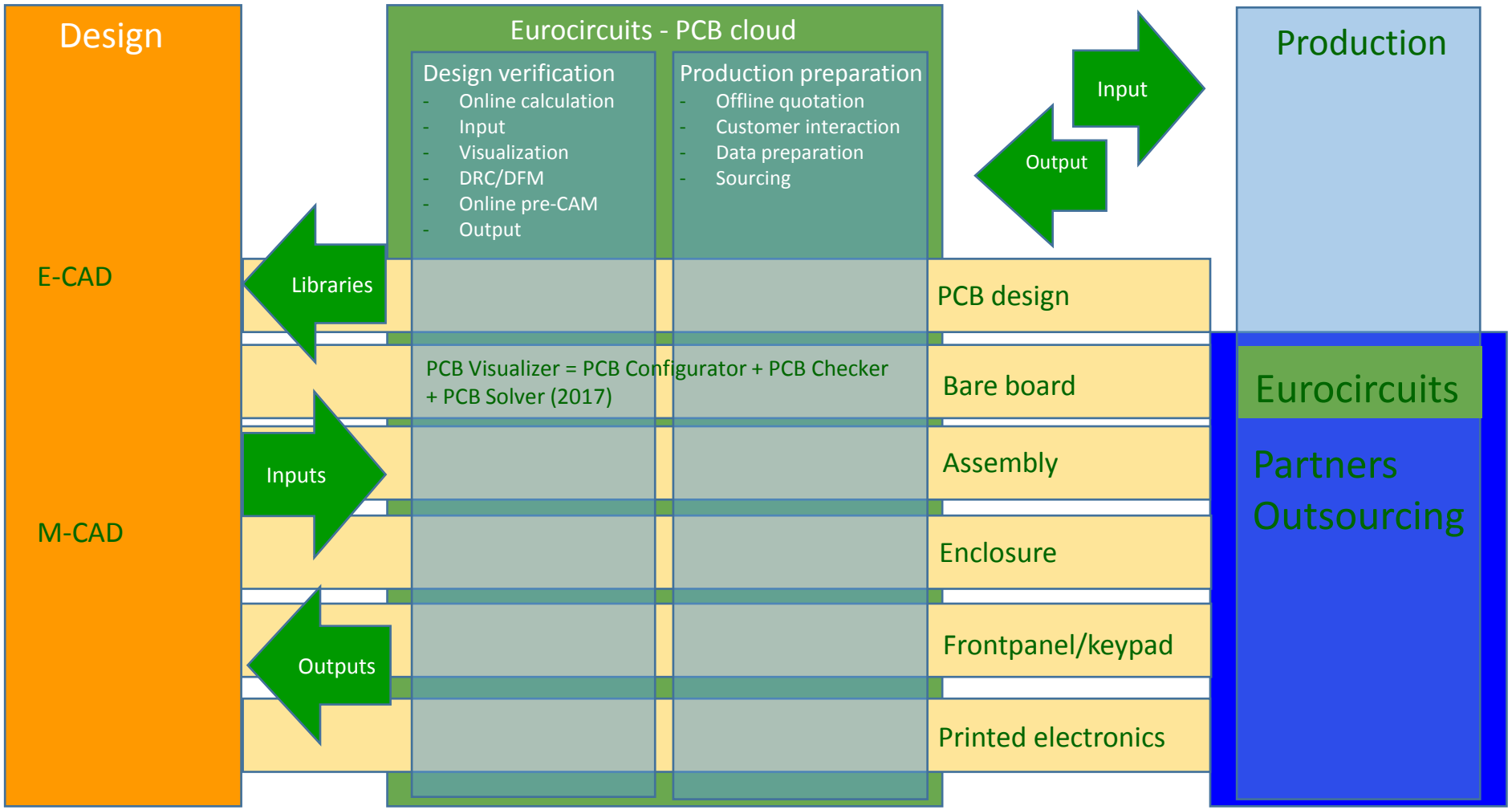
Virtual production in the eC-cloud

Your Board produced
“right first time”

D&E event 2016

Creating electronics



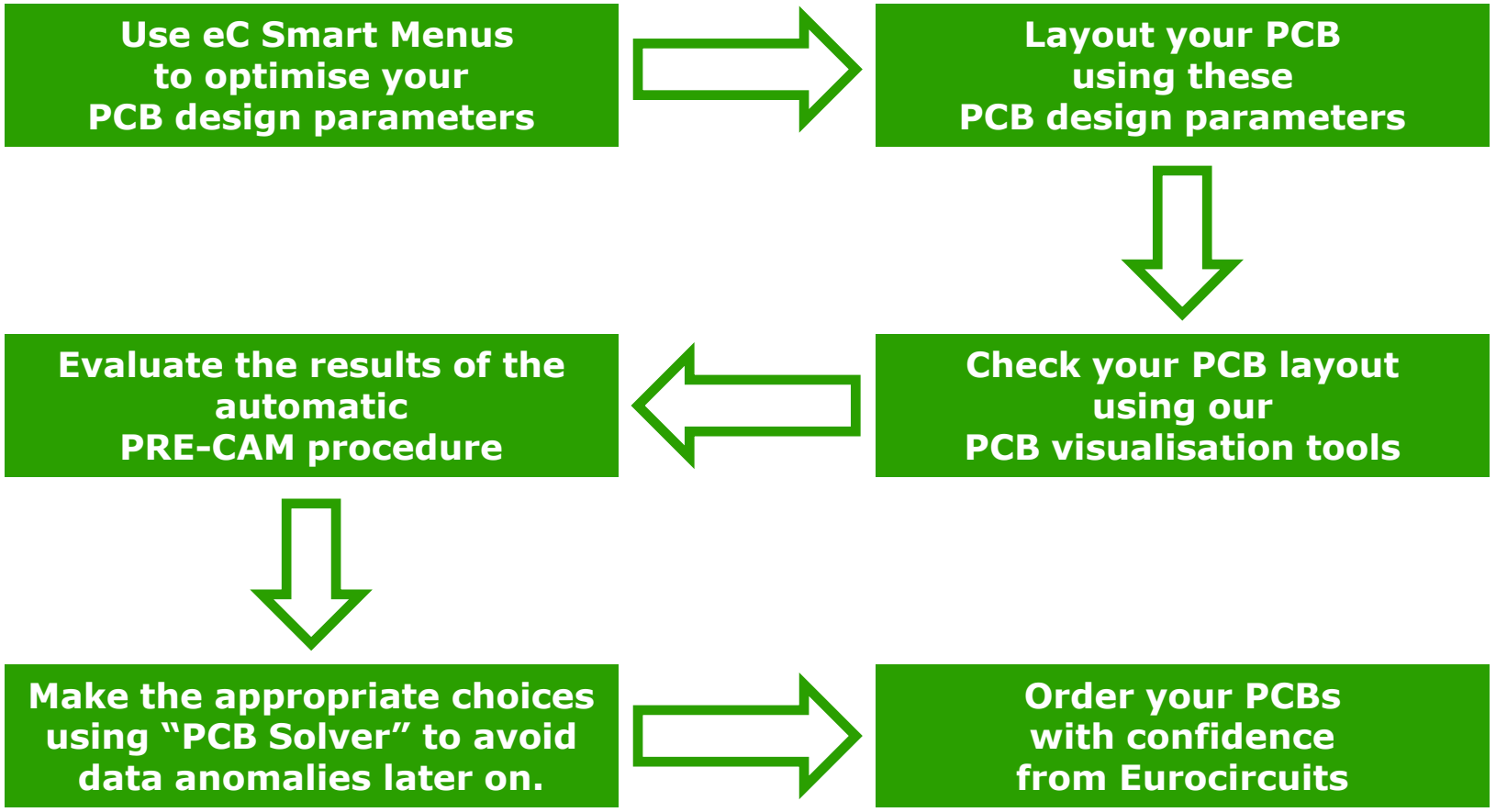
Virtual production - Goals

- Help busy designers get boards "right first time"
  - on time
  - accurate to their intentions
  - at best total cost

- Two inter-related topics
  - Design for Manufacturability (DFM)
    - What are the features that increase board costs?
    - What makes my board harder or impossible to make?
  - Clear data presentation and clear order details
    - How can I be sure the data transfer is accurate?
    - Are there any data issues that will delay delivery?

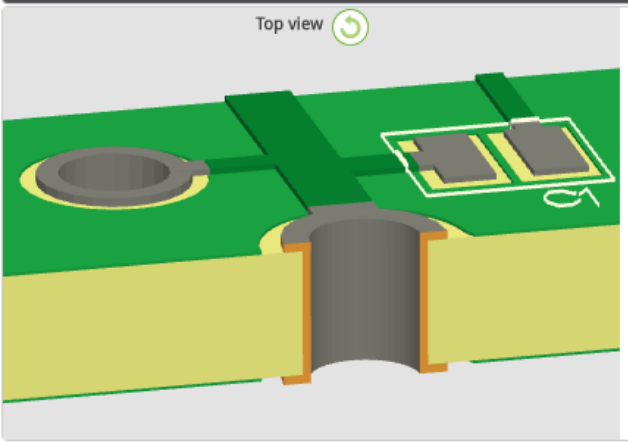
"Wonderful, but I barely have time to design the circuitry, let alone sort out fabrication."

Virtual PCB production – How?



Production panel efficiency

BINDI pool



Delivery format	eC-panel by Eurocircuits
Panel quantity	100
Delivery term	20 working days
Number of layers	2
PCB width (X) (mm)	55.00
PCB height (Y) (mm)	65.00
eC-registration compatible PCB	☑

▶ Stencils

Panel — Panel

Repeat in X	4	Repeat in Y	4
Panel width (X) (mm)	230.00	Panel height (Y) (mm)	270.00
PCBs per panel	16	PCB separation method	V-cutting
Panel border	5.00 mm	PCB spacing	0.00 mm
Panel without cross outs	☐	Panel outline	V-cutting

Summary

Service	BINDI pool
Estimated shipment date	30-09-2016
Quantity	100 panels
Board surface / Order surface	6.21 dm² / 621.00 dm²
Prices	Net
Single panel	*€ 16.23*
Total boards	€ 1623.00
Express transport	€ 0.00
VAT 21.00%	€ 340.83
Total gross	€ 1963.83

Add to basket

Remarks

⚠ The panel is marked as eC-registration compatible, but no stencils are ordered.

⚠ Pooling conditions no longer met due to the following order details:

- Number of production panels

Production panel efficiency: 59%

Improve panel efficiency and lower your price?

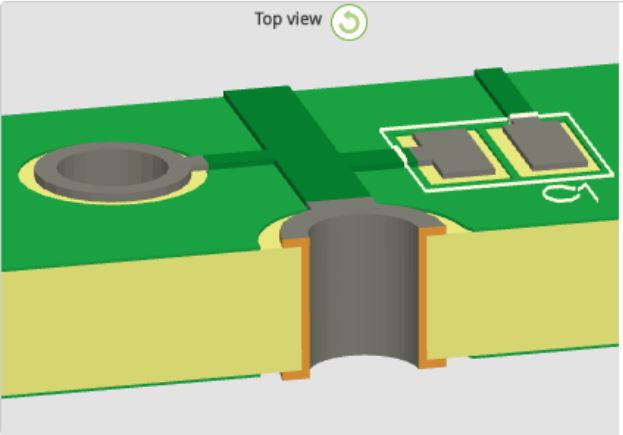
Alternatives — Customized matrix

100 panels | 150 panels | 200 panels

- 2-layer,65x55mm in customer panel, +/- 1.600 pieces needed.
- Customer panel of 4x4 has a production panel efficiency factor of 59% and will result into a price per piece of 16.23€/16 = 1.014€.

