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Design. Analyze. Optimize.

Design for Reliability, Availability, Maintainability and Safety by RAMS methods & tools for overall Risk Assessment and Life Cycle Management

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Ramentor Inc.

- Founded in 2006 and based in Tampere, Finland
  - Personnel ~10 (Dr. & M.Sc. – Mech. & aut. eng. / Applied math. / Software dvlt.)
  - Privately owned and independent software and expertise company
- Background: Competitive Reliability Programme 1996-2000
  - Finnish Technology Agency (TEKES) Competitive Reliability Programme 1996-2000
  - Tampere University of Technology (TUT): Probabilistic approach in reliability and maintenance management 2001-2003 followed by Industry Consortium projects: RAM Products 2003-2005, RAM Solutions 2006-2008, RAM Efficiency 2008-2010
  - Ramentor-TUT-CERN FCC RAMS project 2014-2018
- **Methods and Tools** for **RAMS engineering, Risk Assessment** and **Life Cycle Management**

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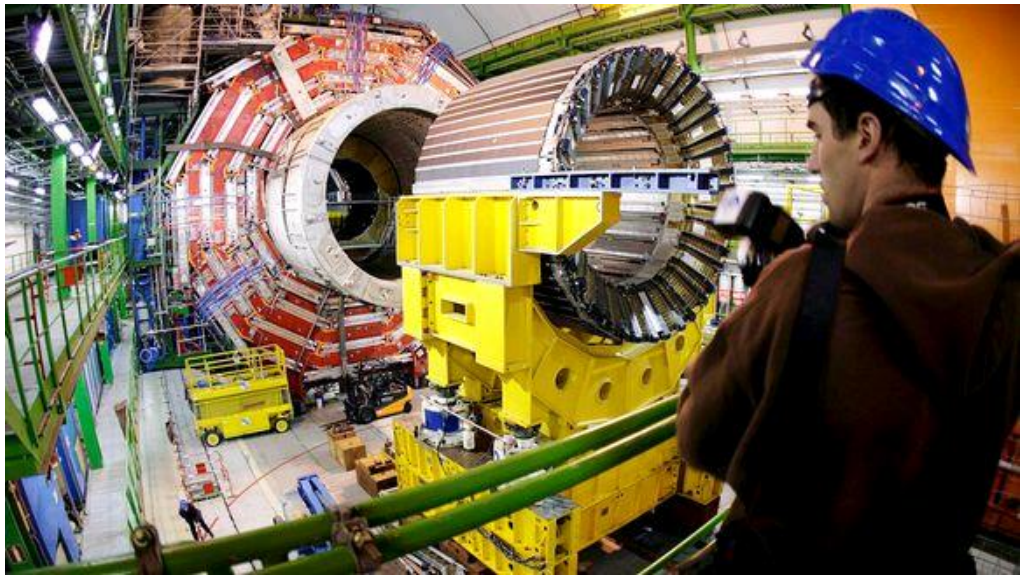
Ramentor – ELMAS Users / Co-developers

Industry Services	Design for Reliability	Quality & Risk mgmt
Caverion, YIT, ALGOL, EMPOWER, ABB, maint partner, Efora	KONECRANES, WÄRTSILÄ, FINGRID, KONE, ABB, PÖYRY, CARGOTEC, CERN, POSIVA, metso	Fortum, TeliaSonera, VACON, Google, elisa, NOKIA
Operation & Maintenance	**After Sales Support Service & Warranty**	**Research & Education**
UPM, TVO, POHJOLAN VOIMA, Fortum, HELEN, RAUTE, Outotec, OUTOKUMPU, SSAB, nokian RENKAAT	Rolls-Royce, KONE, KONECRANES, Valmet, WÄRTSILÄ, CARGOTEC	TAMPERE UNIVERSITY OF TECHNOLOGY, VINCIT, LAPIN AMK, Lapland University of Applied Sciences, PSK STANDARDISOINTI, promaint PRODUCTION & MAINTENANCE, JAMK, HAMK HÄMEEN AMMATTIKORKEAKOULU

A key quality attribute of a Future Circular Collider - Availability performance (RAMS)

Ramentor Oy has successfully carried out many **RAMS-studies** within **feasibility and conceptual design phase** of large scale investment projects (e.g. Wartsila, Metso, Kone, UPM, Cargotec Corporations and Posiva (Nuclear Waste Management)).

Ramentor has developed ELMAS (Event Logic Modeling and Analysis Software) for the RAMS engineering and management of systems and for probabilistic risk assessment throughout their lifecycle.



