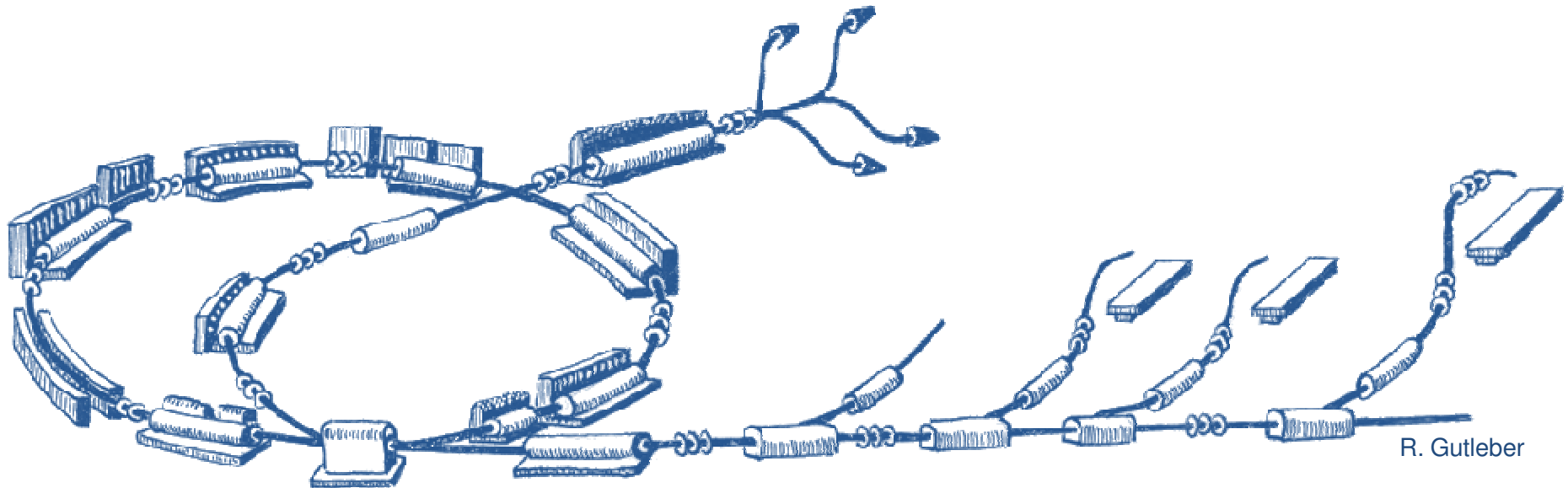


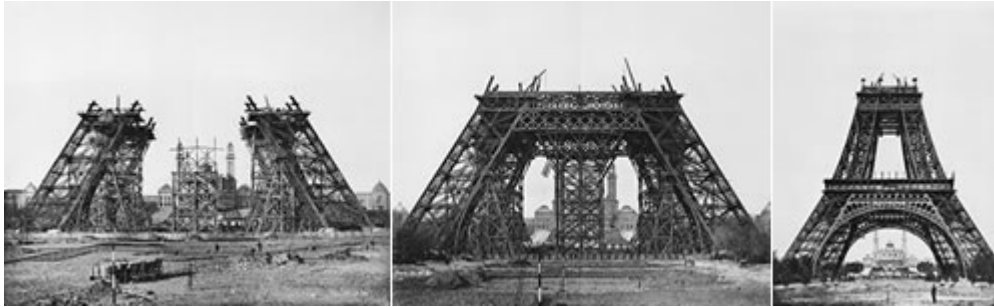
Work Package Controls

Inception Phase Review

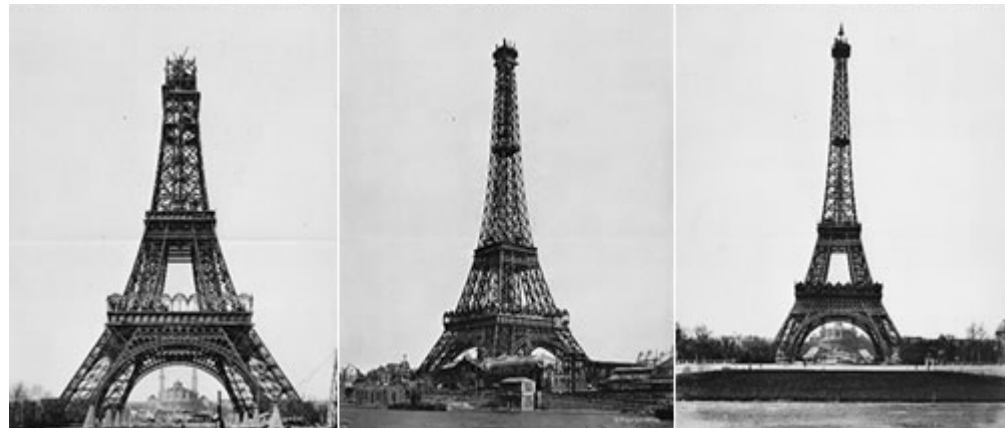
February 5th, 2010

Johannes Gutleber





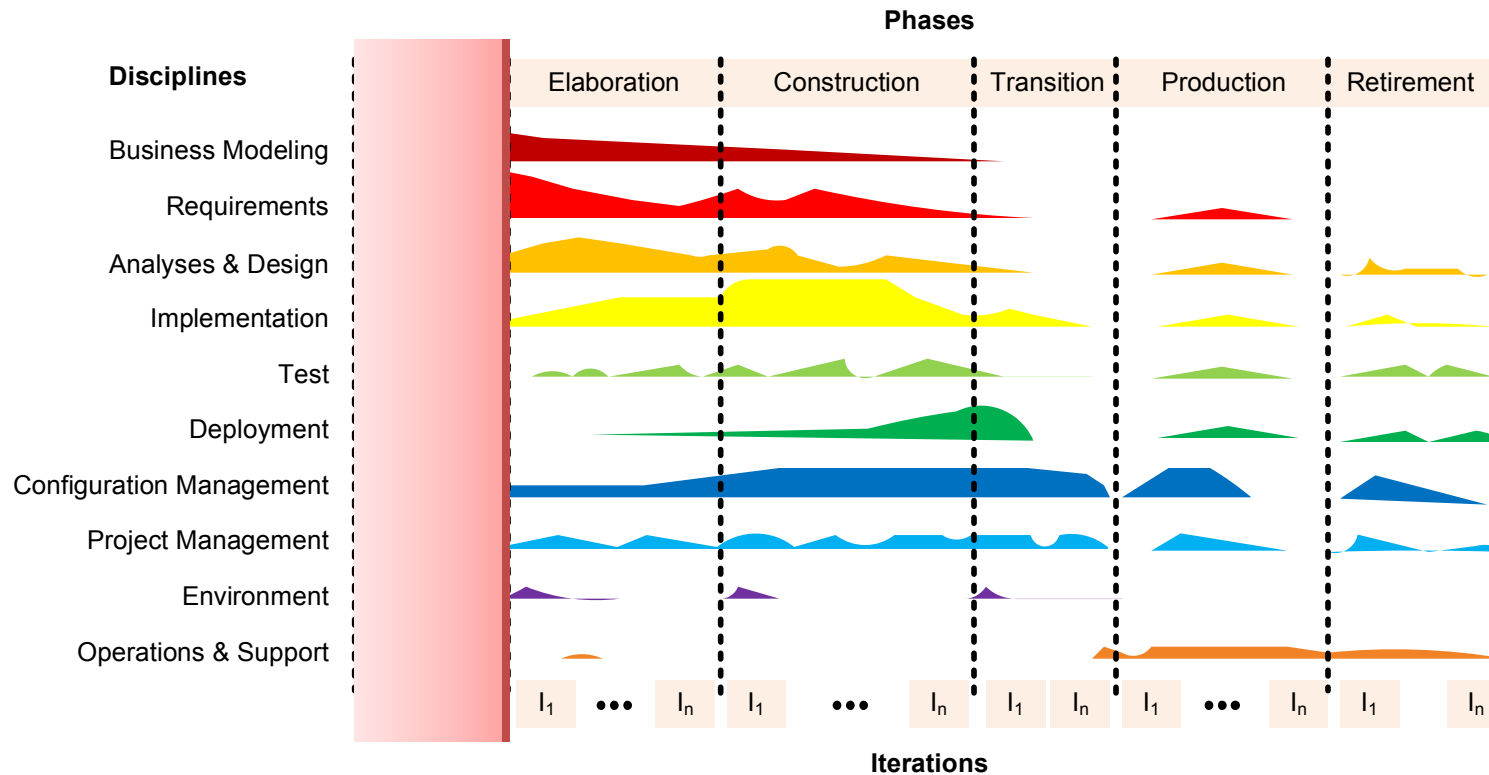
PROJECT ORGANIZATION



Project Organization

- Development lifecycle according industry best practices
 - Rational **U**nified **P**rocess (RUP) with extension to operation (EUP)
 - **IEC 61508** for safety-relevant parts
 - Process defined (**PM-090707-a-JGU**)
- Medical device related parts
 - Rely on ISO 14971 risk management process to be carried out
 - In addition to defined process carried out according to ISO 14385 (= ISO 9001 for development of medical device software)
- Software development and documentation under CM
 - Configuration Management Plan (**PL-090825-a-RMO**)
 - Configuration Management environment (**MG-090907-a-RMO**)
- Project risk management carried out
 - Risk Management Plan defined (**PL-100128-a-JGU**)
 - Risk list maintained

Enterprise Unified Process



- Work attributed to defined **disciplines**
- Disciplines carried out **concurrently** with different load
