# Can accelerator control systems be built by industry?

# COSYLAB

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Your TRUSTED Control System Partner

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# Three Major Topics

- What is a control system in the first place?
- Why get it from industry (or maybe why not ☺)?
- How Cosylab does it.

# What Is Meant By “Control System” ?

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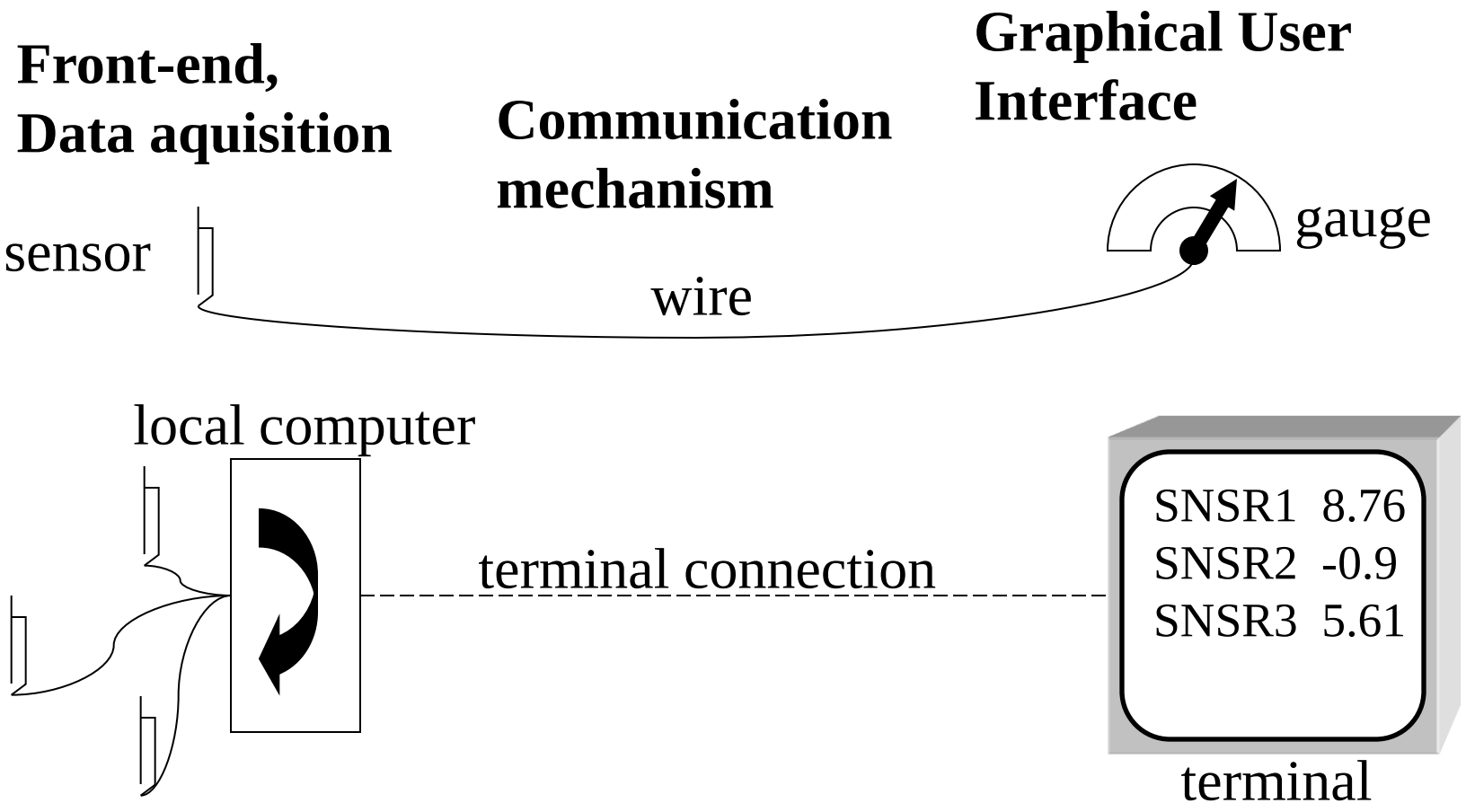