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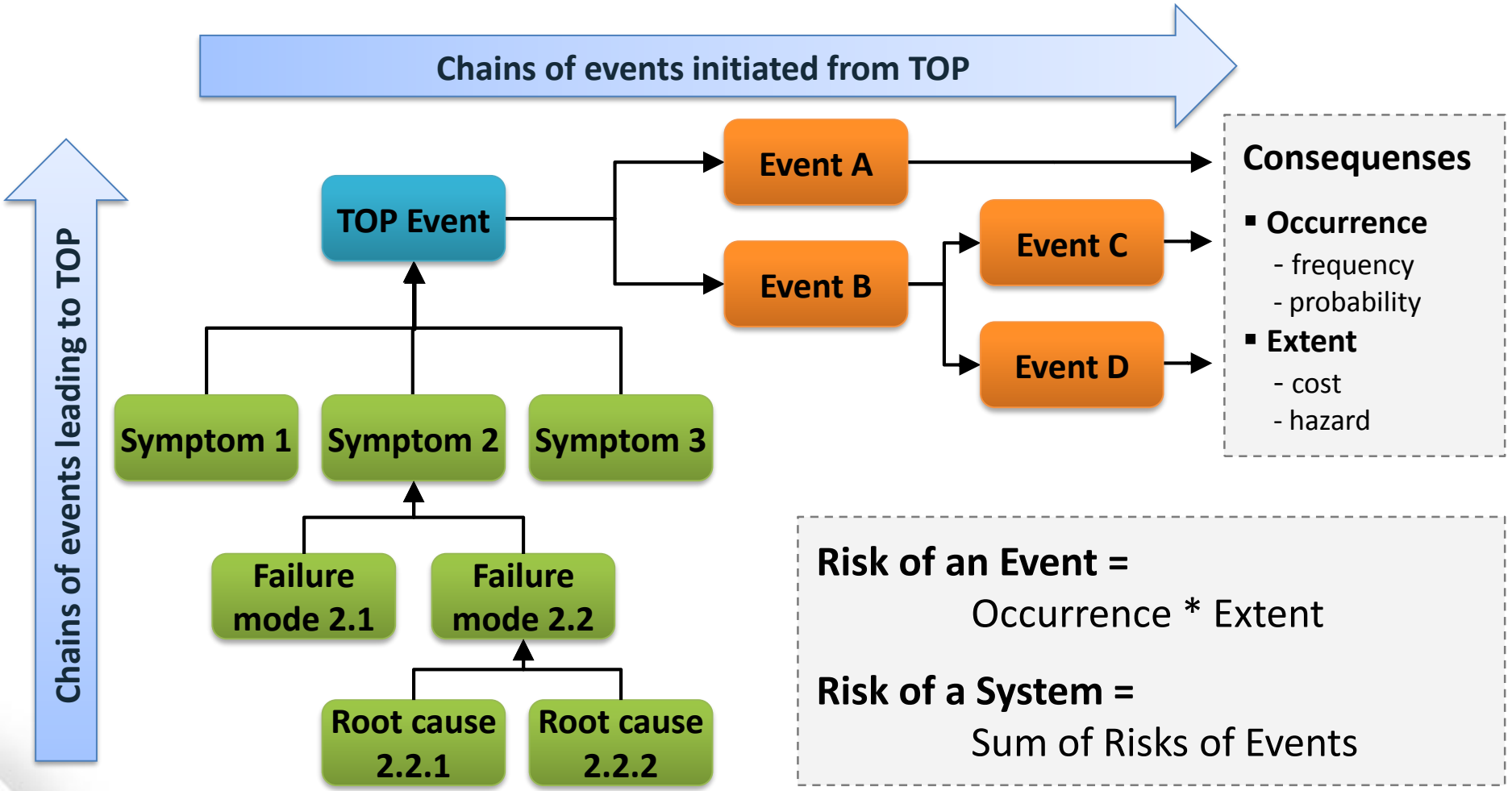
Modeling and Analysing Risks of a System