Production panel efficiency

BINDI pool



Delivery format	eC-panel by Eurocircuits
Panel quantity	107
Delivery term	20 working days
Number of layers	2
PCB width (X) (mm)	55.00
PCB height (Y) (mm)	65.00
eC-registration compatible PCB	☑

▶ Stencils

Panel — Panel

Repeat in X	5	Repeat in Y	3
Panel width (X) (mm)	285.00	Panel height (Y) (mm)	205.00
PCBs per panel	15	PCB separation method	V-cutting
Panel border	5.00 mm	PCB spacing	0.00 mm
Panel without cross outs	☐	Panel outline	V-cutting

Summary

Service	BINDI pool
Estimated shipment date	30-09-2016
Quantity	107 panels
Board surface / Order surface	5.84 dm² / 625.15 dm²
Prices	Net
Single panel	*€ 10.64*
Total boards	€ 1138.48
Express transport	€ 0.00
VAT 21.00%	€ 239.08
Total gross	€ 1377.56

Add to basket

Remarks

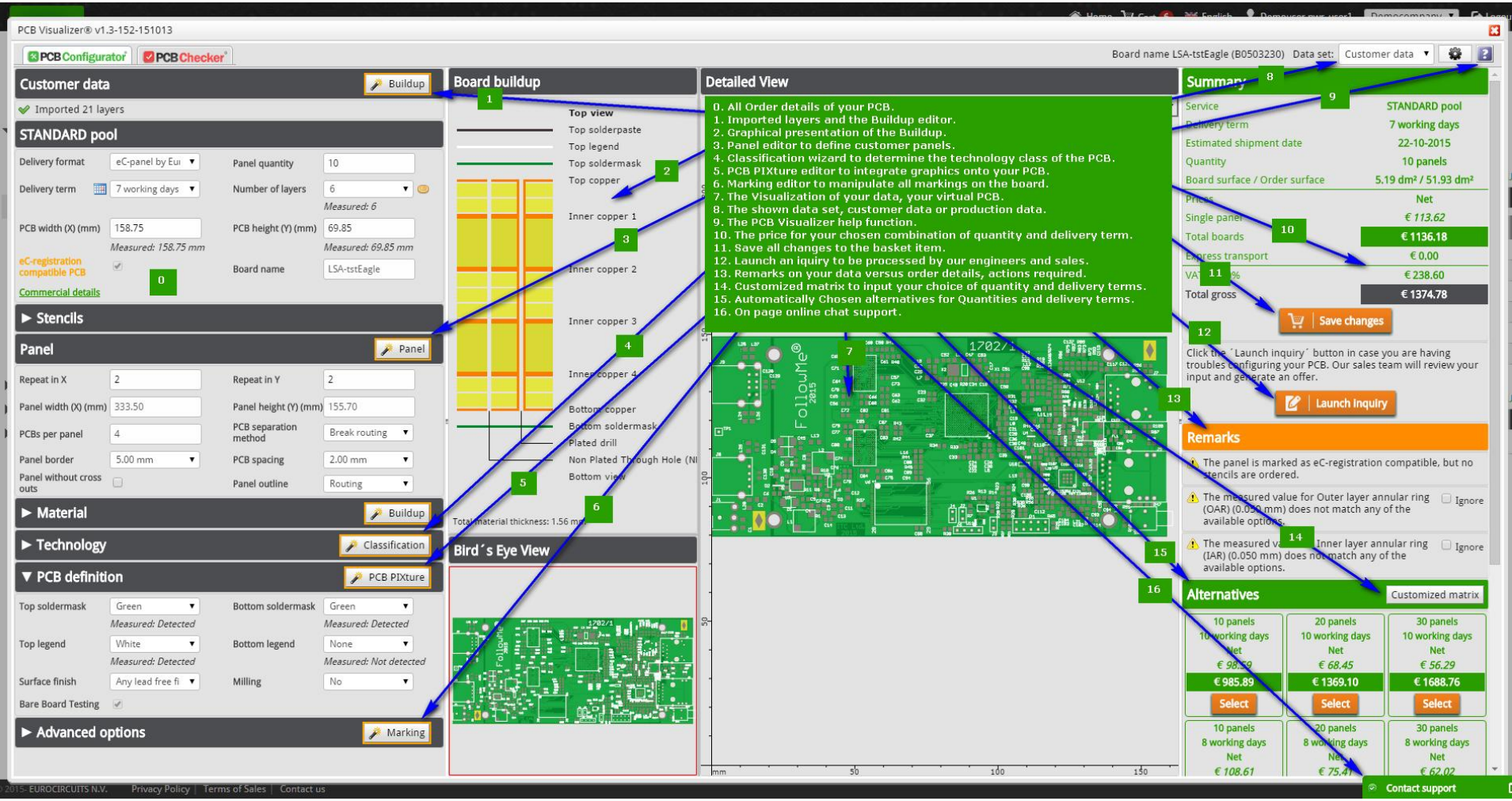
⚠ The panel is marked as eC-registration compatible, but no stencils are ordered.

Alternatives — Customized matrix

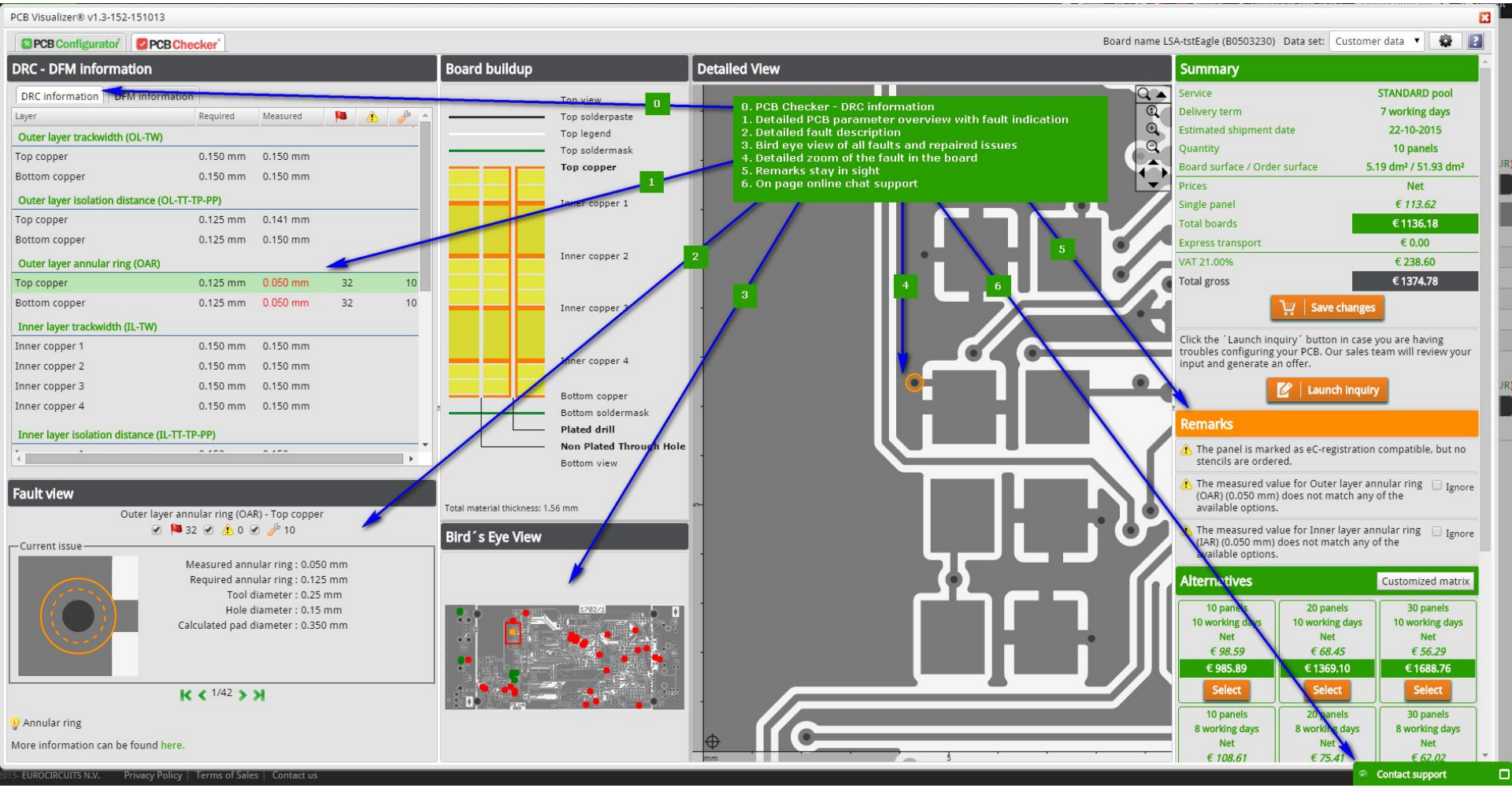
107 panels	150 panels	200 panels
20 working days	20 working days	20 working days
Net	Net	Net
€ 10.64	*€ 9.75*	*€ 9.34*
€ 1138.48	€ 1462.50	€ 1868.00
Select	Select	Select

- Changing the customer panel to 5x3 will solve all remarks and results into a price per piece of 10.64€/15 = 0.709€ or 30% less by simply permitting us to utilize the production panel space more efficiently.

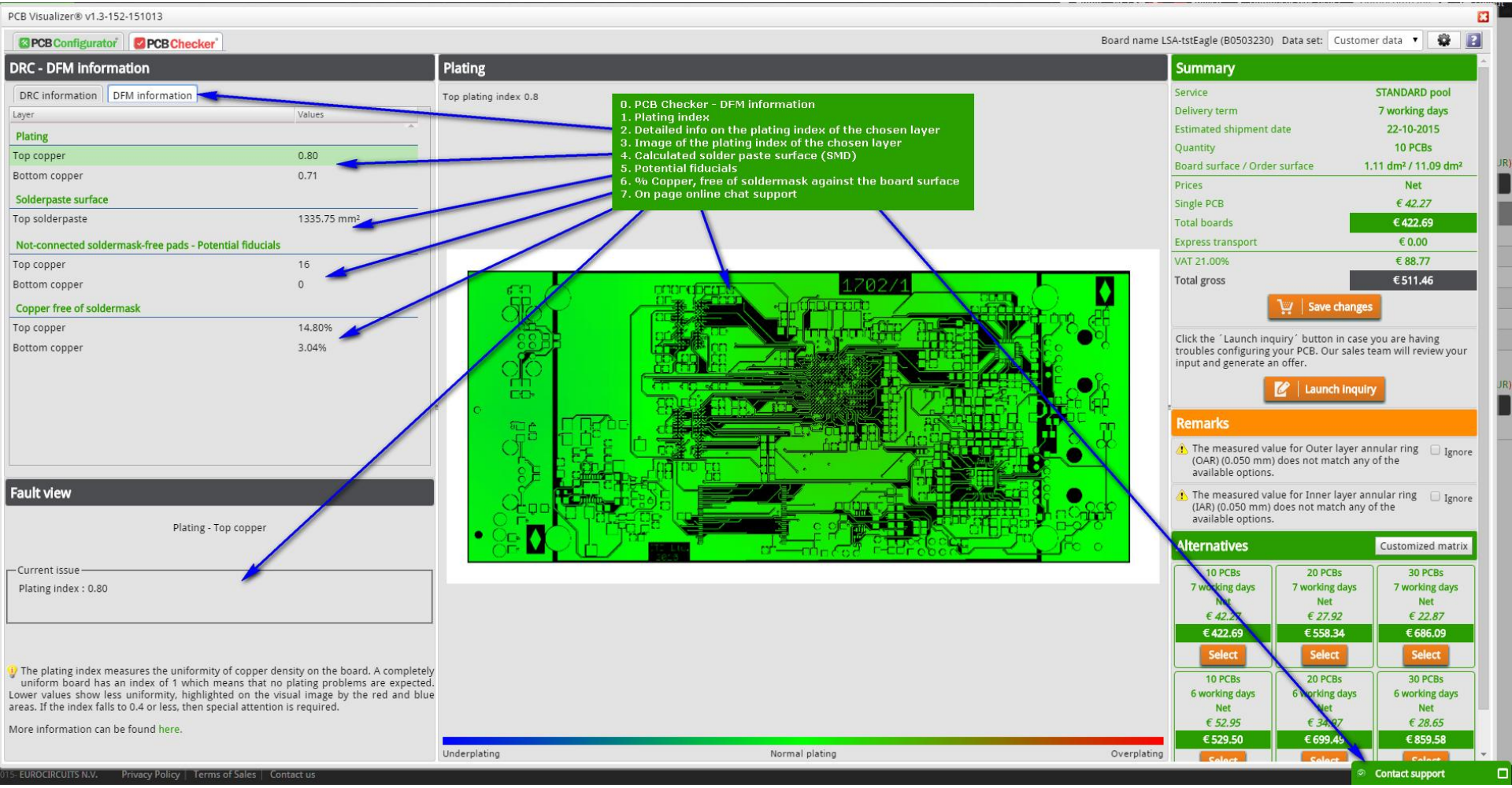
PCB Configurator : Remove data ambiguities online



