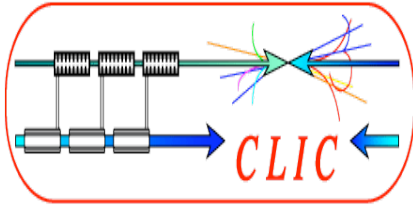


Software Tool Considerations for ILC Cost Management

John Carwardine, Peter Garbincius

October 16, 2008



Three inter-related software tools

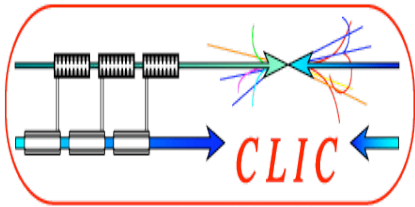


- **Electronic Document Management System (EDMS)**
 - Implemented by DESY using *UBS Teamcenter*
 - Repository for all source information
 - Configuration management (release- and version control)
- **Cost Management database (the focus of this talk)**
 - Roll-ups and analyses of cost estimate information
 - Consolidate spreadsheet data provided by technical groups
- **Project Management tracking**
 - Primavera was selected at beginning of EDR phase for tracking costs and progress for the EDR ‘project’ and as a pre-cursor for implementing an ILC construction project

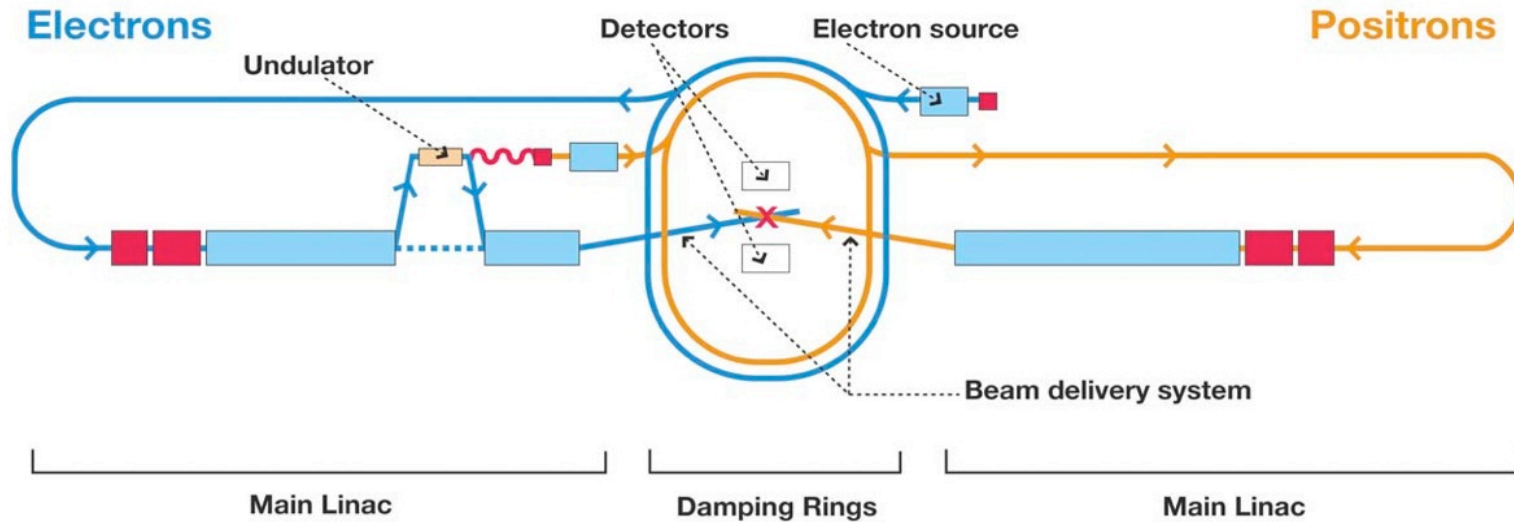
In place

Starting

On hold



ILC RDR Accelerator Layout

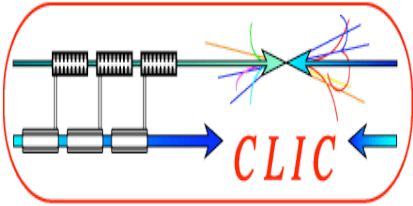


Area Systems	e- source	e+ source	damping rings	RTML	main linac	BDS
Technical Systems						
Vacuum systems						
Magnet systems						
Cryomodule						
Cavity Package						
RF Power						
Instrumentation						
Dumps and Collimators						
Accelerator Physics						
Global Systems						
Commissioning, Operations & Reliability						
Control System						
Cryogenics						
CF&S						
Installation						