Risk of an Event =
Occurrence * Extent

Risk of a System =
Sum of Risks of Events

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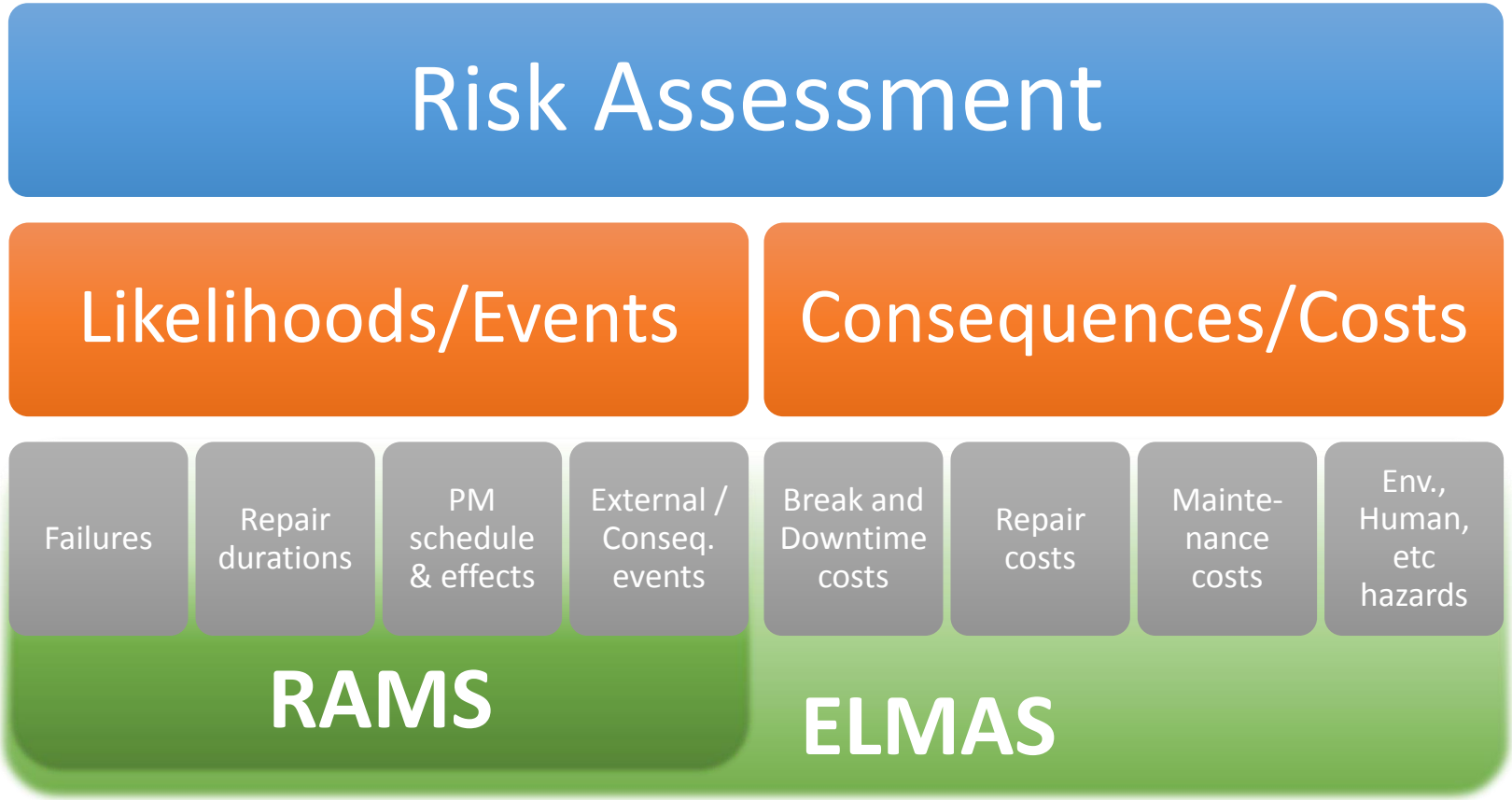
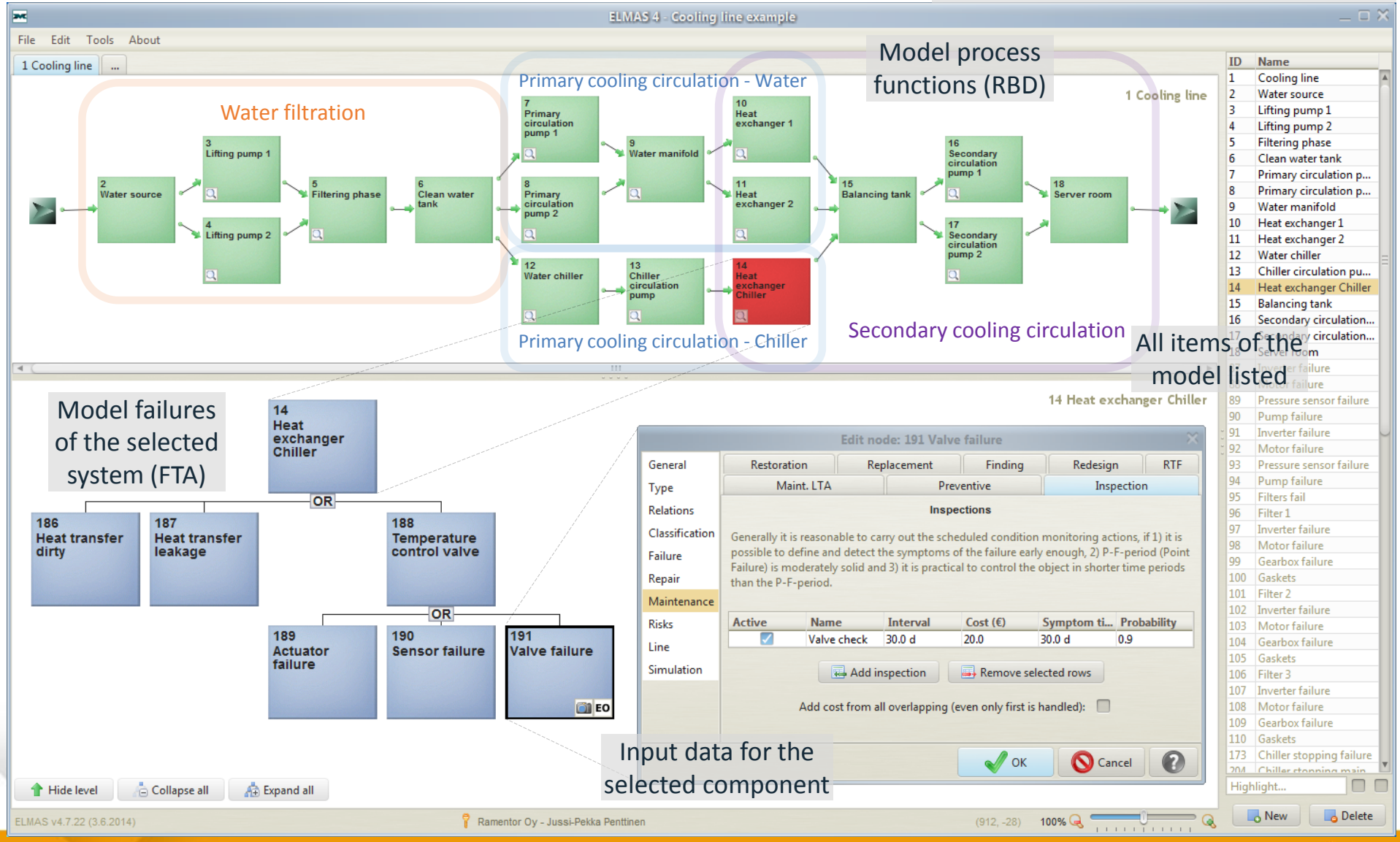
ELMAS – Risk Assessment and RAMS



