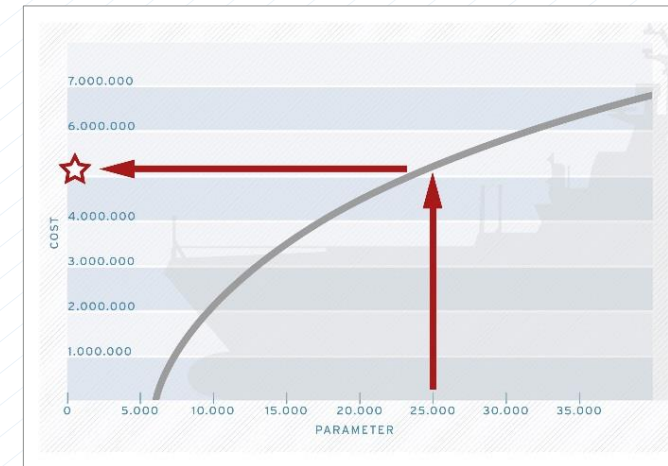
Previous Projects



Regression Analysis



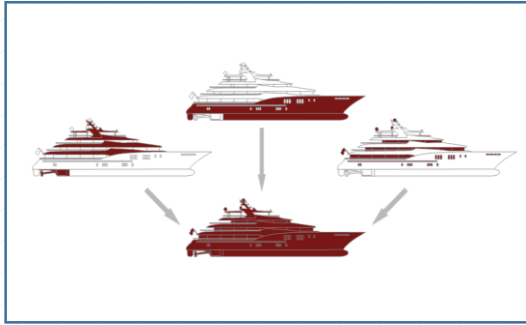
Cost Forecast Current Project



“CostFact is a powerful cost management tool. It enables an impartial cost evaluation and comparison of most different alternative ship designs.”

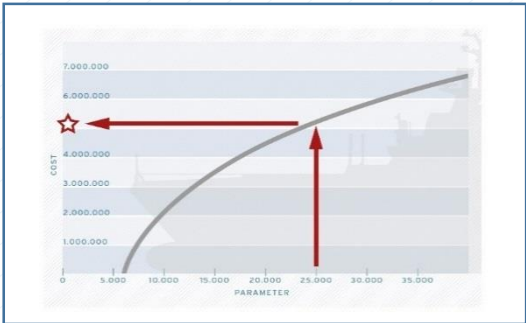
Rolf Nagel, Flensburger Shipbuilders (Flensburg, Germany)

Combine Estimation Approaches



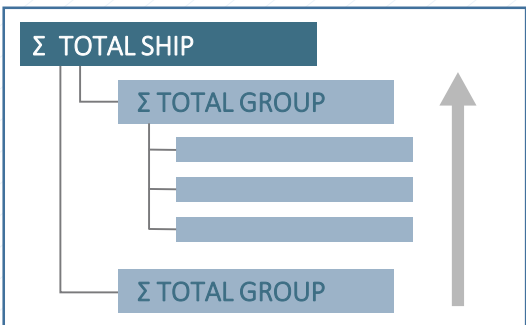
Analogy Approach

Top-down cost estimation that forecasts the cost of a new ship or group based on the historical cost of one or several similar systems.



Parametric Approach

Top-down cost estimation where different regression modules are used to forecast the cost of a new building group or working tasks based on selected cost drivers.

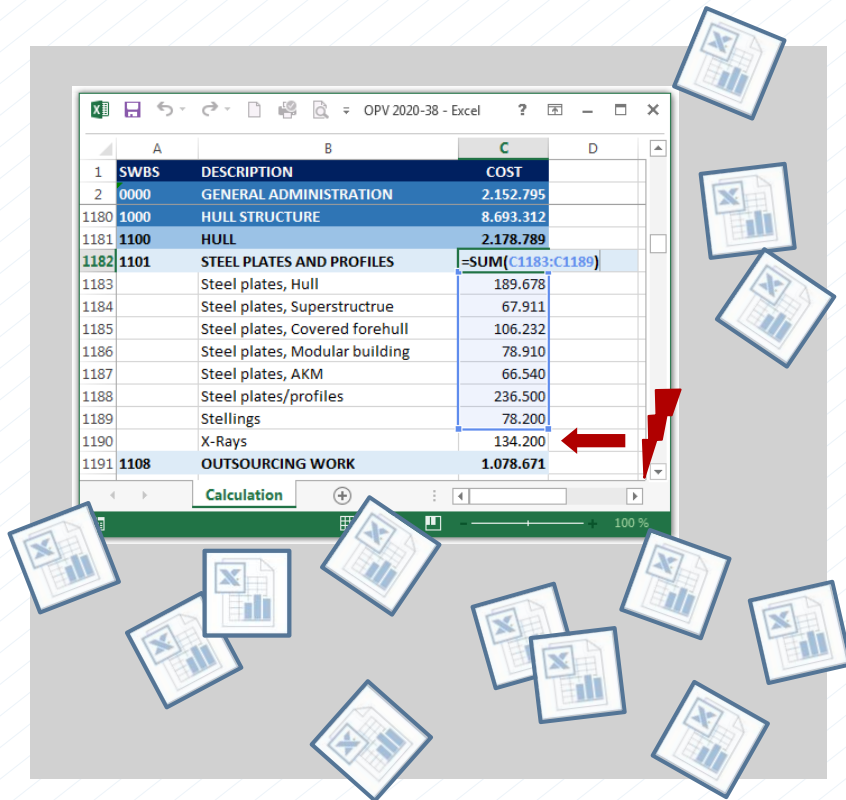


Engineering Approach

Bottom-up cost estimation starting from the level of single cost items within the product breakdown structure and building up to estimate the total cost of a new ship.

Select the optimal approach according to the current project stage and the information available.

Replace spreadsheets by a professional, databased shipbuilding program.

