Global Group 5 Summary

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For GG5 Group

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Outline

- **Charge to GG5**
- **Opening Remarks**
- **Organization of sessions**
- **Agenda & Questions posed to presenters for each of the 3 sessions**
- **Observations, recommendations, plans for future work**
- **Summary**

Charge to GG5: Cost & Engineering

- Develop engineering and costing standards
- Develop cost model for BCD selection
- Develop a process to arrive at cost & schedule estimate for the RDR

Opening Remarks

- GG5 is a new group
  - very much in the mode of collecting information.
  - Only 4.5 hrs of presentations in the 1st week ➔ could not cover all the issues (e.g. cost models, actual costs, ideas for cost reduction).
- Organized our 3 sessions around the following topics:
  - Establishing ILC Project Standards (Tuesday)
  - Cost & Schedule Methodology (Wednesday)
  - Industrial Issues (Thursday)
- Speakers were asked to address a series of question for each session
- Sessions were very “information rich” so summarizing them in 30 minutes means I can only touch a small part of what was presented

Establishing ILC Standards

- Presentations
  - US Project Standards — Harry Carter (FNAL)
  - European Project Standards — Lars Hagge (DESY)
  - Asian Project Standards — Hitoshi Hayano (KEK)
  - LHC experience — Jean Pierre Delahaye (CERN)

- Speakers from each region should address:
  - Engineering standards
  - Safety codes, reviews, and standards
  - CAE software (mechanical, RF, accelerator modeling, etc)
  - CAD software packages & drawing exchange
  - Software license issues
  - Project information exchange (EDMS, etc)
  - Change control in a multi-regional project

Establishing ILC Standards

- Project Standards very important
  - Have a strong influence on how we work and communicate ➔
- Need standard ILC Terminology
  - A lot of people are/will work on ILC we must speak the same "language" (I don't mean.. English, German, Japanese, etc… but rather "ILC"ese)
  - GDE & the WG's should create a "dictionary" of ILC Terms posted on the web that define crisply what is meant by RDR, BCD, ACD, TDR, change control, example civil site, core cost estimate, "operating" cavity gradient…. etc, etc… Explain what it is. Explain what it is NOT.
- Engineering standards are important
  - There are significant issues that must be resolved
  - These issues are largely orthogonal from the issues of cost and schedule methodology standards, cost modeling, etc. and probably don't have a big impact on the costs
  - Create a more specialized group whose focus is Engineering Standards

Establishing ILC Standards

- It is important that the ILC make choices early
  - We won't know the ILC site for some time ➔ Must establish internal "ILC Project Standards" because we don't know which "regional" standards to adopt.
  - Standards are captured as "codes" in use in the various regions
  - Make a matrix of codes vs region
    - Pressure vessel codes, electrical codes, life safety & fire codes, radiation protection, units, drawing standards, etc
    - Adopt "Internal Project Standards" with these in mind
  - Consider the impact of any choice on each region
  - Then PICK something as the ILC standard!
  - Everyone will have to make compromises
  - In general the regions and industry will adapt
  - ILC "Project" can make region specific adjustments to insure we obey relevant codes and laws when the site is known

Establishing ILC Standards

- Need to define the “depth” of ILC standardization

  1) Component Standardization: (Build-to-print, all items interchangeable regardless of where they are made)
  2) Module level Standardization: (modules with well specified interfaces, but internals may vary depending on who makes it)
  3) Machine Segment: (Regions take responsibility for all components in entire sections of the machine)

- Personally I think somewhere between 1) and 2) makes sense, but its probably worth discussing 3)

Establishing ILC Standards

- Fortunately we have examples to follow
  - CERN system for LHC (Impressive! talk by Jean Pierre Delahaye)
  - Other international projects (e.g. ITER)

- Specific near-term Recommendations
  - Examine the CERN LHC system and its applicability to ILC

  - EDMS (Electronic Data Management System)
    - Appoint a group to collect requirements for an ILC data management system
    - Survey available systems
    - Make a recommendation to GDE very soon (already the GDE plan)

  - Engineering Drawings
    - Collect requirements for ILC Standard CAD systems
    - Use 3-D CAD modeling for all drawings including Civil!
    - Establish Drawing standards (units, dimensioning, and language)
    - Survey existing CAD software, including interoperability across regions
    - Recommend a standard ILC system to GDE