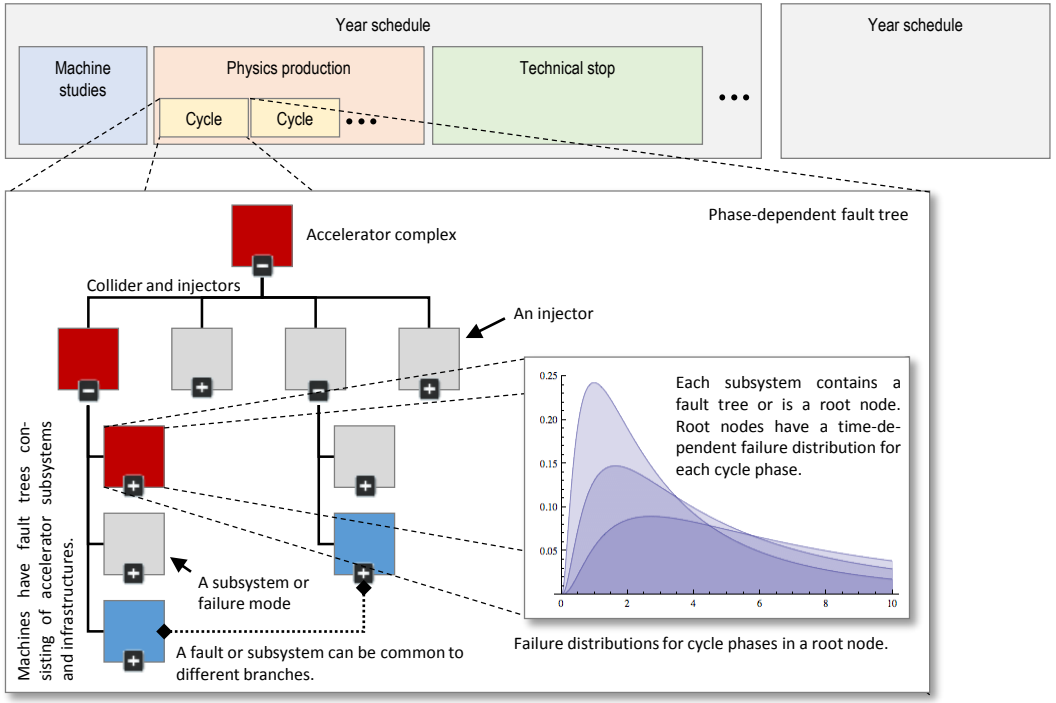
ELMAS 4.8

http://www.ramentor.com/products/elmas/

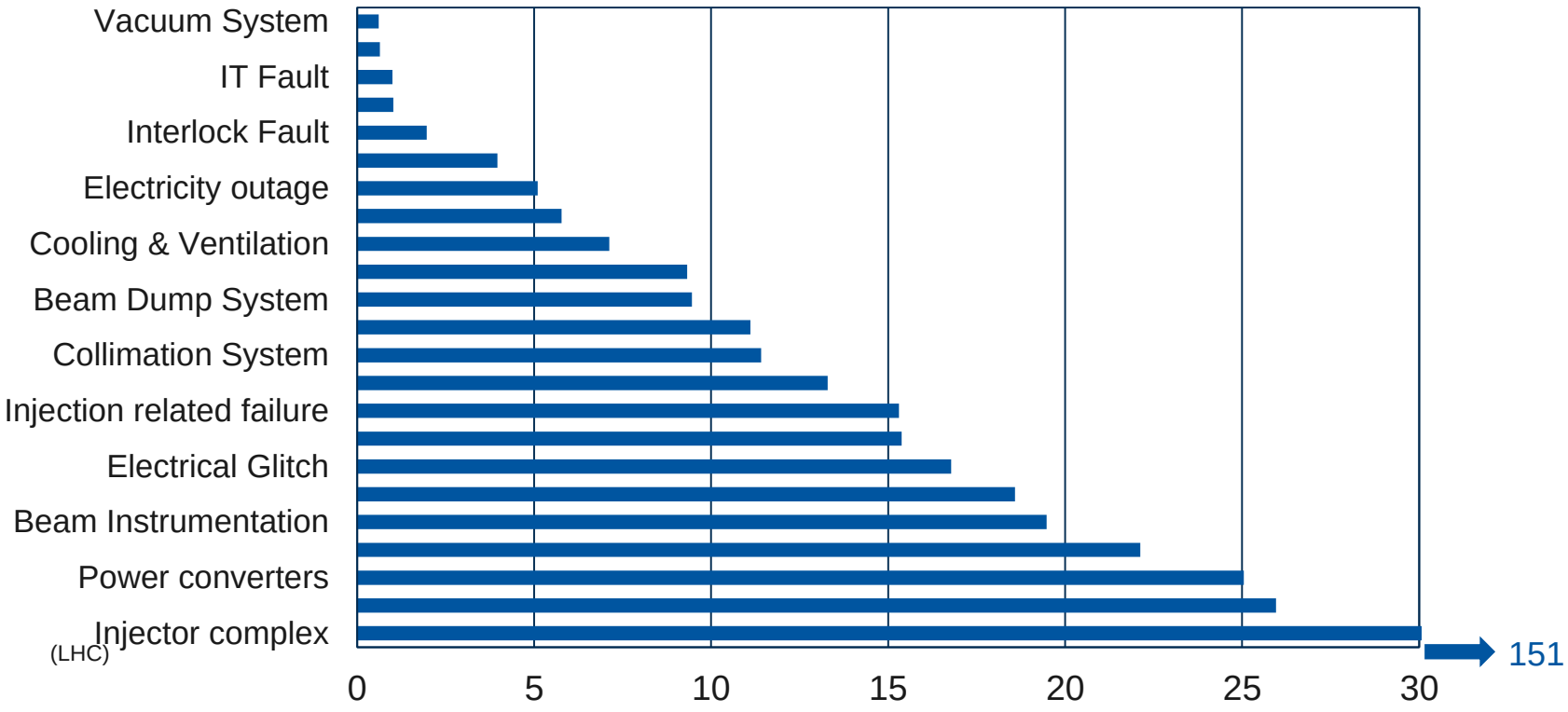


Modelling Approach

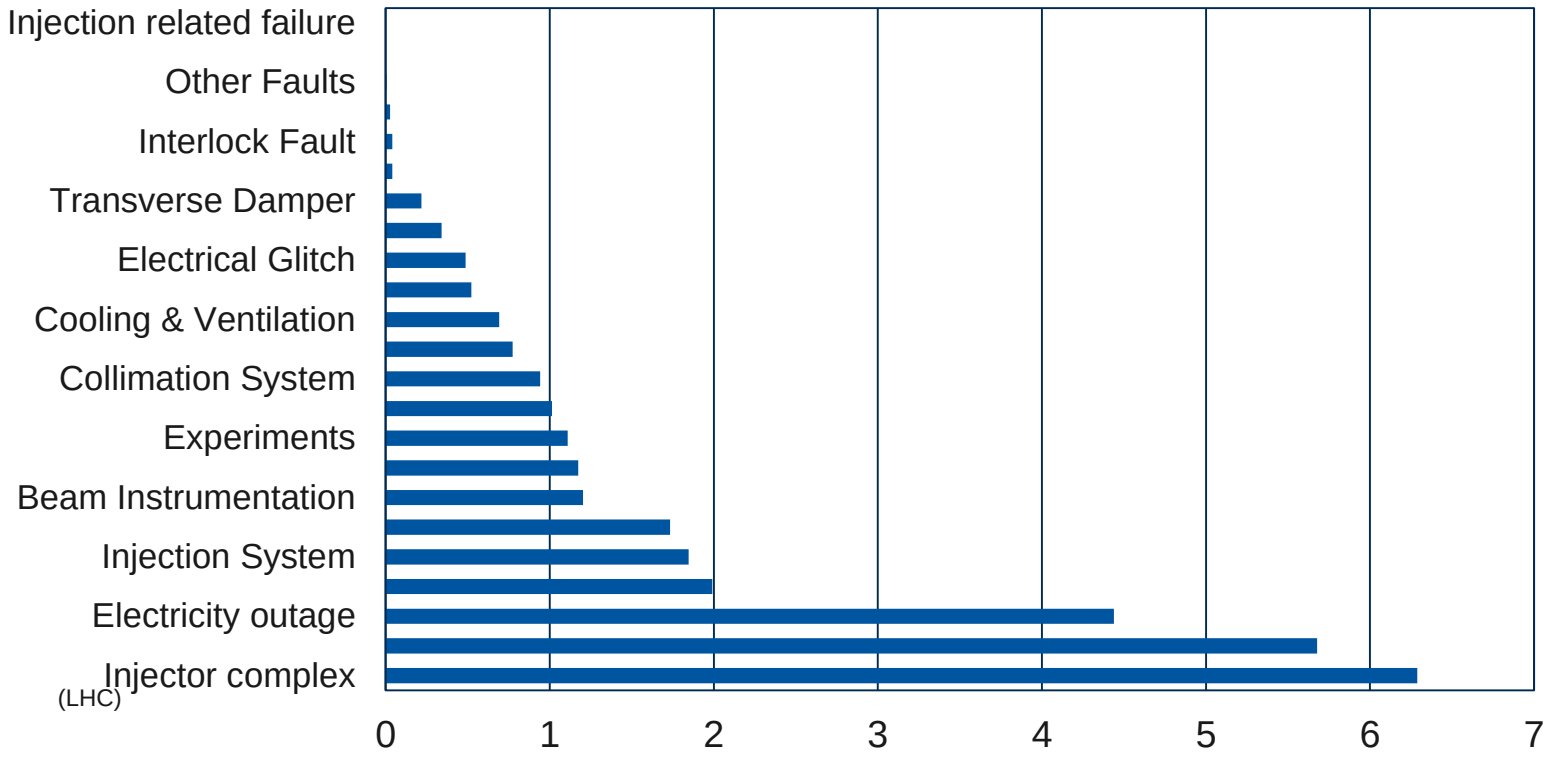
- Monte Carlo model of accelerator operation:
  - accelerator cycles, injections & luminosity production
- Fault tree model of system availability/reliability:
  - Failure rates + repair times