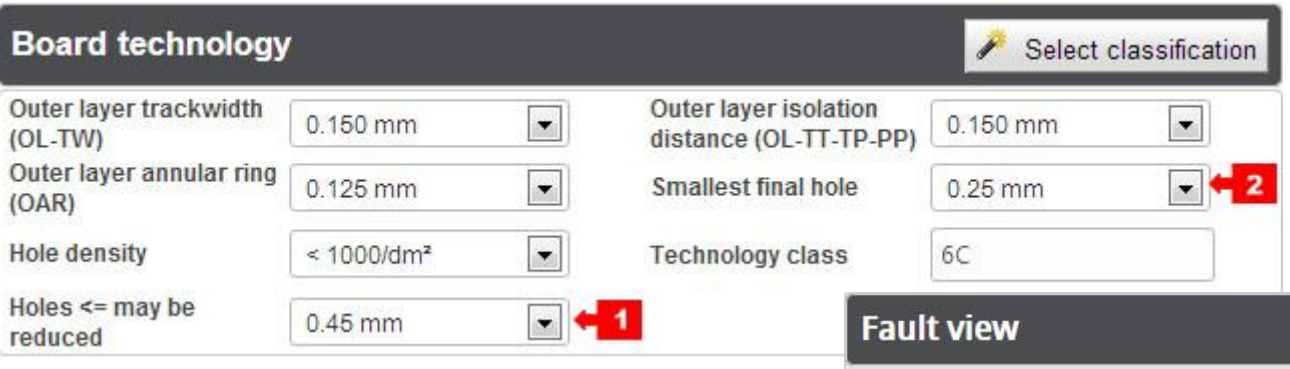
PCB Checker : Evaluate possible DRC issues

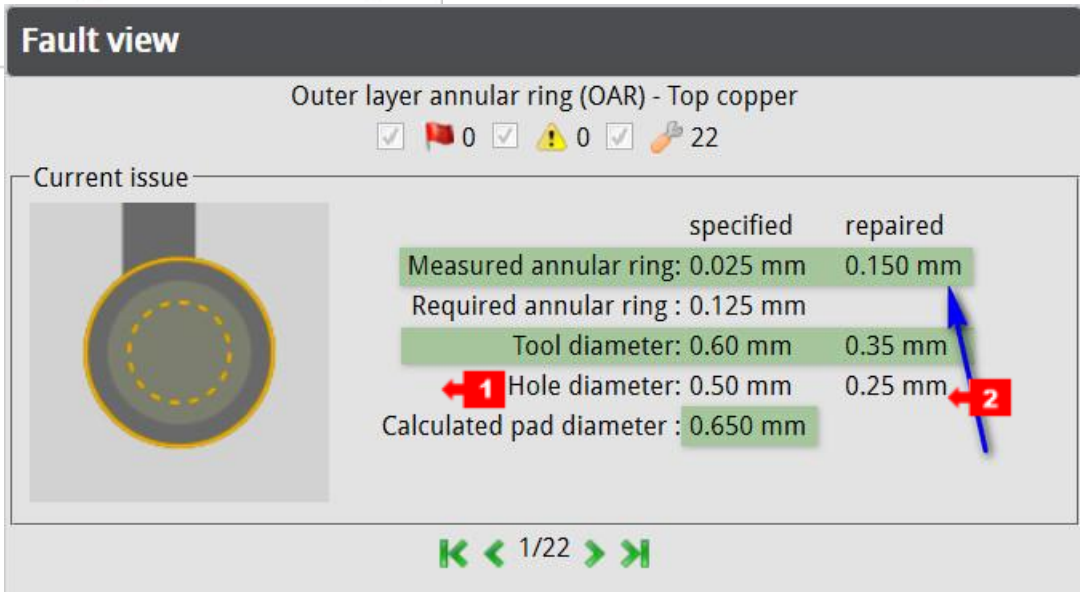


PCB Checker : Evaluate possible DFM issues



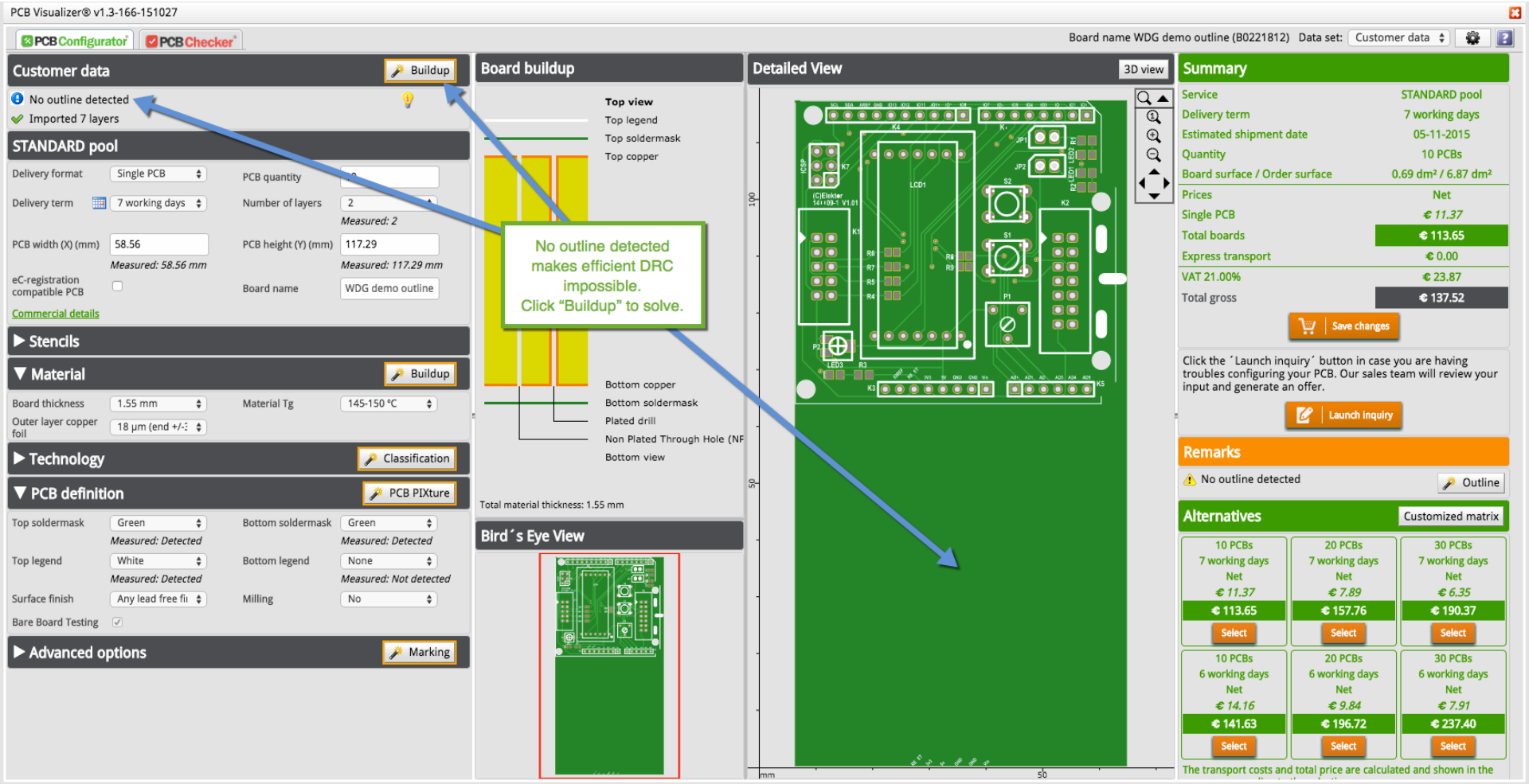
PCB Solver : Auto repair Annular Ring issues



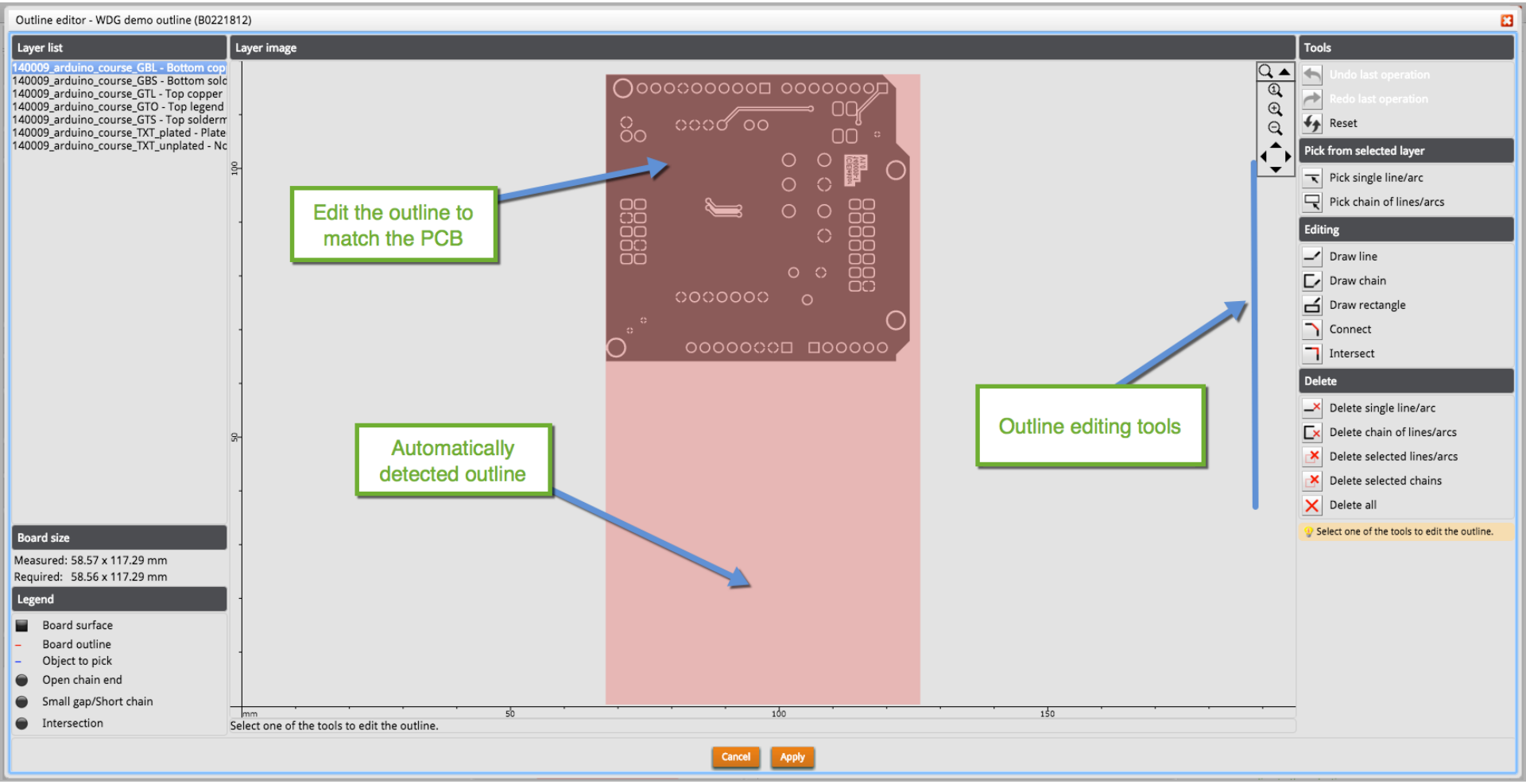


AR = (Pad D – Tool D) / 2 (Tool D = D drill bit)
Faulty AR = (0.650mm – 0.60mm) / 2 = **0.025mm**
Repaired AR = (0.650mm – 0.35mm) / 2 = **0.150mm**

