

# 18<sup>th</sup> ILO Forum Meeting

## TE-MPE-EM Subcontracting of Electronics Modules

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# Summary

- Mandate of TE-MPE-EM
- Structure and resources
- Volume of activity
- Outsourcing and quality management
- How can you help?

# Mandate of TE-MPE-EM

Service providing CERN-wide support in the domain of Printed Circuits Boards (PCB) and Electronic Module Assembly.

- Layout design for electronic boards and crates
- Manufacturing of bare PCB at CERN or by subcontracting
- Mechanical parts production in collaboration with EN-MME
- Assembly and integration of electronic modules, internally or by subcontracting

No visibility for production volumes in more than 3 months in advance

# Structure and resources

A team of 18 members coming from the Industry

- 1 section leader
- 7 technicians for the design of std and special PCB layouts
- 2 technicians specialized in CAD libraries
- 2 engineers specialized in production processes, dedicated to design reviews, subcontractors validation and follow-up
- 3 technicians specialized in PCB assembly and special repair
- 2 technical assistants for ordering components and assembly
- 1 ADMIN student

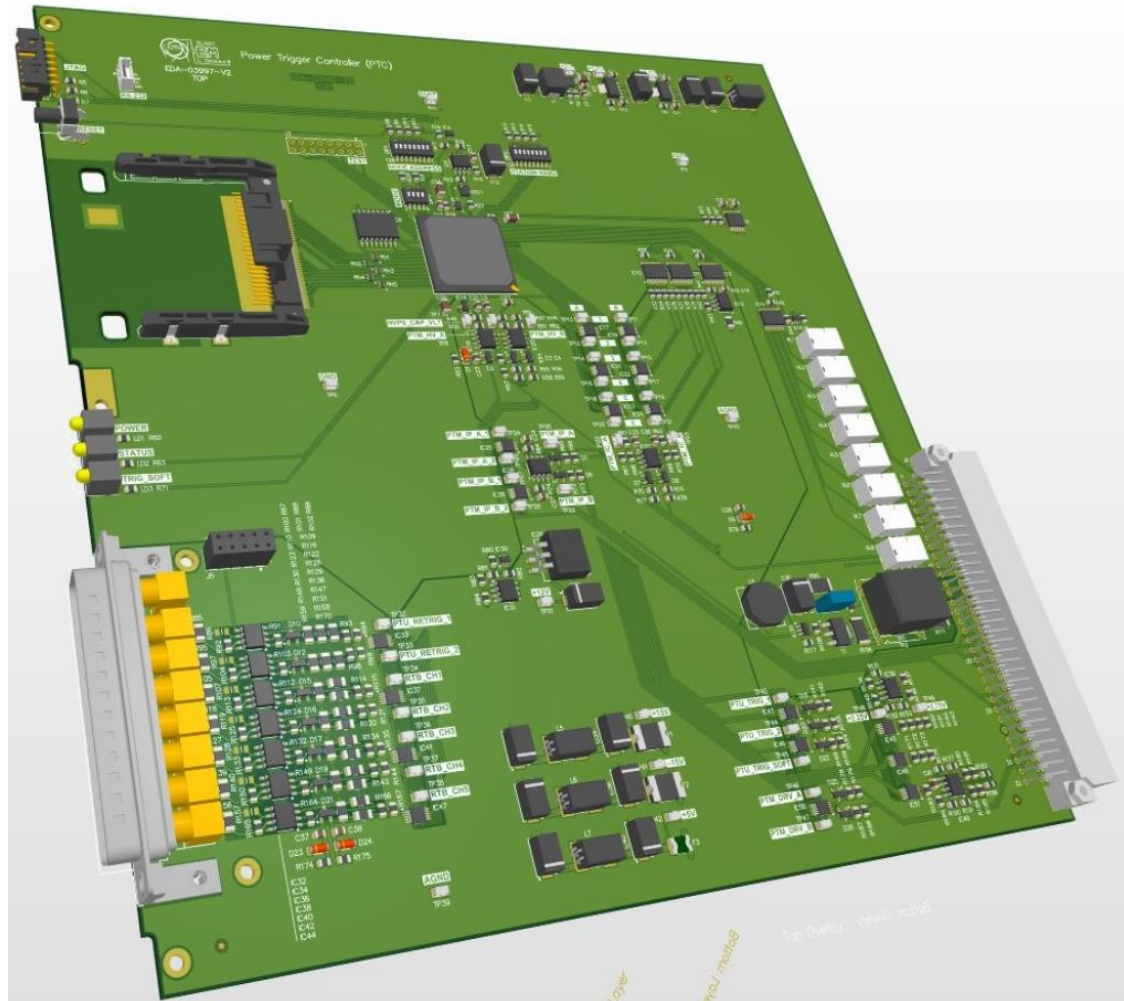
# Typical examples of layout and production