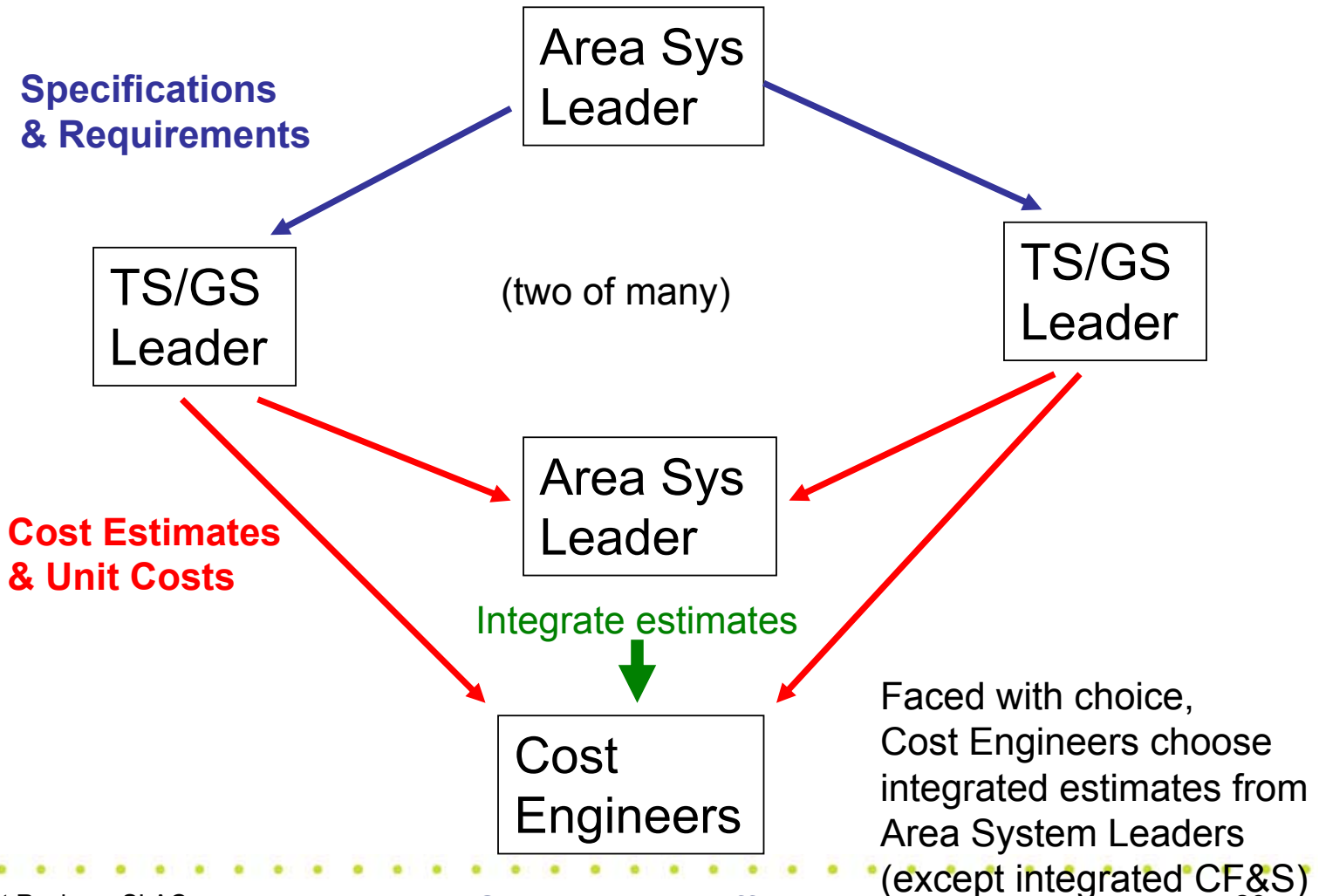
RDR Organization

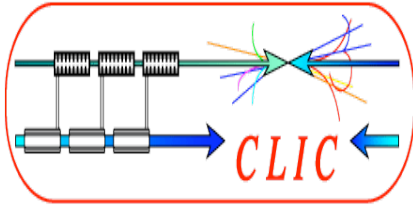
- Accelerator Area Leaders
- Technical System Groups
- Global System Groups