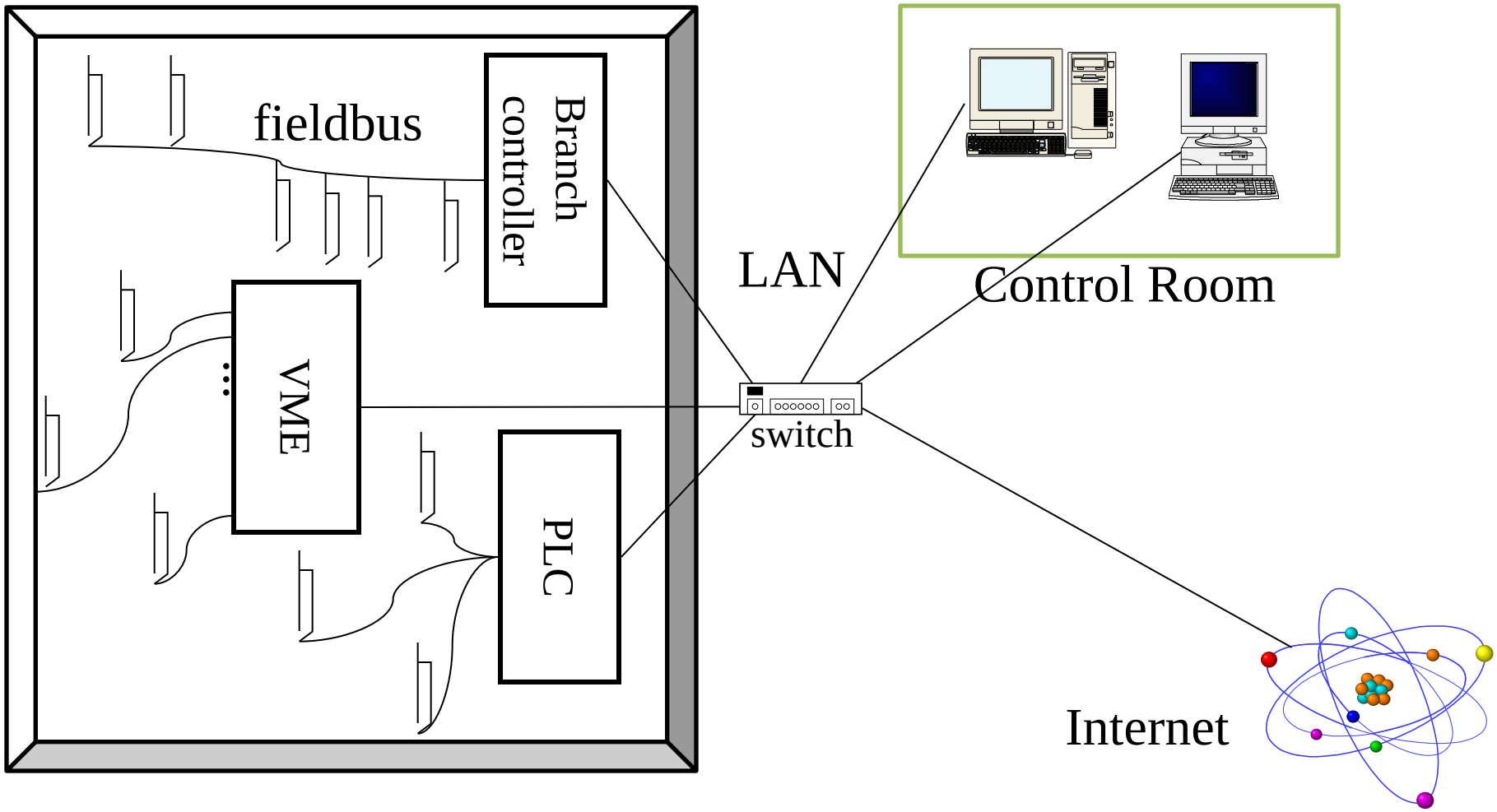
- Not a shrink-wrap package with an installation wizard, but rather a **service**
  - Engineering according to specifications
  - Configuration of packages like EPICS, TANGO, FESA, TINE, LabView, etc.
    - Some hope this is just a few days of work
  - Outsourcing software/hardware development
  - Installation
    - Some believe this refers to cabling
- All customized for a specific accelerator