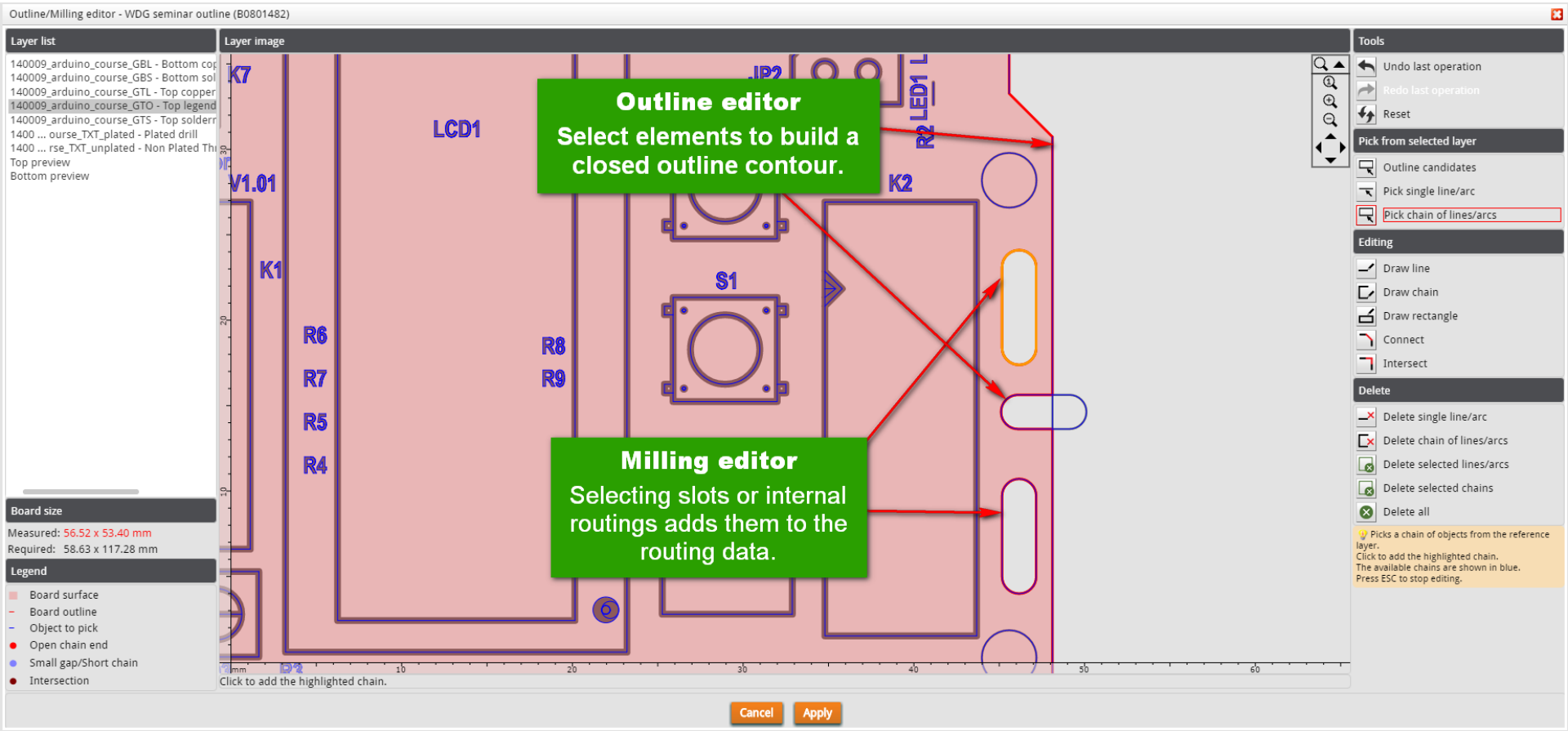
PCB Solver : Outline Editor



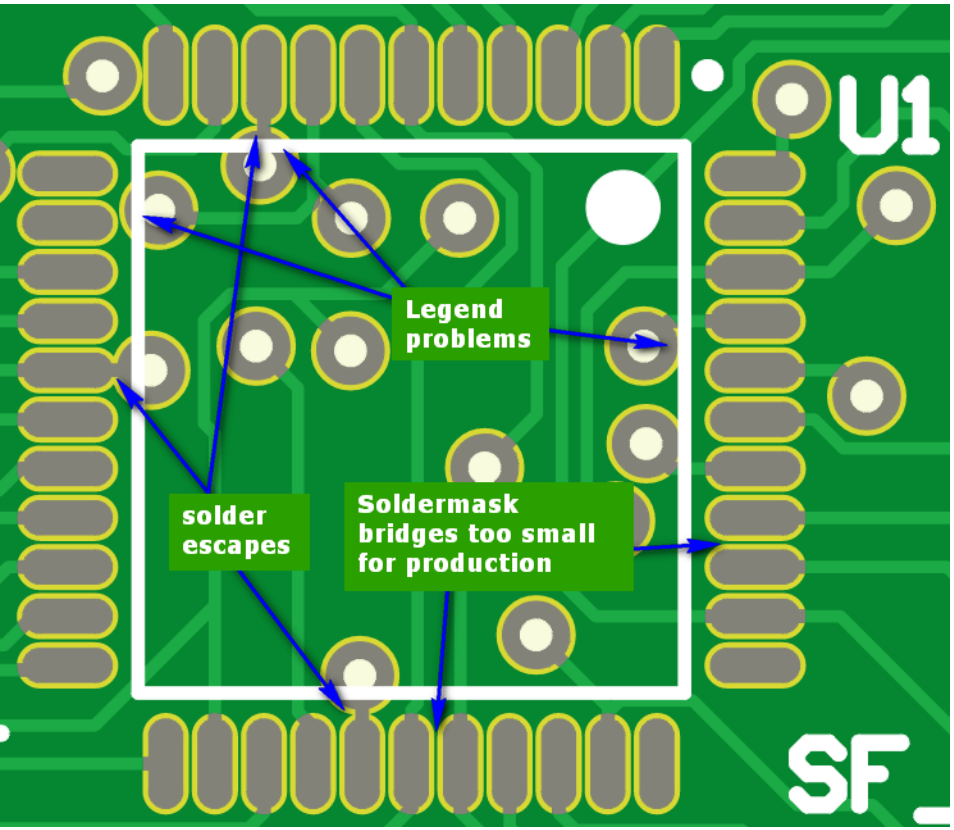
PCB Solver : Outline Editor

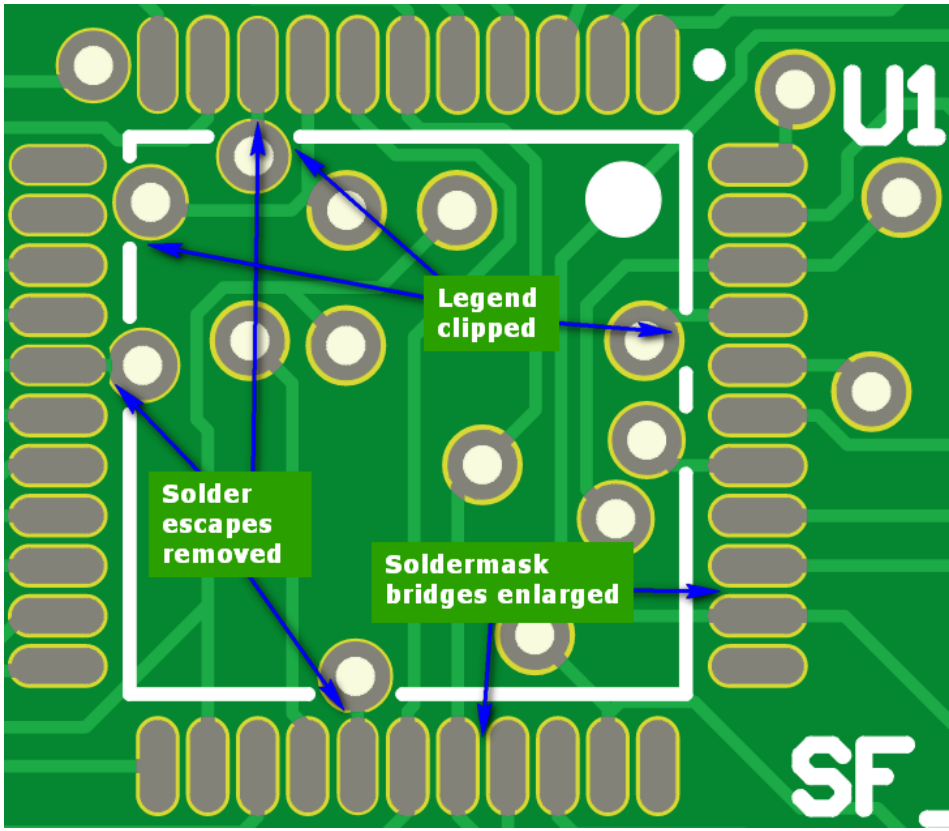


PCB Solver : Milling Editor

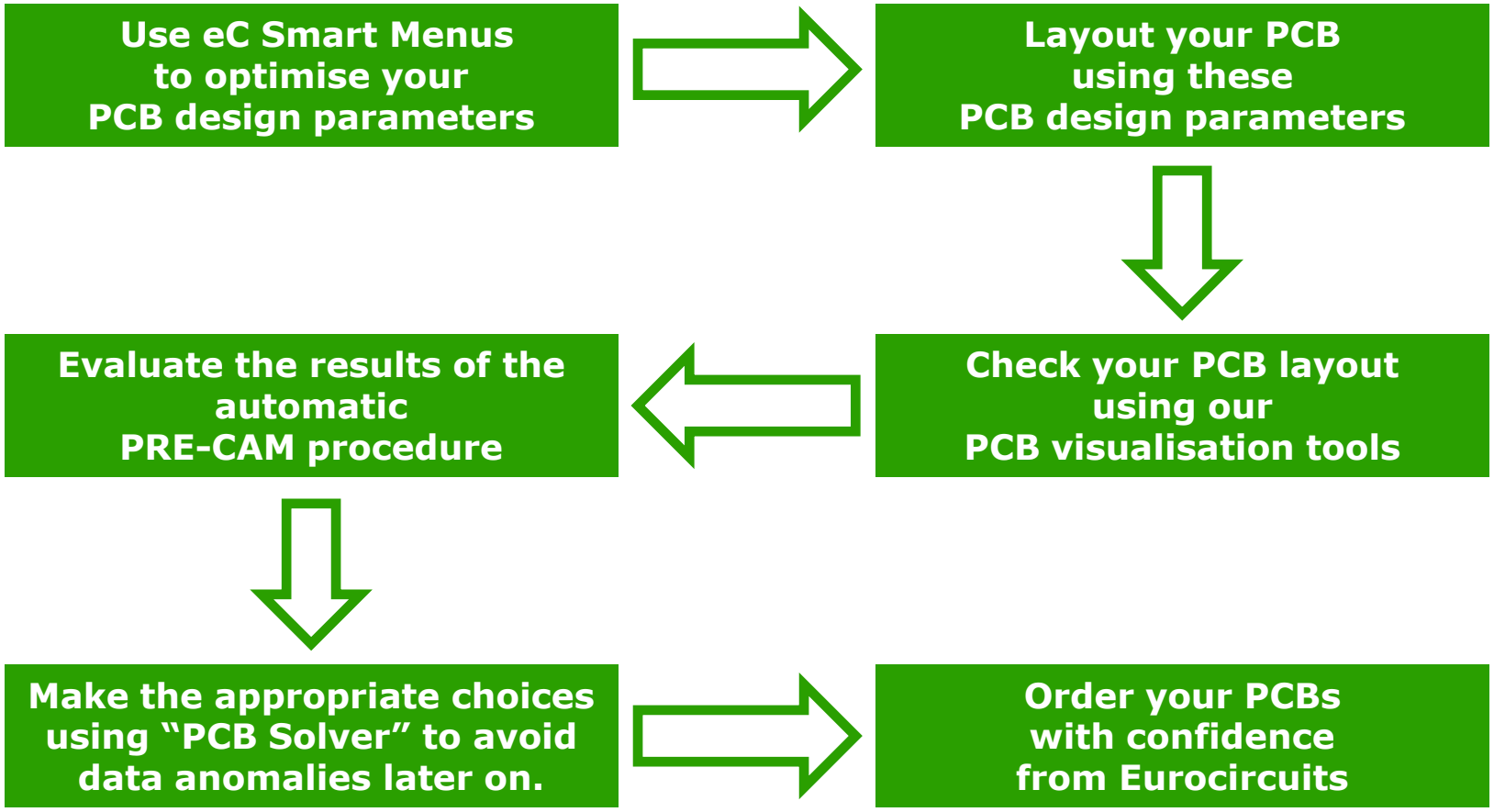


PCB Solver : some more examples

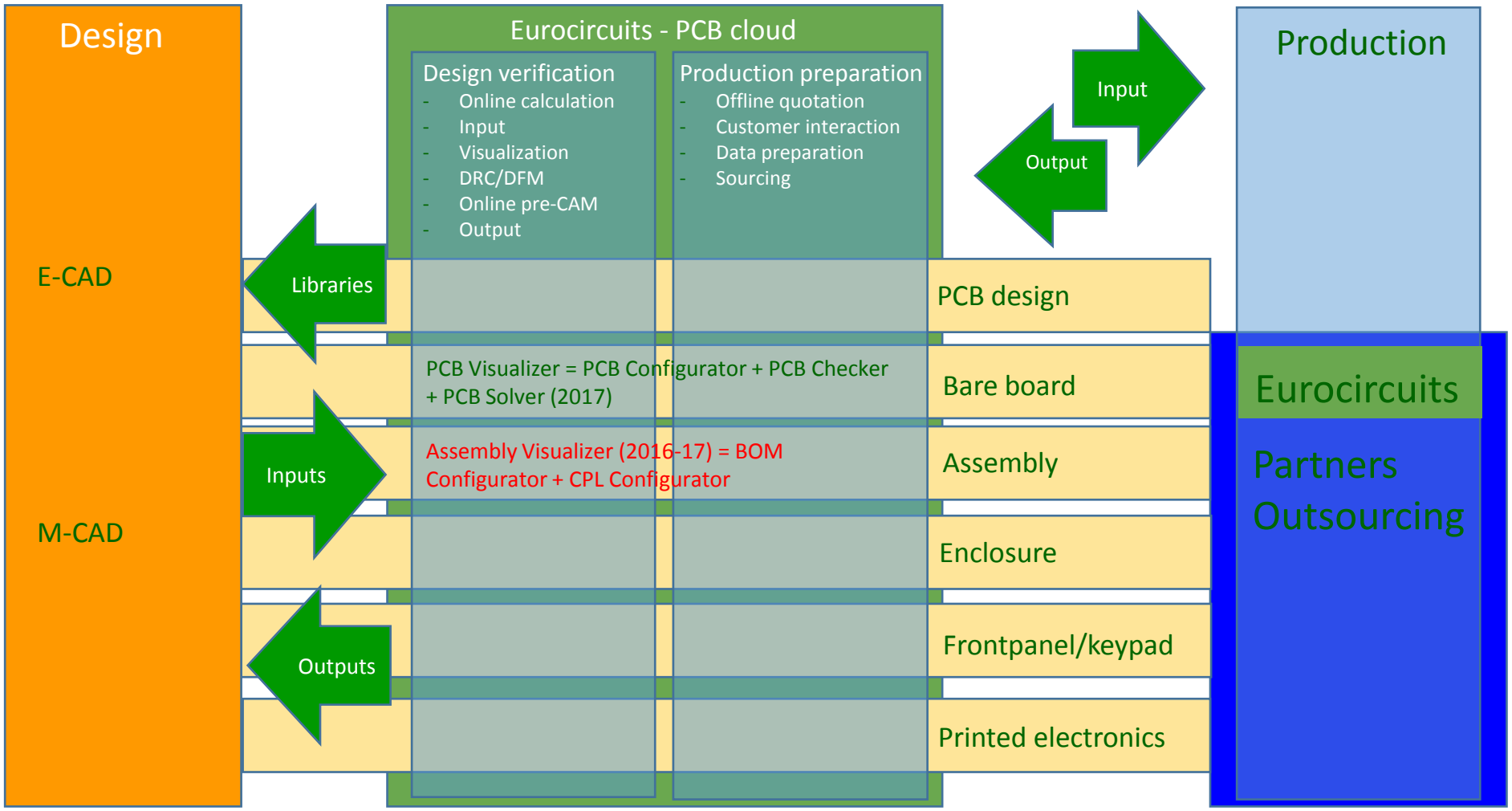




Making PCBs in the eC-cloud



Prototype assembly



Prototype assembly - Target

- We created a system that works for PCB production
  - Order pooling to cut costs
  - Cooperate with our designer customer for data prep
- We have
  - + 11.000 active Eurocircuits customers
  - + 100.000 orders/year in PCB prototyping and small batches.
  - + 300.000 jobs/year analysed through PCB Visualizer.
- We want to
  - Guide designers to create an electronic assembly that can be produced without unnecessary complications
  - Streamline the communcation between designer and producer

Prototype assembly - hurdles

- BOM output from CAD system is limited
- Cryptic description of component and package

	A	B	C	D	E	F
10	9	10k	R_0603	0603_TYPE_B	R6, R7, R8, R9, R10, R11, R12, R25, R26	
11	6	10n	C_0603	0603_TYPE_B	C45, C46, C47, C48, C49, C50	
12	1	10u	C_0805	0805_TYPE_A	C34	
13	1	15EDGRC-3.5/6P	CON_TERMINAL_3.5MM_6-PIN	CON_TERMINAL_3.5MM_6-PIN	CN6	
14	2	18p	C_0603	0603_TYPE_B	C56, C57	
15	1	1k	R_0603	0603_TYPE_B	R13	
16	1	1u	CPOL-EUSMCA	SMC_A	C31	POLARIZED CAPACITOR, European symbol
17	2	1u	C_0603	0603_TYPE_B	C36, C39	
18	2	2.2u	CPOL-EUSMCA	SMC_A	C25, C28	POLARIZED CAPACITOR, European symbol
19	3	20k	R_0603	0603_TYPE_B	R16, R19, R22	
20	4	22	R_0603	0603_TYPE_B	R2, R3, R4, R14	