- **Phases** pre-defined, **iterations** depending on need

Realization Strategy for SCS/ACS

- **Core team** of at least 7 people (5 appointed)
 - Project management
 - Requirements
 - Architecture
 - Integration
 - Testing
 - Project internal Configuration and Quality Management
 - Requires support from top management and manpower (1 FTE)
 - Associated clerks for realize IT infrastructure with WP controls
- Service providers
 - Framework agreement with company to provide skilled labour
 - Software and hardware development
 - Unit testing

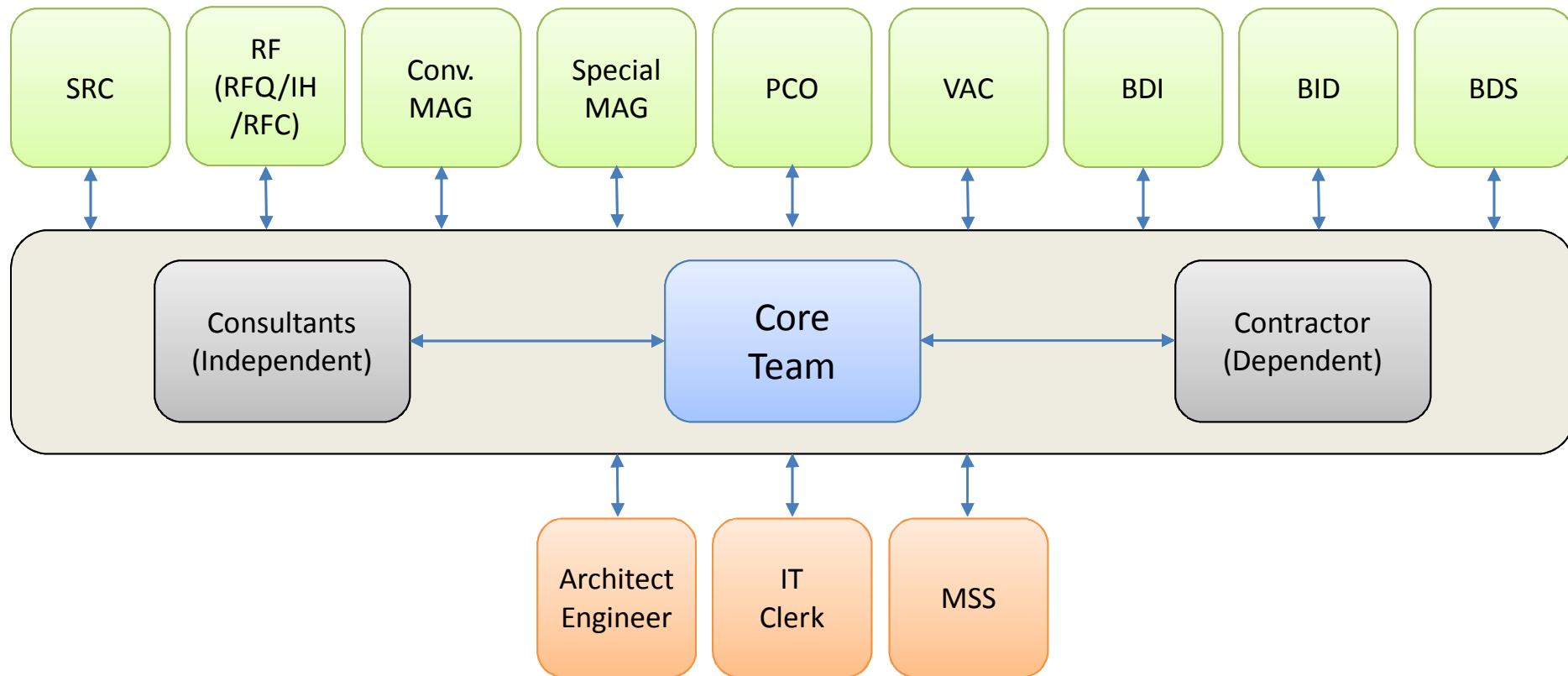
Work Organization

- Work organization
 - Core team that specifies and keeps control (min 7 FTE)
 - Service provision agreement companies working in field
 - Need to be able to work in **ISO 9001/IEC 61508/ISO 13485** environments
 - Industrial standards as much as possible
 - EBG at any point in time owner of docs, code and hardware
- Transition and Operation
 - Core team will operate the system at facility site
 - Core team builds up competences to perform in-house improvements
 - Stand-by service part of framework agreement with contractor