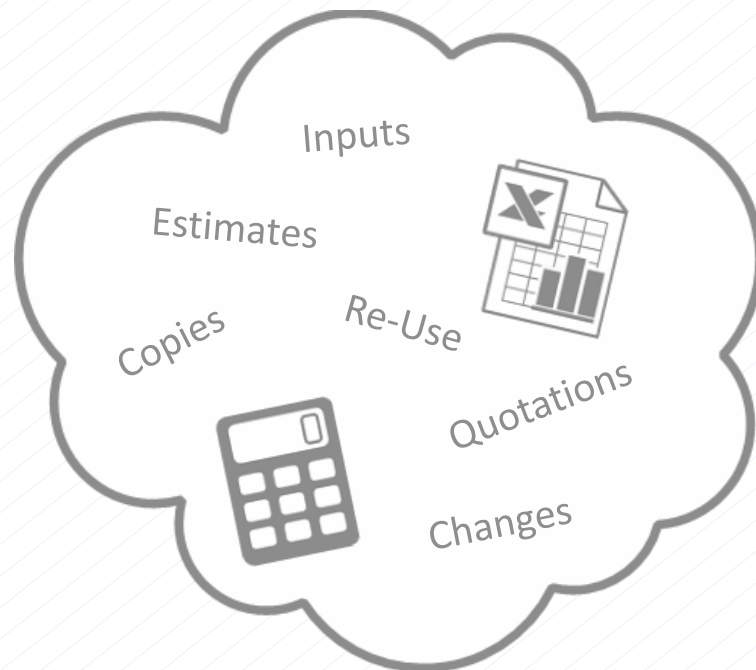


SWBS	DESCRIPTION	COST
0000	GENERAL ADMINISTRATION	2.152.795
1000	HULL STRUCTURE	8.693.312
1100	HULL	2.178.789
1101	STEEL PLATES AND PROFILES	=SUM(C1183:C1189)
1183	Steel plates, Hull	189.678
1184	Steel plates, Superstructure	67.911
1185	Steel plates, Covered forehull	106.232
1186	Steel plates, Modular building	78.910
1187	Steel plates, AKM	66.540
1188	Steel plates/profiles	236.500
1189	Stellings	78.200
1190	X-Rays	134.200
1108	OUTSOURCING WORK	1.078.671

- Similar project structures, independent from client, user etc.
- No errors due to incorrect links in spreadsheets
- Clear and substantial version control

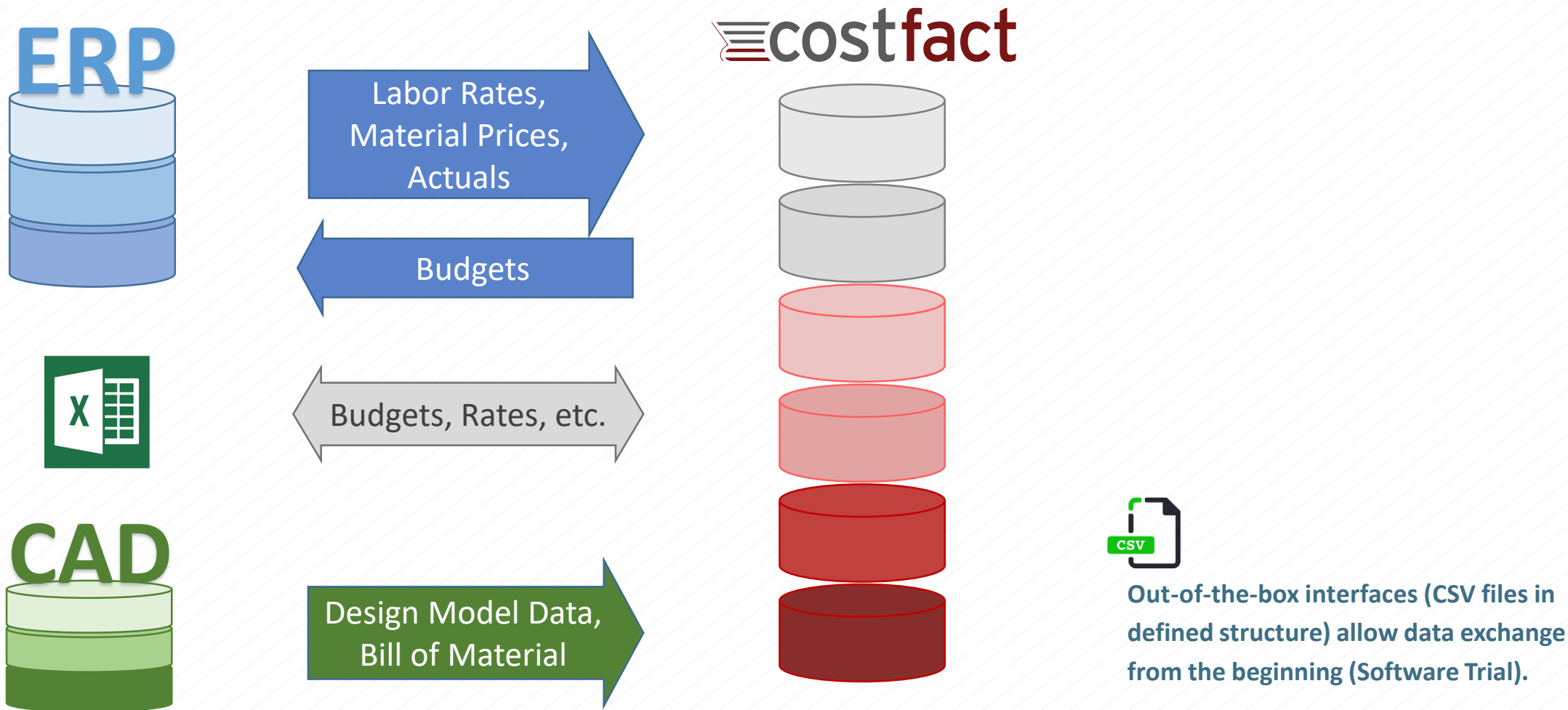


Automatically created cost history that documents all single cost inputs and cost changes.
Plenty analyses give insight into data structure and quality.