21	1	22uH	L-EUL3225M	L3225M	L1	INDUCTOR, European symbol
22	4	4.7u	CPOL-EUSMCA	SMC_A	C1, C33, C35, C37	POLARIZED CAPACITOR, European symbol
23	1	40_PIM_CON_0.5_MM WURTH	40_PIM_CON_0.5_MMWURTH	CON_FFC_40-PIN_0.5MM_WURTH-687140149022	CN2	
24	1	5	R_0603	0603_TYPE_B	R15	
25	1	8MHz	CRYSTAL_2PIN	CRYSTAL_3.2MM_2PIN	Q1	
26	1	AP5724WG-7	AP5724	SOT23-6	IC4	
27	1	AS4C4M16S-6BIN	SDRAM_16-BIT	TFBGA-54	IC2	
28	1	IP4252CZ8-4-TTL,13	EMIF_4CH_IP4252	EMIF_4CH_IP4252	IC7	
29	2	IRLML2246TRPBF	BSS84	SOT23	T1, T2	P-CHANNEL MOS FET
30	1	LD-BZEN-0803	BUZZER_01	BUZZER_01	BZ1	
31	1	M95512-WMN6P	EEPROM_SPI_SO8	SO08	IC5	
32	3	MAX31856MUD+	MAX31856MUD+	TSSOP14	IC8, IC9, IC10	
33	1	MCP130T-300	MCP130	SOT-23-II	IC3	
34	2	PMEG4005AEA.115	SMF5.0AT1	SOD123FL	D2, D3	200 W Transient Voltage Suppressor
35	1	SMLVT3V3	DIODE_SUPRESSOR_UNIDRECTION ALDO-214AA	DO-214AA	D1	
36	1	STM32F429NI	STM32F429N	TFBGA	IC1	
37	1	TSC2046	TSC2046	TSSOP16	IC11	
38	1	W25Q32FVSSIG	EEPROM_SPI_SO8SOIC8_WIDE	SO08W	IC6	

Prototype assembly - hurdles

- Assembler must perform lookup while the knowledge about the selected components is with the designer
  - Overhead for assembler to prepare quotation => Too expensive for prototypes or small series.
  - Communication between assembler and designer
  - Incorrect interpretations
- Heavy logistics for a small job

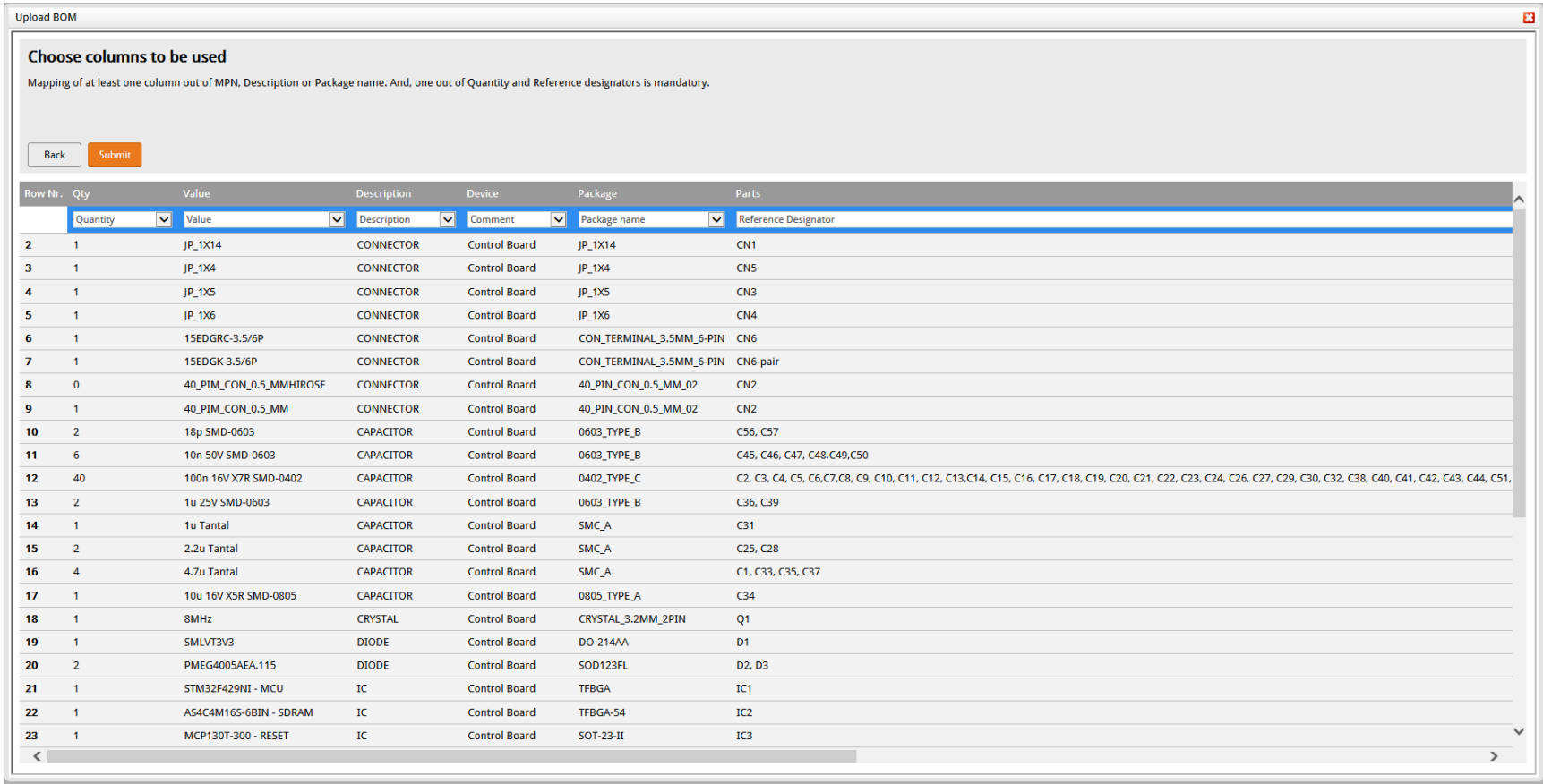
Prototype assembly - solution

- Supply tools to the designer to:
  - complete/validate the BOM (**B**ill **O**f **M**aterials)
  - complete/validate the CPL (**C**omponent **P**lacement **L**ist)
  - communicate between designer and production
  - create output to order assembly