Cost & Schedule Methodology

- Presentations
  - XFEL Costing and Standards — Reinhard Brinkmann (DESY)
  - Methodology for TESLA TDR — Wilhelm Bialowons (DESY)
  - US cost estimates — Rich Stanek (FNAL)
  - Cost estimates in Japan — Tetsuo Shidara (KEK)

- Speakers from each region should address:
  - 1) Current methodology for Project cost and schedule estimates
  - 2) Process for establishing a set of “rules” for ILC cost & schedule estimates
  - 3) How to handle contingency, overheads, “in kind” contributions, lab or university contributions etc. Each region is different.
  - 4) Include actual estimates for industrial work in a public cost estimate? Current practice is yes in US, but no in Europe & Japan
  - 5) What is the correct methodology to include industrial profit in estimates ?
  - 6) Should ILC commission industrial cost studies of ILC in all 3 regions?
  - 7) How do we develop a cost model for ILC?

Cost & Schedule Methodology

- We heard 4 excellent talks describing the methods used by each region to estimate Project Cost and schedule
- Significant differences in C/S methodology in the 3 regions
  - Labor in or out of the cost estimate
  - Contingency explicitly calculated or imbedded in the task estimates
  - Industrial cost estimates public or not
  - Different overheads, or “taxes”, etc applied to final numbers
  - General emphasis/goals of the process are sometimes different
- Is it hopeless to have a common ILC cost estimate?
  - No ! The similarities are larger than the differences in the methods.
  - Similar methods to estimate the numbers (Basis of Estimate)
  - Differences are more in how these numbers are used and presented to the regional funding agencies

