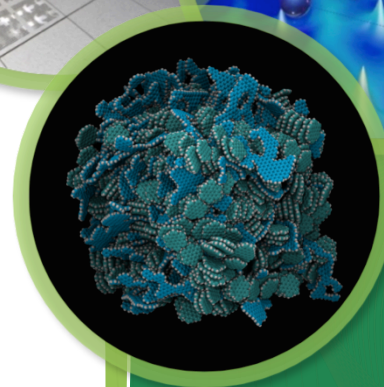
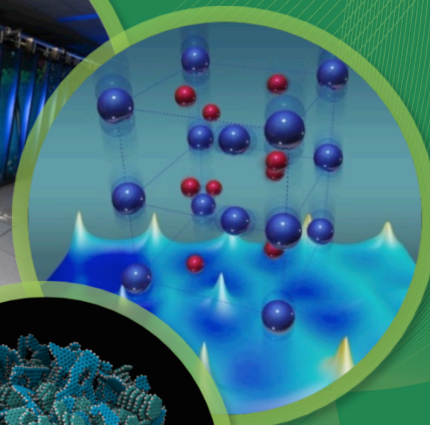


Science Requirements to Engineering Specifications Workshop

DENIM 2016

20 September, 2016



What We Did

- For the first half of the workshop, there were high level presentations discussing the methods for developing Science Requirements into Engineering Specifications are done at ORNL, and LLB
 - David Anderson discussed the Critical Decision path required by the US DOE for large, capital projects, then discussed the development flow for smaller work using eMOD
- Sylvain Desert gave a high level talk about requirements development at LLB
- Patrice Permingeat, LLB gave a talk about selecting the best solution
- Sergei Klimko, LLB gave a talk about specification development optimization software

David Anderson, SNS

- **SNS based on Department of energy model.**
- CD0-CD5 (CD stands for Critical Decision) CD0 Approved mission, CD5 End of project, typically 5 years
- CD2 Conceptual design review
- Small projects goes through eMod up to 100k dollars, engineering process software.
- Scientific productivity process for scientific proposals
- Musts and optionals are shown in the CD1.
- Questions from Group:
 - How do you plan staff?
 - The work is limited to the number of staff not the other way around
 - Priorities are crucial

Sylvain Desert, LLB

- Important to have basic scientific knowledge
- Set scope, validate milestones, give advice
- Lead scientist should not be part of the steering committee
- 1. Define project, here it is important to have a scientific understanding
- Scientists stays scientist
- 2. Bibliography, benchmarking
- . Brainstorming
- 4. Choose best solution
- 5. Prototyping, CAD, McStas etc.

- 6. Test and evaluation, when relevant
- 7. Feedback, “scientist forgot to say”, he wanted something different
- 8. Redesign and iterations
- No questionnaires etc to get the req. from scientists.
- Lead engineer is involved in all instrument projects
- Tool: Equity, Precision, a mathematical and statistical tool to find the right concept

Patrice Permingeat, LLB

- Pairwise Comparison method used at LLB to choose a solution among others
 - Could also be used for athletic tournaments

Sergei Klimko, LLB

- Parameter optimisation of a coil
- ModeFrontier software, can be linked with CAD, McStas, FEA, CAE.
- Comparison of theory and reality.

Phase 2

- We broke up into 4 subgroups, and each identified 5 or 6 problems we all experience developing Science Requirements into Engineering Specifications
- We returned to the large group, and compared the results from the 4 subgroups, and produced 1 single list of the top 5 problems associated with developing Science Requirements into Engineering Specifications
- We went back to the subgroups, and independently proposed solutions to the 5 problems
- Back as the large group again, we discovered that all 4 subgroups had the same answer for the top 3 problems, 4 different solutions for problem #4, and ran out of time before discussing problem 5

Summary Group exercise

- **Problem 1: Scope creep**
 - **Solution:** Change management process
- **Problem 2: Cultural differences**
 - **Solution:** Classes, meetings, informal chats
- **Problem 3: Unnecessary / unreasonable specifications**
 - **Solution:** Explanation of consequences, peer review
- **Problem 4: Prescribed solution from scientist**
 - **Solution:** No agreement
- **Problem 5: Lack of decision making**
 - **Solution:**