# From the Analog to the Digital...



# … to the Distributed Era



# Which Platform To Choose?

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- Don’t worry:
  - modern computer technology allows any reasonable implementation of software and hardware to function properly

- So what is really important?
  - To define the development procedures
  - To make everyone agree on the interfaces (HW and API)
  - To get the signal list ASAP
  - To prepare the test plan and documentation **before** implementation starts

# Development Procedures: Control System is NOT just Playing with Software

Control Systems are an **engineering** discipline like all the others, but with an even more complicated development cycle:

- Write specifications
- Architecture
- Design
- Prototyping – **probably the only fun part**
- Test procedures
- Implementation (coding) – **the only software part**
- Documentation
- Testing
- Debugging
- Acceptance at „customer“

# What a Project Leader Should Request From The Control Group

- Help all stakeholders to define requirements
- Interface definition and management
  - before equipment call for tender!
- Logistics of integration and installations
- Error handling
  - How the system behaves when I/O or other errors occur
  - Machine protection system
- Risk and mitigation plan, i.e. foreseeable bugs ☺
  - Plan testing, debugging and workarounds also of other people‘s problems
- Configuration management

# Why Getting the Control System from Industry?

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- Would you build the vacuum chamber or the magnets in-house?
- Why not?
  - Too complicated (technically, procedures, volume)
  - Boring (not fun playing)
- Also electronics was built in-house 20-30 years ago but now seldomly
- What's so different about the control system then?
  - It can be changed arbitrary number of times?
  - It can't be described by a Hamiltonian!

# In-house or Outsourcing?

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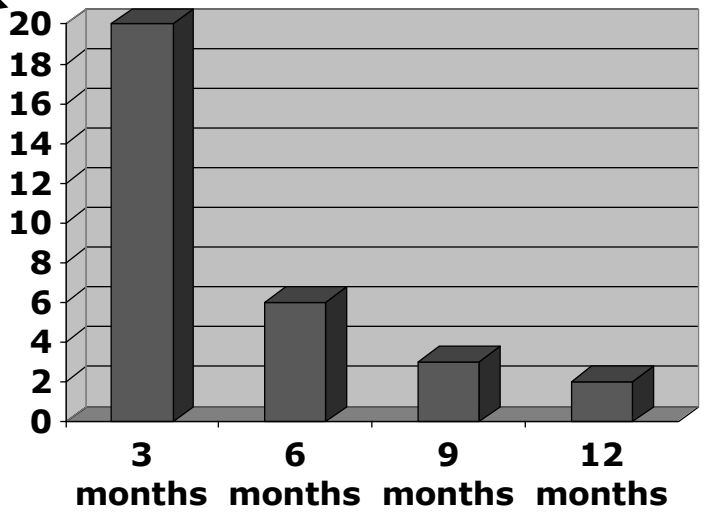
- For in-house: maintenance, upgrades
- Wrong!
- In-house people are smart: but get N different solutions
- Nobody is writing documentation unless forced
  - “Outsourcer” is forced, because of payment
  - In-house person will just tell you, until she/he is gone
- In-house knowhow rests with people, not the lab
- Outsourced knowhow from competent suppliers is like an escrow vault:
  - You pay, but it is well kept for you
  - Over the whole lifetime of the project

# The Keyword is Competent Supplier

- Understands accelerators
  - Programming or automation knowledge is not enough
- Offers standard solutions, well tested **optimized procedures** and **project management**
  - Local scientist-developers have all excellent solutions, but all slightly unique and different
  - We usually deliver more than internal people, just because we know that we get only paid at the end!
- What happens if supplier goes bankrupt?
  - A good and honest supplier doesn't do this
  - Escrow: get all sources at delivery
  - Buy out his people – they know you best!