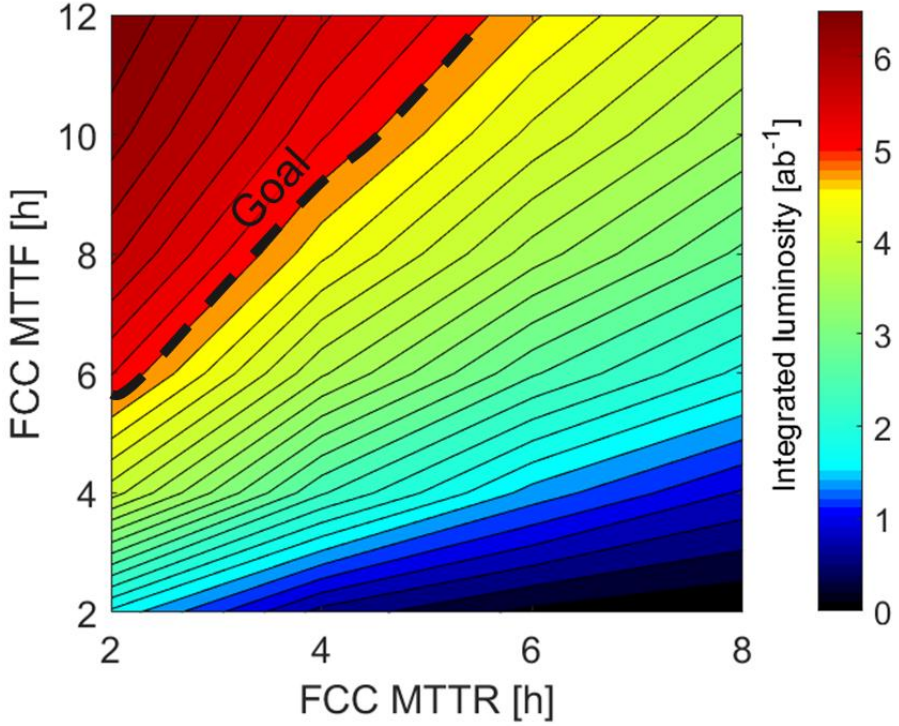
Availability budget: Failures / 100 days



Availability budget: Unavailability [%]



Sensitivity analysis



FCC Study Innovation Award

Read more: http://www.ramentor.com/news/?x20097=1695208

CERN Project - RAMS Methods and Tools

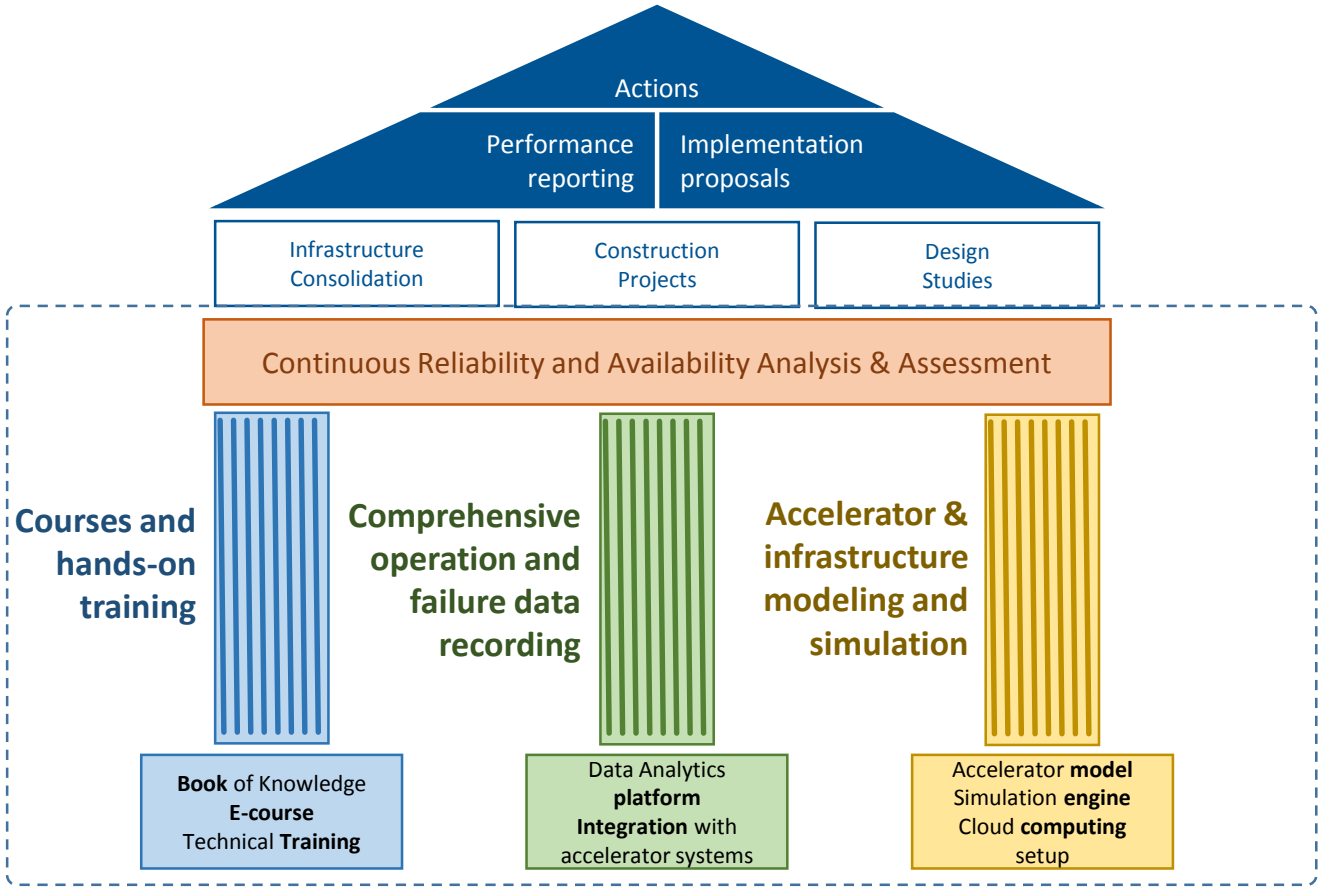
1) Use features of ELMAS tool for particle accelerators
   - Analysis made for current Large Hadron Collider (LHC)