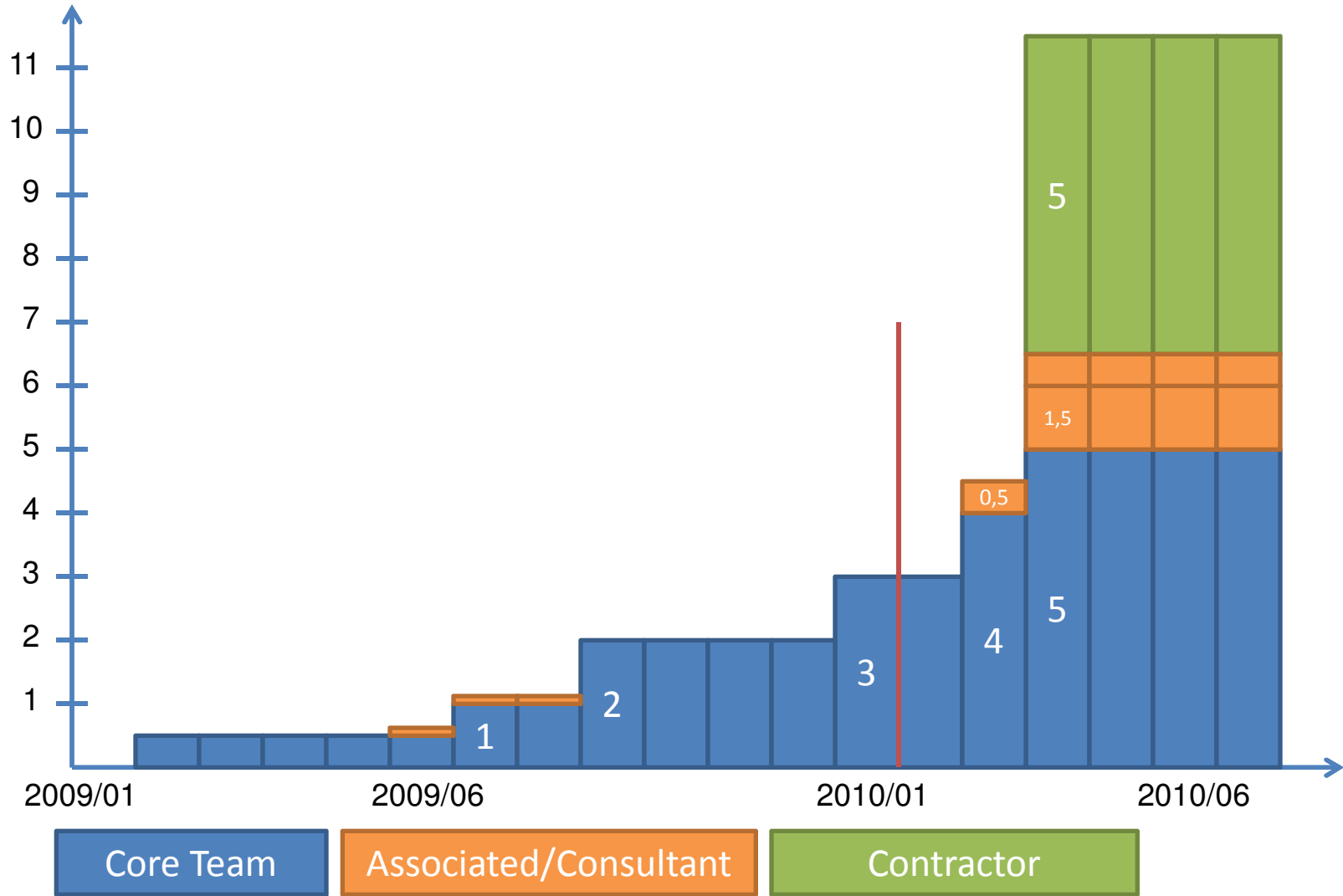


Core Team Liaisons

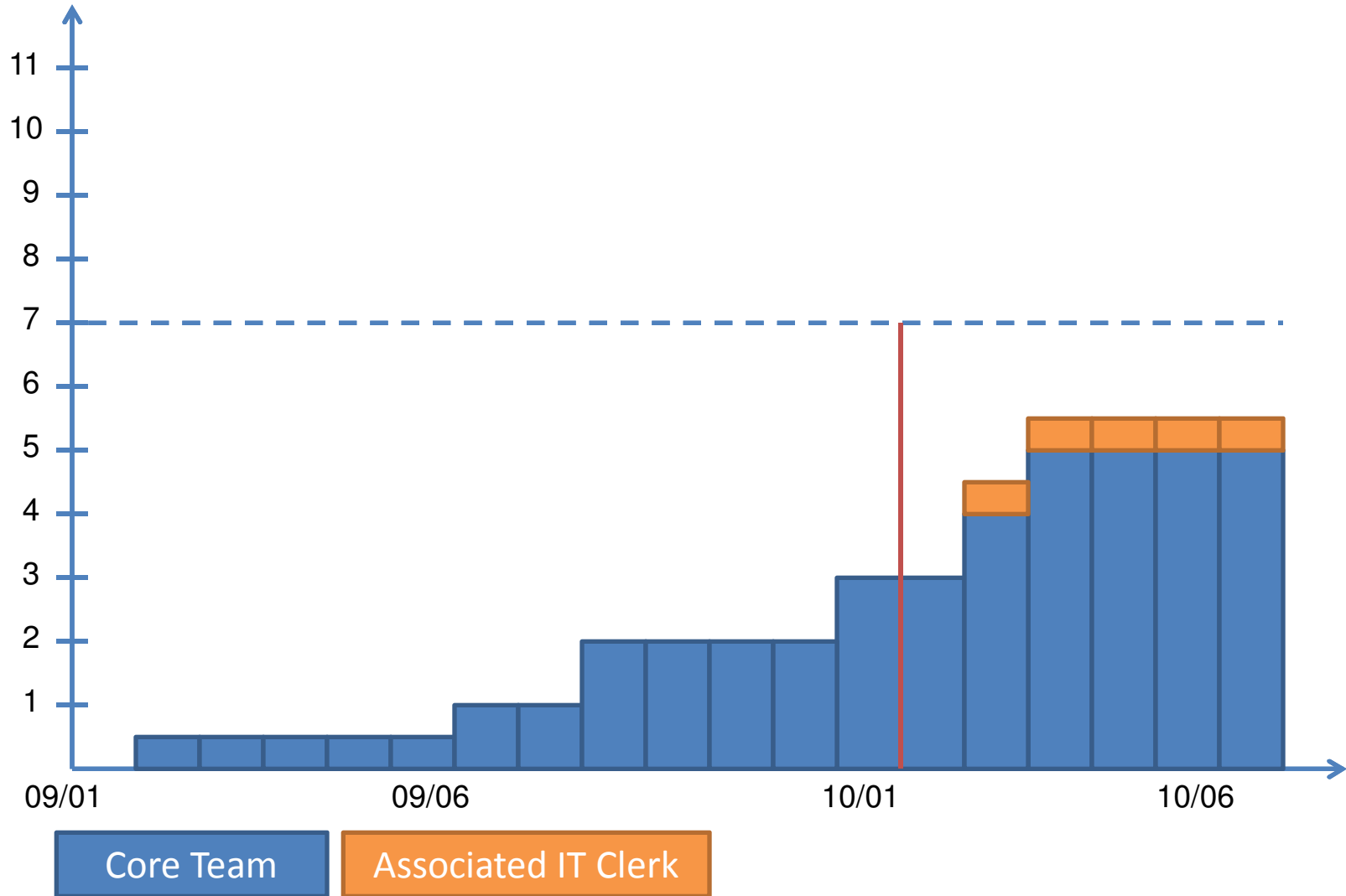
- Competences at each tier of architecture
- Require “controls” **representative in each work package**



