Costing ILD for the DBD

Henri Videau
LLR École polytechnique CNRS/IN2P3

Tomoyuki Sanuki
Tohoku University

Catherine Clerc
LLR École polytechnique CNRS/IN2P3

see also the presentation by C. Clerc at ALCPG Eugene
or for more ancient tales my talk at Seoul

Goal

Costing the detectors is mandatory to present a comprehensive evaluation of ILC at the time of the accelerator TDR.

The point may be not to have a proper estimate of every bolt
but to have identified clearly enough the components of the cost
to state that the global cost estimate is not wrong by more than say 30%.
Are we at the level of 250 MILCU*, 500 (our LoI estimate) or 1 GILCU?

An effort for estimating the cost of an ILD detector
took already place for the RDR in 2007, then for the LoI
and a certain level of consultation existed between the 3 concepts
and with the GDE.

* The MILCU is the unit of what we hope to milk out of financing agencies

Nevertheless IDAG noticed an important difference between
the SiD and ILD estimates (about a factor 2),
making them wondering about the accuracy of one or two of the estimates.

We are then asked to revisit our estimates
with a real consultation and a clear agreement
- on some basic costs like tungsten, iron or silicon,
- on procedures for accounting,
- on exchange rates.

The purpose is not a comparison between the two detectors
but to provide more confidence in the two estimates.

Notice that it exists a group for costing CLIC detectors.
As these detectors are derived from ILD and SiD, people in charge of costing in these two concepts are members of this group who has precisely tackled that point.

For SiD M. Breidenbach and Kurt Krempetz
For ILD Tomoyuki Sanuki and Henri Videau.

The same people form the Common Task Group
and have meetings with the RD for the same purpose.
P Garbincius who was involved in costing for GDE brings his expertise.

But indeed you are all actors

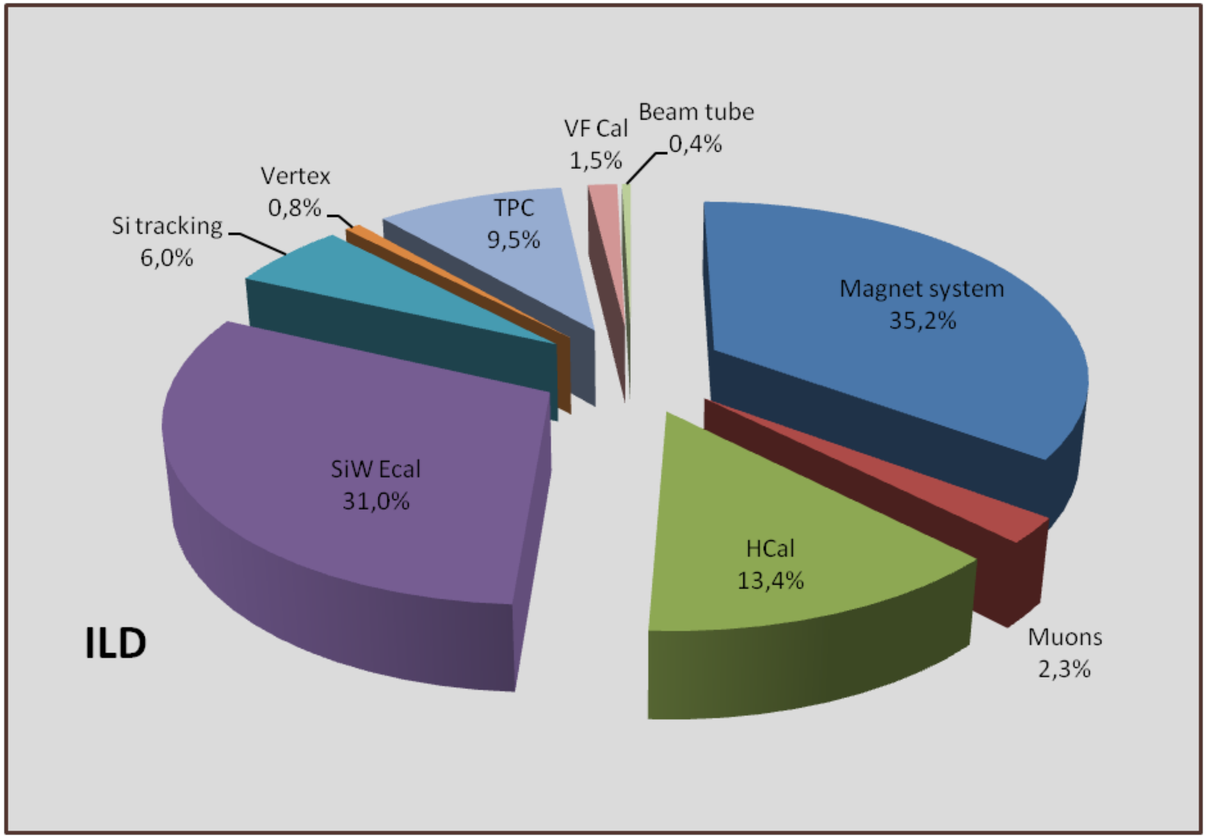
Following GDE we use for unit the ILC counting Unit or ILCU with some conversion factors to different real units.
Typically 1 US dollar = 1 , 1 Euro = 1.5 , 1 CHF = 1, 1 Yen =0.01
It has been decided to refer to the year 2012, when for the LoI it was 2006.
It means that the prices have to be escalated, one way is to use the tables provided by CERN for the evolution of material prices.

