Costing and costing group revival

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as
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Resurrecting what was done at the time of the LoI then DBD
but more thoroughly

Deep questions

as you can have after some sake

Is there a cost for ILD before it is achieved? And even after

when ILD will be produced in many different countries with different currencies and accounting methods, where the manpower can be hidden behind “in kind”

We are looking at an estimate to predict if the cost will be in the ballpark of the LHC experiments cost

Even though it is so much more sophisticated!

And to evaluate the weight of the labs!

The principles for costing are described in the common part of the IL TDR (DBD).
In the ILD specific part, and following more or less the principles, a cost for ILD is elaborated.
ILD people should find some interest in reading the corresponding DBD pages.

Here I try to summarise what I find useful

The game of costing is done by estimating coherently
the cost of each part or subdetector and the global contributions, then summing that
This without knowing who will build what

Parts are sub-detectors or insensitive items like the

The basis for costing is the knowledge of the design, of the materials, of the fabrication process, of the manpower, but also the tooling, the transportation, the assembly and maybe more.

The starting point is then to write a Work Breakdown System (WBS) as complete as possible
where all the actions described in the order of the process are properly summarised by category:
procurements, operations ...

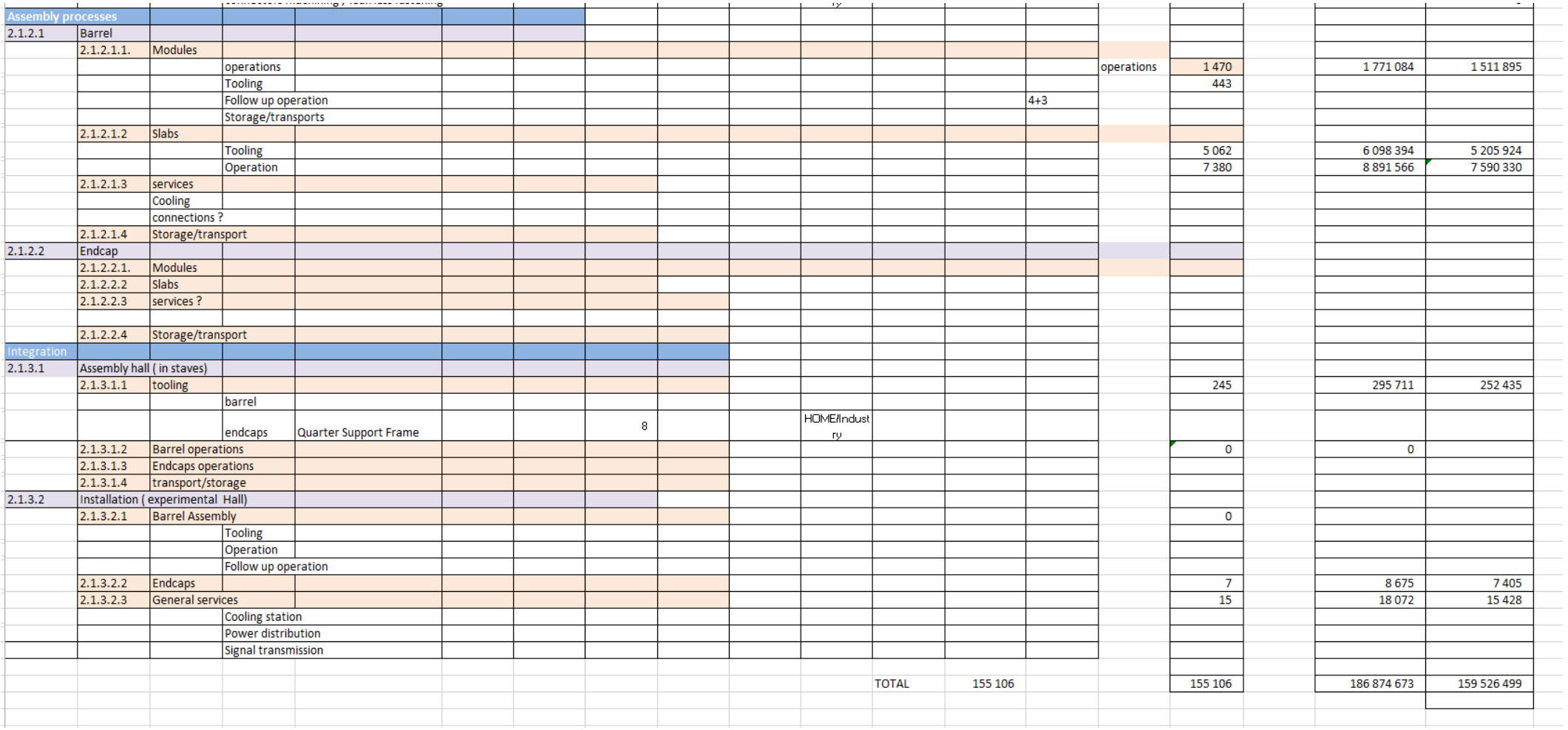
This WBS will appear as an Excel file or equivalent, but it is reasonable to start with an illustrated simple description of the chain of actions with procurements.