Overall Appointment History



Core Team Appointment History



Core Team Needs (excl. BDCS)

Role	FTE					
	2010	2011	2012	2013	2014	2015
Analysts						
Business-Process Analyst	0.2	0.1	0.1	0	0	0
System Analyst	0.2	0.5	0.2	0.1	0.1	0.1
Requirements Specifier	1	0.5	0.2	0.1	0.1	0.1
Developers						
Software Architect	0.25	0.5	0.2	0.1	0.1	0
Designer	0.5	0.5	0.2	0.2	0.1	0
Implementer SCADA	0.5	0.5	0.5	0.5	0.5	0.2
Implementer industr. Autom.	0.5	0.5	0.5	0.5	0.5	0.2
Implementer embedded/RT	0.2	0.5	0.5	0.5	0.5	0.2
Integrator	0.2	0.5	0.5	0.5	0.5	0.2
Managers						
Project Manager	1	1	1	1	1	1
Change Control Manager	0.2	0.3	0.3	0.3	0.2	0.2
Configuration Manager	0.1	0.1	0.1	0.1	0.1	0.1
Test Manager	0.2	0.3	0.3	0.3	0.2	0.2
Deployment Manager	0	0	0.2	0.5	1	1
Process Engineer incl. QA	0.2	0.2	0.2	0.3	0.3	0.3
Risk Management Engineer	0.5	0.5	0.3	0.3	0.3	0.1
Management Reviewer	0.1	0.1	0.1	0.1	0.1	0.1
Reviewer	0.2	0.1	0.1	0.1	0.1	0.1
Production and Support						
System Administrator	0.2	0.2	0.2	0.5	3	5
Tool Specialist	0.2	0.1	0.1	0.1	0	0
Course Developer	0	0	0.2	0.5	0.2	0.2
Production and Support						
Tester	0.2	0.5	1	1	1	0.2
Test Analyst	0.5	0.5	0.5	0.5	0.5	0.2
Test Designer	0.5	0.4	0.3	0.1	0.1	0.1
Total needed FTE	7.65	8.4	7.8	8.2	10.5	9.8
Total available FTE	5.25	5	5	5	5	5
Missing FTEs	2.4	3.4	2.8	3.2	5.5	4.8

Core Team Composition

- Johannes Gutleber – WP leader
- Roland Moser – Junior partner (April)
- Markus Marchhart – Automation Technology engineer
- Angela Brett – Software engineer
- Cesar Torcato de Matos – Embedded systems engineer (Mar)
- Fabian Moser – doctoral student,
20% beam verification analyst

Cover Team Profile Coverage

Role	Person Qualifications					
	JGU	RMO	MMA	ABR	CDM	FMO
Analysts						
Business-Process Analyst	X		X			X
System Analyst	X	X	X			
Requirements Specifier	X	X	X			
Developers						
Software Architect	X	X				
Designer	X	X	X	X	X	
Implementer SCADA			X			
Implementer industr. Autom.			X			
Implementer embedded/RT	X			X	X	
Integrator			X	X	X	
Managers						
Project Manager	X	X				
Change Control Manager		X				
Configuration Manager		X				
Test Manager		X				
Deployment Manager		X				
Process Engineer incl. QA						
Risk Management Engineer						X
Management Reviewer						
Reviewer						
Production and Support						
System Administrator						
Tool Specialist	X					
Course Developer						
Production and Support						
Tester				X	X	
Test Analyst				X		
Test Designer					X	



Consultants and Team Associated

- Luigi Casalegno (CNAO)
 - Technical consulting concerning architecture and software
 - Adaptation and extension of CNAO repository management system
- Sandro Toncelli (CNAO)
 - Technical consulting concerning electronics and real-time systems
- Michael Franz Coreth (MA Austria)
 - IT clerk/EDV Koordinator
 - In cooperation with WP controls, MSS and AE plan and realize a homogeneous IT infrastructure
 - Elaborate authentication and authorization system

Framework Agreement

- EU tendering procedure launched
 - Achieve a Framework Agreement with a company in the field of accelerator controls
 - 3 years with possibility to extend twice for 2 years
- **Provision of** software and hardware **development services**
 - “Leasing” of skilled personnel that in close cooperation with WP controls core team creates the system
- Call-off-contract/Contract Work Order principle
 - Payment in lump sums per CWO
 - COWs contain work descriptions and deliverables for time frames of 2 to 6 months
 - CWOs are agreed between EBG and contractor before “option”
 - 25% payment at option, rest 30 days after successful acceptance
- ~~Stand-by-service foreseen, subject to amendment~~

Framework Agreement Status

- Two stage procedure launched in November 2009
- First stage
 - Request to participate with company exclusion/inclusion criteria
 - Main focus
 - Technical experience and reference projects similar to MedAustron
 - Quality assurance infrastructure (ISO 9001 for software development)
 - Training culture of personnel and long term employment strategy
 - Lean management structure and capability to work on-site (CERN, Austria)
- Second stage
 - Propose a project team and make a bid for 3 years
 - Negotiate framework agreement conditions
- Expected to enter into force at **beginning of April 2010**

Contractor Requirements

- Focus on **experience**
 - Must be established in accelerator control system community
 - Must demonstrate successfully completed reference projects
- **Stability** of staff
 - Must have long-term employment strategy
 - Must demonstrate company internal training program
 - Must offer team consisting of long-term employees
- **Flexibility** and lean management structure
 - Required to work on-site (CERN, Wr. Neustadt)
 - Direct interaction between WP controls and contractor engineers
- Contractor becomes **part of project**
 - Share responsibilities, risks, enthusiasm and success

Contractor Team Asked

- **1 Senior Technical Engineer/Team Leader (1 FTE, 1805 h/yr)**
 - Univ. degree, > 5 yrs experience, > 10 accelerator projects
- **2 Analyst/Programmers (1 FTE, 3610 h/yr)**
 - Univ. degree, > 5 yrs experience, > 5 accelerator projects
 - C# and LV/LV-RT programming, PVSS, CompactRIO
- **1-2 electronics engineers (1 FTE, 902 h/yr)**
 - FPGA programming on NI, board design incl. FPGA, Data transmission (RocketIO, SFP, Aurora) and timing synchronization
 - Integration of beam instrumentation devices
- **1 Tester (1 FTE, 902 h/yr)**
 - Univ. degree, > 3 yrs experience, ISO 9001, RUP
- **1-2 QA and CM officers (0.5 FTE, 902 h/yr)**
 - Tech. diploma, > 3 yrs experience, > 5 accelerator projects
 - RUP, ISO 9001, SVN and Trac, CM best practices

Contractor Evolution

- Contractor should grow with project and us at same pace
- ISO 9001 certified contractor envisaged to evolve into ISO 13485 certified medical software provider
- Could at later stage become active in
 - ISO 9001/ISO 13485 for EBG
 - ISO 14971 in cooperation with appointed risk management officer
- Stand-by clause
 - Keep open for maintenance agreement during operation
 - Win-win situation: contractor knows system, EBG requires less staff