- Source of numbers and figures
- WHO changed WHAT and WHEN
- Cost proportion covered by supplier quotations
- Insight into the reliability of the calculation including prospective deviation
- ETC.





None of CostFact's advanced program features is mandatory when working on a basic calculation

→ All elementary tasks can be carried out after 3 hours training

Utilization of CostFact

Basic Calculation

Advanced Features



"CostFact is easy, nice and friendly."

Danielle Fisher, Southern African Shipyards
(Durban, South Africa)

COSTFACT'S TOP BENEFITS

- Information Management
- Efficiency & Quality
- Parametrical Cost Prediction
- Clarity & Single Source of Truth
- Information Control
- Chaos Avoidance
- Trouble-Free Integration
- Easy Handling



**Improved efficiency, acceleration
and error avoidance**



Higher reliability of cost estimates



**Consistency and transparency
throughout the entire process**

Instead of spending a huge amount of work for validating and checking formulas in spreadsheets, the team can use CostFact to develop the estimate in a real multi-user environment.

Besides cost estimation, the CostFact system supports **Cost Optimization:**

- Set a Price-To-Win and split the Target Costs for the entire ship down to major and minor systems.
- Gain an alternative cost view by calculating the costs in terms of vessel capabilities rather than SWBS elements.
- Develop alternative variants and perform quick what-if analysis by comparing multiple project scenarios.

Screenshots Software System CostFact



Calculating and Reporting in the Individual Breakdown-Structure

Project 2015-01 Bergen II

Project Settings View Edit and analyse Proposals Calculation variants Target Cost External Quick view Specification ?

Search

	Unit	Quantity	h Plan	Mat. Cost Plan	Lab. Cost Plan	Prod. Cost Plan	Cost stru
2015-01 Bergen II			60.230	28.697.514	8.374.724	37.072.237	
0000 GENERAL GUIDANCE AND ADMINISTRATION				1.505.208	659.167	2.164.375	
1000 HULL STRUCTURE, GENERAL			44.310	6.533.627	3.700.168	10.233.795	
2000 PROPULSION PLANT, GENERAL			15.920	12.816.234	2.577.503	15.393.737	
2010 GENERAL ARRANGEMENT - PROP. DRAWINGS				1.133.163		1.133.163	
2020 MACHINERY PLANT CENTRAL CONTROL SYSTEMS							
2030 FUNCTIONAL DESCRIPTION							
2100 ENERGY GENERATING SYSTEM (NUCLEAR)					1.371.165	1.371.165	
2200 ENERGY GENERATING SYSTEM (NON-NUCLEAR)							
2300 PROPULSION UNITS			15.920	11.409.708	1.183.338	12.593.046	
2310 PROPULSION STEAM TURBINES							
2320 PROPULSION STEAM ENGINES							
2330 PROPULSION INTERNAL COMBUSTION ENGINES							
2340 PROPULSION GAS TURBINES							
2350 ELECTRIC PROPULSION			15.480	2.124.508	1.149.890	3.274.398	
2360 SELF-CONTAINED PROPULSION SYSTEMS							
2370 AUXILIARY PROPULSION DEVICES							
2380 SECONDARY PROPULSION (SUBMARINES)							
2390 EMERGENCY PROPULSION							
10 Coupling Pin	pc	12		9.840		9.840	
15 Alignment	Cost Centr...	440	440		25.520	25.520	
20 Foundation Bolt	pc	24		55.728		55.728	
35 Pipes VM2	Alu 95 mm ...	24		696		696	
40 Vibration Damper	pc	6		1.111.661		1.111.661	
50 Fundament	High stren...	4		4.824	1.040	5.864	
M2012-687-d (Pos. 1) Main Diesel Engine	n.s.	1			6.888	6.888	
M2012-687-d (Pos. 2) Main Diesel Engine	n.s.	1		7.989.952		7.989.952	
M2012-687-d (Pos. 3) Main Diesel Engine	n.s.	1		112.500		112.500	
2400 TRANSMISSION AND PROPULSOR SYSTEMS				273.363	23.000	296.363	
2500 PROPULSION SUPPORT SYS. (EXCEPT FUEL AND L...							

Group System View

Cost Structure Analysis

All items

Proposals only

Change proposals: ind.

CP in process

CP offered

CP accepted

CP turned down

Only cost up to milestone:

12 - Warranty

Ind. not allocated cost

Selected cost classes:

Object Material

Manufacturing

Service

Stock Material

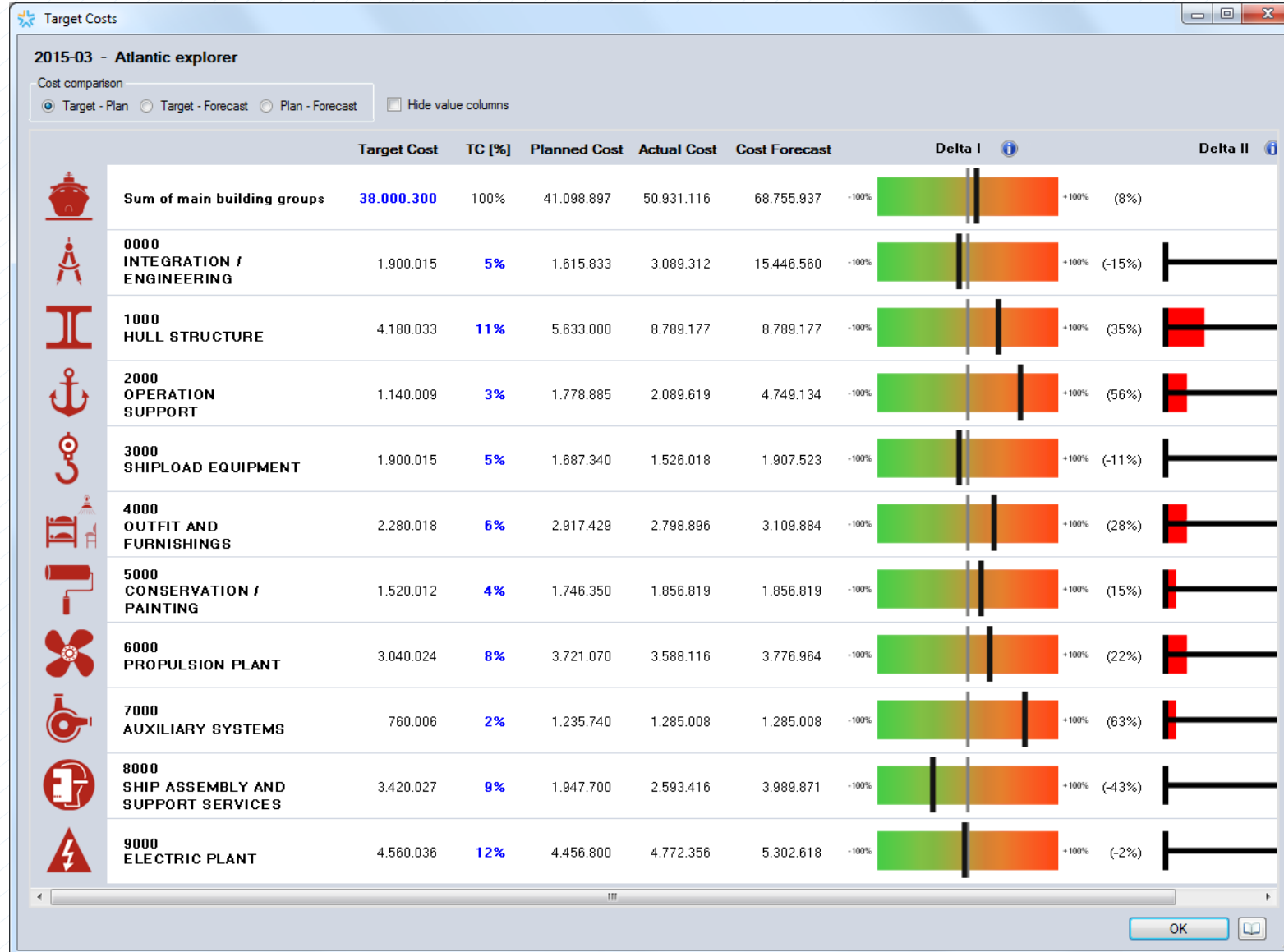
Engineering

Categories

Quantity Structure

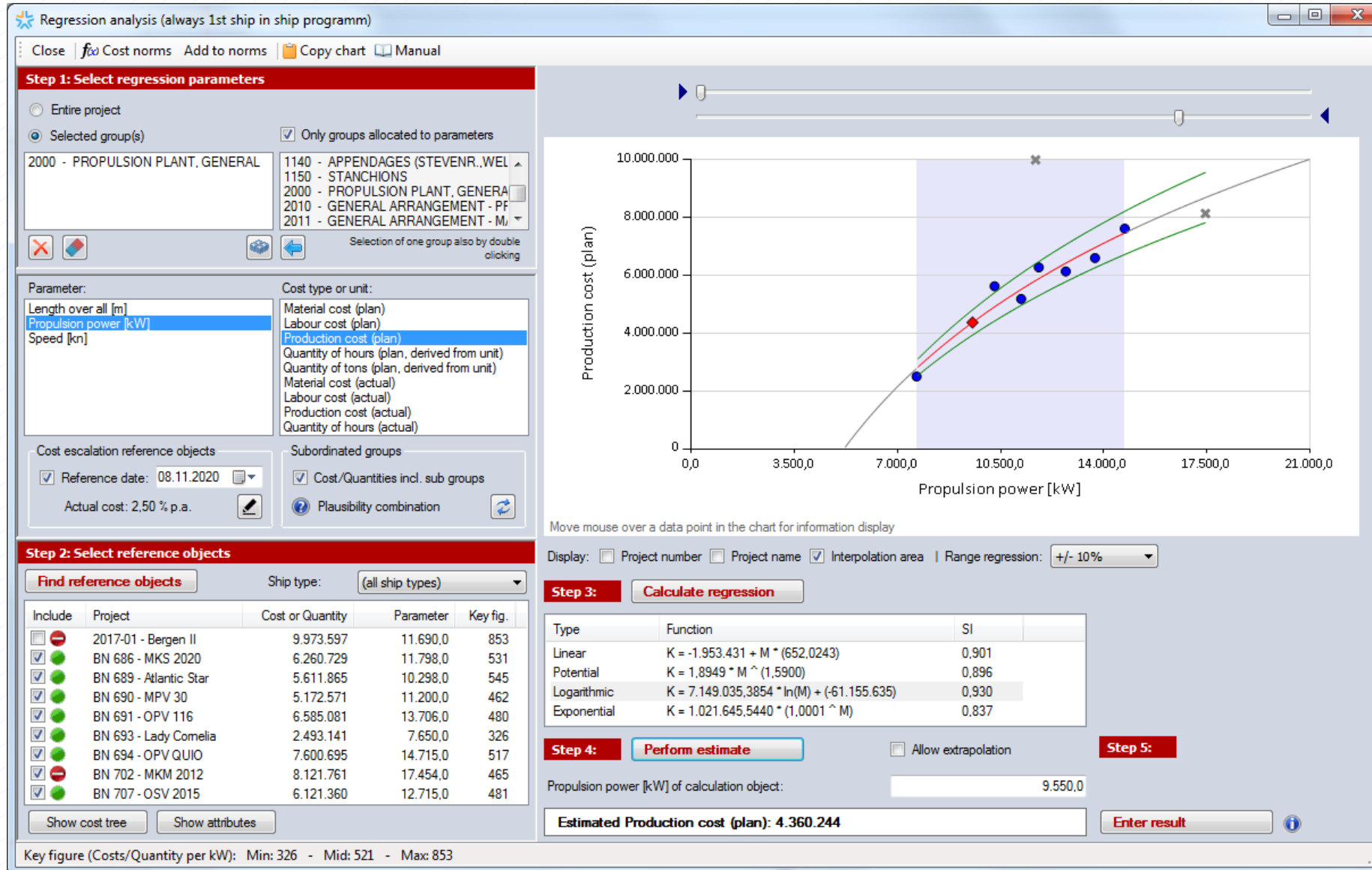
Engineering [h]	12.500
Project management [h]	2.100
Manufacturing [h]	...