## Electronic card:

- 220x233 mm
- 76 components types
- 0805 package type
- BGA484 package type

Qty produced:

- 90 units



CERN 26.10.2016

- 1 populated PCB
- internal cables
- mechanical parts

- 900 units



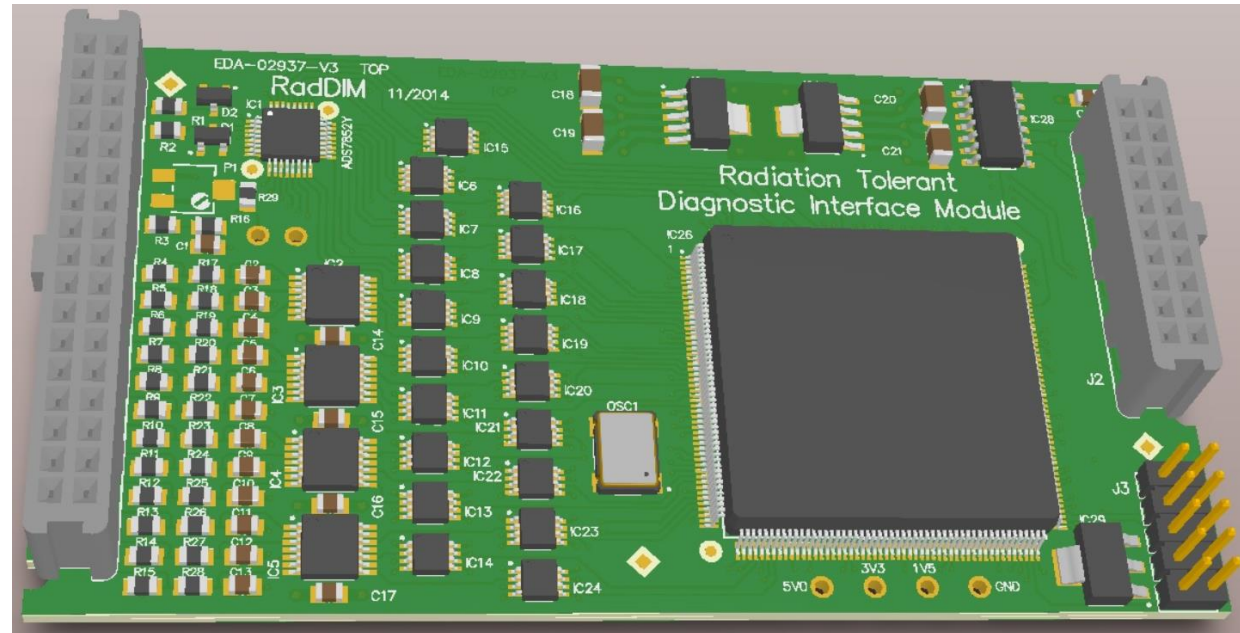
# Examples of production ones or twice a year