# Common Prejudices (I had them, too)

- A company is more expensive
  - Time is money – expensive is what you can't get done!
  - Big effective cost of new people
- In-house people are more efficient
  - No cure – no pay !
- We can do it faster in-house
  - With or without bugs?
  - Beware of 80/20 rule
- A company can let us down
  - We can't afford this in the small community – we'd be dead
- A company just wants money
  - Are you in science to get money? Don't pressume others are.



# The Three Phases of Non-outsourcing

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1. We will outsource, but we don’t know yet what
2. We have some specs, but we can handle them ourselves
3. We should have outsourced to you, but now we have already invested so much of our work that we can not justify throwing it all away

- ❑ Reminds me of unsuccessful dating ☺

# Real Problems

- It's faster to do it than to write specs
  - True, but if you don't write specs for yourself, you'll be in trouble later
- Specs, targets are not clear, can't control cost
  - True, but then also your own cost wouldn't be under control
  - Let's make a fixed price contract, if the effort deviates more than by 10-20%, we renegotiate the contract.
- In-house people can fix problems overnight
  - True: keep one person permanently at lab to collect requests and make quick fixes

# The Right Way to Outsourcing: Rightsourcing (you name it!)

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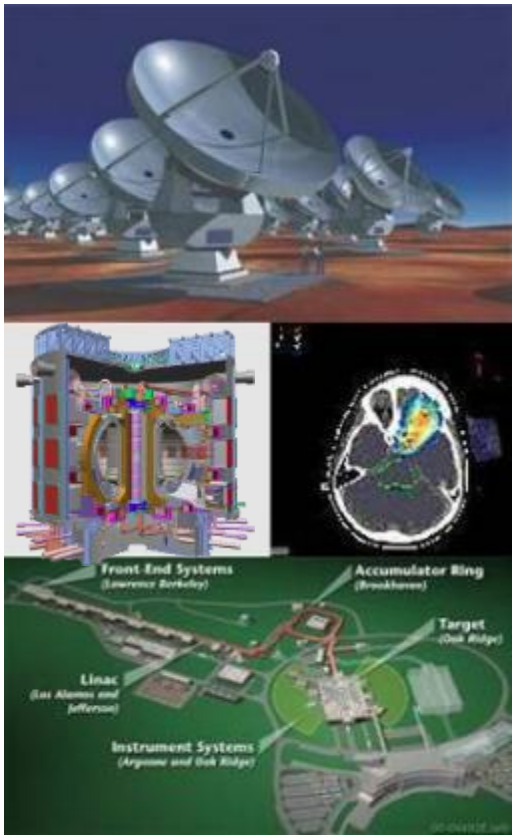
- start with smaller projects (2-4 man-weeks)
- regular visits or work on-site
- Get benefits from both “in-sourcing” and “out-sourcing”:
  - Permanent persons on-site (gather requirements, communicate with customers, organize, support, service…)
  - Expert team at home, professionally organized and managed

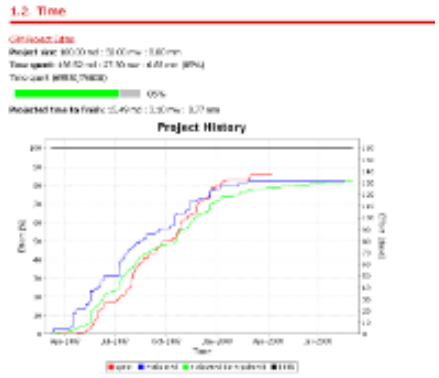
- Benefits for the lab:
  - pay only one person, get an expert in every area
  - scientists retain the established work practice: (almost) no specs, creative academic environment, ask and get (almost) next day
  - value for money (efficiently managed, optimized procedures, no cure no pay!)
  - Lifetime support (see what happened at CERN PS)