We consider having a cost reference detector

We can first identify the cost drivers which are expectedly the largest components:

- The electromagnetic calorimeter
- The hadron calorimeter
- The coil and return yoke

We will focus on them but
the sum of the smaller contributions
may end up being huge!

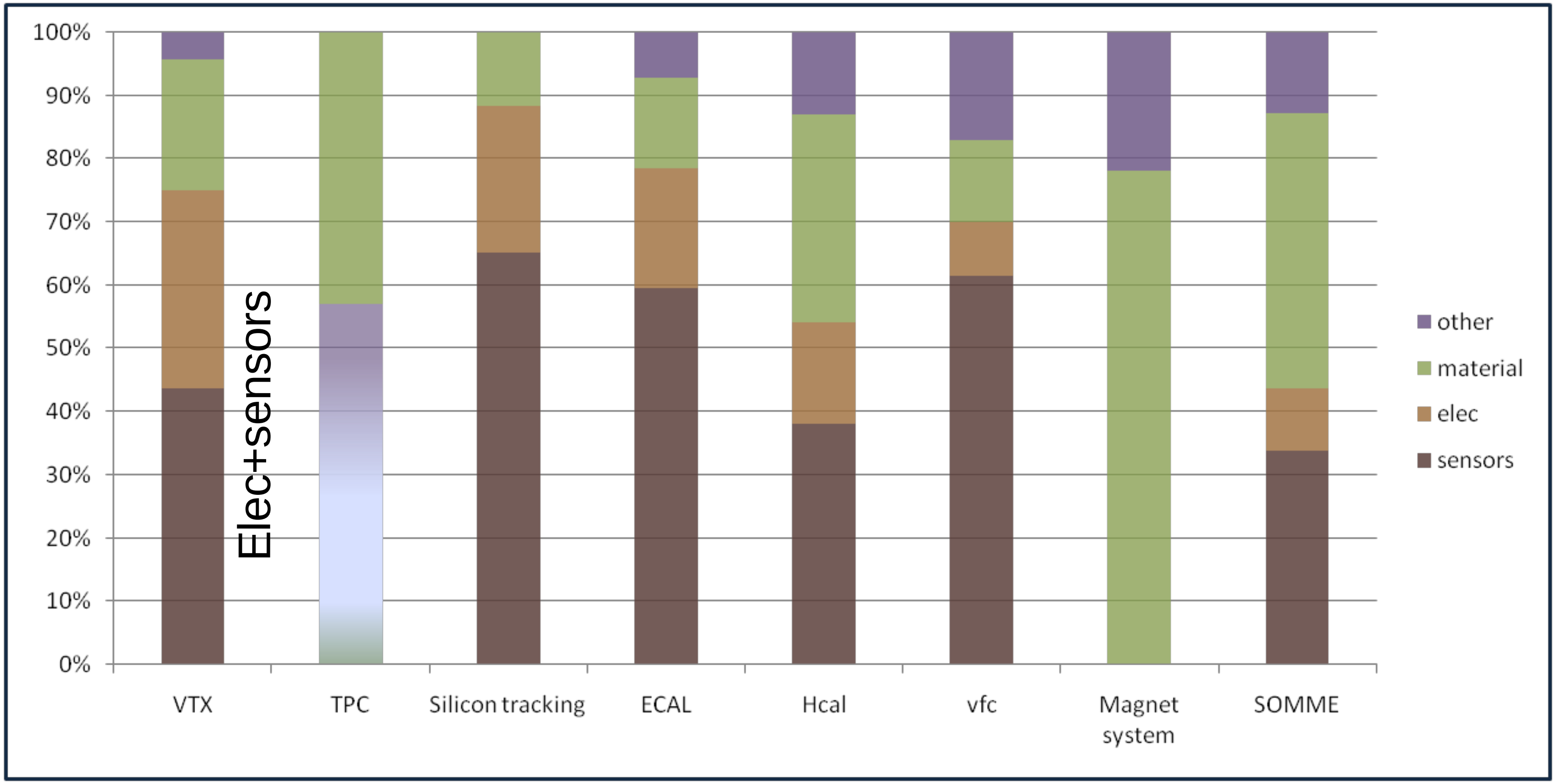


The cost is the cost for construction, R&D is not taken into account except specific R&D for transferring to industry.
We have to make sure that no item is lost in the MDI twilight zone not being paid for by accelerator nor detector.