Setting and Achieving the Price-To-Win



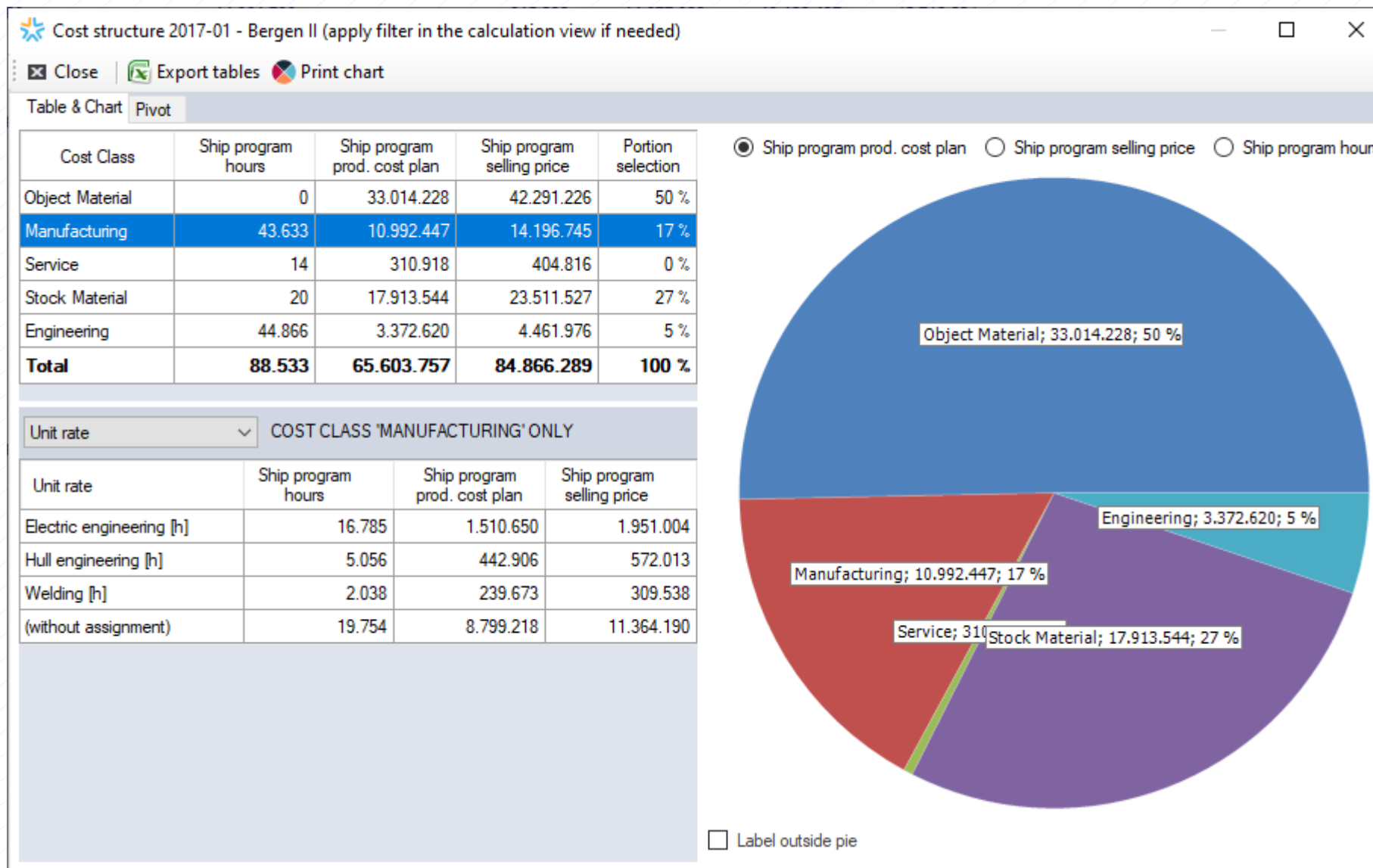
- Setting target costs for the entire project and major groups.
- Contrasting target costs, planned costs and cost forecast to show possible divergences.

Regression Analysis of Historical Projects



- Determining cost functions by statistical analyses of existing objects.
- Predicting costs, based on technical parameters.
- Storing cost norms centrally for upcoming application within future calculations.

In-Depth Cost Structure Analysis On All Project Levels



Free Pivot Analysis of All Cost Item Related Data

Cost structure 2017-01 - Bergen II (apply filter in the calculation view if needed)

Close Export pivot

Table & Chart Pivot

Ship program hours Ship program selling price PBS Element Item Cost

Reliability Class Risk/Opportunity Incurrence Curve (RC/NRC) Distribution

2nd Category 3rd Category 4th Category 5th Category 6th Category

Ship program prod. cost plan

Unit rate group Unit rate Ship program prod...

Aluminium	Alu Standard [t]	1.310.400
Engineering	Electric engineering [h]	4.875.375
	Hull engineering [h]	442.906
	Machines engineering [h]	1.350.313
Engineering Total		6.668.593
Manufacturing	Cost Centre 4712 [h]	114.228
	Welding [h]	239.673
Manufacturing Total		353.900
Pipes m	Alu 70 mm [m]	2.112
Project management	Project management [h]	255.780
Steel	High-strength profiles [t]	3.826.433
	Low-strength plates < 7 mm [t]	516.478
	Low-strength plates > 10 mm [t]	
Steel Total		4.342.911
Grand Total		216.846.248

Cost structure 2017-01 - Bergen II (apply filter in the calculation view if needed)

Close Export pivot

Table & Chart Pivot

Ship progra... Reliability Class

Supplier 1: +/- 30%... 2: +/- 20%... 3: +/- 15%... 4: +/- 5% ... 5: +/- 0% ... Grand Total

