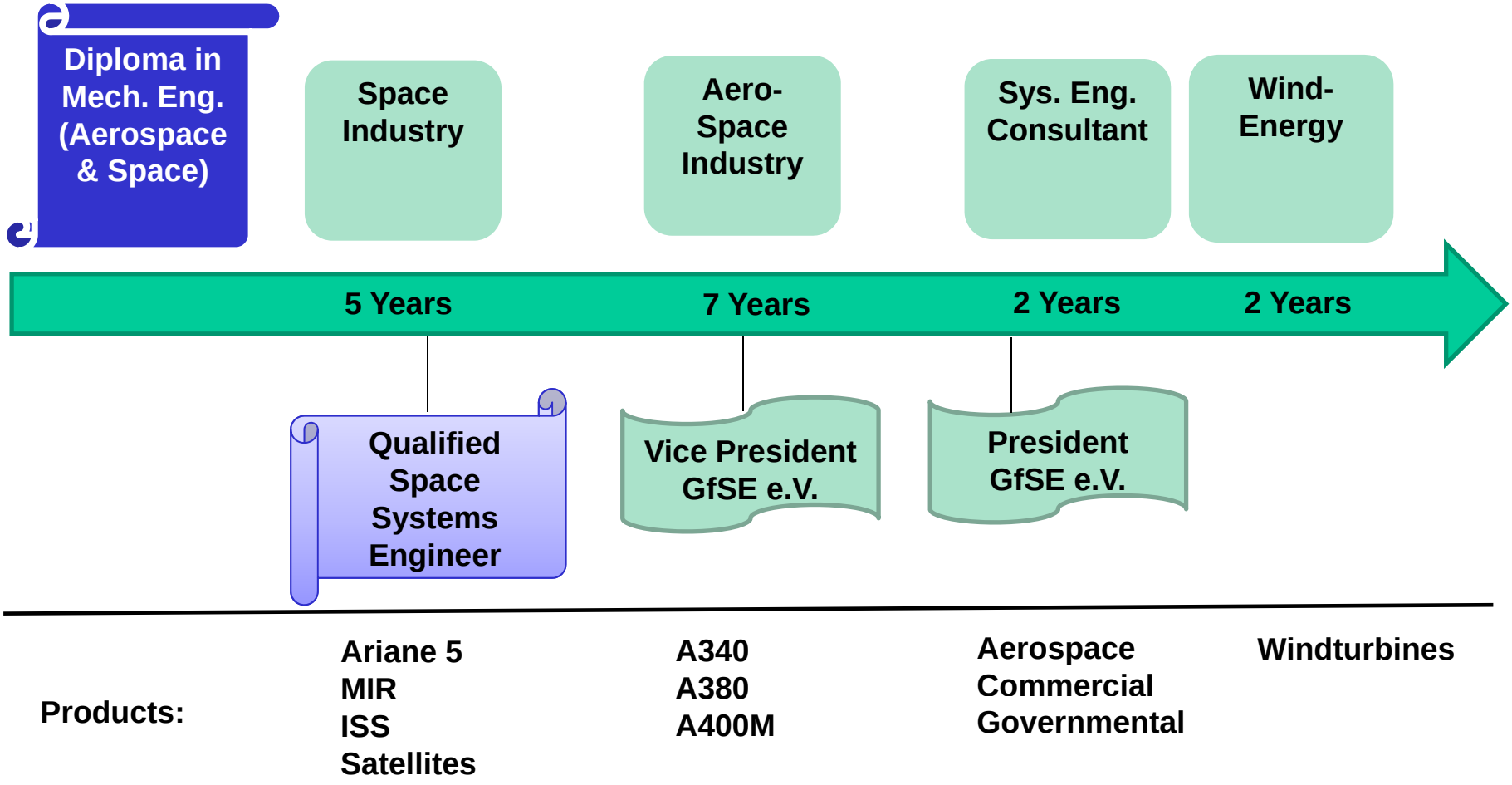
SE in Industrial Applikation

Practical experiences in different industries

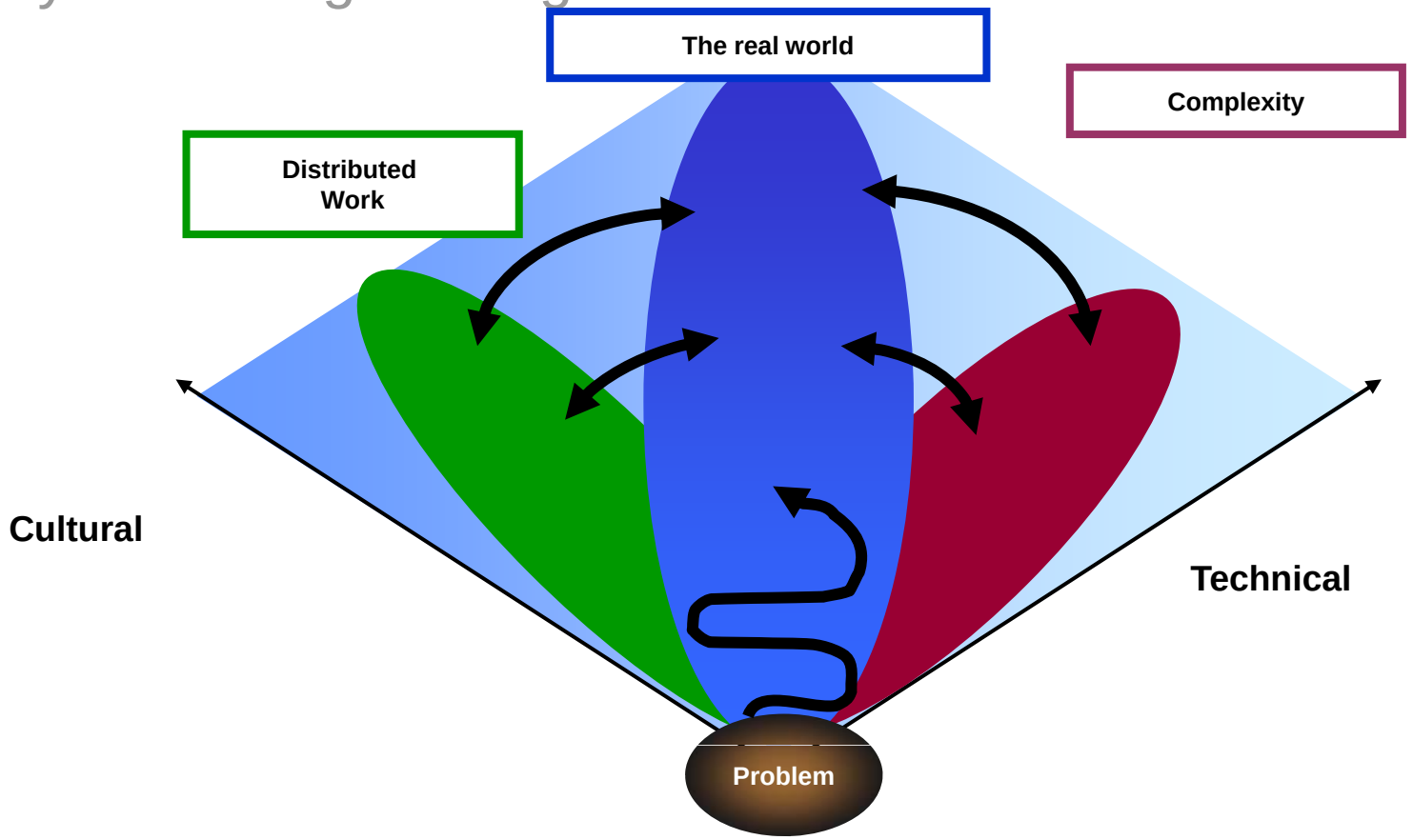
Sven-Olaf Schulze

30th May 2012 (Swiss-Chapter)

Experience Validation



Systems Engineering drivers



- Other words for Systems Engineers:
  - Architect, Integrator, Chief Engineer, Lead Engineer, ….

Constraints & Market changes

1870 (long time ago)

- Products developed without a customer
- One company developed one product
- No “real” constraints on Engineers
- Mechanical or “simple” electrical solution

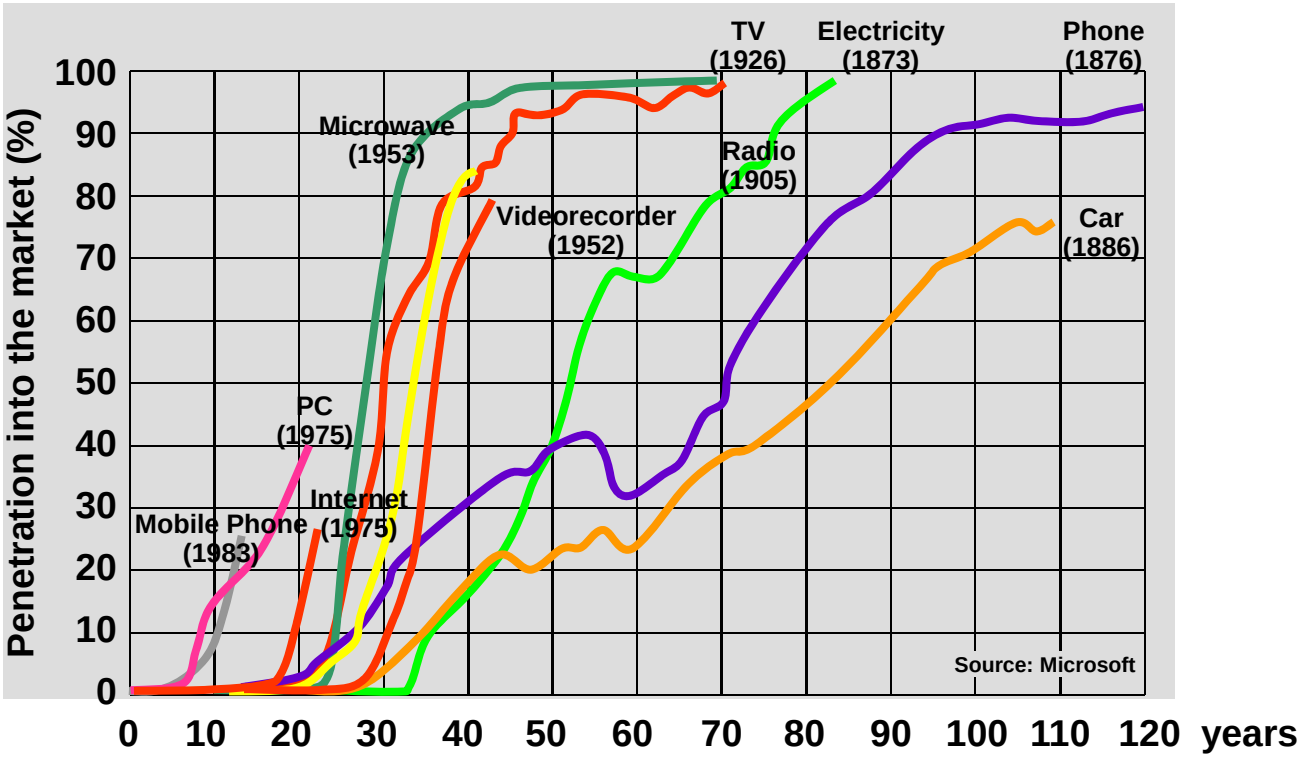
Mid-Term

- More competition in the market
- Cost constraint
- Environmental regulations increasing