## Electronic card:

- 98x54 mm
- 28 components types
- 0805 components
- QFP208 package

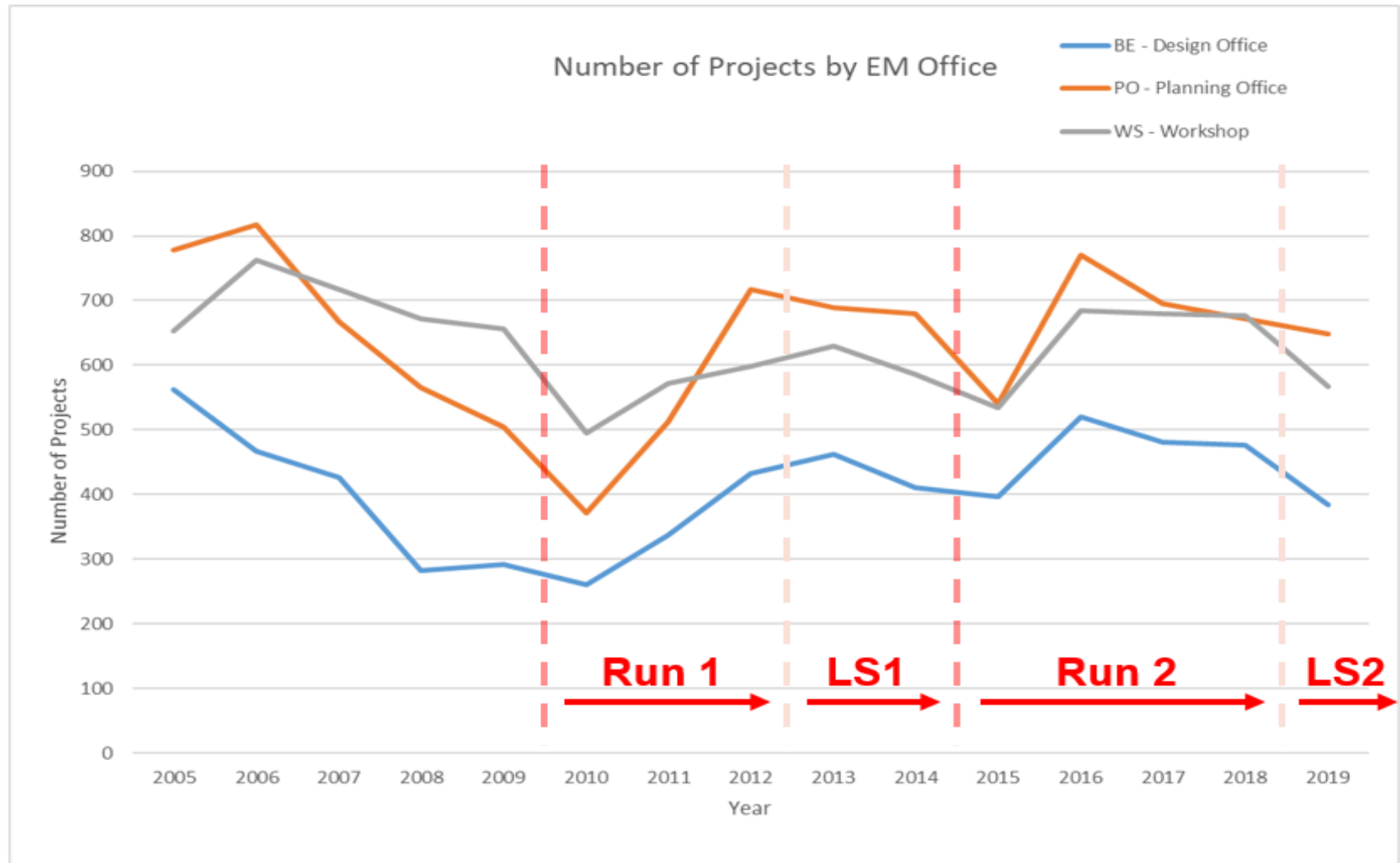
## Qty produced:

- 2'500 units



# Number of projects per year and activity

Quantity produced per project are not included in this graph





# Outsourcing strategy

- The “standard” production type for subcontracting
  - Volumes generally from 10 to 250 pcs, some up to 2'500 pcs
  - Single shot production, no repetitive production are foreseen
- We deliver a complete kit of components, including bare PCB, in order to:
  - Keep control of quality and costs
  - Reduce lead time after design validation and creation of official orders
- Components purchased only through official distributors
- 3-year contracts with 2 PCB manufacturers
- Selected, visited and validated subcontractors for PCB assembly

# PCB procurement

**From 01.01.2019 to 31.12.2019**

Qty of DAI issued on activity code 03021000	297
Total cost:	475'594.- CHF
DAI < 5'000.-CHF:	287
DAI > 5'000.- and <10'000.-CHF:	8
DAI > 10'000.-CHF:	2
Average cost per DAI:	1'601.- CHF

# Assembly procurement

**From 01.01.2019 to 31.12.2019**

Qty of DAI issued on activity code 03030100	209
Total cost:	559'790.- CHF
DAI < 5'000.-CHF:	178
DAI > 5'000.-<10'000.-CHF:	25
DAI > 10'000.-CHF:	6
Average cost per DAI:	2'678.- CHF

# Printed Circuit Boards subcontracting?

# PCB specifics

- One of the most expensive parts of an assembly
- A defective PCB may result in the complete loss of components
- Defects in PCB may be hidden and introduce reliability problems during operation
- The PCB must withstand the assembly process (RoHS, High Tg) and CERN safety rules (halogen-free base material)
- As compared to “of the shelf “ components, each PCB is a new product made in limited quantity

# How do we select a PCB manufacturer ?

## General requirements

- ISO 9001:2015 certified company
- Production shall be done in CERN Member States
- All process steps shall be done in-house, no subcontracting allowed
- Halogen free base material shall be used → IS41, CERN standard
- Acceptance of the PCB shall be compliant with IPC-A-600 standards
- Controlled impedances
- Finished holes diameter: down to 0.2 mm, aspect ratio up to 8:1
- Blind and buried via holes according to IPC-DR-572
- Surface finishing: electroplated Au, electroless Ni/Au

# Purchasing of PCB

- MS sent (early 2017) to 44 firms in 15 member states, 19 replied
  - 10 selected on the basis of their replies to the questionnaire
  - 9 short listed after technical audits
- IT sent to the 9 firms
  - based on a representative sample of representative PCB designs
  - a pricing table was part of the deliverable (to guarantee that the costs of the future orders will comply with those announced for the IT).
- **2 contracts established in April 2018 for 3 years** and 600kCHF

**A new MS process will start early 2021**

And for electronic assemblies?



# Electronic assembly procurement strategy

- 3 categories of assemblies
  - Simple: through hole components, low density
  - Intermediate: Through hole and simple SMD components
  - Complex: BGA, QFN, LGA packages
- Each category has its assembly requirements, leading to different processes and equipment
- A firm equipped for complex boards will not be competitive for simple ones
- Urgent projects often require proximity with the firm
- An open contract requires a pricing model to guarantee the best cost at any time for any project. For assembly, a price model is not easy to establish

# Purchasing of assemblies

We are always looking for new subcontractors in unbalance member states and we base our search on inputs from:

- Purchasing Office
- other CERN groups
- exhibitions at CERN
- adverts in specialised newspapers or websites
- dedicated fairs
- ILO contacting us

Firms looking as adapted to our requirements are highlighted

- A first quote is requested to verify if their price is acceptable as compared to those from usual suppliers
- The firm is then audited on-site to verify their technical capabilities
- A limited panel of firms is qualified to fulfill our purchasing planning
- All large orders are discussed with Purchasing Office before initiating the official DO