# The Company Cosylab

- Started in 2001 as a spinoff (prof and his students)
- Now **worldwide leader** specialized for control system integration of accelerators and large physics facilities, **chosen by the majority of projects**

  - We offer services and develop products where **expert knowledge** is required.
  - We know how to use and develop **state-of-the-art electronics and software**.
  - We **integrate** them into mankind‘s most complex systems.



# Customers From Nearly All Major Labs Worldwide



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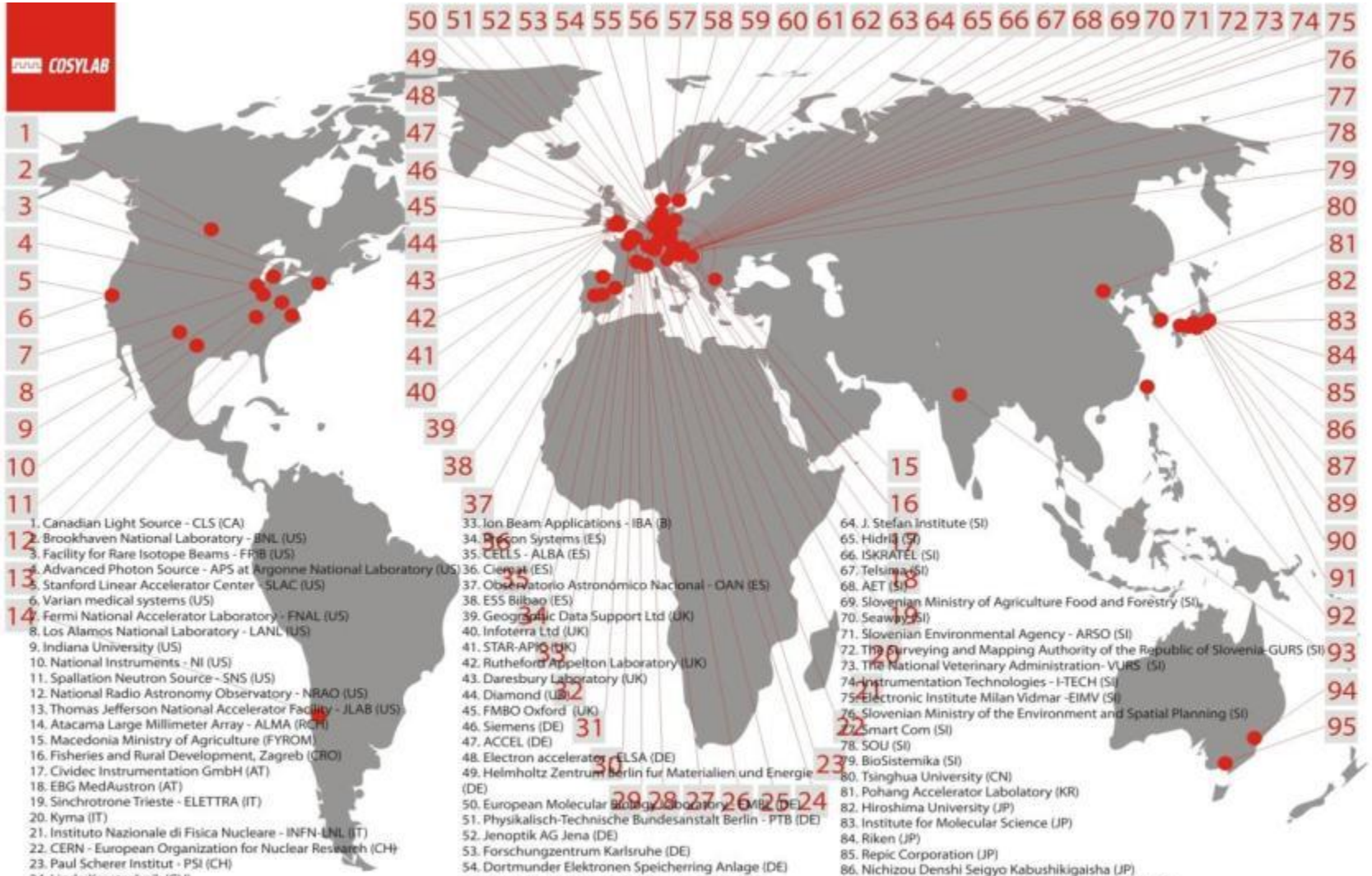
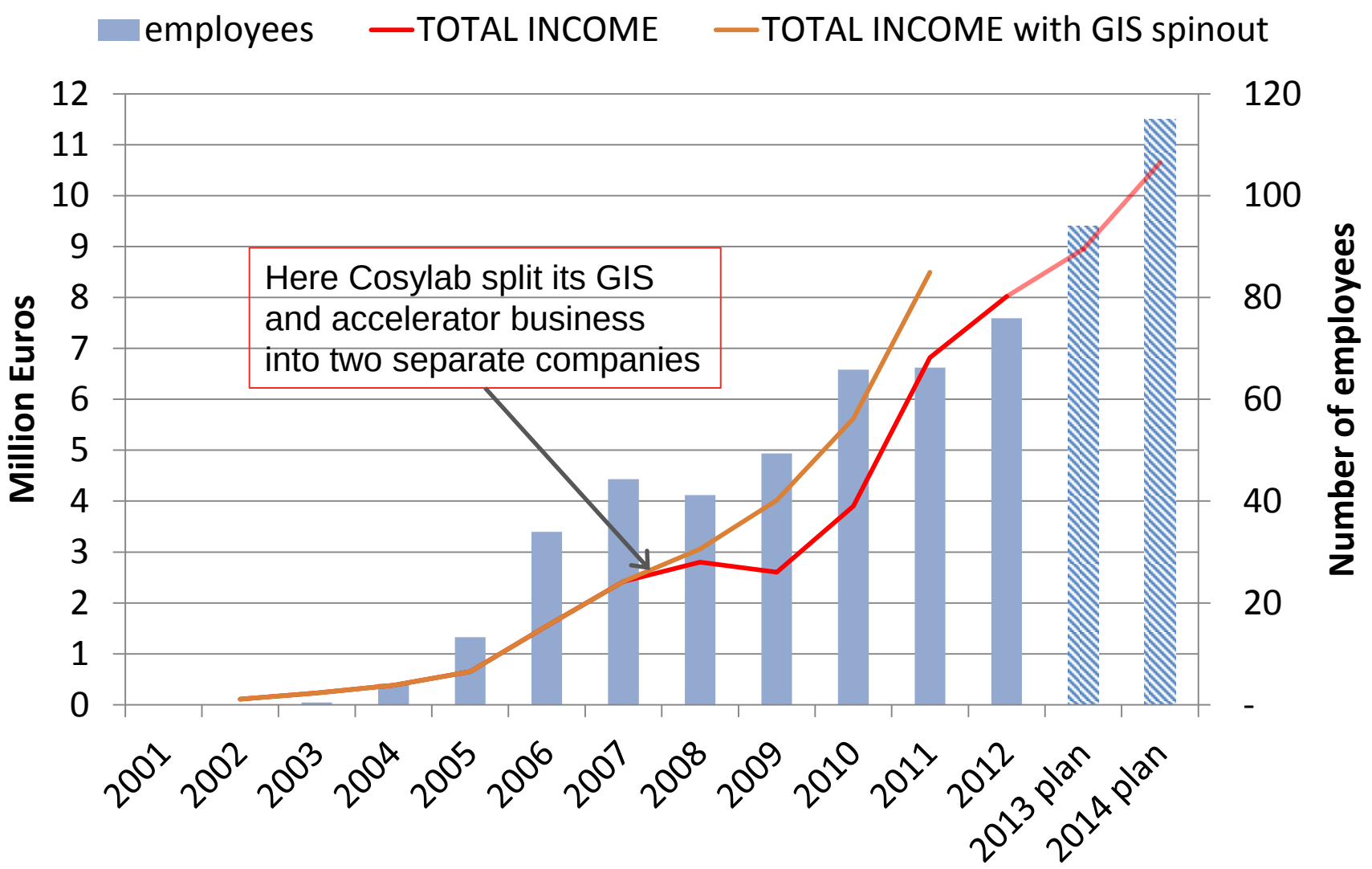