Today

- Business case is essential
- Time to market
- Costumer focus
- World market and competition
- Risk share with other companies & strategic alliances etc
- Complex interaction between Hardware, Software, Electric & Electronics

General overview

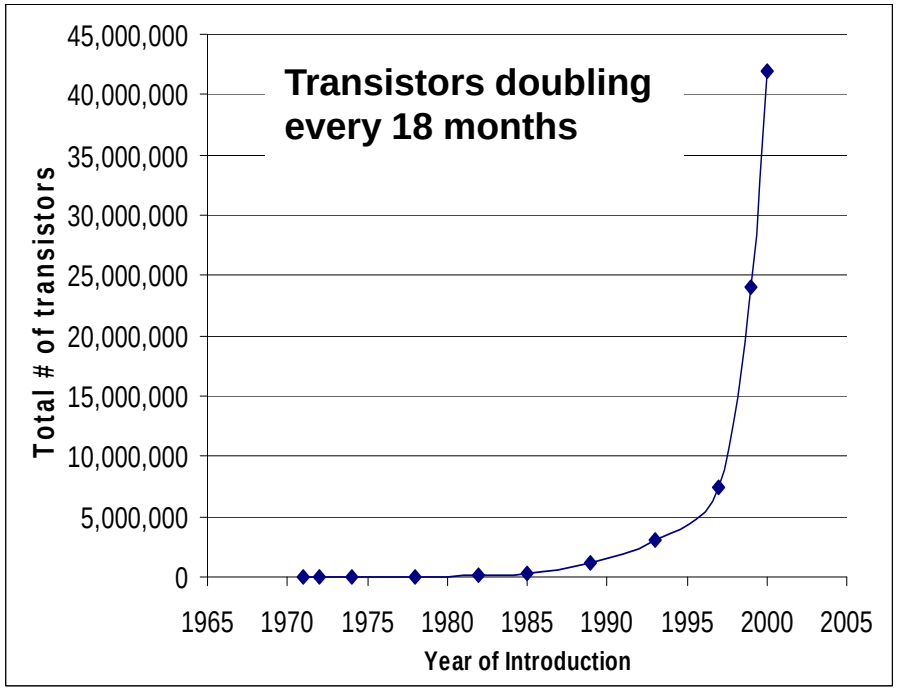


- Product cycles changes
- Innovation process accelerates
- Time to react is decreased

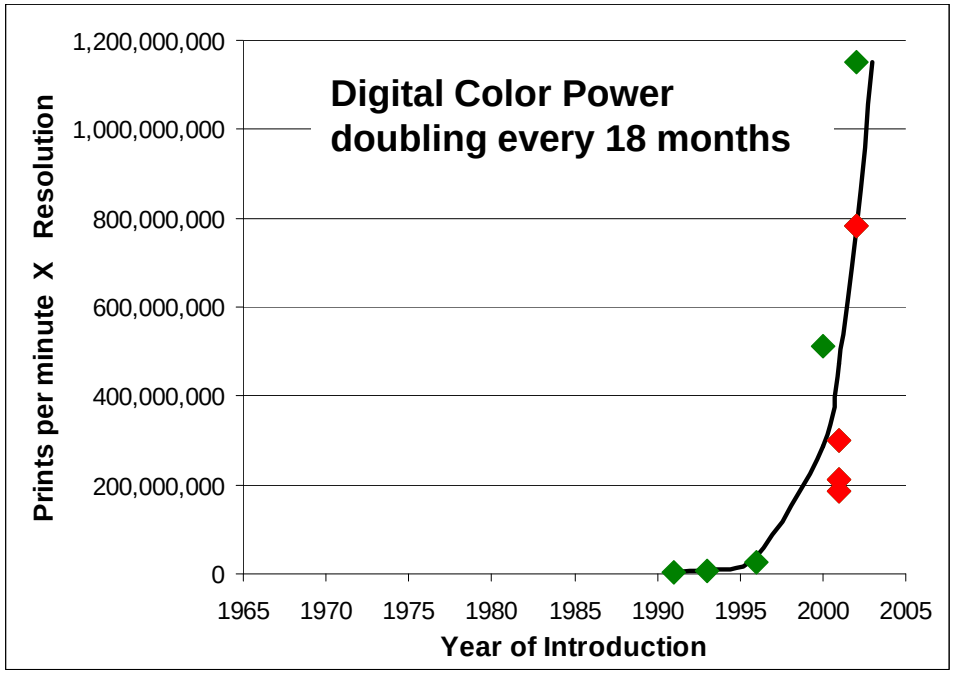
(Prof. H Stoewer, INCOSE IW 2004)

Moore's Law and Digital Color Technology

Moore's Law



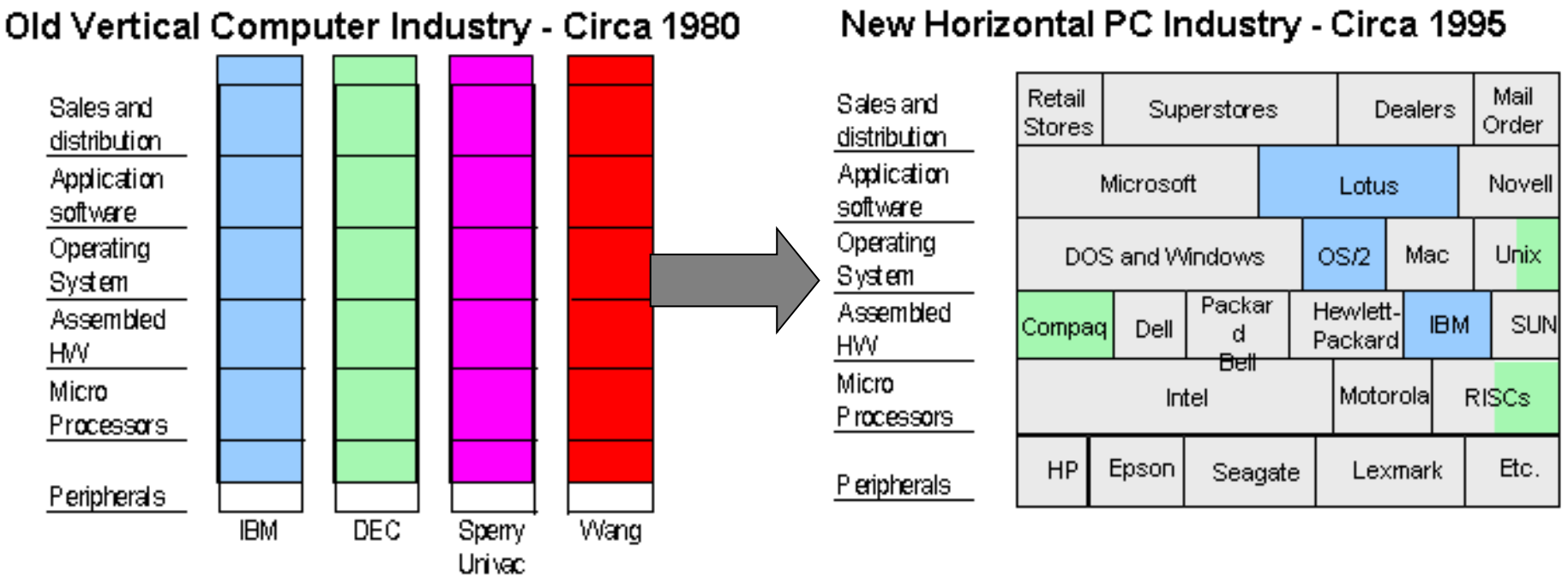
Digital Color Law



Green = Xerox Red = Others

Ref: Tony Federico, Xerox Corporation

Business model changed – THE core competencies



Adapted from: Grove, Andrew S., Only the Paranoid Survive. Bantam Doubleday Dell Publishing Group, Inc., New York, NY. Pg.44)

Ref: Tony Federico, Xerox Corporation

Identify customer needs

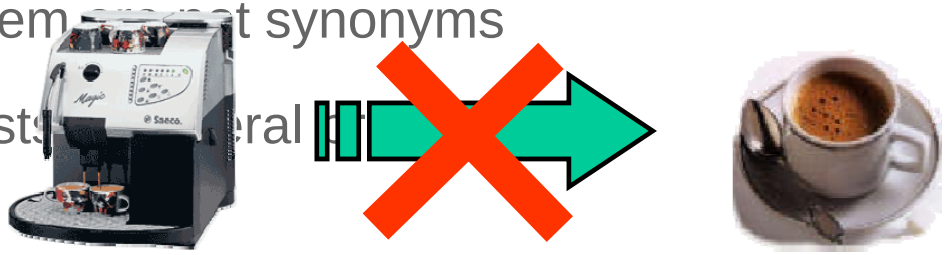
- Customer statement: “I want a coffee machine!”
- What is the key function from customer point of view?

Mercier

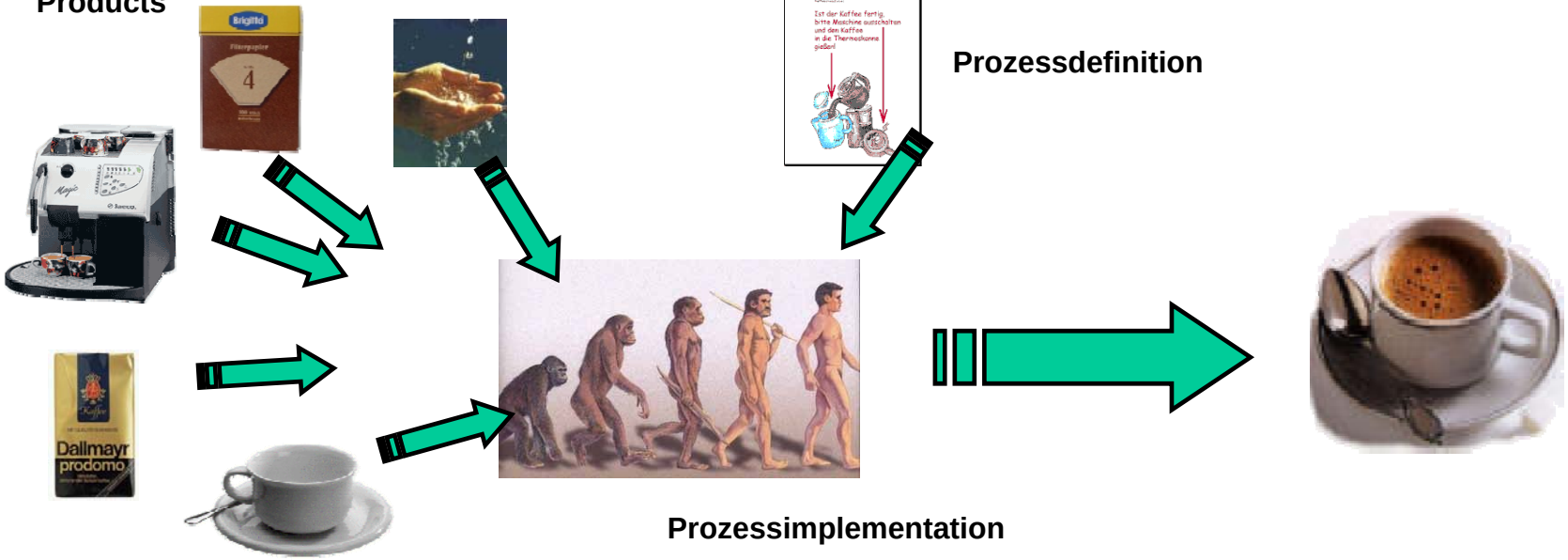
- **Cook repeatable and with same quality, taste and quantity a cup of coffee!**

Relationship Product - System

- Product and System are not synonyms
- But a System exists several times



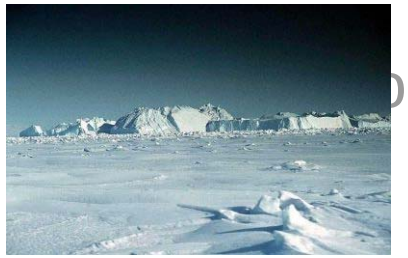
Products



Prozessdefinition

Prozessimplementation

order



The system?