Subgroup 1 Discussion and Solutions

- ① no priority (difficult to set limits) from scientists
 - to strong goals (resolution, tolerances ...)
- ① late change requests (often)
- ① Long duration from first ideas (scientist) to point of decision
 - no balance between budget and technical solution
 - incomplete requirements regarding to environment (practical aspects, safety, access ...)
maintenance
- ① imposed specification by scientists instead of requirements / functionality

- safety rules vs. good working conditions
- language problem at international projects
- different countries = diff. specs, rules requirements

- I. "(!) solution" ?!
⇒ checking procedure (list)
- II. ⇒ more teaching + workshops
- III. ⇒ see II.
⇒ practical demonstration
- IV. ⇒ steering committee
- V.

Subgroup 2 Problems and Solutions

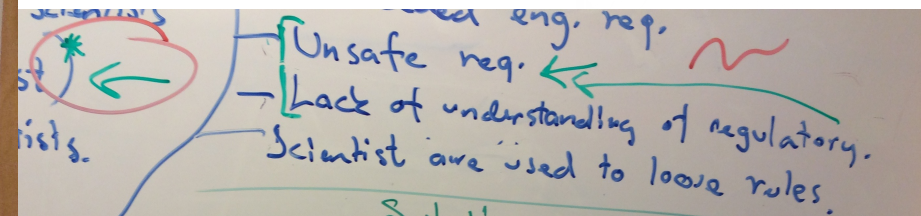


Subgroup 3 Discussion and Solutions

Brainstorming

- Req. too limiting
- Lack of knowledge of science (engineer)
- Lack of experience (engineers and scientists)
- ^{Cultural difference} Communication problem
- Lack of time to talk to scientists
- Physical separation between engineers and scientists
- Disagreement on the expectations (timeline cost)
- Time Quality cost triangle is not known by scientists.
- Sci. does not understand thermal stability
- Assumptions
- Reality vs ideas
- Overconstraining (too many requirements)
- Detailed req. without explanation
- Heritages of ideas, hard to accept new ideas
- Difficult to say no

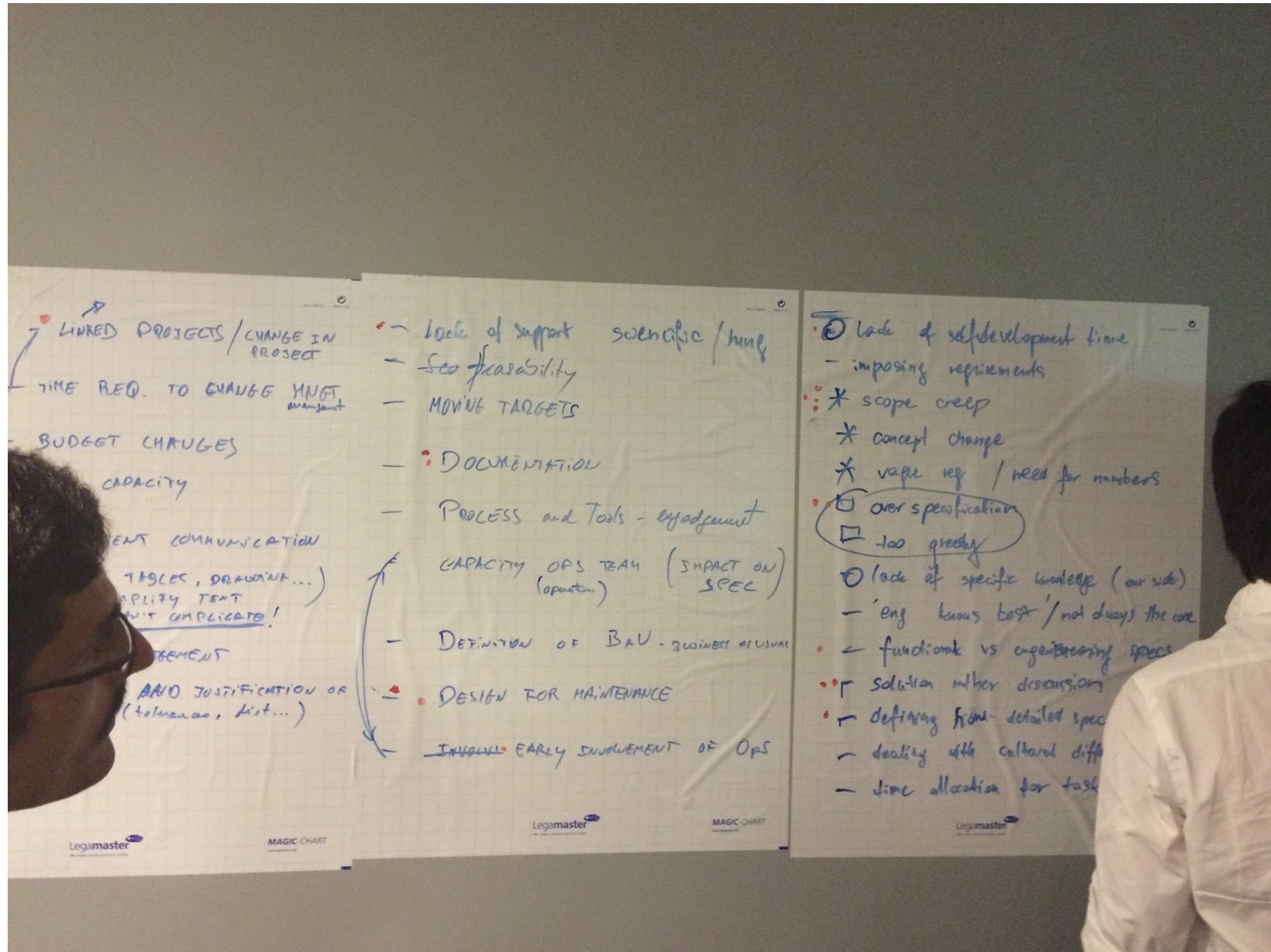
- Balancing requirements*
- Change of lead scientist.
- 'Scientist doesn't agree with new boss
- feature creep*
- No respect for different phases of the project.
- Unwritten req.
- Standard products not used, be flexible on designs.
- Close minded engineers?
- Unneeded eng. req.
- Unsafe req.
- Lack of understanding of regulatory.
- Scientist are used to loose rules.