1. Canadian Light Source - CLS (CA)
2. Brookhaven National Laboratory - BNL (US)
3. Facility for Rare Isotope Beams - FRIB (US)
4. Advanced Photon Source - APS at Argonne National Laboratory (US)
5. Stanford Linear Accelerator Center - SLAC (US)
6. Varian medical systems (US)
7. Fermi National Accelerator Laboratory - FNAL (US)
8. Los Alamos National Laboratory - LANL (US)
9. Indiana University (US)
10. National Instruments - NI (US)
11. Spallation Neutron Source - SNS (US)
12. National Radio Astronomy Observatory - NRAO (US)
13. Thomas Jefferson National Accelerator Facility - JLAB (US)
14. Atacama Large Millimeter Array - ALMA (RCH)
15. Macedonia Ministry of Agriculture (FYROM)
16. Fisheries and Rural Development, Zagreb (CRO)
17. Cividec Instrumentation GmbH (AT)
18. EBG MedAustron (AT)
19. Sinchrotrone Trieste - ELETTRA (IT)
20. Kyma (IT)
21. Instituto Nazionale di Fisica Nucleare - INFN-LNL (IT)
22. CERN - European Organization for Nuclear Research (CH)
23. Paul Scherer Institut - PSI (CH)
24. Linde Kryotachnik (CH)
25. Maatel Scientific Instrumentation (FR)
26. Xenocs (FR)
27. French Atomic Energy Commision (FR)
28. International Thermonuclear Experimental Reactor - ITER (FR)
29. European Synchrotron Radiation Facility - ESRF (FR)
30. bioMérieux (FR)
31. Synchrotron Soleil (FR)
32. Atos Origin (FR)
33. Ion Beam Applications - IBA (B)
34. Bycon Systems (ES)
35. CELLS - ALBA (ES)
36. Ciemat (ES)
37. Observatorio Astronómico Nacional - OAN (ES)
38. ESS Bilbao (ES)
39. Geographic Data Support Ltd (UK)
40. Infoterra Ltd (UK)
41. STAR-APIC (UK)
42. Rutheford Appelton Laboratory (UK)
43. Daresbury Laboratory (UK)
44. Diamond (UK)
45. FMBO Oxford (UK)
46. Siemens (DE)
47. ACCEL (DE)
48. Electron accelerator - ELSA (DE)
49. Helmholtz Zentrum Berlin fur Materialien und Energie (DE)
50. European Molecular Biology Laboratory - EMBL (DE)
51. Physikalisch-Technische Bundesanstalt Berlin - PTB (DE)
52. Jenoptik AG Jena (DE)
53. Forschungzentrum Karlsruhe (DE)
54. Dortmunder Elektronen Speicherring Anlage (DE)
55. Deutsches Elektronen-Synchrotron DESY (DE)
56. European Southern Observatory ESO (DE)
57. Gesselshaft fur Schwerionenforschung (DE)
58. Feinwerk-und-Messetechnik GmbH (DE)
59. Imtech Vonk (NL)
60. Kernfysisch Versneller Instituut - KVI (NL)
61. Danfysik (DK)
62. European Spallation Source (SE)
63. MAX-lab, Lund University (SE)
64. J. Stefan Institute (SI)
65. Hidria (SI)
66. ISKRATEL (SI)
67. Telsima (SI)
68. AET (SI)
69. Slovenian Ministry of Agriculture Food and Forestry (SI)
70. Seaway (SI)
71. Slovenian Environmental Agency - ARSO (SI)
72. The Surveying and Mapping Authority of the Republic of Slovenia-GURS (SI)
73. The National Veterinary Administration- VURS (SI)
74. Instrumentation Technologies - I-TECH (SI)
75. Electronic Institute Milan Vidmar -EIMV (SI)
76. Slovenian Ministry of the Environment and Spatial Planning (SI)
77. Smart Com (SI)
78. SOU (SI)
79. BioSistemika (SI)
80. Tsinghua University (CN)
81. Pohang Accelerator Labolatory (KR)
82. Hiroshima University (JP)
83. Institute for Molecular Science (JP)
84. Riken (JP)
85. Repic Corporation (JP)
86. Nichizou Denshi Seigyo Kabushikigaisha (JP)
87. Japan Atomic Energy Research Institute - JAERI (JP)
88. High Energy Accelerator Research Organisation - KEK (JP)
89. The University of Tokyo (JP)
90. Hitachi Zosen (JP)
91. Japan Synchrotron Radiation Research Institute - JASRI (JP)
92. NSRRC -National Synchrotron Radiation Research Center (TW)
93. Raja Ramanna Centre of Advanced Technology - RRCAT (IN)
94. Australian national nuclear research and development organisation - ANSTO (AU)
95. Australian Synchrotron - AS (AU)