ILC Reference Design Report and cost estimate were released in August 2007



Cost Estimate Information Flow



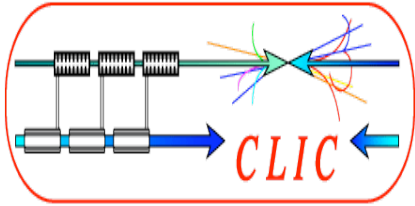


Example: CFS Costing Matrix

(CFS top level from RDR)



Conventional Facilities average over 3 regions	Main Linac	Damping Rings	Rings to ML	Positron Source	BDS & Dumps	Common	Exp Hall	Electron Source	sum
Civil Engineering:									
Outsourced Engineering									
Underground Facilities:									
* Shafts									
* Tunnels									
* Caverns & Exp Hall									
* Crossovers & Penetrations									
Surface Structures									
Site Development									
Electrical									
RF power (MW)	75.7	14.0	7.1	4.1				1.1	102.0
Conventional power (MW)	13.5	1.7	3.8	7.3	4.9			1.2	32.5
Room Temperature Magnets	0.8	7.9	4.7	8.9	2.6			0.7	25.6
Water Systems power (MW)	9.9	0.7	1.3	1.3	3.5			1.3	17.9
Cryogenics power (MW)	33.9	1.8	0.0	0.5	0.3			0.5	36.9
Emergency power (MW)	0.4	0.2	0.2	0.2	0.3			0.1	1.4
Total Power (MW)	134.2	26.3	17.2	22.3	11.7			4.8	216.3
Air Treatment									
Piped Utilities									
Process Cooling Water									
LCW load (MW)	56.0	17.7	9.3	17.5	46.3			2.9	149.6
Chilled Water (MW)	21.1	1.8	1.3	5.3	1.0			1.4	32.0
** Cryo Air Towers (MW)	33.9	1.8	0.0	0.5	0.3			0.5	36.9
Handling Equipment									
Safety Equipment									
Survey & Alignment									
sum									

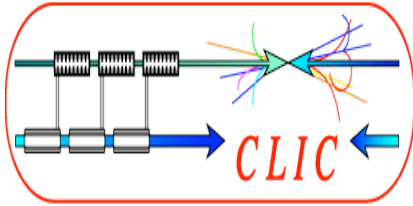


Top-level RDR Costing Matrix



	Main Linac	DR	RTML	e+ source	BDS	common	EXP Hall	e- source	sum
Convent. Facil.									
Cavities & CM									
RF Power									
Cryogenics									
Magnets & PS									
Controls									
Vacuum									
Instrumentation									
Dumps & Collim									
Installation									
e+ specific									
e- specific									
DR specific									
total									

- Consolidation of the costing spreadsheets provided by each technical group
- Level of detail below the top level varies by group

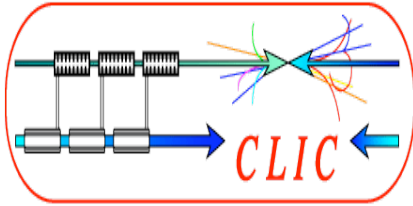


RDR Cost Estimate information ···



- **Cost Estimate data**
 - **Mainly in spreadsheets**
 - **Data was consolidated into a top-level spreadsheet**
 - **Individual WBS structures were retained**

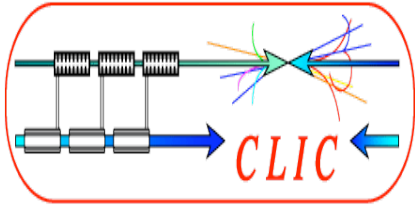
- **Supporting documentation (Bases of Estimates)**
 - **Detailed work-sheets**
 - **Specific bases-of-estimate documents**
 - **Presentations**
 - **Email**
 - **...other**



TD Phase...