(without assign...					
Berger-FIT				1.209.600	1.209.600
Bridge Master NO				77.977	102.036
Caterpillar		1.272.721	281.854	440.451	1.995.027
DALMA SpA				201.600	201.600
DNV GL	169	21		249.229	249.817
FRIENDSHIP SY...				161.965	161.965
Germanischer LI...				99	99
MTU		6.050.370		16.163.699	22.214.069
Thales		846.720			846.720
Grand Total	169	8.169.832	281.854	18.303.021	26.980.934

Management of Options and Cost Impact Analysis

Project 2017-01 Bergen II

Project Settings View Edit and analyse Proposals Calculation variants Target Cost Quick view External CAD Interface Specification ?

antenn Search

	Quantity	Mat. Cost Plan	Lab. d. C...	Lab. Cost Plan	Prod. Cost Plan	Quantity [h]	St
2017-01 Bergen II		18.014.187		9.855.724	27.869.911	25.860	
0000 GENERAL GUIDANCE AND ADMINISTRATION		10.000			10.000		
1000 HULL STRUCTURE, GENERAL		7.929.649		2.073.337	10.002.986	5.660	
2000 PROPULSION PLANT, GENERAL		2.040.421		6.336.598	8.377.019	19.540	
3000 ELECTRIC PLANT, GENERAL		112		329.583	329.695		
4000 COMMAND AND SURVEILLANCE, GENERAL		3.290.354		548.580	3.838.934	220	
4010 GENERAL ARRANGEMENT - COMMAND AND SURVEILLANCE							
4020 SECURITY REQUIREMENTS							
4030 PERSONNEL SAFETY							
4040 RADIO FREQUENCY TRANSMISSION LINES		10			10		
4050 ANTENNA REQUIREMENTS							
4060 GROUNDING AND BONDING							
4070 ELECTROMAGNETIC INTERFERENCE REDUCTION (EMI)							
4080 SYSTEM TEST REQUIREMENTS							
4090 COMBAT SYSTEM GENERAL REQUIREMENTS							
4100 COMMAND AND CONTROL SYSTEMS							
4200 NAVIGATION SYSTEMS							
4300 INTERIOR COMMUNICATION							
4400 EXTERIOR COMMUNICATIONS							
4401 TESTING, INTEGRATED RADIO SYSTEMS							
4410 RADIO SYSTEMS / EXTERNAL RADIO ELEMENTS							
4411 COMMUNICATION ANTENNA SYSTEMS		1.216.832		25.080	1.241.912	220	
020 Standard Antenna Basis System	1	190.000			190.000		
030 Assembly Antenna Basis System	220		95	25.080	25.080	220	
100 COMB4CPB CP Beam and COMBINE4 Package	1	12.582			12.582		
200 Channel IEM transmitter combiner	8	880.000			880.000		
300 CP Beam antenna							
400 25' RG8X coaxial cable	110	18.150			18.150		
500 CAD Audio DA4090 UHF Antenna and Power Distribution System	2	65.000			65.000		
600 DFIN Diversity Fin Antenna w/f cover, stand mount	5	51.100			51.100		
4412 ANTENNA MULTICOUPLERS-TUNERS							

Calculation saved at 15:25:31.

Options

☐ Project incl. options 'Accepted'

☒ According selection:

Accepted

☒ Additional antenna (exten...)

☐ Additional spare parts pac...

☐ Simulators (crew training)

☐ Defense systems (defenc...

☐ Additional stowage on bo...