# Who are we?

- 85 employees
  - 70 „production“ FTEs effectively
  - additional ~30 students in the pipeline
- Branches in the USA and Japan

# Sustained Growth



# How Do We Do It?

- Hiring only the best people
  - 7% PhDs, 8% PhD students employed
  - own education and training system (CosyAcademy)
  - strong company culture and great employee loyalty
- Know and understand the science and the scientific community
- Processes: ISO 9001,13485,14971, IEC62304 (medical)


# OUR OFFER: „Quality Service, Support And Extended Maintenance That Takes The Risk Out Of Control at a Fair Price“

COSYLAB

- **Turnkey control system** adapted to your accelerator – with open source components
- **Development&Integration** of subsystems and equipment into **your control system**
- **Outsourcing** – we provide experts
- EPICS&TANGO training - worldwide

- Specialized in all Software and Hardware technologies used in accelerators:
  - EPICS, CSS, PLC, Timing, Machine Protection System (MPS), LabView, National Instruments, PCIe, PXI, VME, xTCA, Linux, FPGA, Matlab,..

# So Make or Buy?

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- A Lab Should Do Both:

- Keep the system responsibility
  - Requirements gathering
  - Technology evaluating / Prototyping
  - Operation and modifications
  - **Have know-how to make acquisitions in a professional manner**

- Buy expert knowledge
  - Architecture
  - Partially design
  - Professional quality software and hardware
  - Testing
  - Writing documentation and training
  - Maintenance
  - **=> Guaranteed performance, remove risk**

# Conclusions: Can the Control System be bought from Industry?

- yes, but...
  - you must first choose the right company, one with good understanding of accelerators and with proven competence
- Even if not, it is wise to write specifications anyway
- Software and Control are going where Electronics went 30 years ago
  - Remember the LeCroy advertisement in the CERN Courier from 1984?
- We believe Industry can **deliver extra value** to in-house development of control systems:

"Do what you do best
and let us do the rest"

# THANK YOU!

Mark Plesko

**COSYLAB**

Web: www.cosylab.com