Repository Management System

- CNAO developed software for in-house use
 - Investment about 2 FTE years
 - Numerous improvements over the time
 - Continued functional improvements as CNAO goes ahead
- Gap analysis performed (**PM-091001-a-JGU**)
 - Defined 4 CWOs for total of 16 months development work
 - Most urgent: MA naming convention, coordinate system, versioning
- Agreement between EBG and CNAO (**CO-091103-a-JGU**)
 - Use software as common baseline for both accelerators!
 - Takeover of software in 4 steps (CWOs)
 - EBG pays compensation for consultant to CNAO after each milestone
 - IPO shared between EBG and CNAO
 - Plan to adopt and learn software 2nd half of February 2010

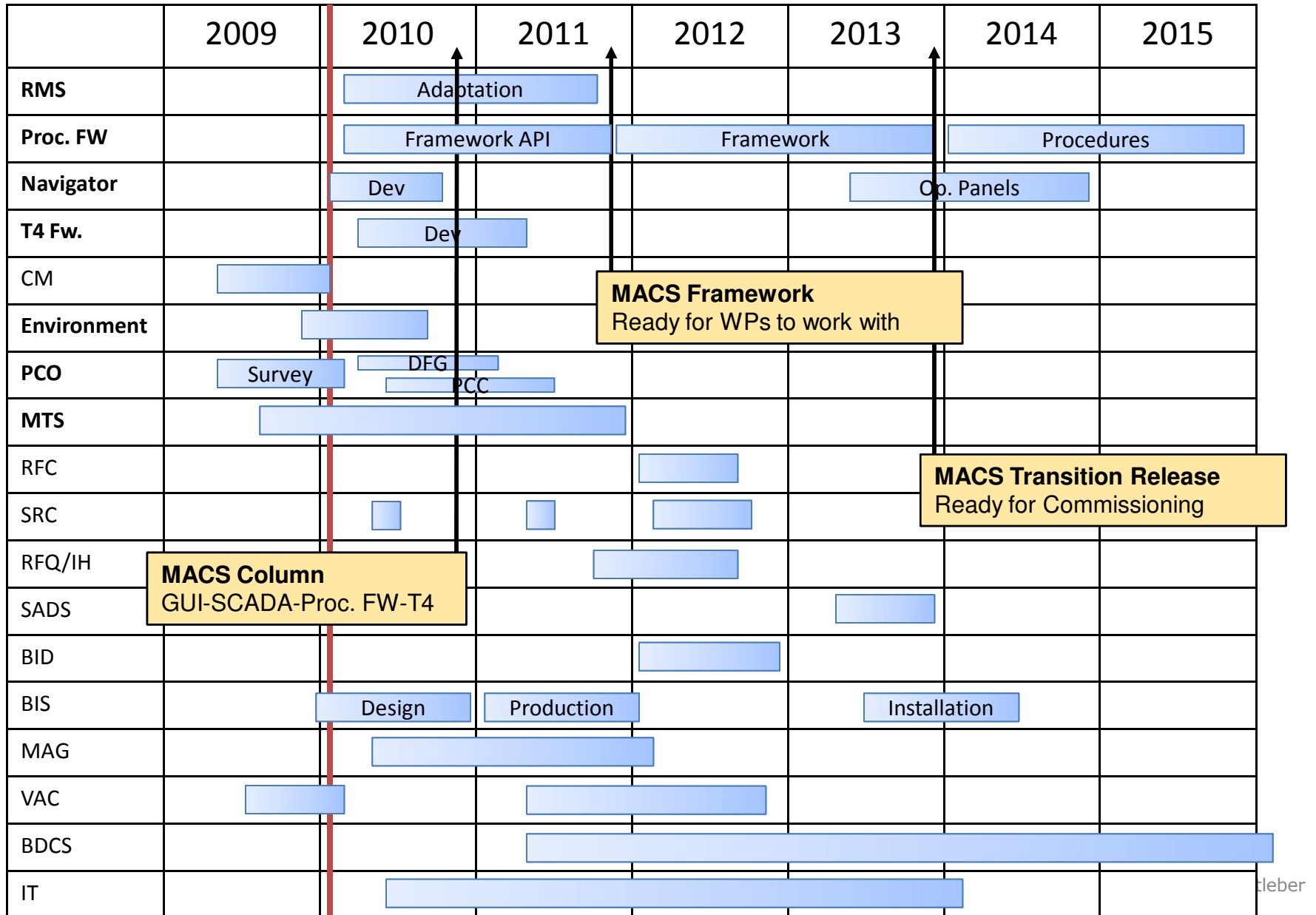
Companies that requested information

- Cosylab
- DCCS GmbH
- Infoniqa Informationstechnich GmbH
- BEKO Engineering & Informatik AG
- IBM Austria
- Diamond Informatics GmbH
- Frontworkx Workflow & document management solutions
- Triestram & Partner GmbH
- PKE Electronics AG
- Siemens Austria
- SAP Austria
- Accenture GmbH
- Alceli Hunt Consulting
- Albel Automation GmbH

Project Plan

- System described in PBS (**PM-090902-a-JGU**)
- Tasks to be carried out described in WBS (**WBS-090130-a-JGU**)
- Preliminary plan submitted for integration into PIMS
 - **PL-091118-a-JGU**
 - O(20) nodes, total of O(70) activities
 - Time to transition 5.5 years (Q4 2009 – Q2 2015)
- Plan requires consideration of
 - External constraints
 - Dependencies emerging from other work packages
 - Dependencies imposed on other work packages