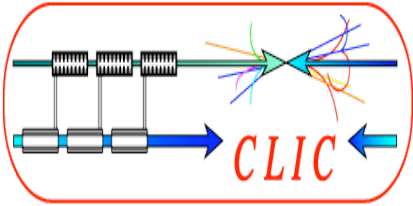
- **RDR – Now 18 months old**
 - Legacy design effort
 - **CRITICAL: maintain and document traceability of value estimate, bases of estimates, and RDR design**
 - Every day more is ‘forgotten’
- **TD Phase extended to 2012, resources are much reduced from RDR**
- **CRITICAL: demonstrate clear effort to reduce the cost**
 - Begin to identify possible cost reductions
 - ‘Minimal Machine’ value engineering studies
- **Must plan for critical reviews: internally in 2010, publically in 2012**



Cost Management for TDR



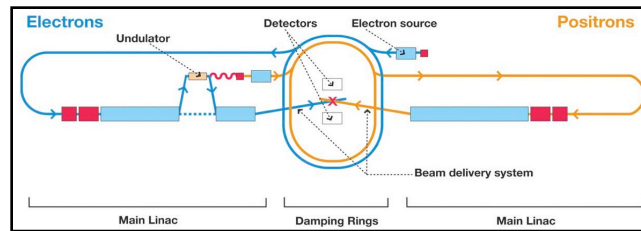
- **Machine design value engineering**
 - **Eg underground volume, cooling water, ...**
 - **Advance the RDR technical design**
 - **Study alternative designs and configurations**
 - **Central injector complex**
 - **RF clustering proposal**
 - **Top-level parametric studies**



TDR Value Engineering Studies



RDR



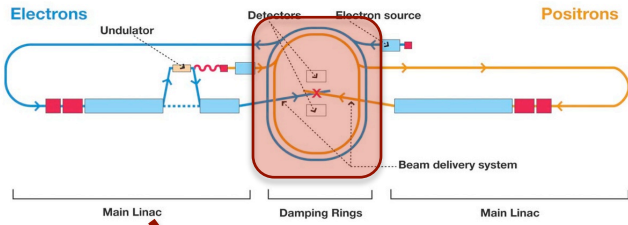
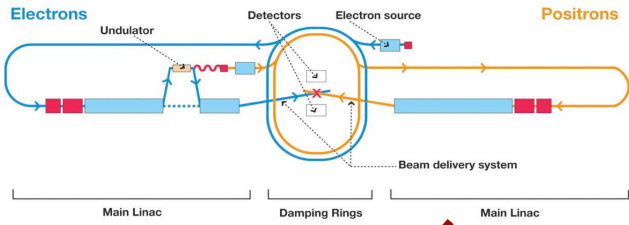
Must be able to track costs for several parallel studies