Process definition

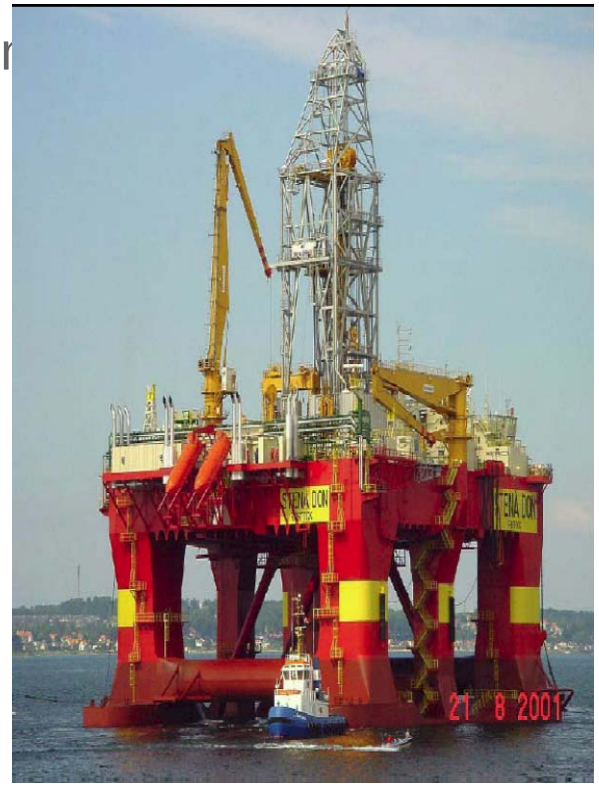
Prozess implementation

What is a system?

- Anybody's System is somebody's sub-syster
  2004)

Actuator

Control Unit



All pictures from FMC Energy Systems

Why SE in Windenergy

- From 500 kW up to 7MW (extrapolation?)
- Onshore versus Offshore
- One Turbine versus Windpark

Space procedure and remaining risk

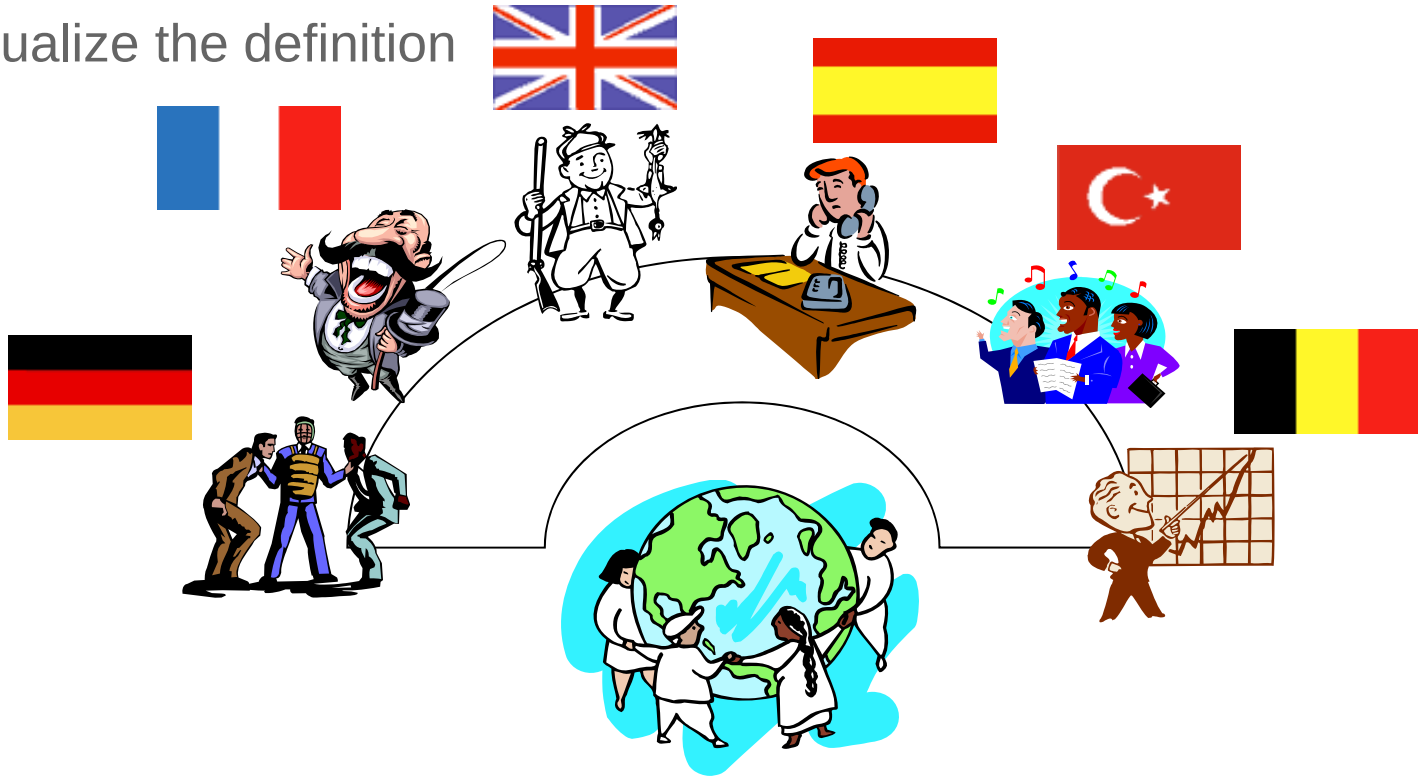
- Inspection procedure for thrusters
- Calibration

http://www.aerodynamite.tv/wp-content/uploads/2010/04/gps_satellite_nasa_art-iif.jpg

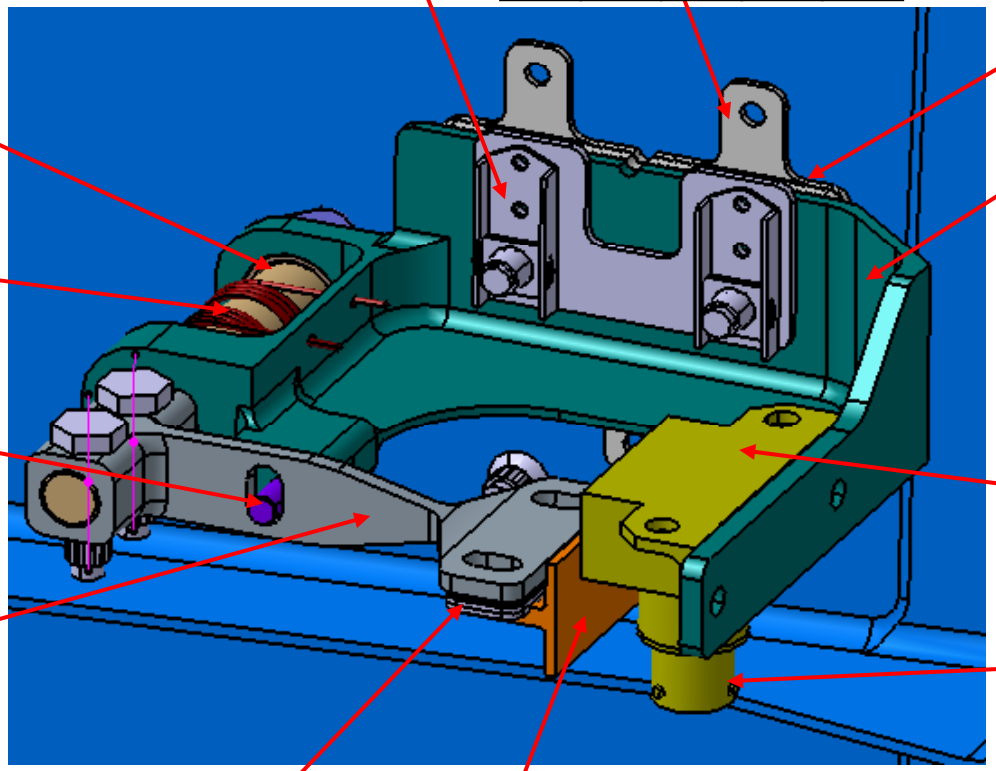
http://cs.astrium.eads.net/sp/spacecraft-propulsion/hydrazine-thrusters/index.html

Cultural aspects

- Fix the language
- Clarify terms used in the team (step by step)
- Visualize the definition