A strong achievement will be to get a description of the process with the time for the different operations. This will provide not only the price but an estimate of the manpower needed, of the time needed, of the assembly space needed.

All what makes a project.

Example from the Si-Ecal WBS

							Quantities	Unit	Tools	Place	Unit cost/tim	Cost in k€	M.Y	intermediate costs			cost in ILCU 2012	
Electromagnetic Calorimeter												155 105,98	140,90		cost k€	Cost in ILCU	159 526 499	Total ILCU
	General procurement (Barrel + endcaps)																	159 526 499
2.1.1.1	Mechanical structures																	
	2.1.1.1.1	W													15 876	19 127 711	16 328 466	
			barrel														0	
				Material			90	ton		Industry S	120	10 836					0	
				Dimensional inspection			24 000	plates	3D measuren	HOME/Industry			5				0	
			endcaps														0	
				Material			42	ton		IndustrySeve	120	5 040					0	
				Dimensional inspection			12 000	plates	3D measuren	HOME/Indust	0		3				0	
	2.1.1.1.2	Carbon fibers prepeg													2 074	2 499 277	2 133 520	
			K (H structure)				8 600	m²		Industry	0	774					0	
			3K (Modules)				19 000	m²		Industry	0	950					0	
			Carbon plates(modules) 12 K														0	
				Th. :2mm	BARREL		40	plates		Industry	1	40					0	
				Th. :15 mm	BARREL		40	plates		Industry	2	80					0	
				Th. :2mm	ENDCAPS		24	m2		Industry	0	10					0	
				Th. :15 mm	Endcaps		24	m2		Industry	9	221					0	
	2.1.1.1.3	Metal inserts					1 728	inserts		Industry	0	41			41		0	
	2.1.1.1.4	Rails				Rails fabricat	80	rails		Industry	1	40			40		0	
2.1.1.2	Detector																0	
	2.1.1.2.1	Wafers		processed			308 800			Industry seve	0	75 038			75 038	90 407 711	77 176 994	
	2.1.1.2.2	ASIC					1 235 200			Industry	0	16 058			16 058	19 346 506	16 515 242	
	2.1.1.2.3	PCB					75 500			Industry	0	18 875			18 875	22 740 964	19 412 938	
	2.1.1.2.4	Boards										0			864	1 040 964	888 624	
			DC/DC converters				400				1	400					0	
			Data Concentrator				440				1	352					0	
			GDCC				140				1	112					0	
	2.1.1.2.5	other elect. Components															0	
			Active														0	
			passive														0	
	2.1.1.2.6	Materials for construction													1 258	1 515 181	1 293 442	
			HT Kapton				7 080			Industry	0	708					0	
			Interconnection kapton				122 400			Industry	0	490					0	
			Copper sheet	Barrel			6 000			Industry		60					0	
				endcap			1 080										0	
			Aluminum cover														0	
2.1.1.2	staves & endcaps														2 162	2 605 301	2 224 028	
		Cables/connectors					105 000				0	2 100					0	
		Patchpanels					24				3	62					0	
		Pipes/connectors					8 + 8			Industry							0	
		pumps															0	
2.1.1.3	Services from front end to 1st patchpanel (edge module to 1st common interconnection point)														386	465 060	397 001	
		Cables/connectors															0	
		Patchpanels															0	
		Cooling station															0	
			Cooling station skid				1			HOME/Industry	5	5					0	
			Tank, pumps, level gauge, pressure & flow sensors, heaters,...				1			Industry		65					0	
			Pipes and connectors				64M-272col			Industry		40					0	
			Supervision control equipment				1			Industry	50	50					0	
			Cabling				1?1?624			Industry		30					0	
			Electric cabinet				1			HOME/Industry	12	12					0	
			water treatment, deionization, IR,				1			Industry	5	5					0	
			T° sensors							Industry		13					0	
			Copper cooling blocks / machining / brazing				272			Industry	1	136					0	
			connectors machining / leak less fastening				272			HOME/Industry		30					0	