Including

Filter Suppliers

Quantity Structure

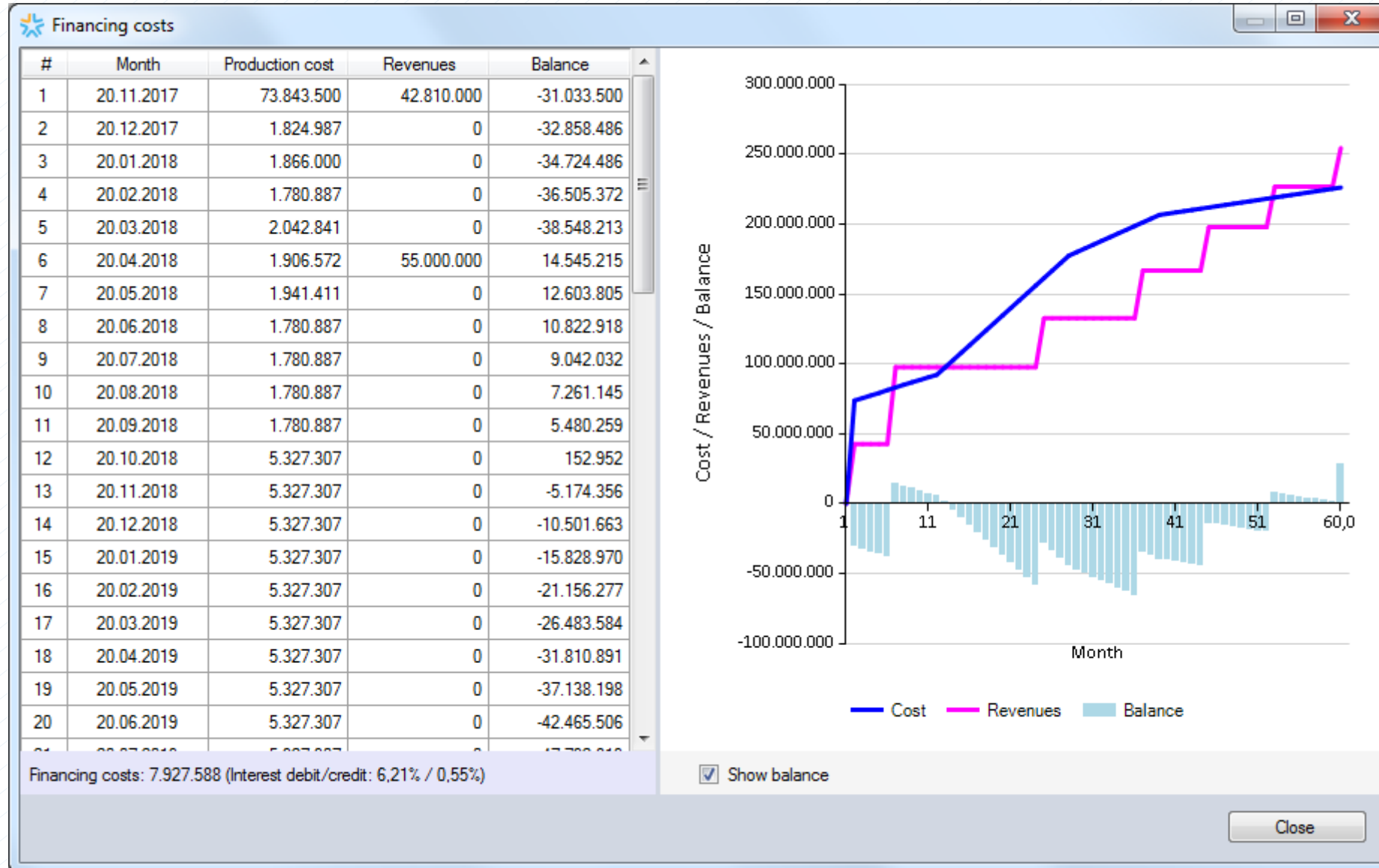
Cost Driver Analysis

Status Groups

Comments

- Project integrated calculation of options
- Consolidation and display of cost items, related to the respective options in the option administration (separate dialogue form)
- Analysis of cost/price impact and option scenarios

Time-Phasing of Projects



Comparison of Alternative Projects and Project Variants

Compare projects and revisions				
Reference project: OPVD 180 - VENDOR A		Value type: Product cost	Reference OPVD 180 - VENDOR A: OPVD 35-01	Reference OPVD 180 - VENDOR B: OPVD 35-01
			Escalation: No escalation	
PBS Group	OPVD 180 - VENDO...	OPVD 180 - VENDO...	Difference	
Project	53.903.182	54.955.134	-1.051.951	
0000 GENERAL GUIDANCE AND ADMINISTRATION	312.000	312.000		
1000 HULL STRUCTURE, GENERAL	2.968.492	3.145.288	-176.795	
2000 PROPULSION PLANT, GENERAL	21.477.186	21.715.593	-238.407	
3000 ELECTRIC PLANT, GENERAL	2.651.518	2.705.553	-54.035	
4000 COMMAND AND SURVEILLANCE, GENERAL	22.346.733	22.840.450	-493.717	
5000 AUXILIARY SYSTEMS, GENERAL	1.735.963	1.774.294	-38.331	
6000 OUTFIT AND FURNISHINGS, GENERAL	504.861	513.424	-8.562	
6010 GENERAL ARRANGEMENT - OUTFIT AND FU...				
6020 HULL DESIGNATING AND MARKING	8.844	9.039	-195	
6030 DRAFT MARKS				
6040 LOCKS, KEYS, AND TAGS				
6050 RODENT AND VERMIN PROOFING				
6100 SHIP FITTINGS				
6200 HULL COMPARTMENTATION	42.208	43.141	-933	
6300 PRESERVATIVES AND COVERINGS	355.374	360.680	-5.306	
6400 LIVING SPACES				
6500 SERVICE SPACES				
6600 WORKING SPACES				
6700 STOWAGE SPACES				
7000 ARMAMENT, GENERAL	1.897.046	1.938.964	-41.918	
8000 INTEGRATION/ENGINEERING (SHIPBUILDER R...	8.527	8.696	-169	
9000 SHIP ASSEMBLY AND SUPPORT SERVICES	854	872	-17	

6000 OUTFIT AND FURNISHINGS, GENERAL Filter: (no filter) Incl. subordinated Total row									
OPVD 180 - VENDOR A									
ID	Name	Quantity	Unit	Mat. d. Cost Plan/Unit	Lab. d. Cost Plan/Unit	Mat. Cost Plan	Lab. Cost Plan	Prod. Cost Plan	Quantity [h]
C92-31	12 x Crew cabins	12,00	SET	1.320,00	0,00	16.473,60	0,00	16.473,60	0,00
C92-32	External	0,00	SET	5.400,00	0,00	0,00	0,00	0,00	0,00
C92-40	Dock and wharf operations	8,00	[h]	88,20	88,20	726,77	846,72	1.573,49	8,00
C92-50	Crew corridor lower deck	1,00	SET	0,00	0,00	0,00	0,00	0,00	0,00
C92-60	12 x crew cabins	12,00	SET	1.202,00	0,00	14.424,00	0,00	14.424,00	0,00
C92-70	External	1,00	SET	33.202,00	0,00	34.862,10	0,00	34.862,10	0,00
C92-80	Crew corridor lower deck	6,00	[h]	88,20	88,20	545,08	635,04	1.180,12	6,00
C92-84	12 x Crew cabins	12,00	[h]	88,20	88,20	1.090,15	1.270,08	2.360,23	12,00
C92-85	Corridor Crew Deck	1,00	SET	9.650,00	0,00	9.650,00	0,00	9.650,00	0,00
OPVD 180 - VENDOR B									
ID	Name	Quantity	Unit	Mat. d. Cost Plan/Unit	Lab. d. Cost Plan/Unit	Mat. Cost Plan	Lab. Cost Plan	Prod. Cost Plan	Quantity [h]
C92-10	Officers and Crew mess	1,00	SET	16.813,55	0,00	17.486,09	0,00	17.486,09	0,00
C92-20	Officers and crew mess	4,00	[h]	0,00	90,86	0,00	374,34	374,34	4,00
C92-30	Corridor Crew Deck	5,00	[h]	0,00	89,08	0,00	445,40	445,40	5,00
C92-31	12 x Crew cabins	12,00	SET	1.349,17	0,00	16.837,64	0,00	16.837,64	0,00
C92-32	External	0,00	SET	5.519,34	0,00	0,00	0,00	0,00	0,00
C92-40	Dock and wharf operations	8,00	[h]	89,52	89,52	737,64	859,39	1.597,04	8,00
C92-50	Crew corridor lower deck	1,00	SET	0,00	0,00	0,00	0,00	0,00	0,00
C92-60	12 x crew cabins	12,00	SET	1.214,02	0,00	14.568,24	0,00	14.568,24	0,00
C92-70	External	1,00	SET	34.204,70	0,00	35.914,94	0,00	35.914,94	0,00