# Purchasing of assemblies

Selection Matrix with internal returns for period 2019

Firm	Country	Industrial Returns	SMD			Through Hole				Tests			Cabling	Box build	Proximity	Volume
			Simple ≥0402	Complex QFP/QFN	SMD BGA/LGA	Manual	Wave	Selective wave	Pressfit	Functional	AOI	Flying Probe				
A	DNK	PB														
B	DEU	PB														
C	BEL	PB														
D	FRA	WB														
E*	CHE	WB														
F	DNK	PB														
G	FRA	WB														
H	NOR	VPB														
I	PRT	PB														
J	ESP	PB														
K	FRA	WB														
L	GRC	PB														
M	GBR	PB														
N	NOR	VPB														
O	ITA	WB														
P	GBR	PB														
Q*	FRA	WB														
R	DNK	PB														
S	NOR	VPB														
T	SWE	PB														
U	GRC	PB														
V	ESP	PB														
W	NOR	VPB														
X	CHE	WB														

- 24 firms based in 12 Member States
- 7 firms in well balanced countries
- 13 firms in poorly balanced countries
- 4 firms in very poorly balanced countries

We are now in the validation process with 1-2 Lituanian firms, 1 Slovenian company and 1 UK company

# Purchasing of assemblies

Our objective is to accentuate the collaboration with unbalanced countries

PO by member state over the period 2017 – 2019

Country	DAI	Cost (kCHF)	Cost/DAI (kCHF)
DNK	22	267	12.1
SWE	3	33	11.0
GBR	20	141	7.1
NOR	22	123	5.6
DEU	25	136	5.4
GRC	59	312	5.3
ESP	44	192	4.4
PRT	25	78	3.1
<b>TOTAL Unbalanced</b>	<b>220</b>	<b>1282</b>	<b>5.8</b>
ITA	60	374	6.2
FRA	122	300	2.5
CHE	245	414	1.7
<b>TOTAL Balanced</b>	<b>427</b>	<b>1088</b>	<b>2.5</b>

Real effort to work with companies in unbalanced countries

# Purchasing of assemblies

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PO by member state over the period 2013 – 2016

Country	DAI	Cost (kCHF)	Cost/DAI (kCHF)
NO	1	46	46
BE	4	66	17
DK	24	236	10
DE	6	24	4
GR	14	51	4
UK	7	20	3
ES	31	64	2
<b>TOTAL Unbalanced</b>	<b>87</b>	<b>507</b>	<b>6</b>
IT	5	15	3
CH	118	212	2
FR	176	494	3
<b>TOTAL Balanced</b>	<b>299</b>	<b>721</b>	<b>2</b>

Table presented during 13th ILO meeting

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+152%

+152%

Table presented during 13th ILO meeting

Work with companies in unbalanced countries increased significantly over 3 years and we will continue to develop our prospecting

# How do we select a supplier

## ➤ General requirements

- ✓ ISO 9001:2015 certified company
- ✓ Production shall be done in CERN member states
- ✓ All steps of process shall be done in-house, no subcontracting allowed
- ✓ Acceptance of the electronic assemblies shall be compliant with IPC-A-610 standard, class 3

### **Class 1 -- General Electronic Products**

Includes products suitable for applications where the major requirement is function of the completed assembly.

### **Class 2 -- Dedicated Service Electronic Products**

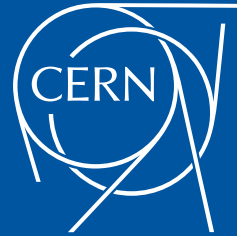
Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically the end-use environment would not cause failures.

### **Class 3 -- High Performance Electronic Products**

Includes products where continued high performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems.

- ✓ Industrial cleaning equipment in house
- ✓ Vapor phase oven may be an advantage

# How can you help?





# How can you help?

- When you organize exhibitions at CERN
- When you organize for us visits to such firms
- We are always willing to meet you at our lab to more deeply discuss the technical constraints of our activities
- **We need your help to identify possible subcontractors according to our technical requirements**



# Questions?