Solutions

- Change req. → Steering committee, project owner
- scheduled Meetings to prevent cultural diff. (Interaction, coffee breaks) v. budget authority
- Understand science and explain eng. implications.
- Question the need, understand spec.
- Explain the implications of delayed decision making
- Use eng. tools to help dec. making.

Subgroup 3 Solutions



Group 4 Discussion and Solutions

Communication:

- Prepare Communication Plan
 - Definition of responsibilities
 - respecting and goodwill

Scope

- STRONG TECHNICAL MANAGEMENT
- COMMUNICATION PLAN (BUYING/commit.)
- ~~SLIGHT~~ CHANGE CONTROL

Solutions

- RISK MNG. PLAN - SOLUTIONS V.S. REQ. (management)
- ~~DISTINCTION BETWEEN~~
- 1. DOC IS FUNCTIONAL AND
- 2. DOC IS ENG. SPEC.

Large Group Problem Statements, plus 3 Solutions

MAGIC-CHART Legamaster

CULTURAL DIFFERENCES
TRAINING SESSIONS BETWEEN
SCIENTISTS & ENGINEERS

SCOPE CREEP
DOCUMENTED HIGH LEVEL SPEC
CHANGE PROCEDURE
↳ IMPACT ON PERFORMANCE
BUDGET
SCHEDULE

UNREASONABLE SPEC
DIALOGUE BETWEEN SCIENTIST &
ENGINEER

PEER/INDEPENDANT REVIEW

PRESCRIBED SOLUTIONS
DIALOGUE- REASONS FOR
SOLUTION

LACK OF DECISION MAKING
ASSIGNING RESPONSIBILITY FOR
DECISION

MAGIC-CHART Legamaster

SCOPE CREEP
CHANGE MANAGEMENT PROCESS
APPROPRIATE TO PROBLEM

CULTURAL DIFFERENCES
CLASSES, MEETING, INFORMAL CHATS

UNREASONABLE SPECIFICATION
EXPLANATION OF CONSEQUENCES
PEER REVIEW

PRESCRIBED SOLUTIONS