SWBS-Oriented Administration of Specifications

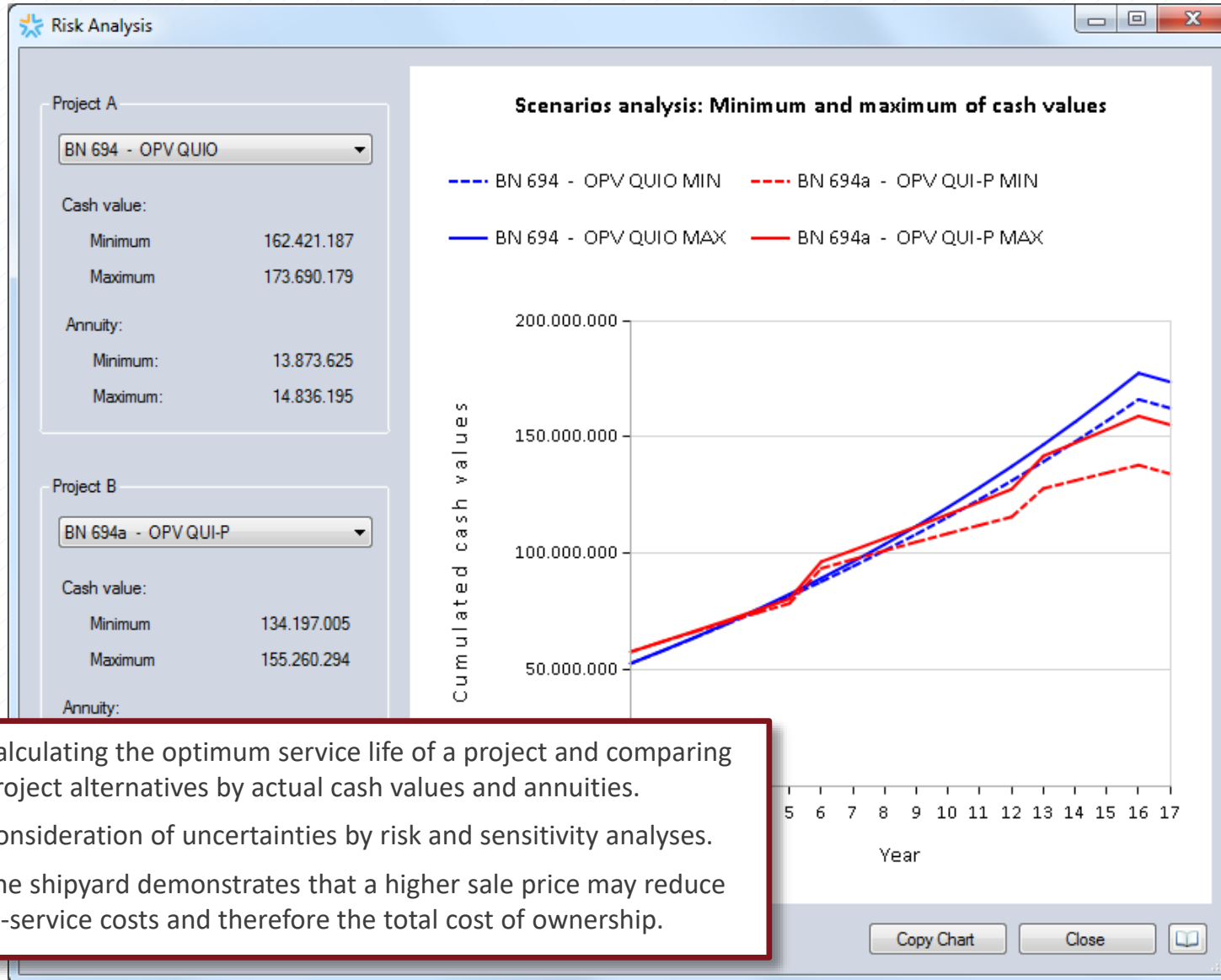
The screenshot displays the CostFact software interface for 'Specification Project 2021-02, User profile 'Estimator''. The interface is divided into three main sections:

- Left Panel (SWBS Tree):** A hierarchical tree structure showing the breakdown of the project. The tree is organized into levels, with '2021-02 - Shiptec' at the top. The '1672 DOORS' item is highlighted in blue.
- Center Panel (Text Editor):** A text editor window titled 'Building Regulation 1672 DOORS'. It contains a list of specifications for 'Weatherproof Exterior Sliding Doors'. The text is formatted with bold, italic, and underline styles. Below the text is a photograph of a double leaf weathertight exterior sliding door. Two callout boxes point to specific features: 'Max. 2,000mm from highest finish floor to door lintel' and 'Double leaf weathertight exterior sliding door'.
- Right Panel (Statement of Work):** A panel titled 'Statement of Work 1672 DOORS'. It contains a single line of text: '# To be specified'.

The top of the interface features a menu bar with options like 'Close', 'Text editing', 'Insert', 'View', 'Review', 'Basic functions', and 'Text search'. Below the menu bar is a toolbar with various icons for text editing, formatting, and navigation.

- Specification input and administration according to the breakdown structure
- Simultaneous administration of two specifications
- Import of specifications from Microsoft Word documents
- Linking calculation and specification
- Consistency check between specification and calculation
- Tracking specification changes with cost impact
- Creating and managing text templates

Scenario Analysis and Optimization of Life Cycle Costs



- Calculating the optimum service life of a project and comparing project alternatives by actual cash values and annuities.
- Consideration of uncertainties by risk and sensitivity analyses.
- The shipyard demonstrates that a higher sale price may reduce in-service costs and therefore the total cost of ownership.