- Eurocircuits Assembly Visualizer:
  - BOM Configurator (analyses + editing)
  - CPL Configurator (Virtual placement + editing)
  - eC-communicator (communication tool: designer-producer)
  - eC-generator (generation of outputs: PCB Gerber X2, Validated BOM, validated CPL, …)

Assembly Visualizer – Step 1

- Read BOM list with intelligent tools
  - Detect BOM list format
  - Assign column types
  - Automated search



Upload BOM

Choose columns to be used

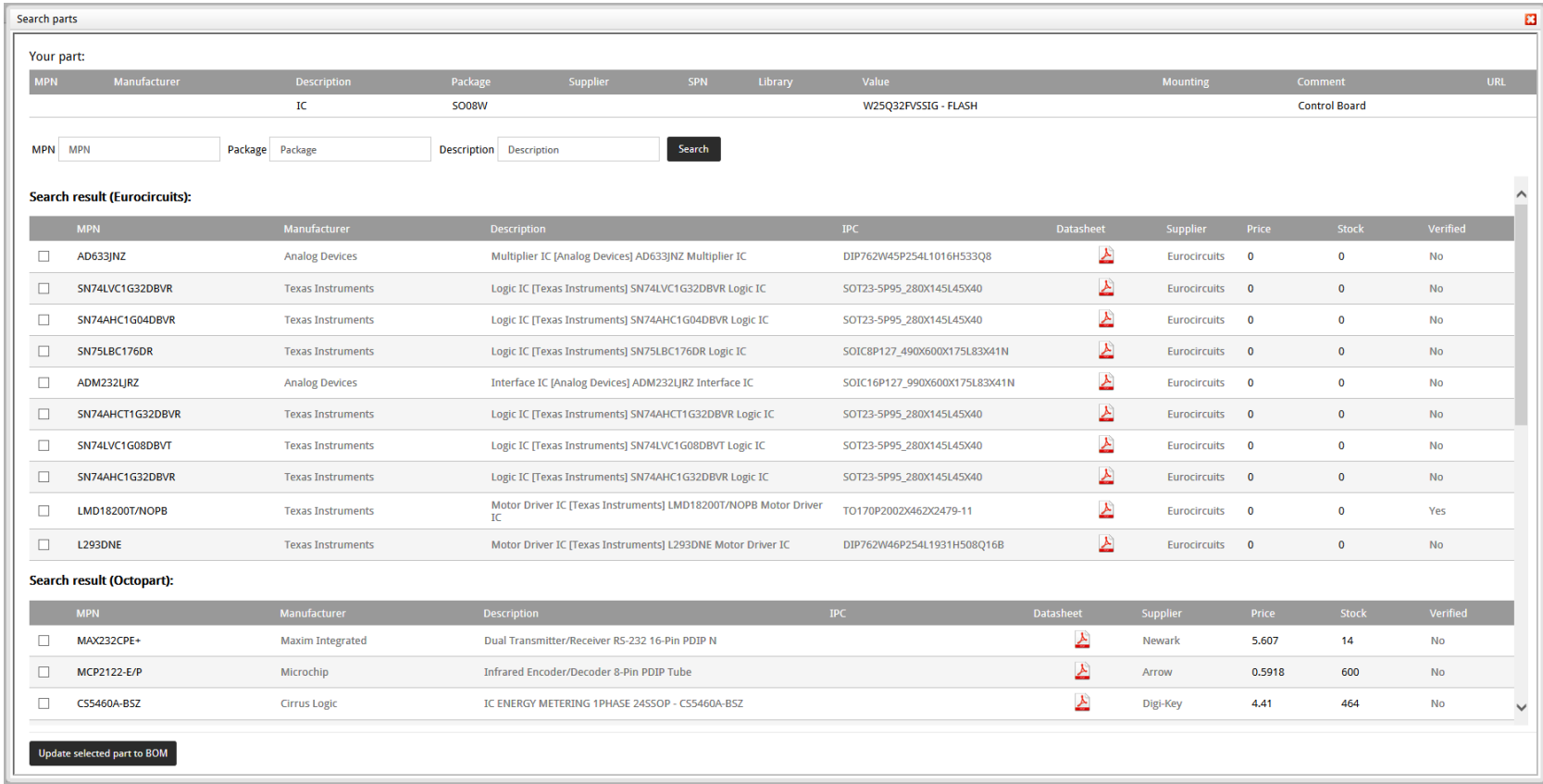
Mapping of at least one column out of MPN, Description or Package name. And, one out of Quantity and Reference designators is mandatory.

Back | Submit

Row Nr.	Qty	Value	Description	Device	Package	Parts
	Quantity	Value	Description	Comment	Package name	Reference Designator
2	1	JP_1X14	CONNECTOR	Control Board	JP_1X14	CN1
3	1	JP_1X4	CONNECTOR	Control Board	JP_1X4	CN5
4	1	JP_1X5	CONNECTOR	Control Board	JP_1X5	CN3
5	1	JP_1X6	CONNECTOR	Control Board	JP_1X6	CN4
6	1	15EDGRC-3.5/6P	CONNECTOR	Control Board	CON_TERMINAL_3.5MM_6-PIN	CN6
7	1	15EDGK-3.5/6P	CONNECTOR	Control Board	CON_TERMINAL_3.5MM_6-PIN	CN6-pair
8	0	40_PIM_CON_0.5_MMHIROSE	CONNECTOR	Control Board	40_PIN_CON_0.5_MM_02	CN2
9	1	40_PIM_CON_0.5_MM	CONNECTOR	Control Board	40_PIN_CON_0.5_MM_02	CN2
10	2	18p SMD-0603	CAPACITOR	Control Board	0603_TYPE_B	C56, C57
11	6	10n 50V SMD-0603	CAPACITOR	Control Board	0603_TYPE_B	C45, C46, C47, C48,C49,C50
12	40	100n 16V X7R SMD-0402	CAPACITOR	Control Board	0402_TYPE_C	C2, C3, C4, C5, C6,C7,C8, C9, C10, C11, C12, C13,C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C26, C27, C29, C30, C32, C38, C40, C41, C42, C43, C44, C51,
13	2	1u 25V SMD-0603	CAPACITOR	Control Board	0603_TYPE_B	C36, C39
14	1	1u Tantal	CAPACITOR	Control Board	SMC_A	C31
15	2	2.2u Tantal	CAPACITOR	Control Board	SMC_A	C25, C28
16	4	4.7u Tantal	CAPACITOR	Control Board	SMC_A	C1, C33, C35, C37
17	1	10u 16V X5R SMD-0805	CAPACITOR	Control Board	0805_TYPE_A	C34
18	1	8MHz	CRYSTAL	Control Board	CRYSTAL_3.2MM_2PIN	Q1
19	1	SMLVT3V3	DIODE	Control Board	DO-214AA	D1
20	2	PMEG4005AEA.115	DIODE	Control Board	SOD123FL	D2, D3
21	1	STM32F429NI - MCU	IC	Control Board	TFBGA	IC1
22	1	AS4C4M16S-6BIN - SDRAM	IC	Control Board	TFBGA-54	IC2
23	1	MCP130T-300 - RESET	IC	Control Board	SOT-23-II	IC3

Assembly Visualizer – Step 2

- Manual search if automated results are ambiguous
  - Integrated search on different sources
    - Eurocircuits component database
    - Supplier/Manufacturer websites
  - Direct access to spec sheets



Search parts

Your part:

MPN	Manufacturer	Description	Package	Supplier	SPN	Library	Value	Mounting	Comment	URL
		IC	SO08W				W25Q32FVSSIG - FLASH		Control Board	

MPN | Package | Description | Search

Search result (Eurocircuits):

	MPN	Manufacturer	Description	IPC	Datasheet	Supplier	Price	Stock	Verified
☐	AD633JNZ	Analog Devices	Multiplier IC [Analog Devices] AD633JNZ Multiplier IC	DIP762W45P254L1016H533Q8		Eurocircuits	0	0	No
☐	SN74LVC1G32DBVR	Texas Instruments	Logic IC [Texas Instruments] SN74LVC1G32DBVR Logic IC	SOT23-5P95_280X145L45X40		Eurocircuits	0	0	No
☐	SN74AHC1G04DBVR	Texas Instruments	Logic IC [Texas Instruments] SN74AHC1G04DBVR Logic IC	SOT23-5P95_280X145L45X40		Eurocircuits	0	0	No
☐	SN75LBC176DR	Texas Instruments	Logic IC [Texas Instruments] SN75LBC176DR Logic IC	SOIC8P127_490X600X175L83X41N		Eurocircuits	0	0	No
☐	ADM232LJRZ	Analog Devices	Interface IC [Analog Devices] ADM232LJRZ Interface IC	SOIC16P127_990X600X175L83X41N		Eurocircuits	0	0	No
☐	SN74AHCT1G32DBVR	Texas Instruments	Logic IC [Texas Instruments] SN74AHCT1G32DBVR Logic IC	SOT23-5P95_280X145L45X40		Eurocircuits	0	0	No
☐	SN74LVC1G08DBVT	Texas Instruments	Logic IC [Texas Instruments] SN74LVC1G08DBVT Logic IC	SOT23-5P95_280X145L45X40		Eurocircuits	0	0	No
☐	SN74AHC1G32DBVR	Texas Instruments	Logic IC [Texas Instruments] SN74AHC1G32DBVR Logic IC	SOT23-5P95_280X145L45X40		Eurocircuits	0	0	No
☐	LMD18200T/NOPB	Texas Instruments	Motor Driver IC [Texas Instruments] LMD18200T/NOPB Motor Driver IC	TO170P2002X462X2479-11		Eurocircuits	0	0	Yes
☐	L293DNE	Texas Instruments	Motor Driver IC [Texas Instruments] L293DNE Motor Driver IC	DIP762W46P254L1931H508Q16B		Eurocircuits	0	0	No