Eg. Process Cooling Water system value engineering

Parametric Studies

Design evolution

Eg. Optimize central injector region

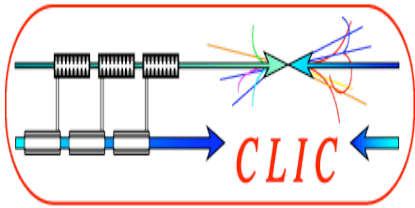


Cost impact limited to Process Cooling Water system

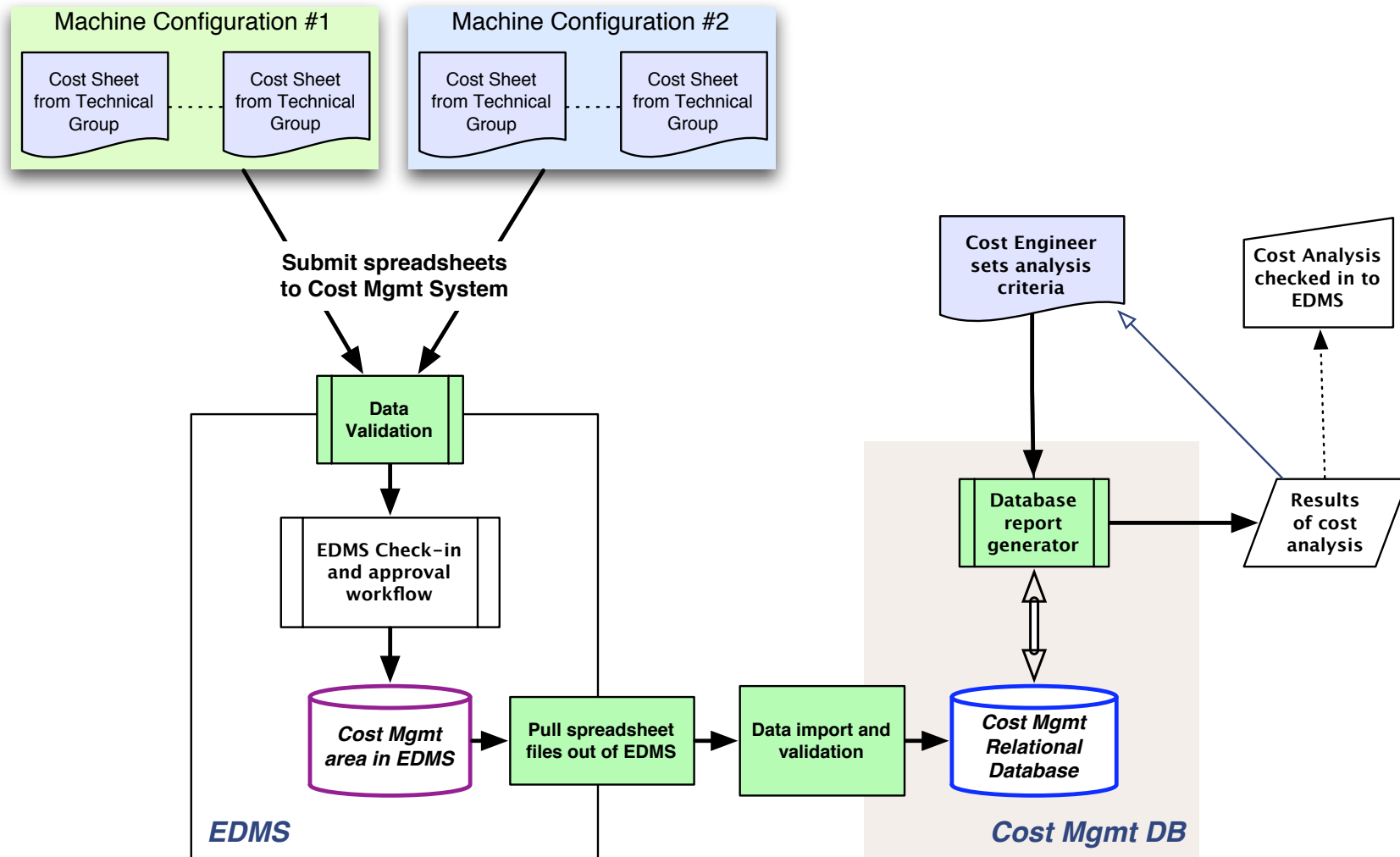
TDR design decisions

Broad cost impact to injector area systems and CFS

TDR

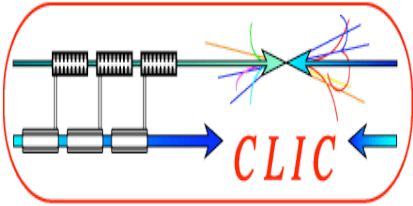


ILC Cost Management Tools Functional Model



Original information will be under configuration management in EDMS

Cost Management Database will be largely a reporting tool

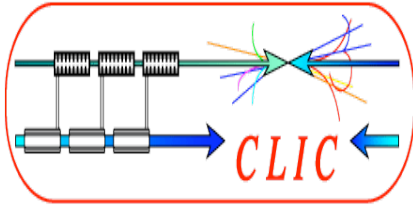


Translation of RDR Matrix into PBS (snippets)



1.2	Positron Source		where is the
1.3	Damping Rings		note difference
1.4	Rings to Main Linac		
1.5	Main Linac		
1.6	Beam Delivery System		
1.7	Experimental Facilities (only Conventional Facilities)		
1.8	Common Infrastructure		
1.9	Conventional Facilities		do we need
1.10	Operations, Reliability, Commissioning - Labor only		
1.11	Accelerator Physics/Simulations - Labor only		
1.12	Central Lab Team (based on SSC personnel)		