2) Reliability training given twice a year
   - Train CERN system experts in the best practices of applying the method to study and assess systems' RAMS requirements

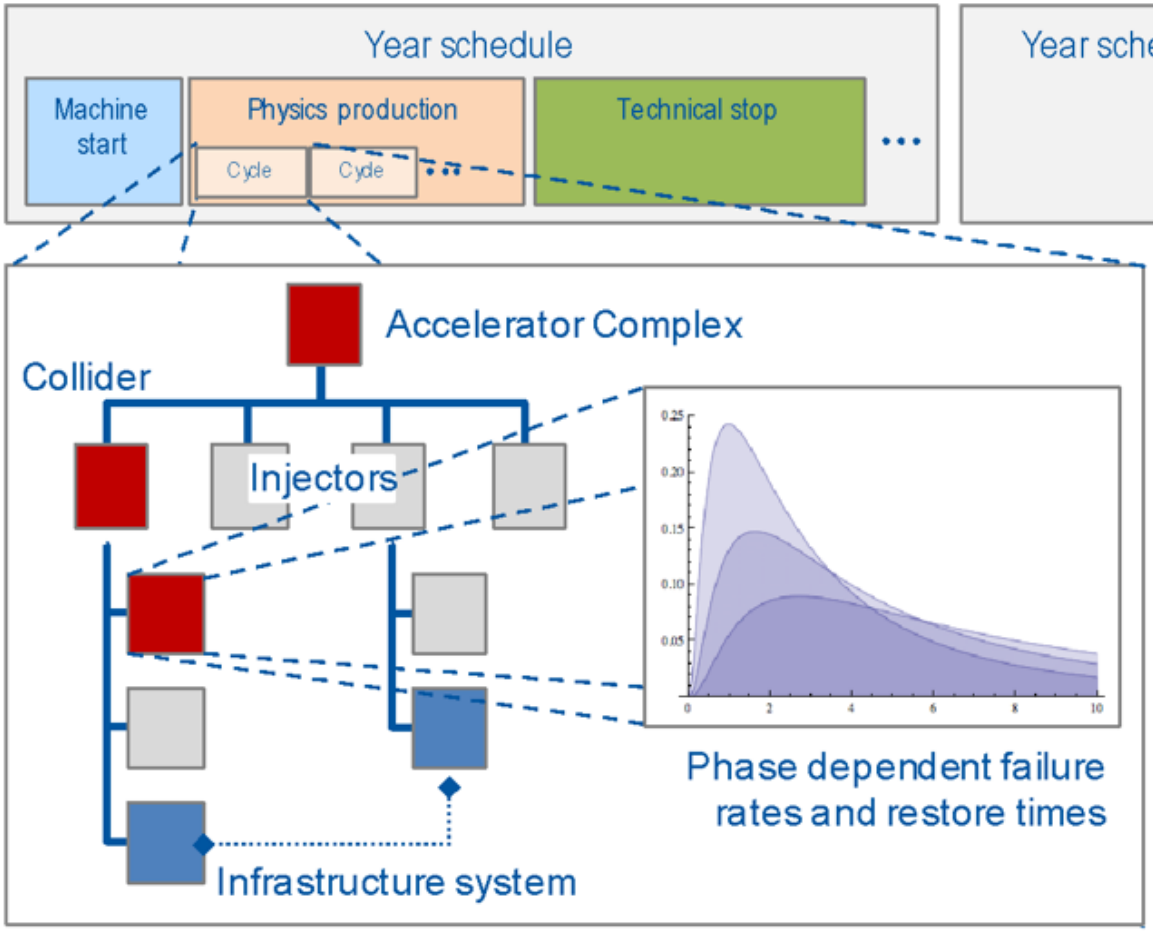
3) Enhanced modeling concept and calculation engine
   - Model and analyze the behavior of large systems efficiently