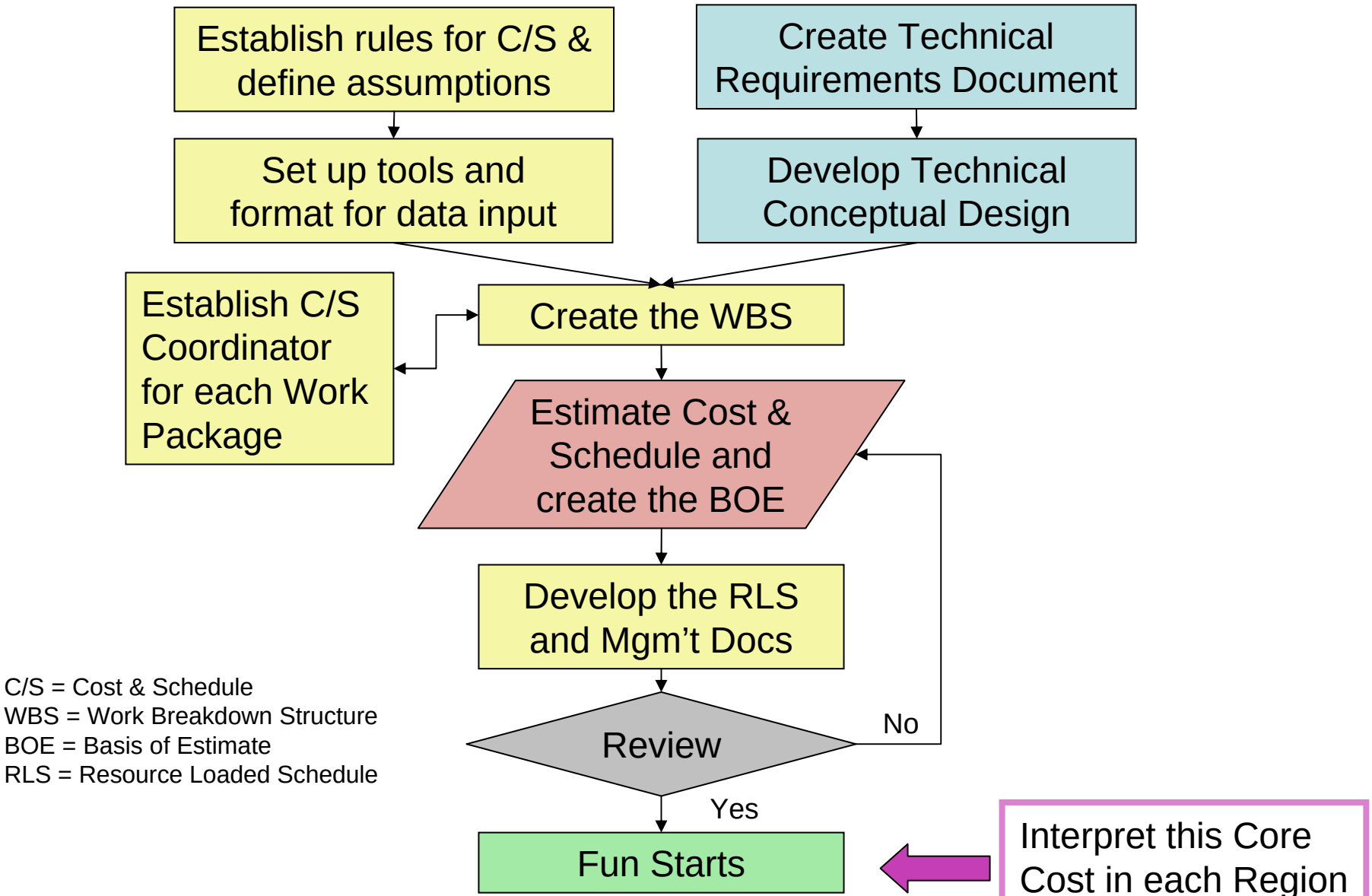
Cost & Schedule Methodology

- Need to agree on a standard method for the “Basis of estimate” for the ILC project.
  - Use this method to identify the “core cost” of the project
  - Core cost = best guess of the cost of all materials, labor, and resources the Project will need to be built on an agreed upon schedule (50/50 that cost will be this number)
  - An all inclusive estimate. “Public” with nothing hidden or assumed
  - Industrial costs included, but encrypted in a way that the numbers will not be useful for “rigging” subsequent bids
  - No “hidden” contingency or risk management funds
- Regions can then “interpret” these numbers in the way the regional funding agencies are used to seeing
  - Example: increase task prices or add contingency to manage risk
  - Adjust labor costs as appropriate for the region, etc.

Cost & Schedule Methodology

- Claim is that this is similar to what ITER has done
  - ITER is a large multi-regional science project so we should look carefully at what they have done
  - Task for next week
- Agreeing on how to estimate the "core" costs is not enough
  - To estimate the cost & schedule, we must also have a "model" for how the project will proceed
  - Example: Regional funding agencies might force production of klystrons in 3 regions (3 orders of 200 klystrons will cost more than 1 order of 600)
  - Example: A cryogenic plant built in Japan may be much more than one built by the same company that just built them for the LHC
  - Make a model of how the project might proceed
  - Get regional funding agencies to endorse this model early in the game (adjust as required)

General Methodology



C/S = Cost & Schedule
WBS = Work Breakdown Structure
BOE = Basis of Estimate
RLS = Resource Loaded Schedule

Tools & Process

- Need Standard Project wide tools
  - Data/Information Manager (web accessible)
  - WBS development software
  - Spreadsheet (or equivalent) for cost estimate (MS Excel…)
  - Schedule Software (e.g. Open Plan, Primavera…)
  - All must be interoperable
  - Simple user interface for data input and monitoring
- Then…
  - Machine Design Parameters ➔ requirements database
  - Reference Design
  - Develop parametric cost models
  - Develop risk assessment software
- Finally: Input actual cost estimates & iterate

Cost & Schedule Methodology

- If you know the answer before you perform the Cost & Schedule exercise => expect problems (Rich Stanek)
  - Cost overruns and schedule slippage
  - Technical compromises or descoping
  - Project cancellation !
- There is a natural tension between an accurate cost estimate, and the desire for a low number so the project is approved.
- Set the rules for the C/S exercise and develop the tools before asking people to fill in the numbers
  - Consistency is important
  - Estimate the cost, schedule and risk concurrently
- Accurate answer 1st, then deal with the consequences

Cost & Schedule

- Misc comments:
  - Big Task➔ Need people to do all this ! (full time)
  - Focus on cost drivers, but don't ignore the rest.
  - Industrial Cost estimates and Studies should be done in each region with goal of understanding & bringing down costs
  - Locate machine near an existing Lab! (Wilhelm)
  - Use experience from other Japanese projects (Tetsuo)
  - Need to have some level of "stable" conceptual design to perform a reasonable cost and schedule estimate
  - Everyone needs to be cost conscious during entire RDR process