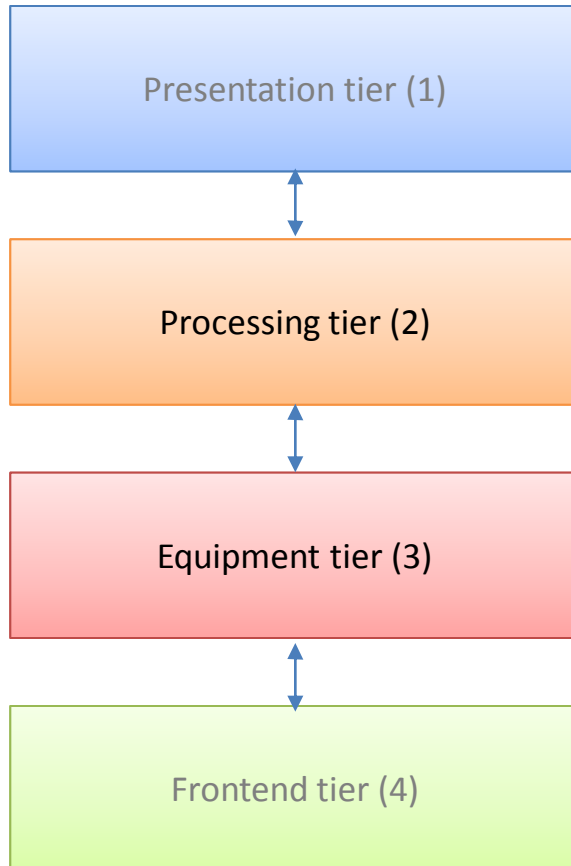
Preliminary Schedule





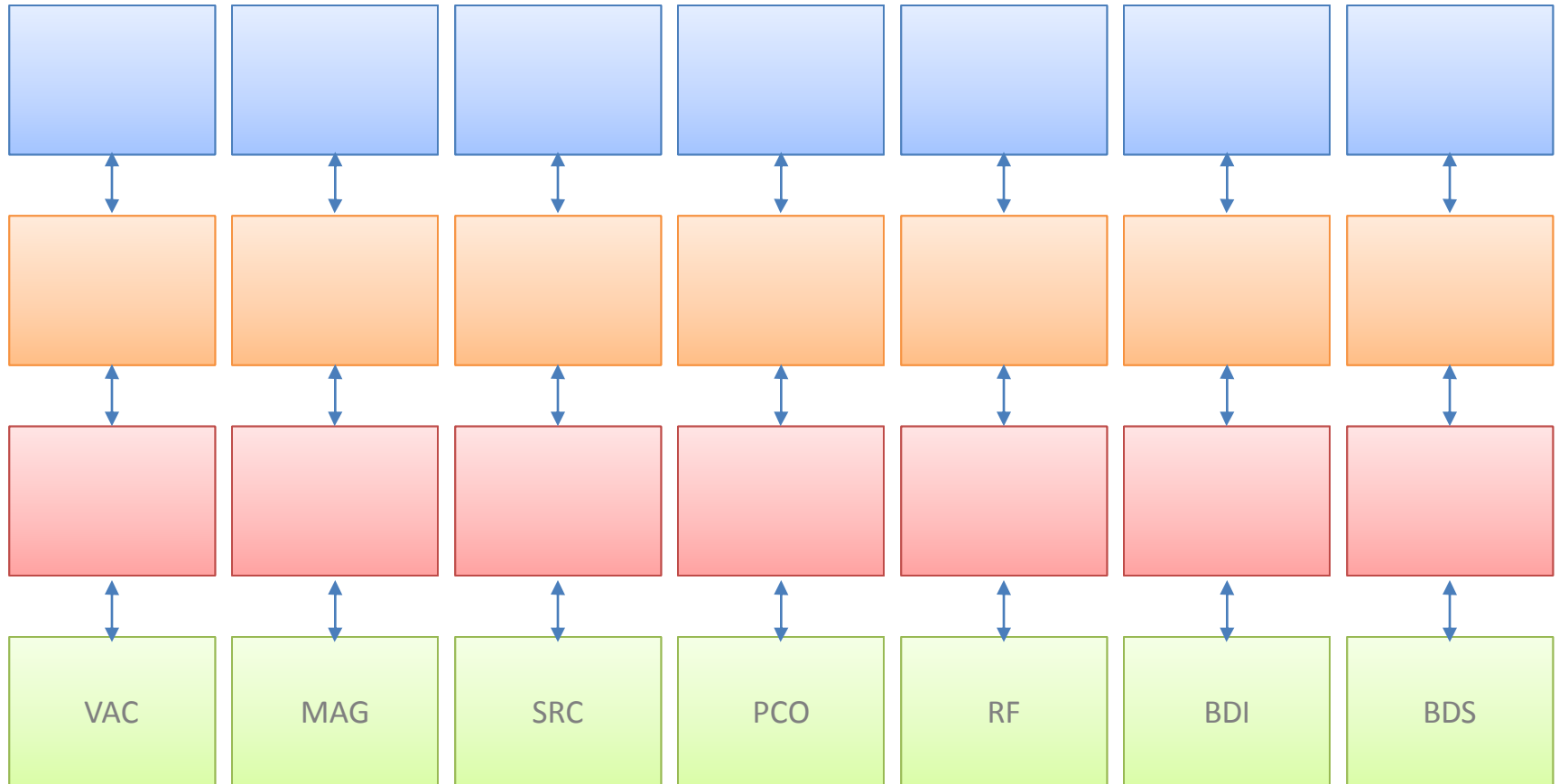
MACS COLUMN 2010

MACS Column

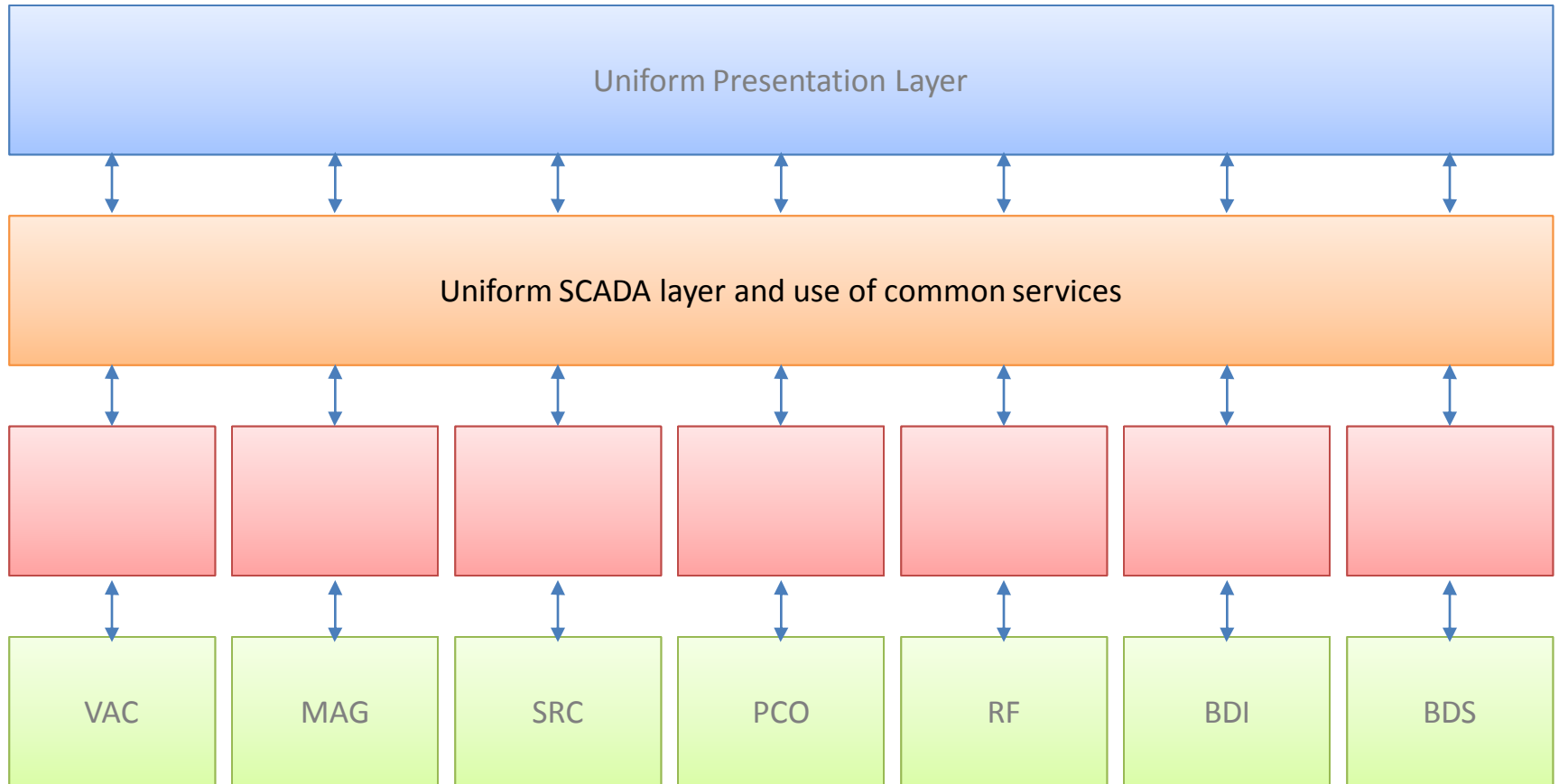


- Functional **vertical cut** through the control system architecture for
 - confirming technology choices
 - Refining the design
 - Improving project cost/time estimate
 - Providing users with a working infrastructure
- To be **replicated** for each subsystem
- Should lead to a **scalable** system
 - In terms of performance
 - In terms of management