Increased work share break down increases complexity



Washer plate
P D I M A

Serrated plate frame
P D I M A

Serrated plate middle
P D I M A

Drive lever shaft
P D I M A

Base bracket
P D I M A

Lever spring
P D I M A

Stop pin
P D I M A

Sensor
P D I M A

Target lever
P D I M A

Electrical installation
P D I M A

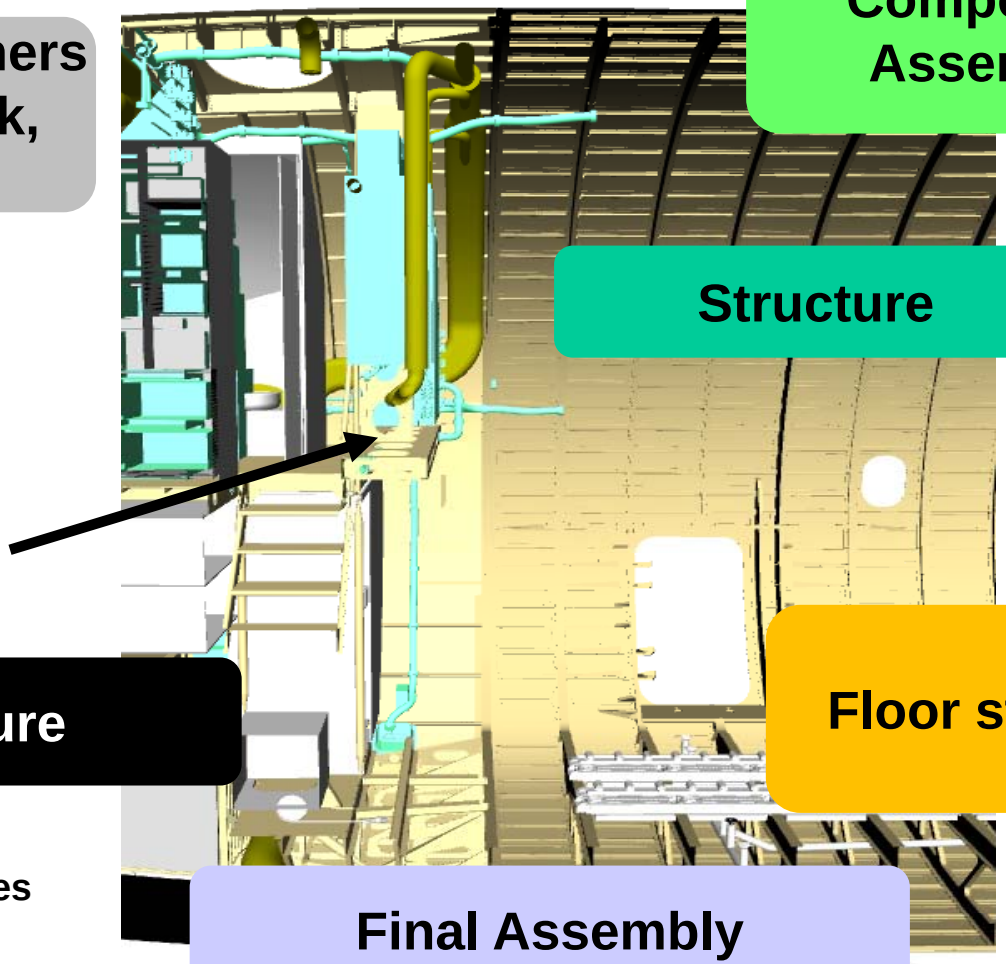
Shim plates
P D I M A

Target
P D I M A

Different colours represent Different companies @ diff. stages

Interface management

Installation / div. Partners Eg Electric, Hydraulik, Communication



Component Assembly

Structure

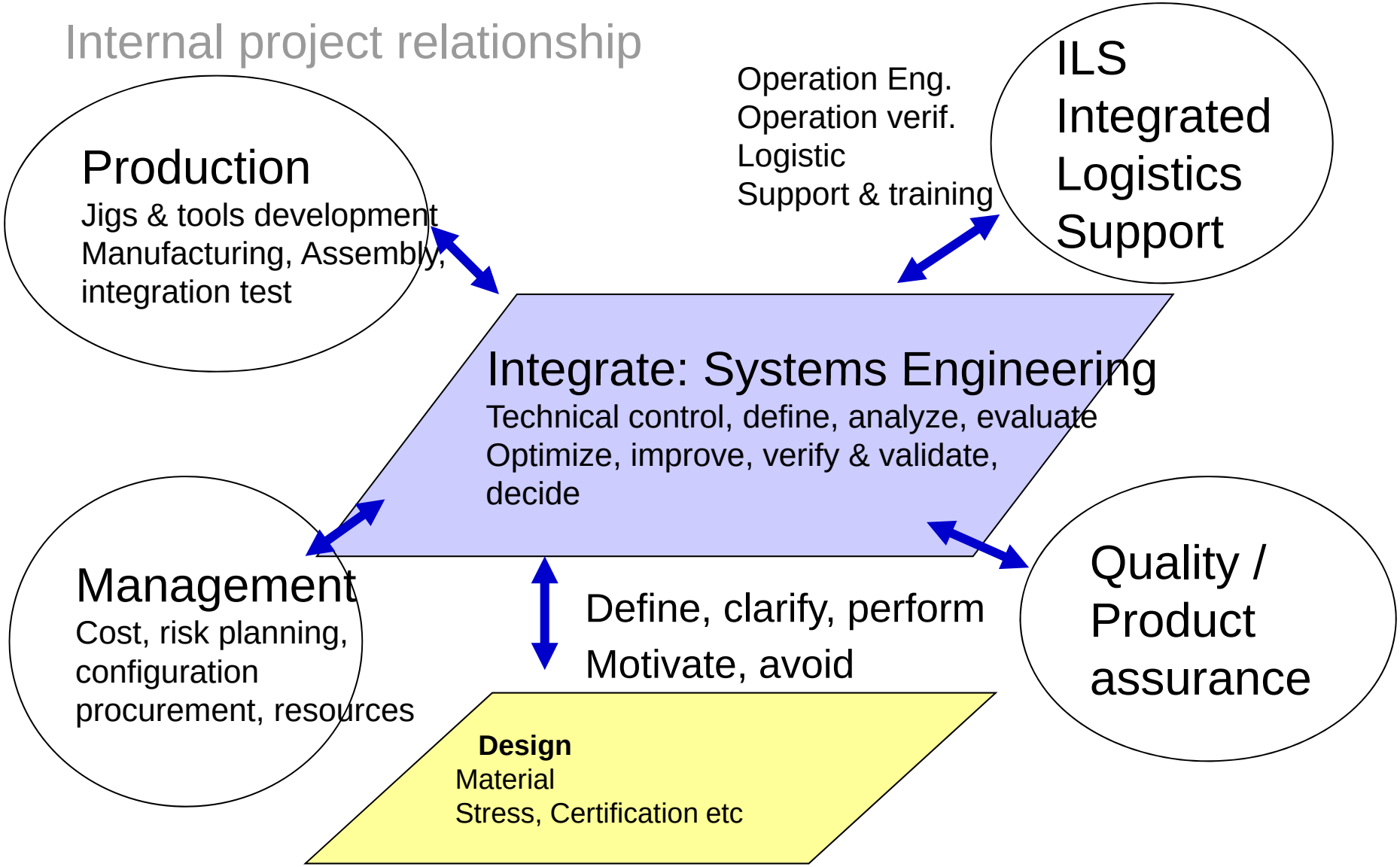
Floor structure

Structure

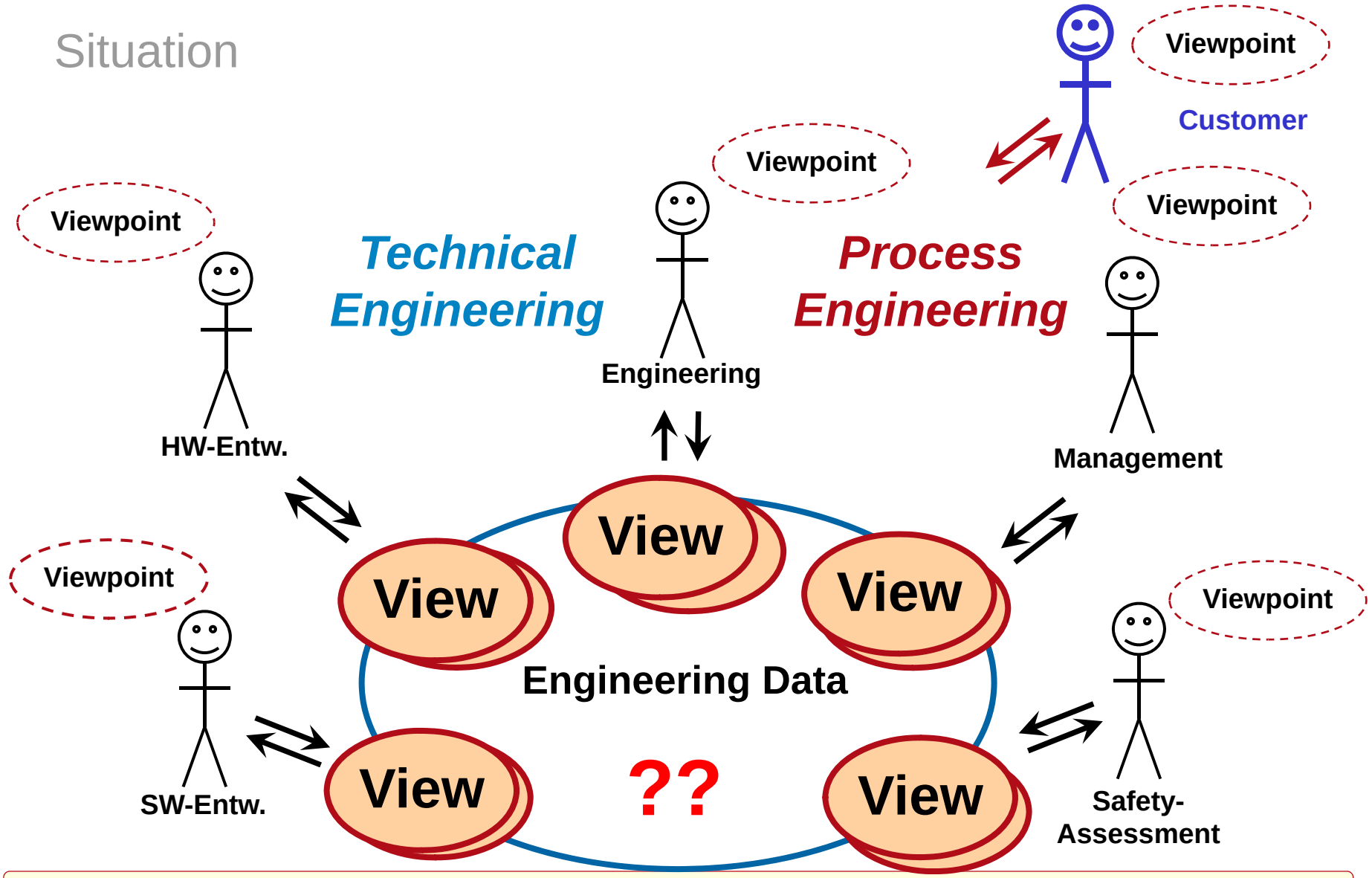
Final Assembly

Different colours represent different department / companies

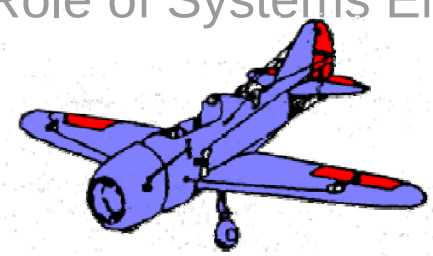
Internal project relationship

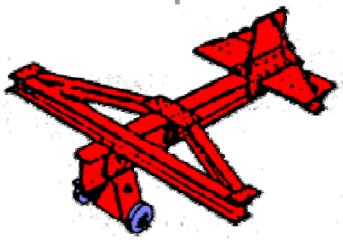
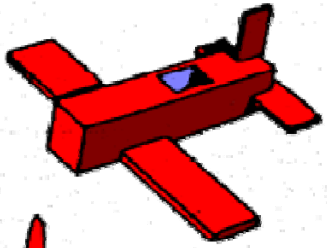
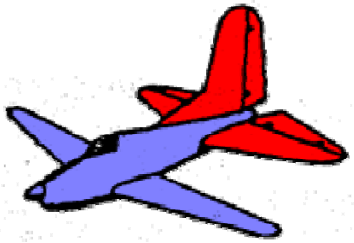
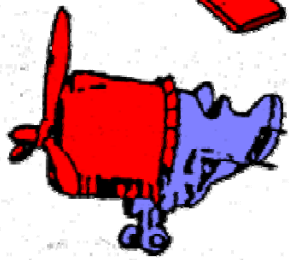