Industrial Issues

- Presentations

  US Industrial Forum: Tony Favale (AES)

  Euro Industrial Forum: Michael Peininger (ACCEL)

  Japanese LC Forum: Norihiko Ozaki

  Speakers should address:

  1) Principle issues in industry for a multi-regional project?
  2) Can companies deal with different engineering and design standards?
  3) Technical information sharing
  4) Revealing industrial costs estimates vs competition for contracts
  5) Intellectual property rights for industrial processes
  6) Design drawings, CAD packages, etc.
  7) Build to performance specification vs build to print?
  8) Infrastructure Issues
  9) Industrial studies.

Industrial Issues

- Again we heard 3 very interesting talks that provoked a lot of discussion
- Industrial point of view is that “ ILC is a Project, not a business”
  - There is no follow-on business in SCRF cavities of this scale
  - This has impacts for the required infrastructure
  - Big industry typically has a Business Plan and stock holder demand a plan for 5-7 years in the future
  - Uncertain, one-time projects do not fit well in this scheme
  - It may be that Big Industry in the US and Europe will not be interested in the ILC. (probably not true in Japan)
  - ILC may have to depend on small and medium scale industry which has implications on cost & schedule

Industrial Issues

- Infrastructure Issues:
  - For industry to invest in the large infrastructure required for ILC there would have to be a follow-on business or market ➔ that the ILC project should plan on paying for all the required infrastructure wherever it is built.
  - Unlikely that Industry will invest in cryomodule infrastructure before the project receives final approval ➔ it may take 1.5-2 years to build this up before production can begin
  - These issues need to be included in the ILC cost and schedule estimates
  - Possible ideas for getting around these problems (A region might be able to buy the infrastructure beforehand and industry bids to use it)

Industrial Issues

- Intellectual Property rights seem not to be a significant issue for industry
  - Not clear there all that many marketable ideas in ILC
  - Transregional information exchange is not an issue
  - They are used to dealing with this (license technology)
- Shared Costs estimates
  - Not a problem for industry
  - Common in US cost estimates and not a problem
  - Recommend that TESLA reevaluate its position on releasing costs for the ILC cost estimate
- Early standardization is important
  - Can deal with whatever standards ILC chooses

Industrial Issues

- Industrial Studies
  - Important to understand industrial costs
  - Important to examine potential cost reductions
  - Need to think about what studies are needed and when
  - Focus on the cost drivers for ILC, important for cost estimate
  - Focus on places where there is technical risk to the project goals
  - ILC need a point-of-contact and a plan for industrial studies
- Risks
  - Let industry make up its mind on risks, then ILC should LISTEN
  - Perceived risks will influence the actual cost of contracts from industry. (Cavity Gradient !!! Be careful not to set this too high)