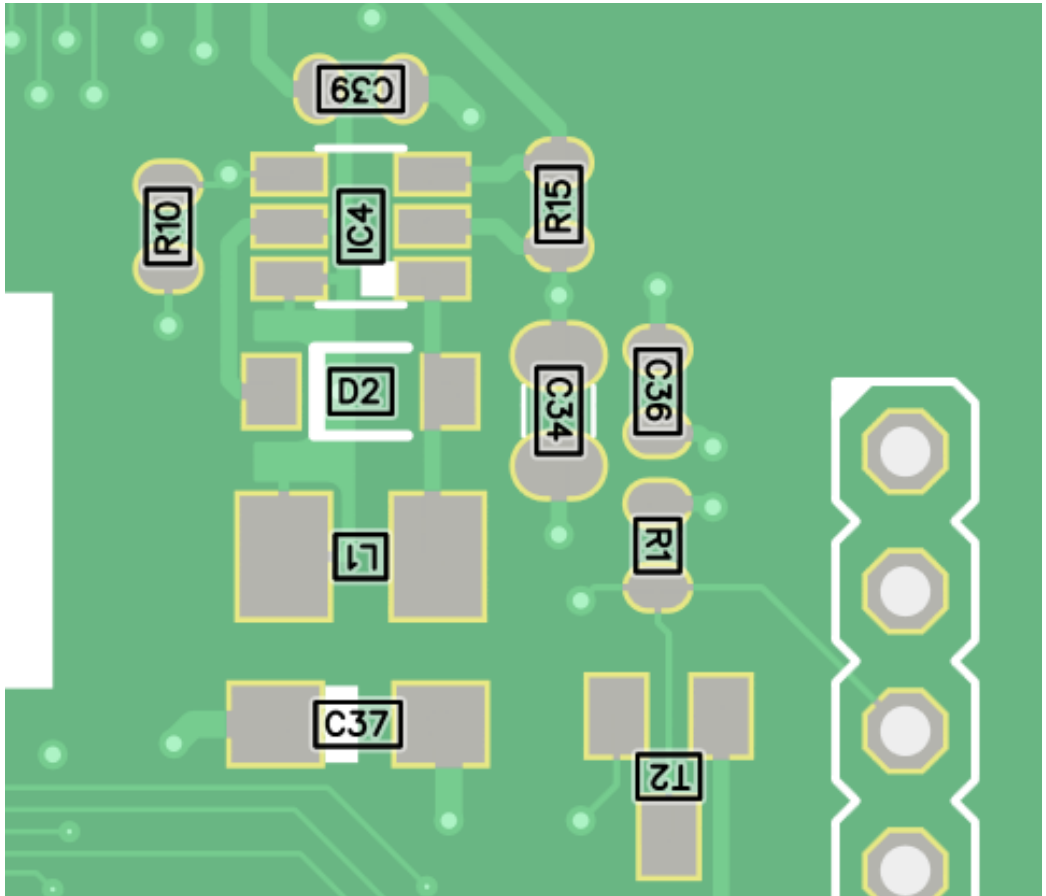
Search result (Octopart):

	MPN	Manufacturer	Description	IPC	Datasheet	Supplier	Price	Stock	Verified
☐	MAX232CPE+	Maxim Integrated	Dual Transmitter/Receiver RS-232 16-Pin PDIP N			Newark	5.607	14	No
☐	MCP2122-E/P	Microchip	Infrared Encoder/Decoder 8-Pin PDIP Tube			Arrow	0.5918	600	No
☐	CS5460A-BSZ	Cirrus Logic	IC ENERGY METERING 1PHASE 24SSOP - CS5460A-BSZ			Digi-Key	4.41	464	No

Update selected part to BOM

Assembly Visualizer – Step 3

- Read and visualize CPL data
  - Detect CPL format
  - Assign column types
  - Visualize component locations on PCB data



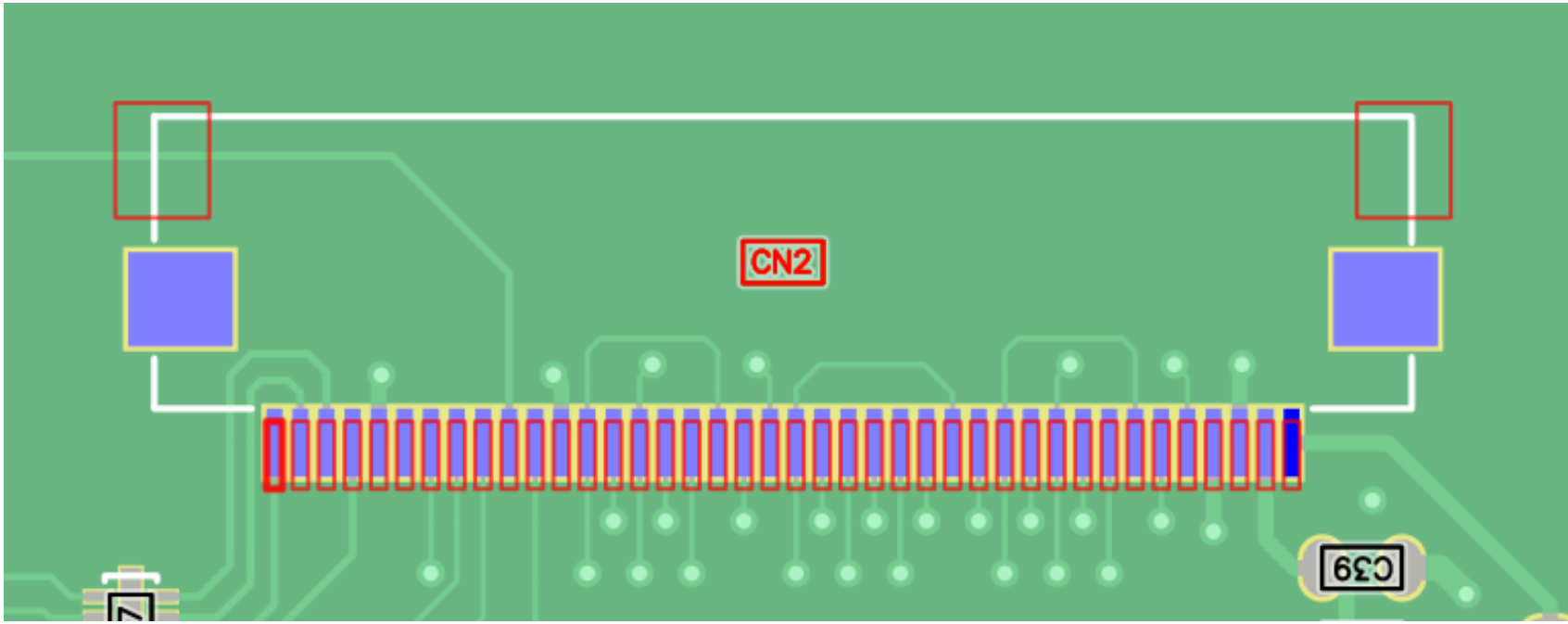
Assembly Visualizer – Step 4

- Visually validate component data:
  - Visualize component footprints on top of board data
  - PIN1 of component footprint against board legend data or board PIN1 copper pad.

- In other words – check:
  - Footprint
  - Location
  - Rotation

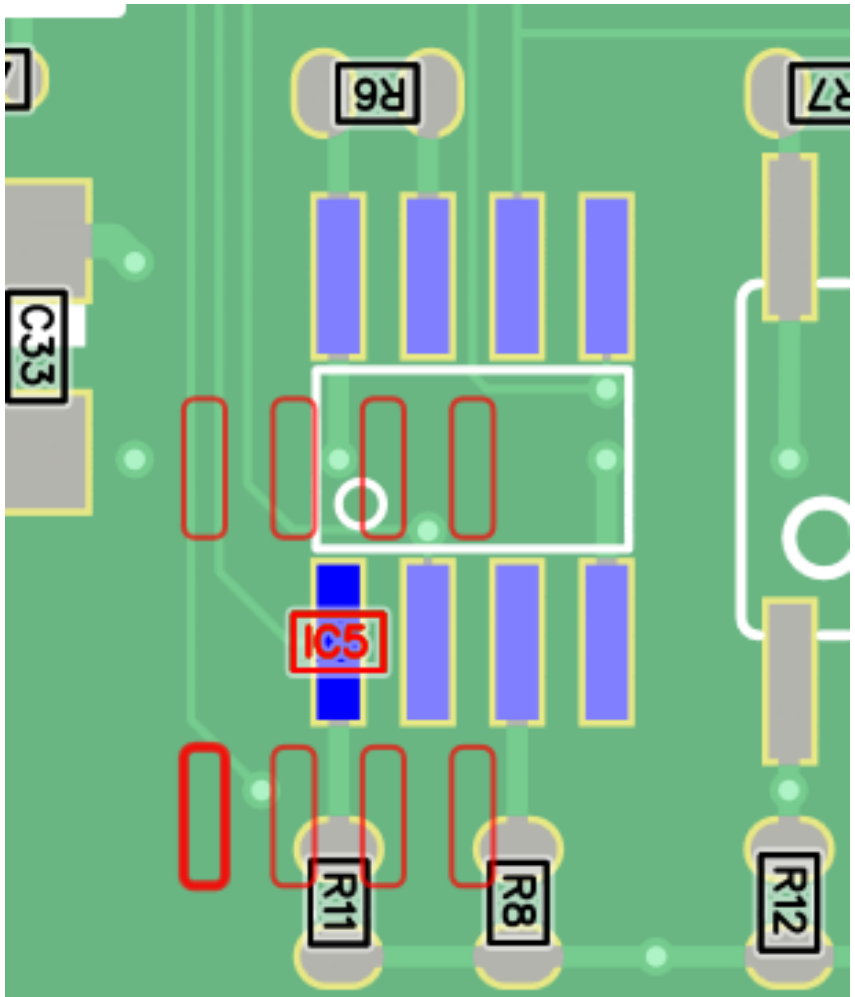
Assembly Visualizer – Step 4

- Footprint
  - Incorrect component chosen. Same device available with different packages
  - Incorrect footprint definition in CAD library



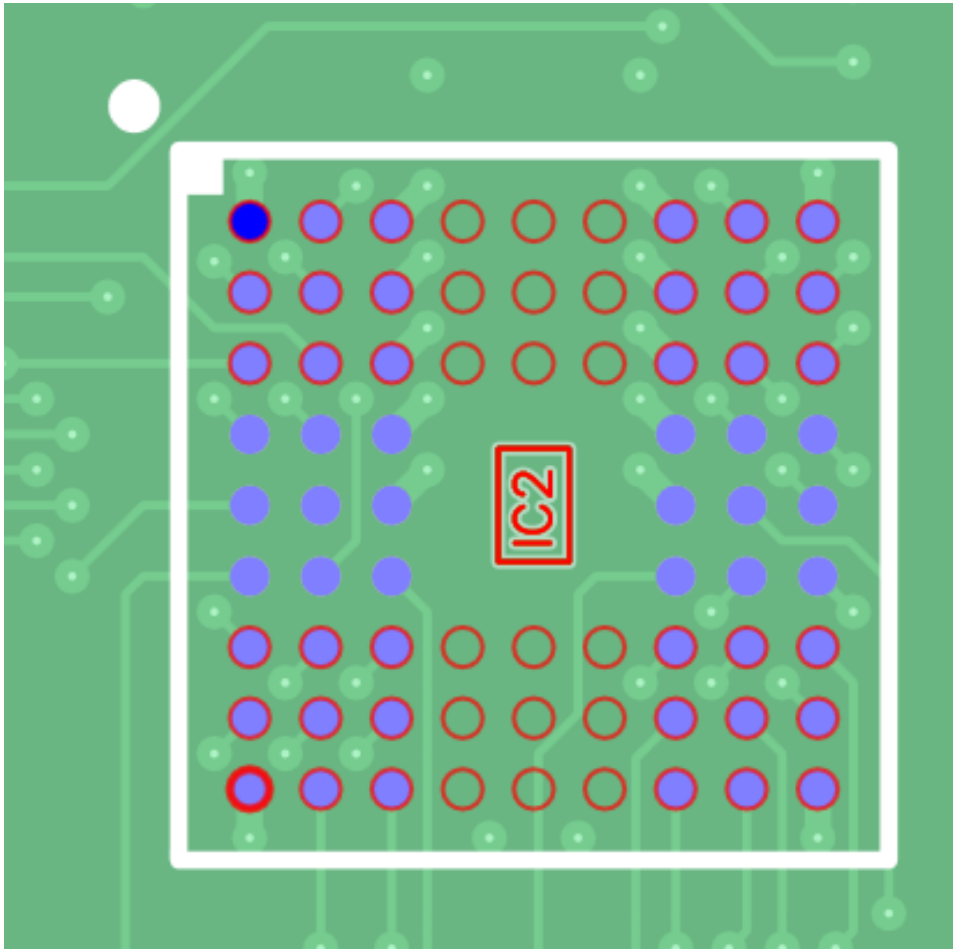
Assembly Visualizer – Step 4

- Location
  - PIN1 vs centroid location in CPL file



Assembly Visualizer – Step 4

- Rotation
  - Each library can define its own default rotation
  - Verified against eC standard rotation