Driver costs

As a first step we can try to agree on common pricing for driving cost materials :
W, Fe, SS, Silicon

but



The cost of materials may deeply vary with the level of machining required
we tried for example to identify two categories for iron and tungsten.

from the CLIC report in preparation

Table 16.1: Assumed unit cost for some materials [1]	**agreed unit cost**
Tungsten for HCAL	105 $ / kg
Tungsten for ECAL (tighter mechanical tolerances)	180 $ / kg
Steel for Yoke (semi-product)	1000 $ / ton
Steel for Yoke (final product, including assembly supervision)	6000 $ / ton
Stainless Steel for HCAL	4500 $ / ton
Silicon Detector	6 $ / cm^2

A difficult point in accounting comes from the different methods used in different regions, the in house manpower is not treated the same way.

We consider that the manpower at the industrial level is already taken care of in the price,

then we should focus on manpower which could be provided by institutions.

There we want to evaluate in man*years with few levels of qualification (2 or 3).

We should notice that, for the cost drivers at least, the amount of work may be so enormous, tens of millions of channels, that tasks usually done in labs like assembly or testing are likely to be industrialised

the estimate in man-years can be anyway relevant in the absence of an industrial offer.

LoI state

Item	Cost	fraction
VTX	1 700 000,00 €	0,53%
TPC	26 347 269,00 €	8,20%
Sup.tracking	6 900 000,00 €	2,15%
Ecal	93 360 746,00 €	29,07%
AHcal	52 952 954,00 €	16,49%
VFC	4 440 200,00 €	1,38%
Muon	2 500 000,00 €	0,78%
Magnet coil	39 688 000,00 €	12,36%
yoke	41 064 000,00 €	12,79%
magnet ancillaries	9 196 000,00 €	2,86%
offline computing	30 000 000,00 €	9,34%
Transport	13 000 000,00 €	4,05%
total	321 149 169,00 €	

Some options are not present

Subdet.	MY
VTX	100
Sup.Tracking	200
TPC	100
Ecal	300
Hcal	300
Magnet	200
Muons	100
Total	1300

State of the estimate

Since the LoI estimate has been published,
many sub-detectors have developed rather large prototypes
much closer to the ILD design.

It is clear that $1m^3$ is still far away but the estimates are surely much more precise and some aspects have been dealt with which were forgotten.
Then we have to go back to our Excel sheets and provide much more exhaustive accounting of the prices and the manpower.

On top of this quite some work has been done on the integration of the detector and services,
understanding how the detector can be mounted and maintained,
tools are better understood.

Then the services and tools costs can be properly included.

No assumptions should be made about future technology impact
or demand fluctuations on the unit prices used.

Some items will be estimated but not included in the final number like the offline computing

Duties

Therefore the sub-detector groups are requested to revisit their estimate taking into account
- the progress of their technical knowledge
- the progress in the integration of their part, cables, supports
- the progress of the assembly schemes, in particular the tooling.

A specific point concerns maintenance,
not that the sub-detectors have to provide a budget for this purpose
but, as the access may be difficult, the detectors have to be built
taking a particular care of the quality.
This means careful testing at different levels,
providing a certain redundancy
and serialisation can be limited in favour of parallelism.

In many cases the testing is not just a in house problem and an industrialisation scheme has to be developed.

To achieve that, a risk analysis should be performed at least at a certain level and a mitigation for the recognised risks studied. This has a cost!

Notice on the other hand
that a thorough quality control does not mean “spatial quality”.

Spatial quality has a huge cost but most of it comes from the environmental protection and testing.

We do not expect to check the behaviour of the yoke under a 10g acceleration or any sinusoidal vibration or shock,
we do not consider testing under extreme thermal conditions.

We understand all the meaning and the limits of such an exercise

but we will have to get through it by the beginning of 2012

in order to cross examine within ILD and with SiD.

Should we consider and mention ways to reduce the cost?
Does it make sense today to present a de-scoping plan?