Situation


Viewpoint
Customer
Viewpoint
Viewpoint
Technical Engineering
Process Engineering
Engineering
Viewpoint
HW-Entw.
Management
Viewpoint
View
View
View
Engineering Data
Viewpoint
SW-Entw.
View
??
View
Safety-Assessment

Role of Systems Engineering in Product Development



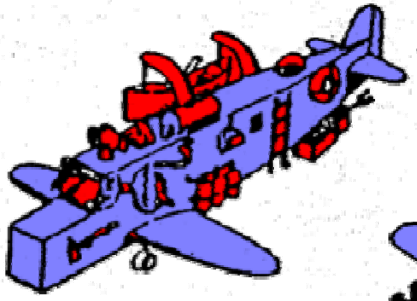
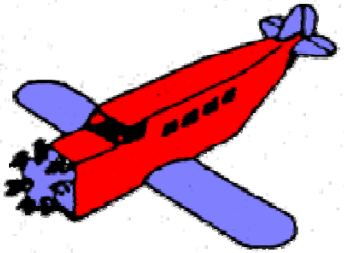
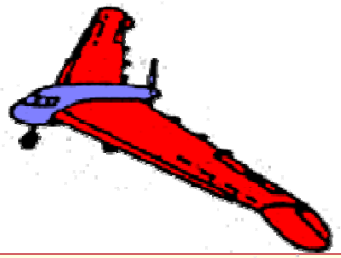
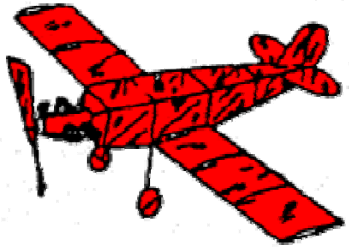
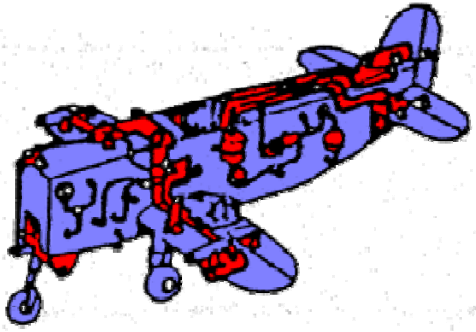





INTEGRATE all views

&

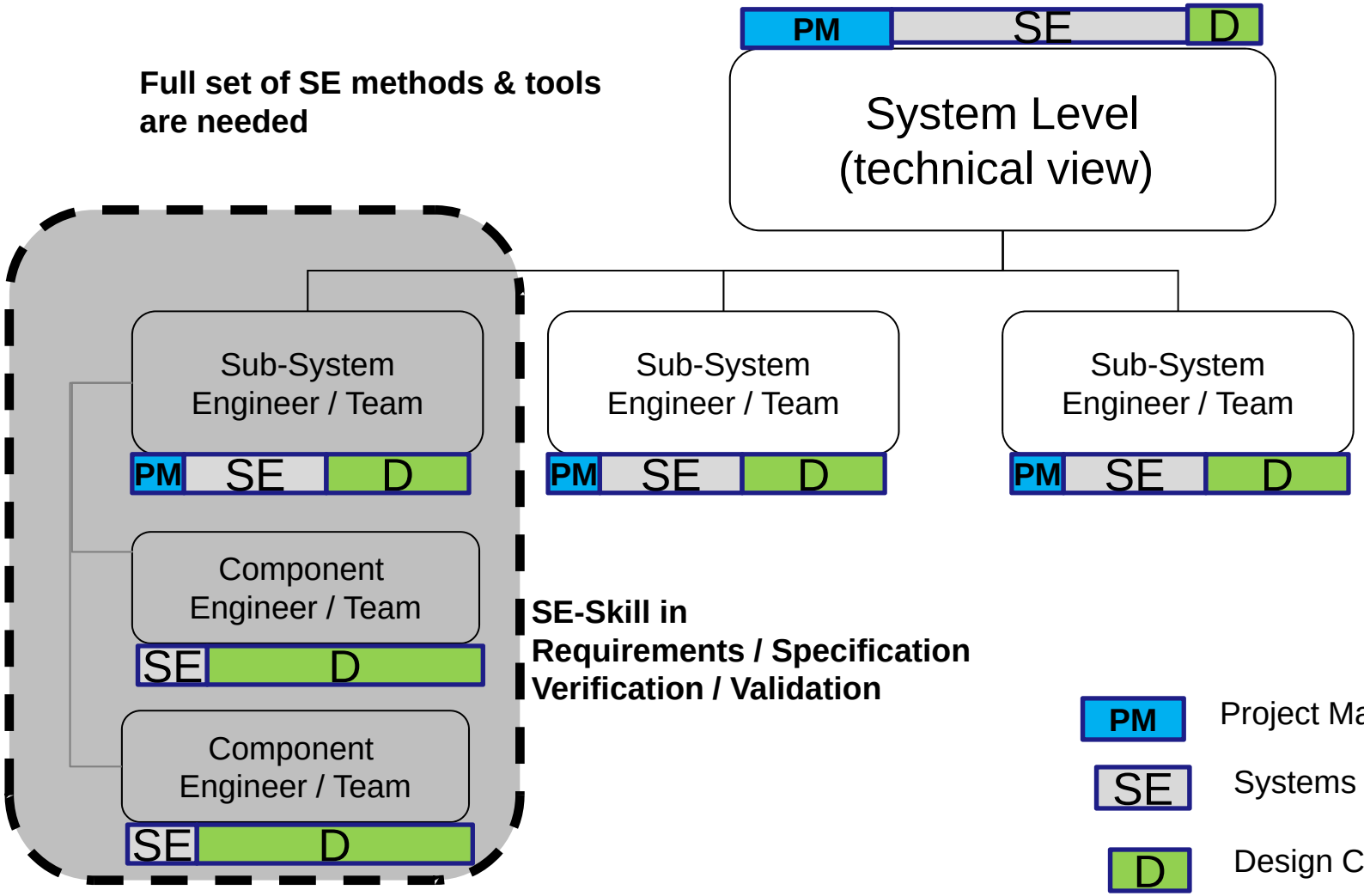
Find the best possible solution

for the costumer

Skill “distribution & need”

Full set of SE methods & tools are needed



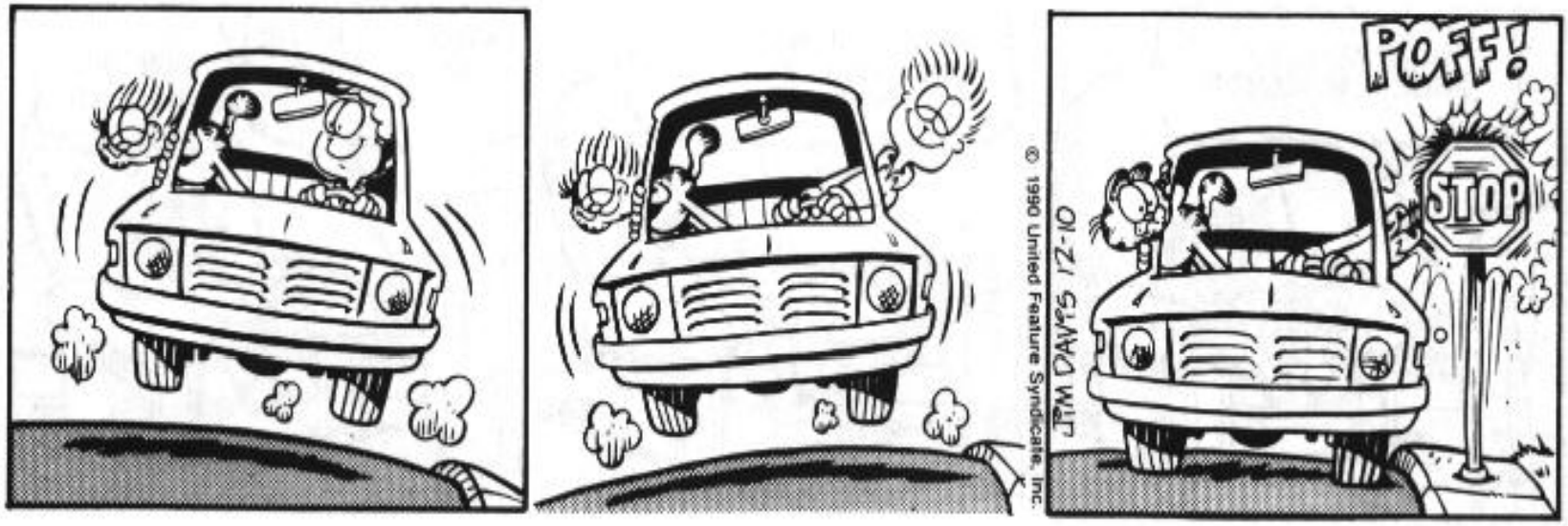
SE-Skill in
Requirements / Specification
Verification / Validation

PM Project Management

SE Systems Engineering

D Design Competence

Summary



What suits one customer might not suit the next

- An exercise
- Tayloring
- Culture

Communication

INCOSE and GfSE acitvities

View from the member board

INCOSE goals

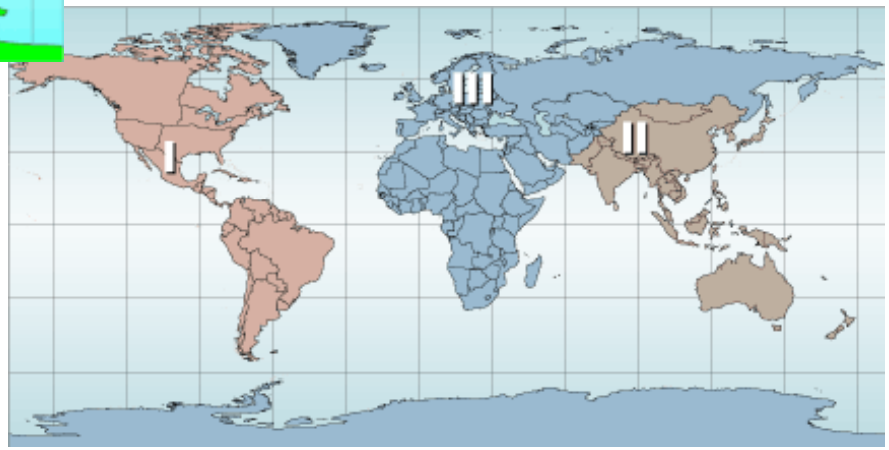
- To provide a focal point for the dissemination of systems engineering knowledge
- To promote international collaboration in systems engineering practice, education, and research
- To assure the establishment of competitive, scalable professional standards in the practice of systems
- To improve the professional status of all persons engaged in the practice of systems engineering
- To encourage governmental and industrial support for research and educational programs that will improve the systems engineering process and its practice