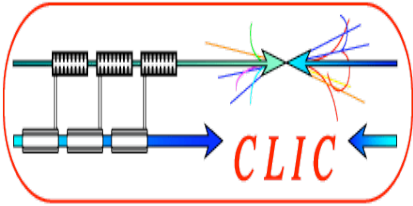
1.5 Main Linac			
	Cryomodules (Cavities, Couplers)		
	RF Power Systems		
	Cryogenics		
	Controls & Computing Infrastructure		
	Installation		
	Instrumentation		
	Dumps & Collimators - none in ML		
	Vacuum		
	Magnets & Power Supplies		
	Areas System-specific items		
			Labor only
1.6 Beam Delivery System			
	Cryomodules (Cavities, Couplers)		
	RF Power Systems		
	Cryogenics		
	Controls & Computing Infrastructure		
	Installation		
	Instrumentation		
	Dumps & Collimators		
	Vacuum		
	Magnets & Power Supplies		
	Areas System-specific items		
			Labor only



Cost Estimate Templates



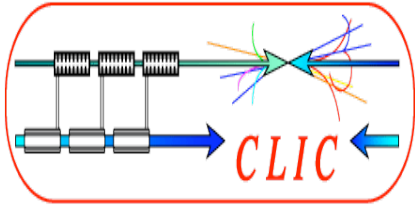
- **Goal is to have technical groups provide TDR cost estimate information via a common template**
- **Simplify the process of rolling up an overall cost estimate**
- **Define a level of detail in the WBS/PBS to be included in the cost estimate roll-up**
- **Identify the specific required information**
- **Define top-level parameters provided to groups**
- **Establish consistent assumptions and bases of estimates across all the technical groups**
- **Provide framework for traceability of cost estimate information**



ILC Template example



Item name (short, but unique and complete)	CM 8C1Q	PS 200 A
EDMS unique item identifier number		
version number	1	1
description	1.3 GHz Cryomodule with 8 cavities and 1 magnet package	magnet PS - 200 A, 5 KW
cost est in K of currency		
currency (dollars, euros, yen, yuan, pound, CHF, etc.)		
unit of estimate (each, lot, kg, meter, etc.)		
year and month, for which estimate is quoted (2006, 2007)		
confidentiality class 1-5 (see next sheet for description)		
inflation category (construction or non-construction)		
region of estimate (for inflation calculations)		
estimate provided by: (Engineer in Charge)		
approx quantity assumed for cost estimate		
region or country where labor assumed		
Final Design - institutional labor summary - hours		
Sustaining Engineering - hours		
Install-Integrate-Test (for item, not system) - hours		
estimate reference (URL or EDMS #)		
Basis of Estimate document reference (URL/EDMS)		
Beam Deck file reference: name, date, URL/EDMS?		
Technical System/Global System Group (parent)		
TS/GS sub-group (sub-parent)		
uncertainty shape		
lower parameter %		
upper parameter %		
uncertainty reference		
date entered		
entered/logged by who		

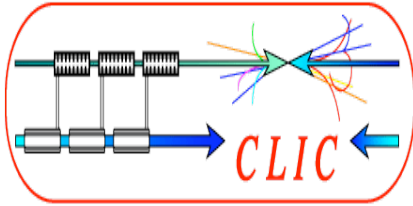


Examples of reports

(from CM Tool Requirements document)



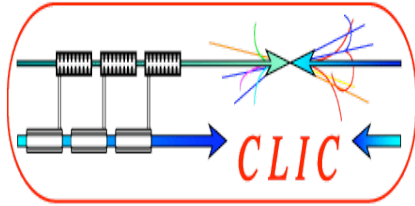
- **WBS style reports that further drill down on any item**
- **Total cost of each part with that tag is listed in the matrix.**
- **Magnet costs, grouped by magnet type**
- **Magnet costs, grouped by accelerator area**
- **Damping Ring costs, grouped by technical system**
- **Damping Ring costs, grouped by accelerator sub-area**
- **All EDIA (engineering design) costs where they exist**
- **Export a flat table of the parts and costs to Excel**



Implementation practicalities



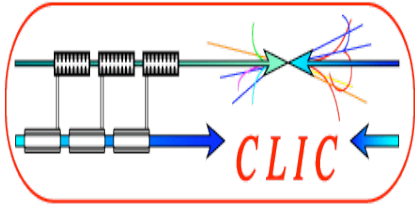
- **DB project will be implemented in stages**
 - Start simple, get some experience using the basic functions to see if they are really what we want
 - Multiple machine configurations likely implemented as separate database instances
 - Other functionality to be implemented later as needed, eg automatic linking to documents in EDMS
- **Data-entry of RDR cost estimates**
 - Eventually will have to capture all RDR and TDR cost estimates
 - Begin by entering RDR costing data ‘as is’ (WBS,...)
 - Migrate specific cost information to a common format as necessary and as resources allow
 - It is unlikely that all cost estimates will be re-visited for TDR, so some RDR costs must be carried forward