Assembly processes																	
2.1.2.1	Barrel																
	2.1.2.1.1.	Modules															
			operations											operations	1 470	1 771 084	1 511 895
			Tooling												443		
			Follow up operation										4+3				
			Storage/transports														
	2.1.2.1.2	Slabs															
			Tooling												5 062	6 098 394	5 205 924
			Operation												7 380	8 891 566	7 590 330
	2.1.2.1.3	services															
		Cooling															
		connections ?															
	2.1.2.1.4	Storage/transport															
2.1.2.2	Endcap																
	2.1.2.2.1.	Modules															
	2.1.2.2.2	Slabs															
	2.1.2.2.3	services ?															
	2.1.2.2.4	Storage/transport															
Integration																	
2.1.3.1	Assembly hall (in staves)																
	2.1.3.1.1	tooling													245	295 711	252 435
			barrel														
			endcaps	Quarter Support Frame			8			HOME/Industry							
	2.1.3.1.2	Barrel operations													0	0	
	2.1.3.1.3	Endcaps operations															
	2.1.3.1.4	transport/storage															
2.1.3.2	Installation (experimental Hall)																
	2.1.3.2.1	Barrel Assembly													0		
			Tooling														
			Operation														
			Follow up operation														
	2.1.3.2.2	Endcaps													7	8 675	7 405
	2.1.3.2.3	General services													15	18 072	15 428
			Cooling station														
			Power distribution														
			Signal transmission														
											TOTAL	155 106			155 106	186 874 673	159 526 499

This is not the most developed version and I see points I would modify.

When there are different technologies one WBS per technology should be developed.
The WBS have been developed in the form of Excel sheets.

It exists from the DBD time a number of WBS in ILD for different ensembles, (most of them can be found on EDMS):

- Muon system,
- Supplementary tracking inner/outer
- Magnet coil, yoke & vacuum tank, ancillaries, installation. Derived from CMS even though it is unlikely this will be done that way.
- TPC
- Sci-Ecal
- Si-Ecal procurements, assembly processes and integration with tooling and manpower
- sDHCAL barrel, end caps, rings, cooling, gas, services
- AHCAL mechanics, sensors, electronics, cooling, assembly, DAQ
- Forward calorimeters

But they are at very different levels of detail and accuracy and the decomposition does not follow the same scheme for the different parts.

Action: provide, if sound, a common decomposition scheme
and request a certain level of detail, on the operations, procurements and manpower.

At the time of the DBD we were requested to have some similarity with SiD and CLIC
In particular for the material driving costs.

Does it still make any sense?

The same name can cover very different items: Si for Ecal ≠ for strips ≠ for pixels …

The methodology of costing was derived from the accelerator costing methodology

We should pursue

Estimating a procurement price:
The price of the procurements may vary brutally, e.g. tungsten, just give what is today?
But evolution is likely for technical components:
The rule adopted was to provide the current cost from real technological prototypes or real experiments
with some justified expectation for large orders and a more mature technology.

Who considers the expectation as justified?

The problem of PPP (Purchasing Power Parity)
The pieces being procured from different countries
should we use exchange rates to estimate in a specific currency?
It was considered that currencies are fluctuating for non economical reasons and it would be better to consider that a given product obtained from different countries should have the same value then use the PPP.

This does not help much the estimate of a real price, but is very important to estimate the contribution of different countries, hence the weight they have in the collaboration.

But this is a slightly different story.

In order to go on

To make things move we need to identify people in every sub-ensemble
who dream to use their time on breaking down their sub-system,
collecting prices,
understanding the assembly procedures
doing the cost evaluation, the planning evaluation, …

This function could, maybe, and in view of the scarce manpower,
coexist with being in charge of assembly and integration.

Do we have integration officers everywhere?
The work would be better done
by quality engineers than by physicists

The work has to be made coherent by creating that way, a coherent group where
the rules to apply could be discussed briefly, then the work coordinated.

At the central level few people should look at the coherence of the effort,
at the quality of the arguments.

Action by the management: find the poor guys

The end