Individual Columns



Unified at Later Stage



MACS Column Concept



Windows, NI Measurement Studio GUIs
and PVSS Panel Navigator

SCADA and Procedure Framework Skeleton

Control and Data Exchange

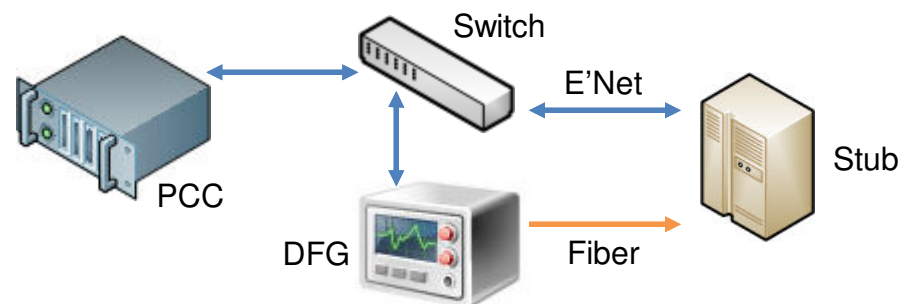
Tier-4 programming framework skeleton



POWER CONVERTER CONTROLS

Power Converter Controls

- Optical link definition and development – Production rated
 - Required for power converter tendering documents
- Digital function generator (DFG) – First release
 - Sends waveforms to power converters over optical link
- Power converter controller (PCC) - Mockup
 - Slow controls and set-point driven operation over Ethernet
- Power Converter Stub
 - Needed for testing