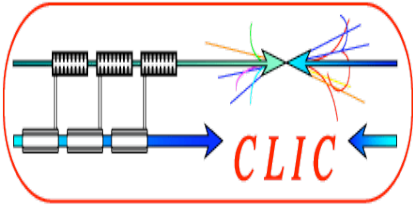
Summary



- **Conceptually, we think we know what we want**
 - **“Devil is in the details”**
- **Cost Management database is strongly linked with EDMS**
- **Regardless of the tools, there will be effort in translating and entering cost estimate information**
- **We expect to have Stage-I implementation and first level of data entry within the next several months**



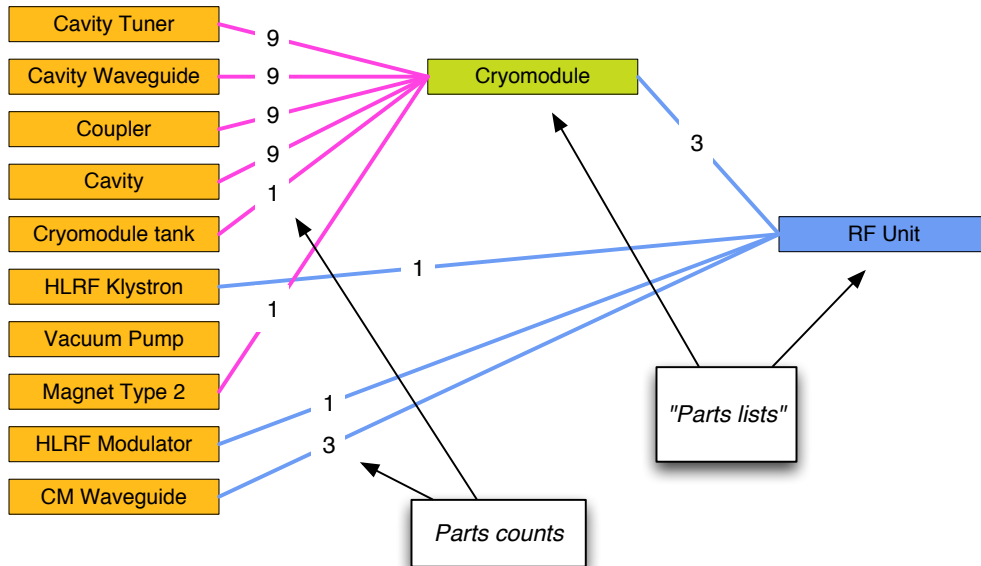
Extras



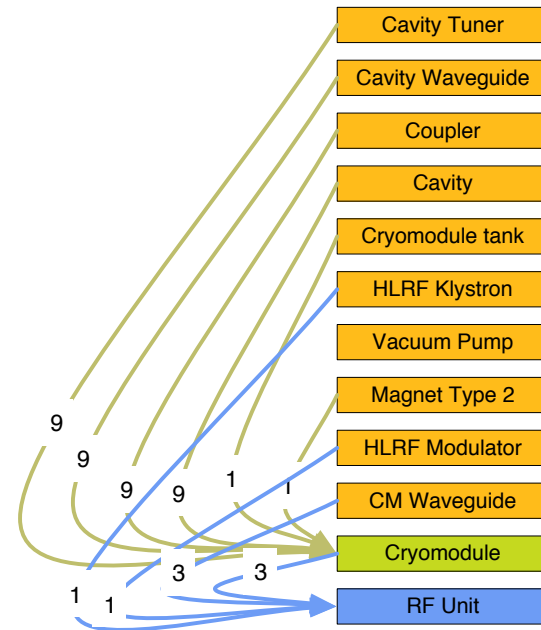
WBS or Catalog of Parts...?



WBS/PBS



Catalog of Parts



- Traditional structure
- More or less how the existing data is structured

- Perhaps easier to analyze ‘many’ different configurations
- Perhaps easier to explore unit costs
- More work to implement in db
- Requires translation of existing data