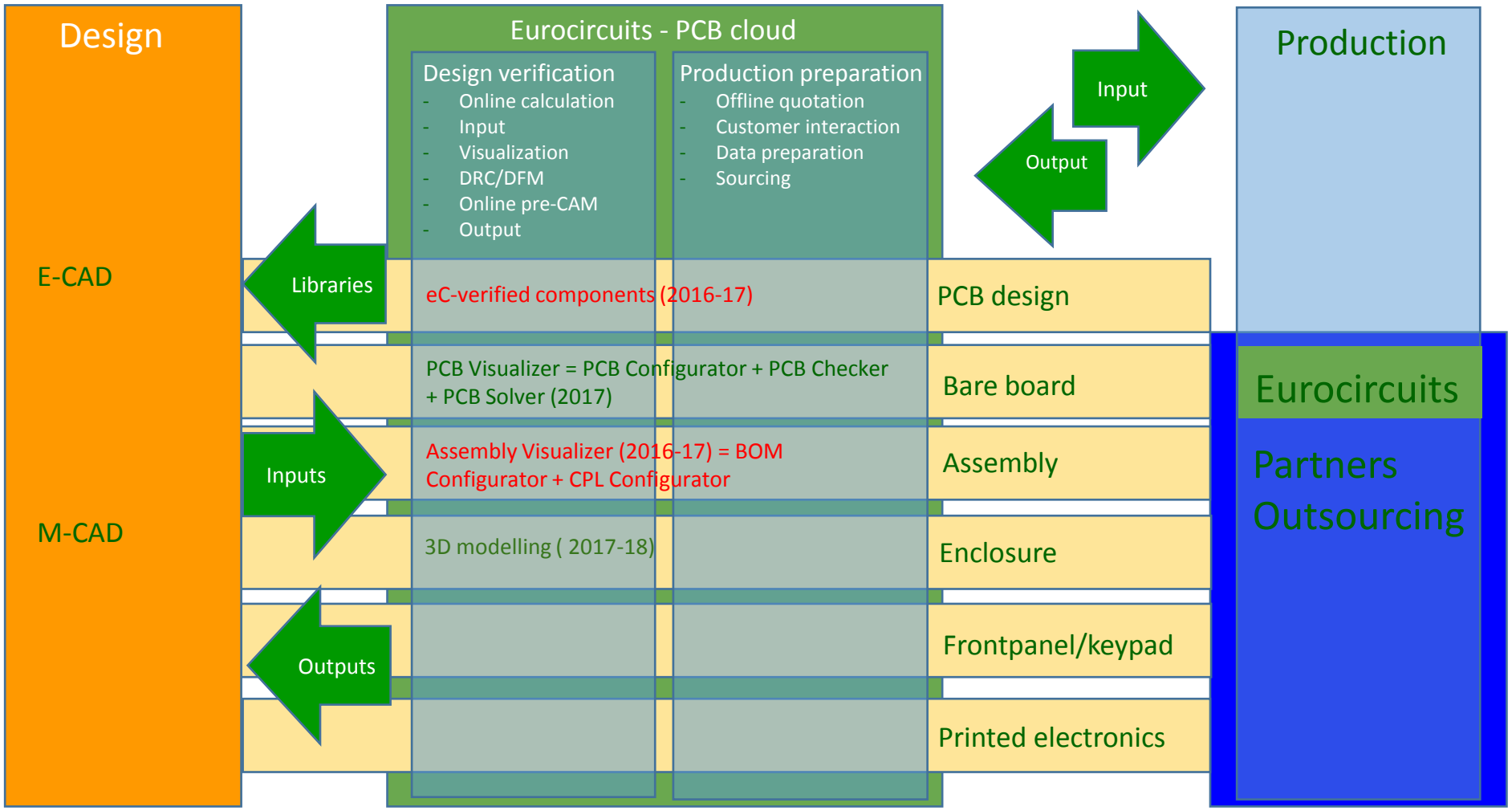


Assembly Visualizer – Step 5

- eC-generator (generation of outputs):
  - Validated BOM
  - Validated CPL
  - 3-D data (pdf)

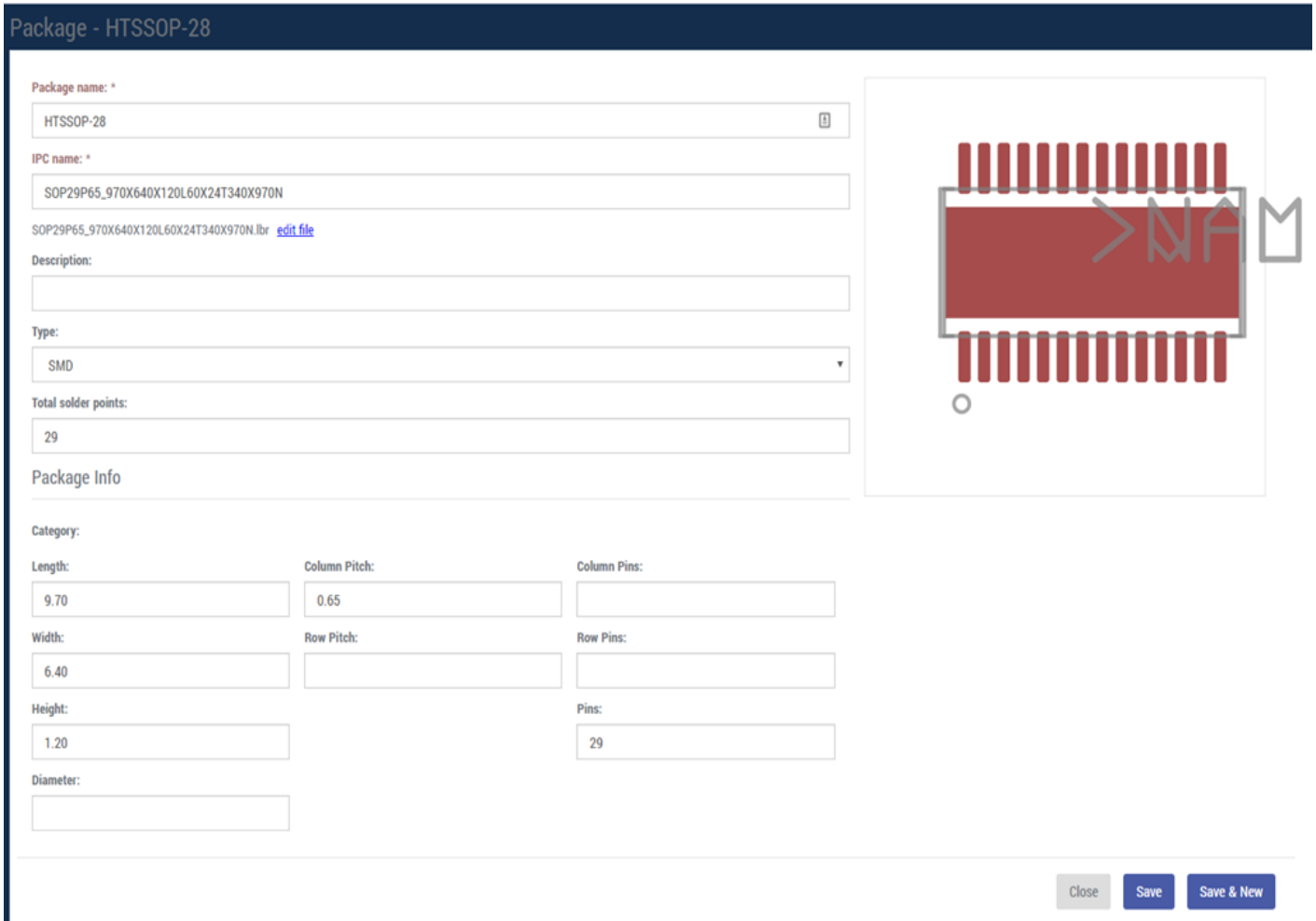
- Your board “right first time”
  - on time
  - accurate to your intentions
  - at best total cost

Future Tools



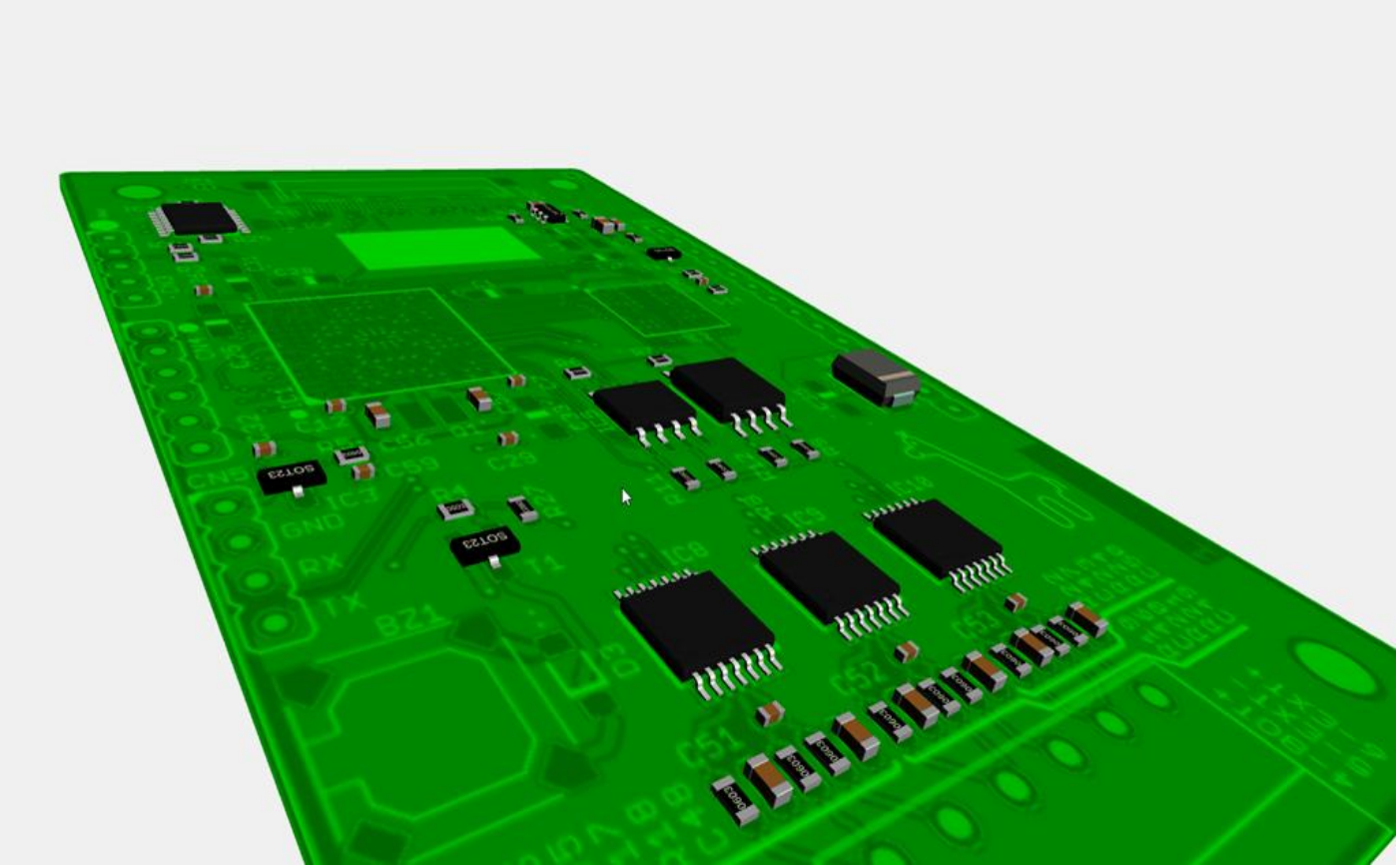
Assembly Visualizer – future

- eC-verified component database (DB)
  - Verified footprints (IPC-rules + Own practical experience)
  - Output to various CAD-packages



Assembly Visualizer – future

- Eurocircuits CAM department
  - pool of electronics engineers for data preparation … to get a virtual 3D assembled board

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