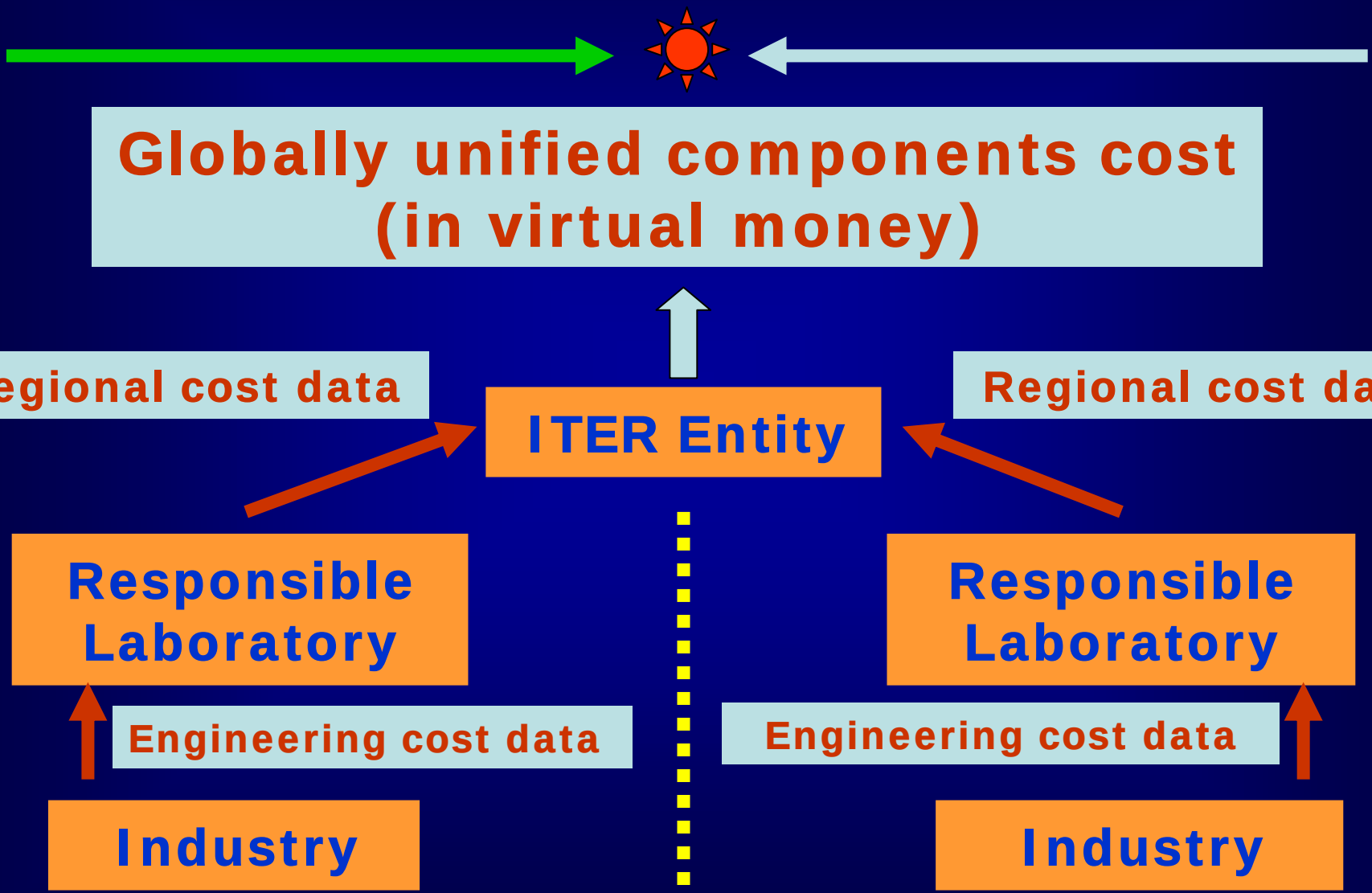
Industrial Issues

- Performance guarantees ?
  - Industry is prepared to guarantee performance of cryomodules
  - Low risk = low price, high risk = high price
  - Very High Risk ➔ no bid
    or build-to-print with ILC project accepting the risk
    or minimum performance guarantee with incentives for improved performance
- Industry will build the cavity using the best known techniques at the start of the project
- Know-how exists in small and medium industry to deliver the cryomodules that ILC will require (Peininger)

Industrial Issues

- In Kind Contributions: (Ozaki-san)
  - Model is regions provide large components or sub systems
  - Follow the ITER system
  - Components categorized as “Key” or “conventional”
    - “Key” components allocated fairly across the 3 regions
    - “conventional” components shared across the 3 regions
  - Host Country assumes cost of infrastructure & civil engineering
- For Cost estimate, ILC should compute the “equivalent value” of in kind contributions
  - Recommend a system like the ITER system

Unified Cost in ITER



Industrial Issues

- Cost Reduction (Ozaki-san)
  - Number of components for ILC is small vs industrial scales
  - Be careful about assumed cost reductions vs quantity
  - Especially true if production is shared among several regions and/or several companies
- Cost Reductions might be achieved with joint facilities

Summary

- **Lots of things to consider**
- **Lots of work to do**
- **Situation is complicated, but not hopeless**
- **Establishing ILC internal Standards is important**
- **Near-term actions**
  - **Choose an EDMS system**
  - **Choose cost and schedule software**
  - **Establish an engineering standards group**
  - **Choose common engineering tools (e.g. CAD system)**
  - **Define the cost & schedule methodology for ILC**
  - **Develop parametric models to guide the design**
- **Study other large international projects and LEARN !**