From REGIONS to SECTORS

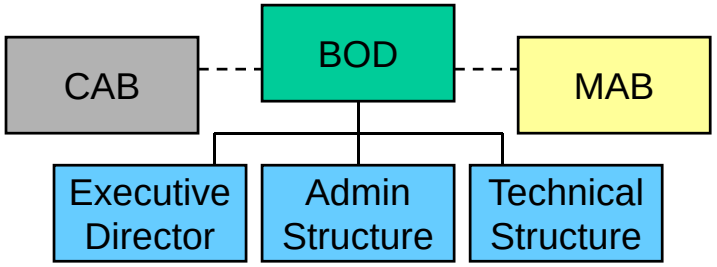
6 Regions

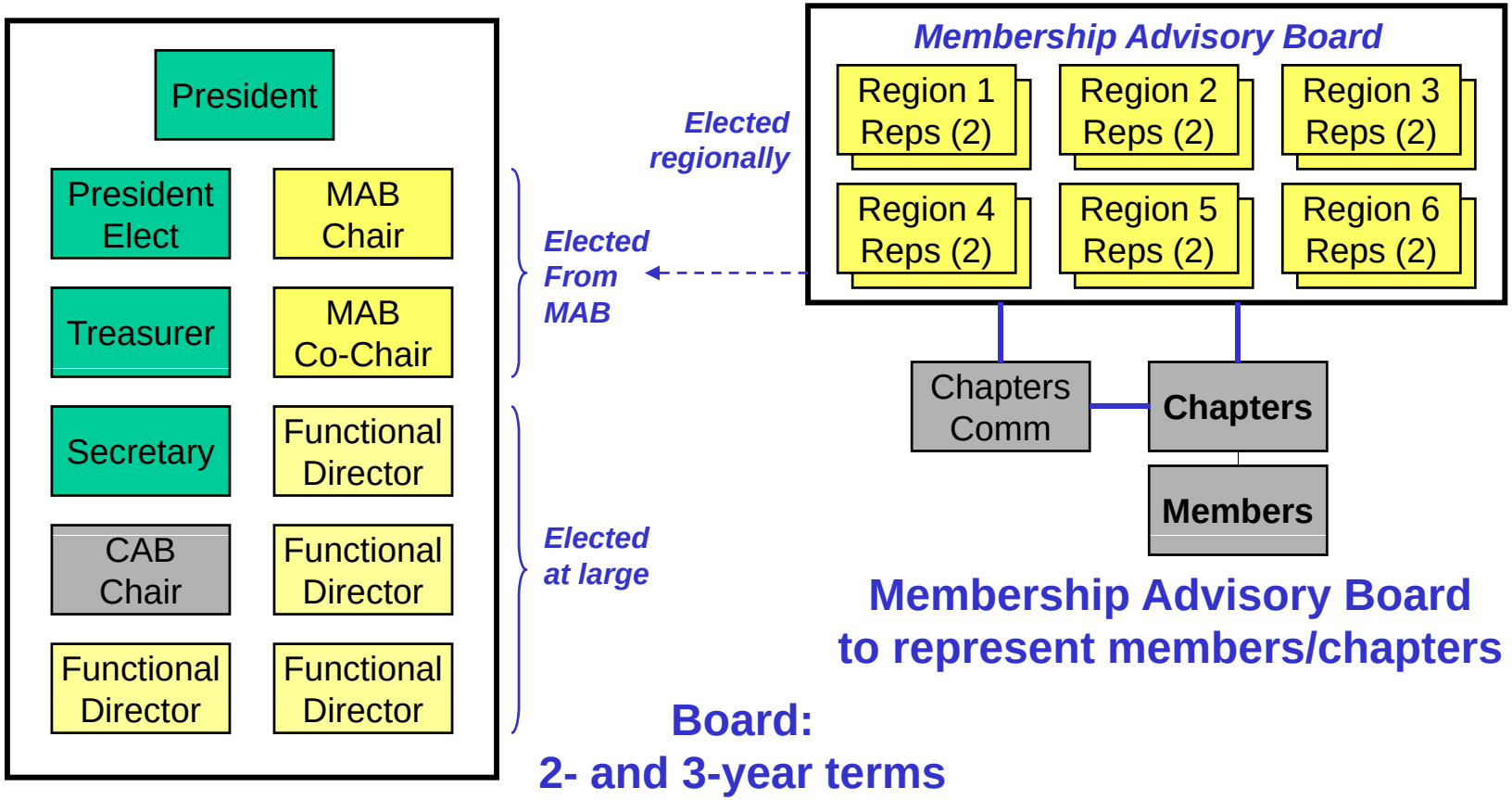
- Web: www.eusec-conf.org
- OR www.incose-region3.org

3 Sectors



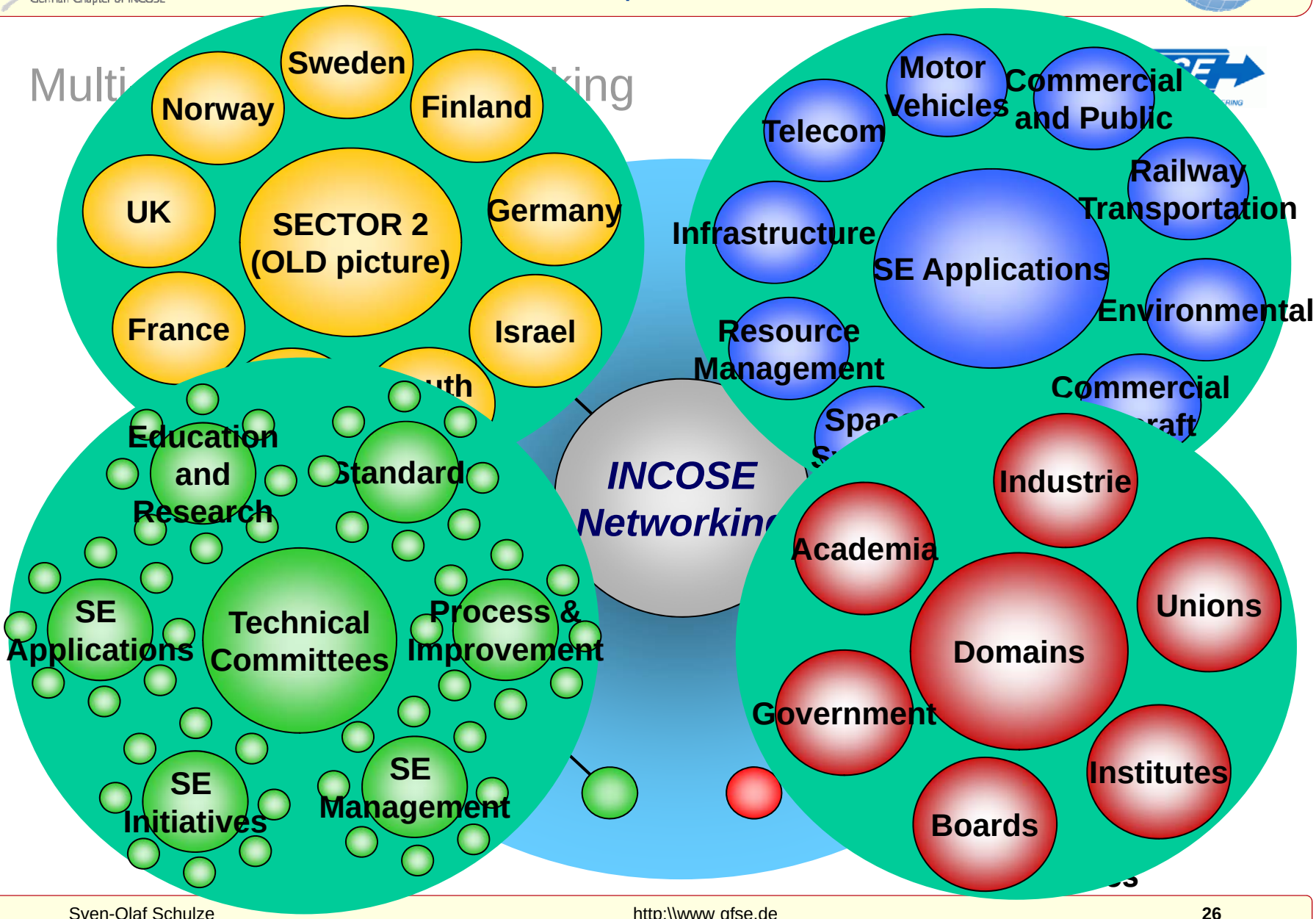
Organisation





Membership Advisory Board to represent members/chapters

Board: 2- and 3-year terms


Multi
king
Sweden
Norway
Finland
UK
SECTOR 2
(OLD picture)
Germany
France
Israel
Motor
Vehicles
Commercial
and Public
Telecom
Railway
Transportation
Infrastructure
SE Applications
Environmental
Resource
Management
Commercial
Education
and
Research
Standard
INCOSE
Networkin
Industrie
Academia
SE
Applications
Technical
Committees
Process &
Improvement
Unions
Domains
Government
Institutes
SE
Initiatives
SE
Management
Boards

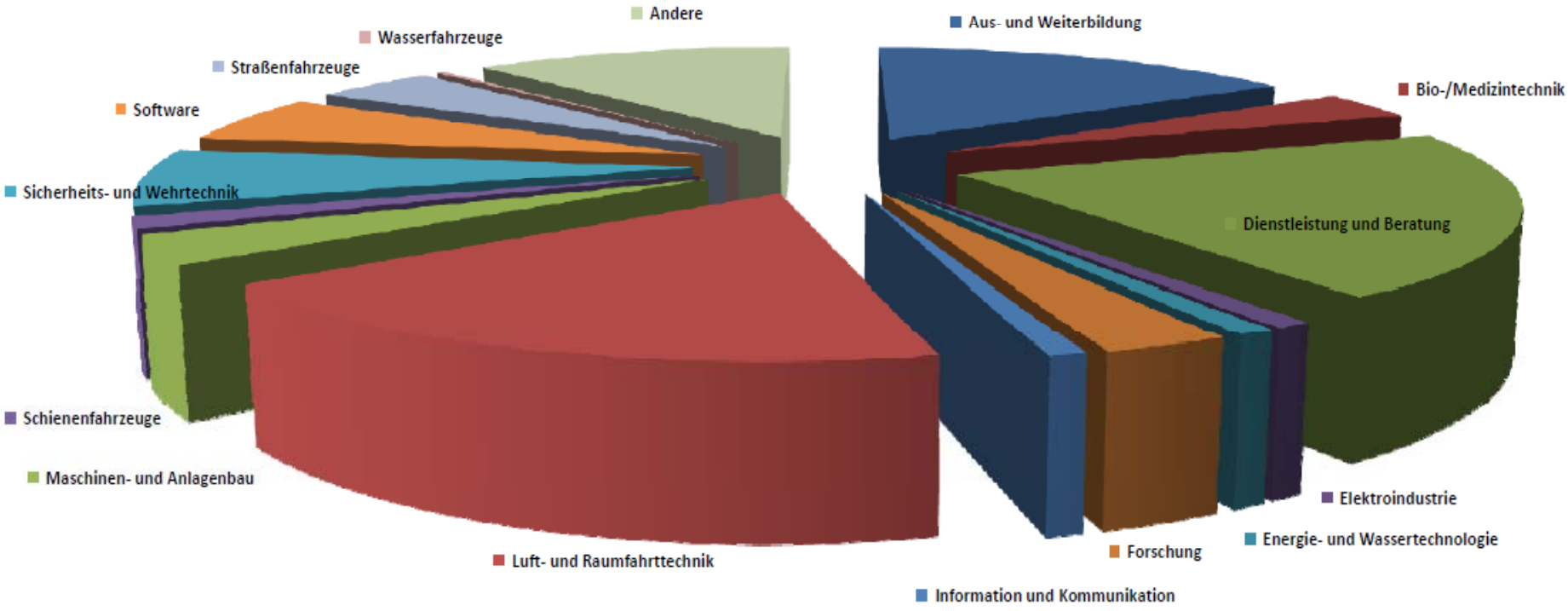
Technical Operations (Working Groups)

- Air Transportation
- Anti-terrorism International
- Architecture
- Autonomous System Test & Evaluation
- Biomedical
- Complex Systems
- Cost Engineering
- Defense Systems
- Global Earth Observation System of Systems
- Human Systems Integration
- Information Systems
- Infrastructure
- Intelligent Transportation & Transit Systems
- Lean Systems Engineering
- SE Management
- Measurement
- Model-Driven System Design
- Motor Sports
- Net-centric Operations
- Power & Energy Systems
- Process Improvement
- Requirements
- Resilient Systems
- Risk Management
- SE in the Commercial World
- Space Systems
- Standards
- Systems Safety Integration
- Systems Security Engineering
- Technology Life Cycle
- Tools Database
- Tools Integration& Operability
- Verification & Validation
- Very Small & Micro Entities
- .....