Sector-wide Accelerator Reliability & Availability Initiatives

by Johannes Gutleber, CERN ATS/DO



Towards a Common Method and Tool Federating Industry and Academia



Finland AT CERN

HELSINKI INSTITUTE OF PHYSICS

November 1 – 3, 2017

Ramentor engaged carrying out a dedicated R&D project with CERN will be present. The company provides **tools and services for system cost/performance reviews for design and operation with respect to reliability, maintenance optimisation and safety.** The company is also partner in S4FLEET (https://www.dimecc.com/dimecc-services/s4fleet/) bringing IoT and analytics to fleet optimisation. The organisers encourage one-to-one meetings with the companies.

RAMS / ELMAS Analysis Implementation and Benefits

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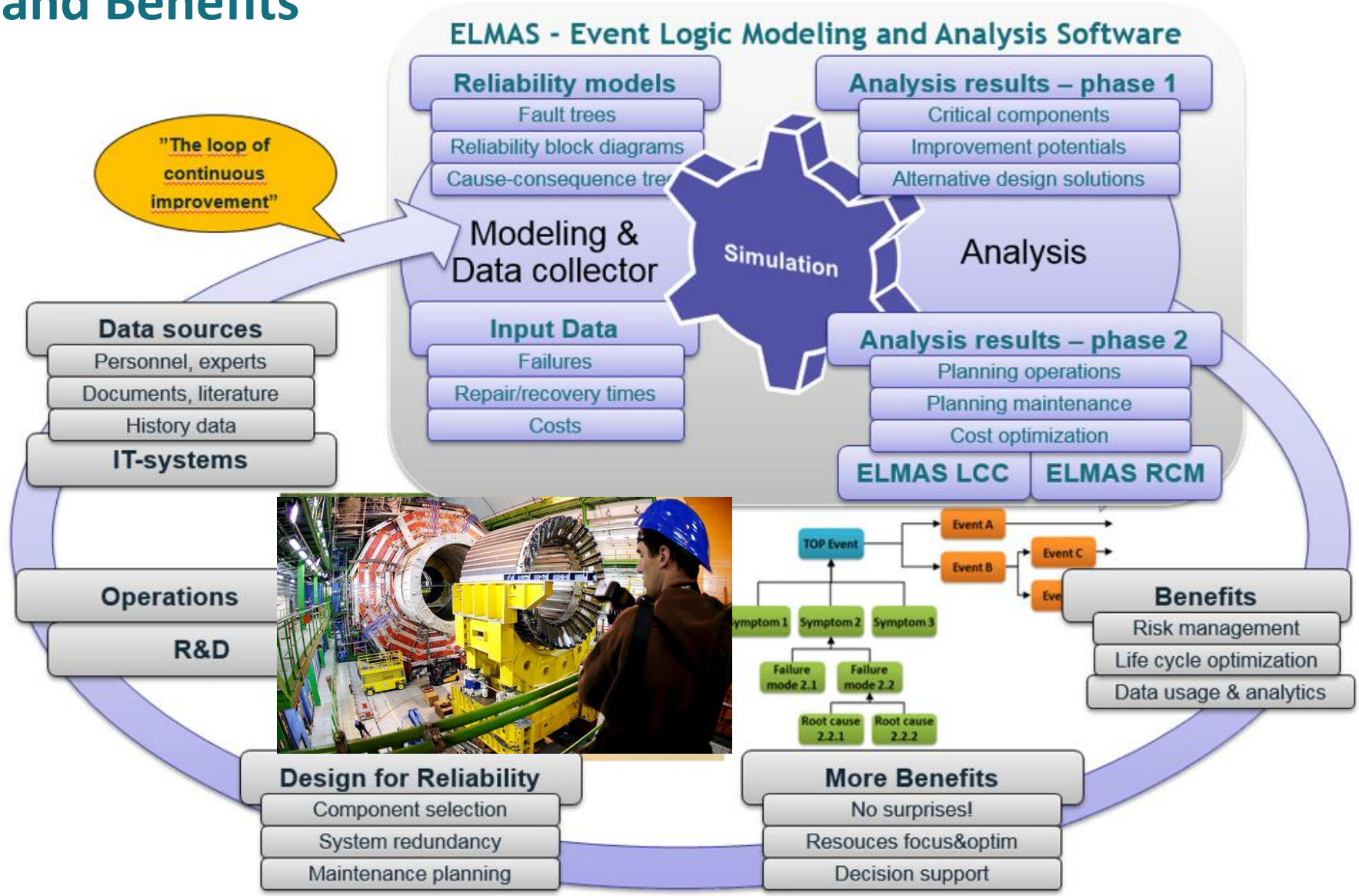

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