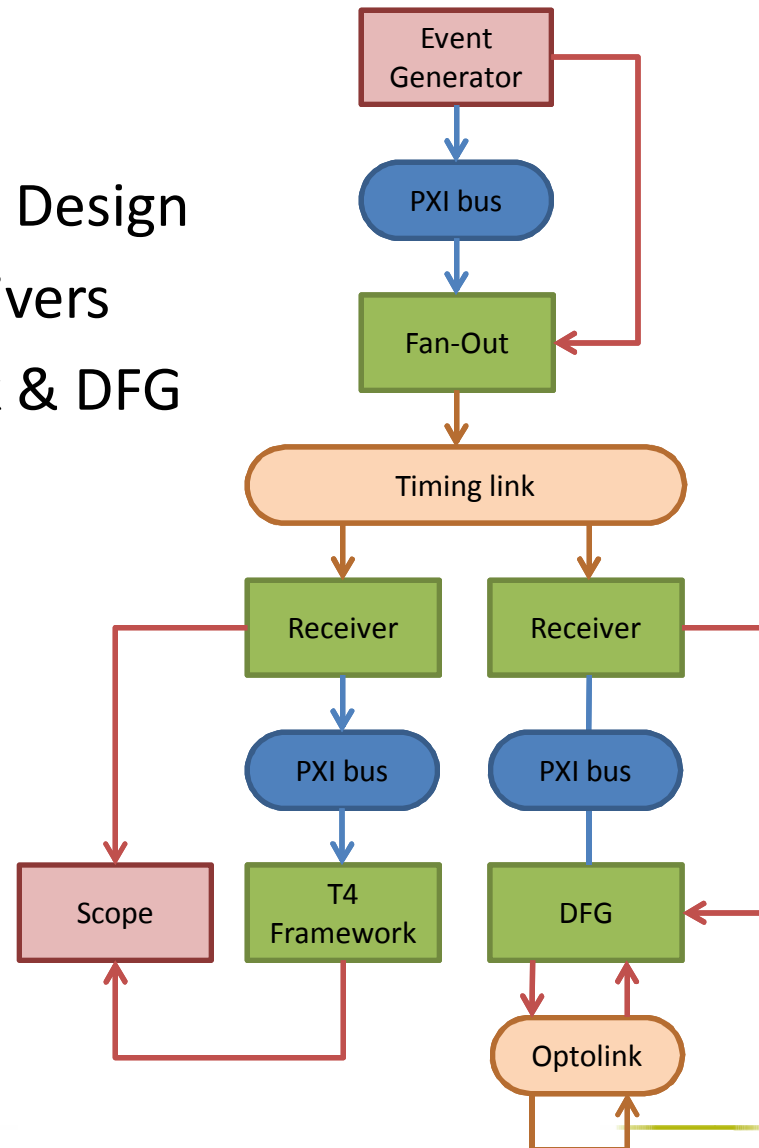




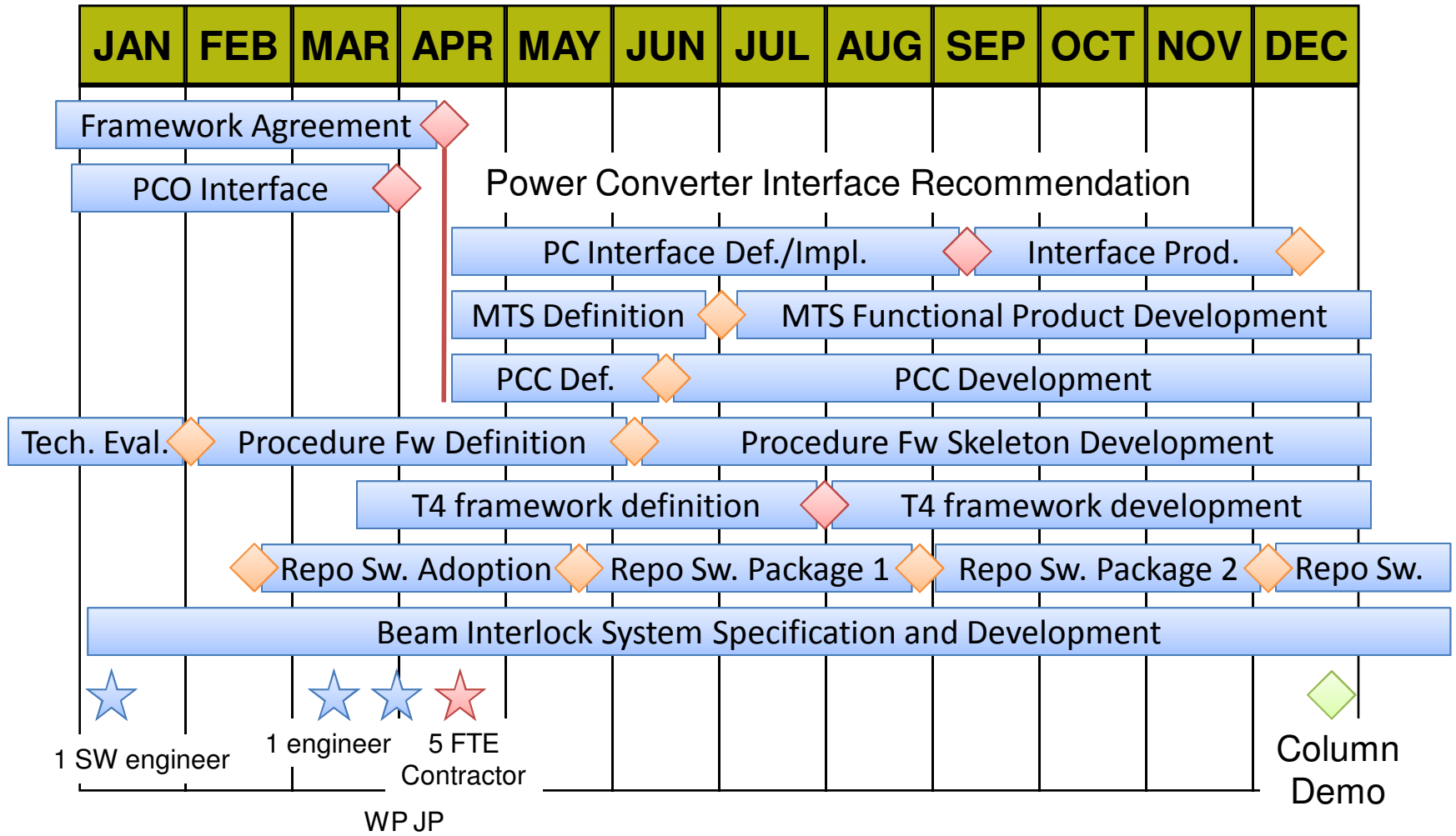
MAIN TIMING SYSTEM

Main Timing System

- Requirements, Architecture & Design
- Standalone sequencer & receivers
- Integrated with T4 framework & DFG



Column Time Frame 2010



Project Risk Management

- Risk Management Plan created (**PL-100128-a-JGU**)
- Manages and controls events with potential negative impacts on control system work package
- Goals
 - Identify risks (description, impact, likelihood to materialize)
 - Assess risks
 - Find mitigation strategies
 - Plan for contingency
 - Track and report risk evolution
- Risk list
 - Database created and accessible to project leaders

Example

Evolving list of version controlled risks

Characteristics of risks

Likelihood and Impact assessment

MedAustron Control System > Project Risk List
Project Risk List

New Actions Settings		View: Standard
B-Train !NEW	Title	B-Train
Constraint induced by overall project schedule !NEW	Attachments	
DIM won't work on CNAO !NEW	Issue ID	7
HTTP client on Labview RT unavailable !NEW	Title	B-Train !NEW
Lack of manpower for Elaboration Phase !NEW	Monitoring Assigned To	Ulrich Dorda
Missing System Administrator !NEW	Risk Status	Active
No Junior Partner !NEW	Identification Date	02/11/2009 12:00 AM
Non Acceptance of Development and CM Process !NEW	Start of Impact	01/11/2010
Power Converter Interface Choice !NEW	Likelihood of Impact	Low
PVSS C# Integration !NEW	Impact Severity	Medium
Repository Management Software Contract with CNAO !NEW	Mitigation type	Avoidance
Safety/Medical Device Risk Management	Mitigation Description	A B-train requirements document shall be written within Q2 2010. The responsible work package must be identified.
	Contingency Plan	Start working without B-train inducing further risks.
	Closing date	
	Closing Reason	
	Category	Technical
	Identified By	Johannes Gutleber
	Impact description	If B-train requirements are not specified, digital function generator may be under- or over-required. If B-train system is missing it must be retro-fitted, leading to increased budget, project delays and potentially reduced functionality by increased complexity.
	Risk Description	In order to provide a feedback loop onto the main dipole power converter, a B-train system is envisaged. This system can also be used to display the current main dipole field and synchronize other accelerator components. The digital function generator foresees an input for positive and negative signals corresponding to increasing and decreasing field changes. However the exact requirements on the change frequency, latency of signal propagation and exact corrective values on a pre-configured main dipole waveform remain to be identified in a dedicated document.

Risk Priority Matrix

Risks entered into matrix according to likelihood and impact assessment

Risks deserve attention in order of priority

Likelihood	Impact		
	Low	Medium	High
High (most likely)	High	Extreme	Extreme
Medium (moderate)	Low	High	Extreme
Low (unlikely)	Low	Low	High

Current Risk Priority Matrix

Likelihood	Impact		
	Low	Medium	High
High (most likely)	/	1	4
Medium (moderate)	/	1	2
Low (unlikely)	2	2	/

Project Risks

- Separation of safety/non-safety related parts not settled
- Safety/risk management for medical device partially covered
- Core team not staffed within time
- Human resources for elaboration phase not in time
- Repository Software agreement not settled in time
- WP and overall project plan inconsistencies
- Non acceptance of development process, CMP and RMP
- WP scope definition not unambiguously settled
- Power converter interface choice not adopted



OUTLOOK AND SUMMARY

Outlook

- Elaboration phase
 - Complete requirements specifications
 - Complete overall system architecture and design
 - Build control system software foundations
- MACS column
 - Demo of integration of all tiers by end 2010
 - Navigator - SCADA PVSS – Proc. Framework API - NI LV/RT API
 - Main timing system basic building blocks
 - Power converter controller interface
 - Digital Function Generator optical link
- Reinforce collaboration/contacts with similar projects
 - CNAO, PSI, HIT to mention but a few

Regular Reviews and Workshops

- MACS weeks at least twice per year
 - Tentative dates: **June** 24/25 and **December** 2/3
 - Presentation and summary of technical progress
 - Forum for information exchange with external contributors
 - Possibility to refocus and trajectory correction
- Intermediary management reviews
 - In function of outcome of this review
 - June (MAC week), September (intermediary), December (MACS week)
 - Track incorporation of reviewers inputs

Areas needing particular Attention

- Medical Device Risk Management & Quality Management
 - Needs a full time employee
 - Needs to be done top down and should coordinate WP activities
 - Needs support from management
- Quality Management
 - We require certain standards in development
 - Core team is itself not certified or trained!
- Core team staffing
 - Staffing progresses, but process requires significant time (> 3 months)
 - Specialized skills, experience, age, mobility
 - 7 people needed, 5 by Q2 2010 available
 - Beam Delivery Control System staff remains to be allocated
 - Consensus estimate for BDCS O(15) man years

Achievements

- **Scope** of work package defined
- Major **risks** identified
- **Development process** defined (according to RUP/IEC 61508)
- **CM** environment existing and in use (ISO 10007:2003)
- Project **Risk Management Plan** existing and in use
- **Development strategy** defined
- **HR** and budget **plans** prepared
- Preliminary **project plan** prepared
- **Core team** about to be staffed
- **Framework agreement** with contractor about to be settled
- **Requirements** preparation in progress