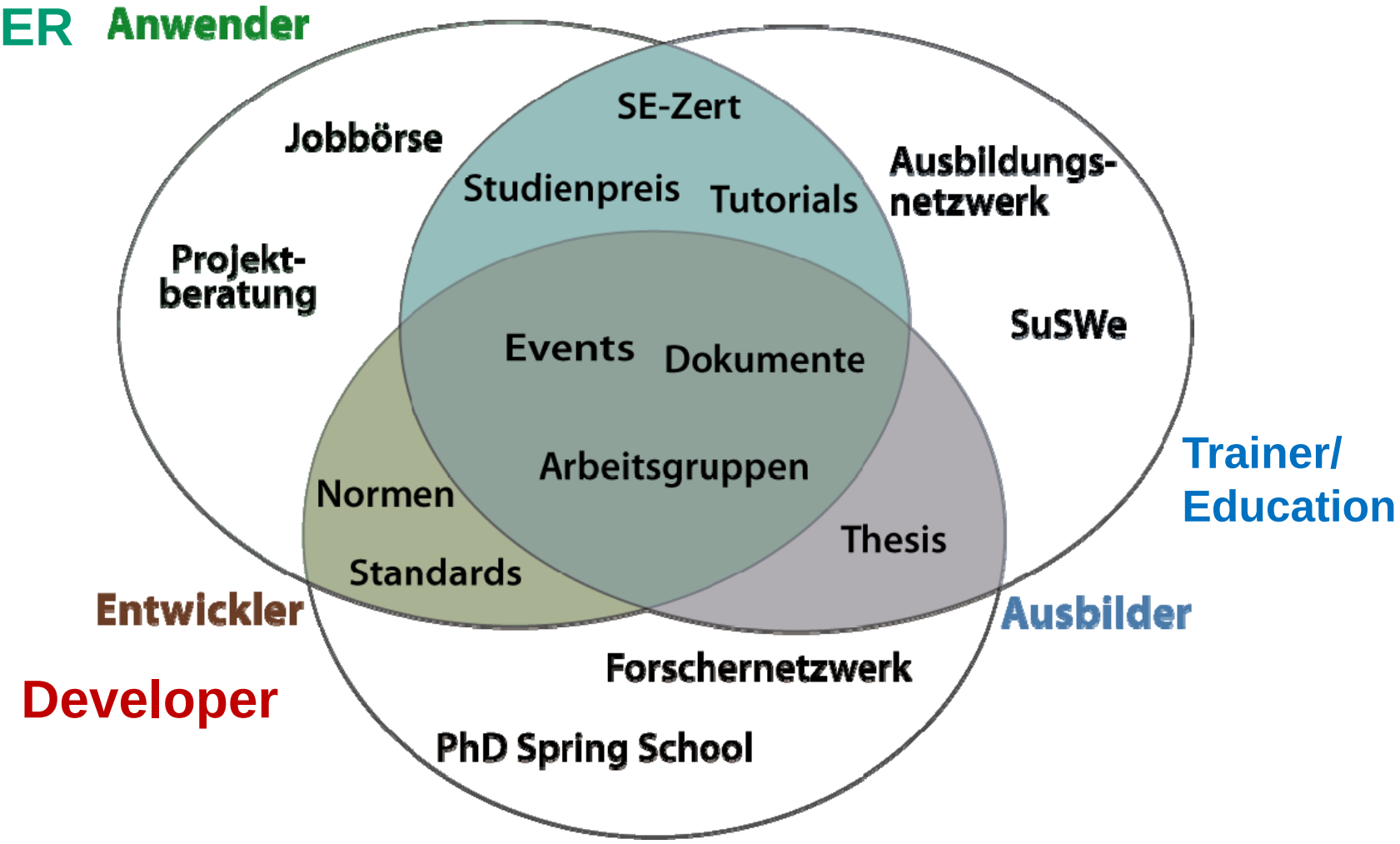
Products

- Products from Working Groups
  - Free to the public on the Web (www.incose.org)
    - Tools Database
    - Technical resource center
  - From the Members Area **on INCOSE Connect**
    - *Measurement Primer*
    - *Systems Engineering Handbook*
    - *Systems Engineering Technical Vision 2020*
    - *Webinar archives*
    - Obtain logon and password from the INCOSE Office
- Products and publications available for purchase through INCOSE Office

Industries (September 2011)



GfSE-Portfolio



KEYEVENTS

- INCOSE
  - International Symposium in ROM
    - 9. until 12 July 2012
    - www.incose.org/symp2012
  - International Workshop
    - USA end of January – beginning of February
    - Workshing Group meetings and admin meetings
- German Annual Conference (German)
  - TdSE in Paderborn
    - Heinz-Nixdorf MuseumsForum
    - 7 until 9 November 2012
    - www.tdse.org
  - National GfSE Workshop
  - Mid of February
  - Working group meetings and SE projects

Sector 2 info

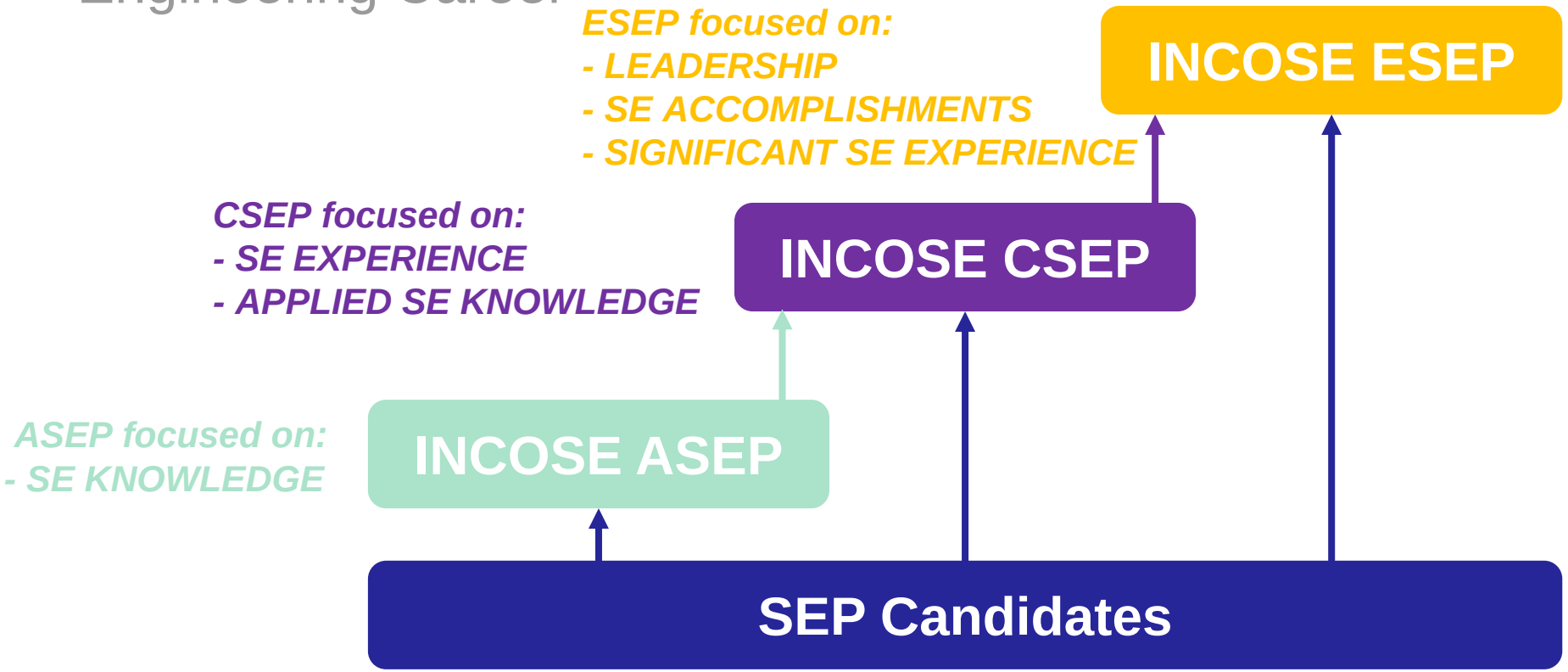
- Event: EuSEC conference as bi-annual Event
  - NEXT in SOUTH AFRICA (2014)
- Web: www.eusec-conf.org OR www.incose-region3.org

INCOSE Certification

ESEP	Expert Systems Engineering Professional
CSEP-Acq	CSEP w/ US DoD Acquisition
CSEP	Certified Systems Engineering Professional
ASEP	Associate Systems Engineering Professional

- Target group: International (accepted by DoD)
- Language: Englisch
- Test: Mutliple Choice based on INCOSE Handbook

The SEP Aligns with the Typical Levels of a Systems Engineering Career



You can enter at whatever SEP level is appropriate and can seamlessly transition between levels when ready.

Requirements

LEVEL	Experience	Education	References	Exam
	None Required	None Required	None Required	Same Exam as CSEP
	Minimum 5 years SE experience	Technical Degree (can be augmented with additional years of experience without a technical degree)	3 references (cumulative coverage of the years of experience)	CSEP exam based on INCOSE SE Handbook
	Minimum 25 years (20 if CSEP) SE experience Minimum 5 years of professional development credit	Technical Degree (can be augmented with additional years of experience without a technical degree)	3 references (cumulative coverage of at least the most recent 10 years of experience)	No examination, panel review
	Same as base certification	Same as base certification	Same as base certification	Acq exam based on US DoD Acquisition Guidebook Chapter 4

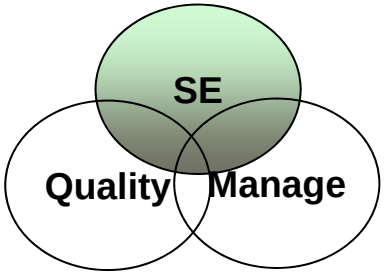
INCOSE offers organizations the opportunity to partner on SEP while still maintaining the quality and integrity of the credentials.

- Industry agreements
  - EADS
  - Booz Allen Hamilton
  - ManTech
  - MITRE
  - Lockheed Martin
  - TASC
  - BAE Systems
  - Jacobs Technology
- University agreements
  - Stevens Institute of Technology, USA
  - University of Texas – El Paso, USA
  - École Polytechnique, France

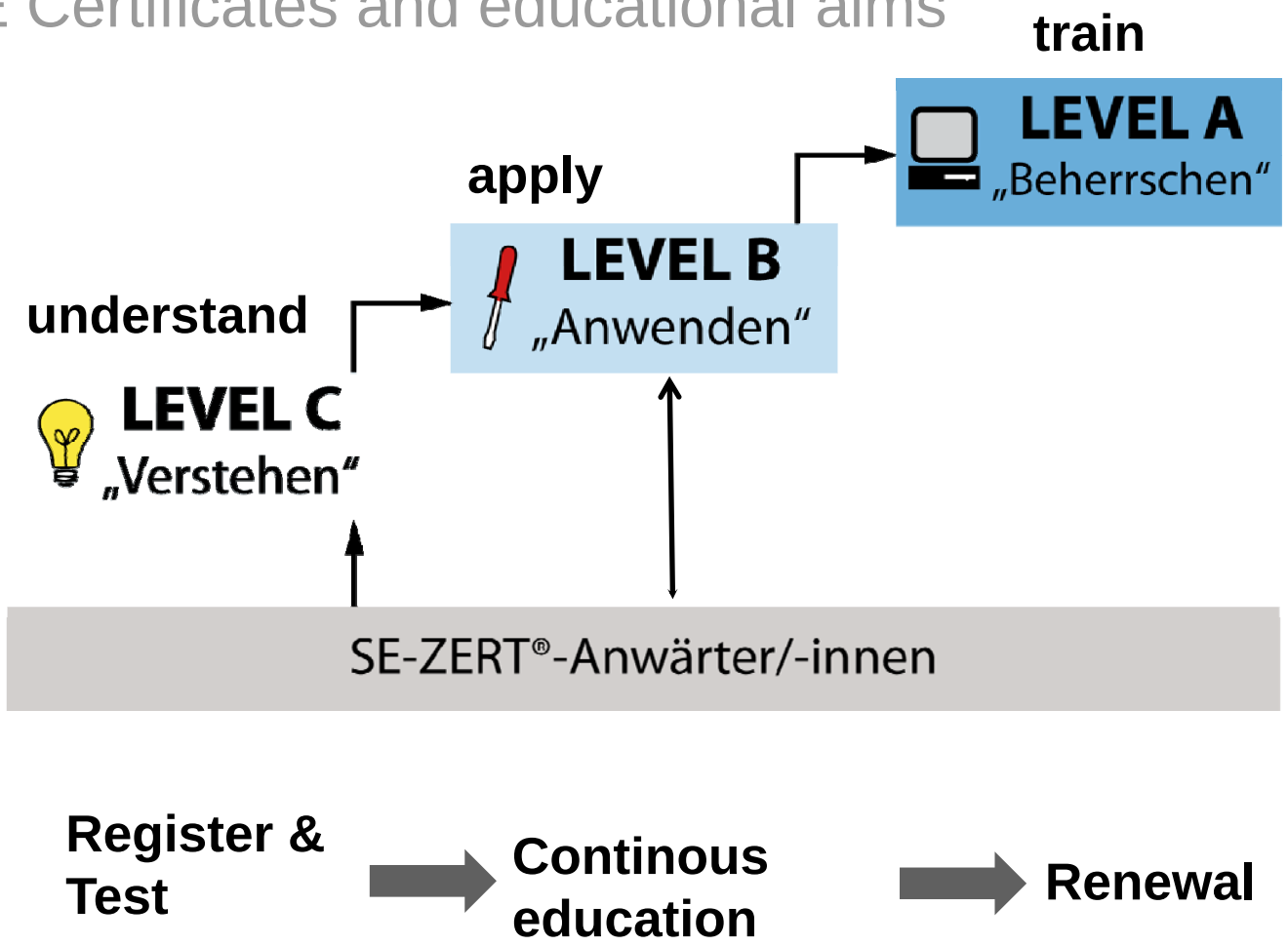
- Other “special” agreements
  - USA Defense Acquisition University (DAU) SYS 101 and SYS 202 equivalency
  - Object Management Group (OMG) OCSMP collaboration
  - Institution of Engineers, Singapore (IES) certification framework
  - **INCOSE German Chapter (GfSE) certification framework**
  - Korean Council on Systems Engineering (KCOSE) certification framework

Motivation / Idea

- Establish a standard for post graduate („berufliche Weiterbildung“)
- Education parallel to the job with practical exercises
  - Target group: Companies without internal financed educational program (Small and medium enterprises and others)
- Basis
  - German (EU) Interpretation of the INCOSE Systems Engineering Handbooks
  - ISO15288
  - Overview about SE industrial standards
- Harmonization with the INCOSE Certification



GfSE Certificates and educational aims



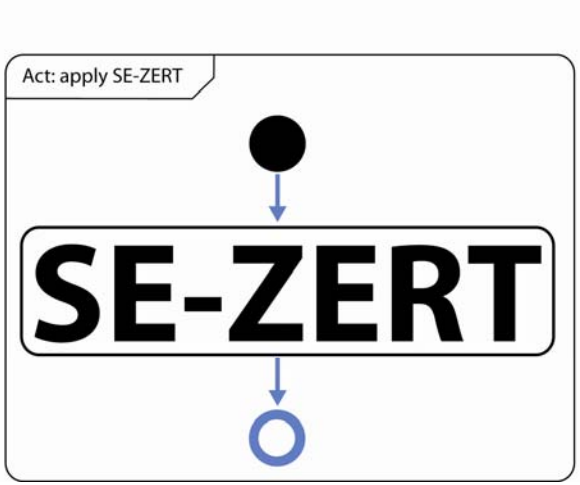
SE-ZERT ® Pre-Requisites

LEVEL	Experience & Education*	References	Test
C	1 Jahr Dipl-Ing / Master 2 Jahre Bachelor 5 Jahre techn. Ausbildung	Competence Areas (KB)	120 Minuten Multiple Choice & Open questions
B	5 Jahr Dipl-Ing / Master 6 Jahre Bachelor 9 Jahre techn. Ausbildung	KB im SE TEAM	120 Minuten Multiple Choice & Open questions
A	10 Jahr Dipl-Ing / Master 11 Jahre Bachelor 14 Jahre techn. Ausbildung	KB im SE TEAM	Assessment

*** Studiengänge mit techn. Schwerpunkt; Technische Ausbildung mit Abschluss Meister oder Techniker**

Content and compentence areas (* Difference to INCOSE)

- Systems Engineering Einführung
- Übergreifende Schnittstellen
  - Life-Cycle Management
- Projektmanagement Schnittstellen
- Systems Engineering Management
- Anforderungsmanagement und V&V
- Realisationsprozesse
- **Querschnittsfunktionen***
- Operationelle Aspekte und Entsorgung im Design
- **Konfliktmanagement und soziale Kompetenz***

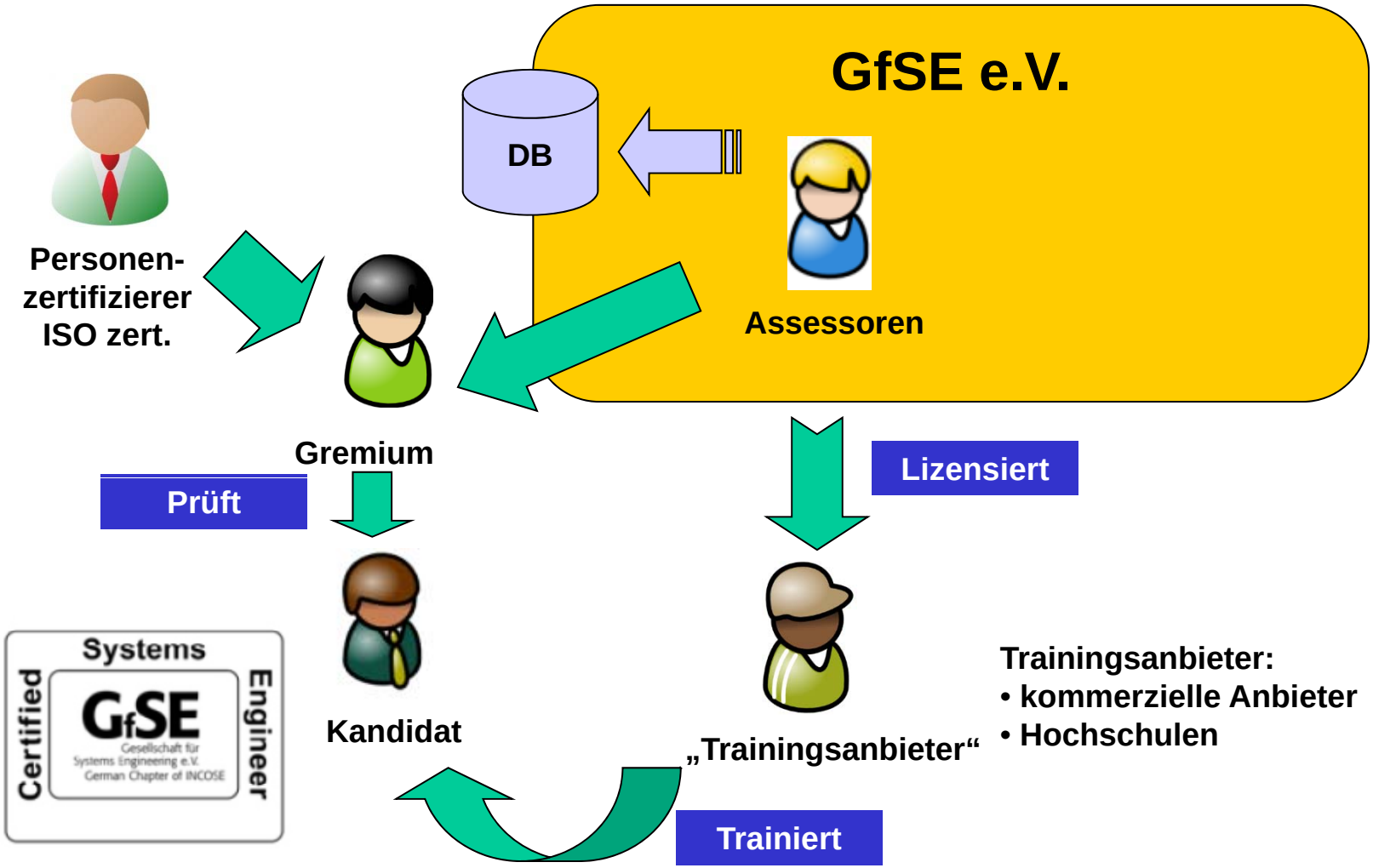


Renewal & Validity

Level	Constraints
C	120 Fortbildungspunkte (PDU) 5 Years
B	120 Fortbildungspunkte (PDU) 3 Years
A	120 Fortbildungspunkte (PDU) 3 Years

- Fortbildungspunkte aus den Bereichen
  - Teilnahme an Veranstaltungen der GfSE
  - Kurse und Veröffentlichungen
  - SE im Beruf

Beteiligte Rollen und Prozeß



Trainingsanbieter:
- **kommerzielle Anbieter**
- **Hochschulen**


THANKS