UNITY
CONSULTING & INNOVATION

Commercial Systems Engineering and ROI

Nordic SE Tour 2013
Hamburg, Copenhagen, Stockholm

Presenter: Sven-Olaf Schulze (Senior Expert)

Our Consulting Services

We elevate innovative strength and operative excellence

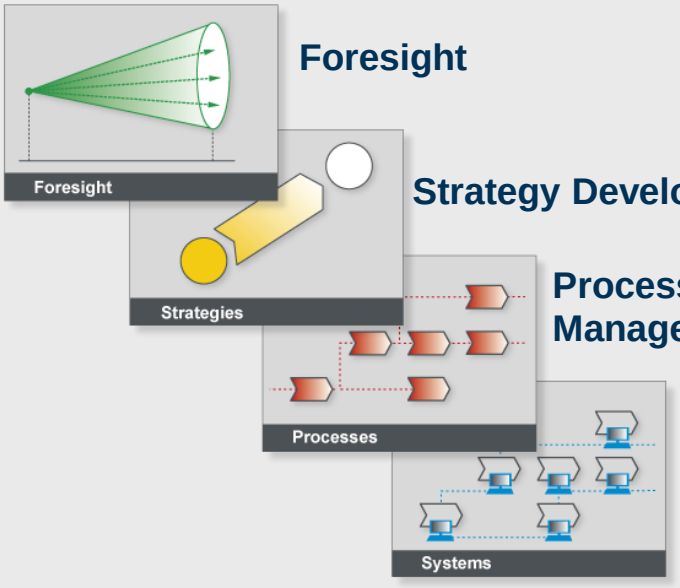
UNITY
CONSULTING & INNOVATION

Productivity & Revenue

Growth & Investment Security

Competitive Advantage

Modern Management Knowledge



Foresight

Strategy Development

Process Management

IT-Management

Our approach is based on the Four-level-model of future-oriented company structuring.

Best-Practice-Knowledge across the product lifecycle

We possess best practice knowledge across the entire product lifecycles of tomorrow's markets.

Competence through a Comprehensive Insight into the Industry

UNITY
CONSULTING & INNOVATION

Automotive

Aerospace Industry

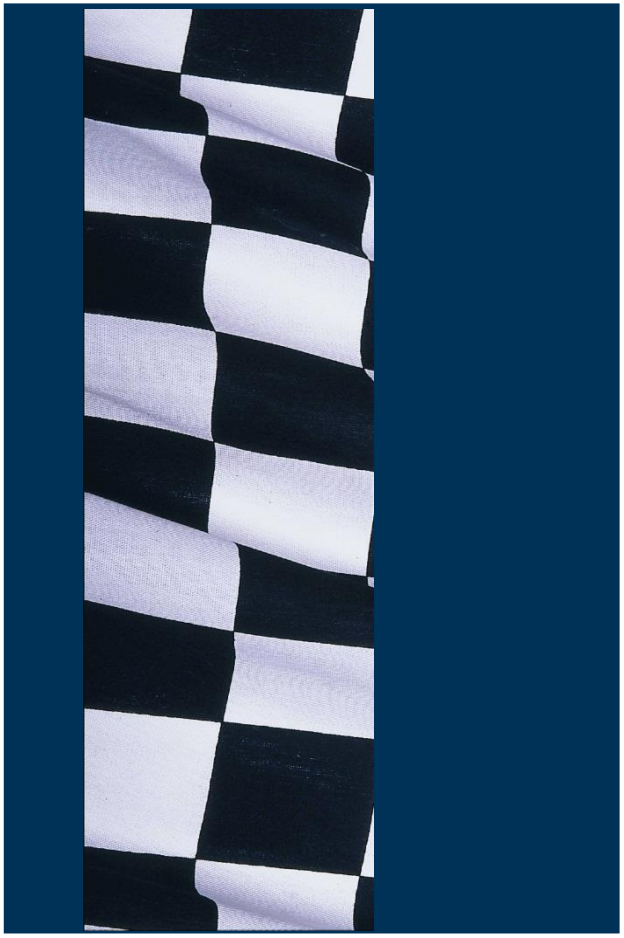
Manufacturing Industry

Healthcare Management and Medical Engineering

Energy

Pharmaceuticals and Chemistry

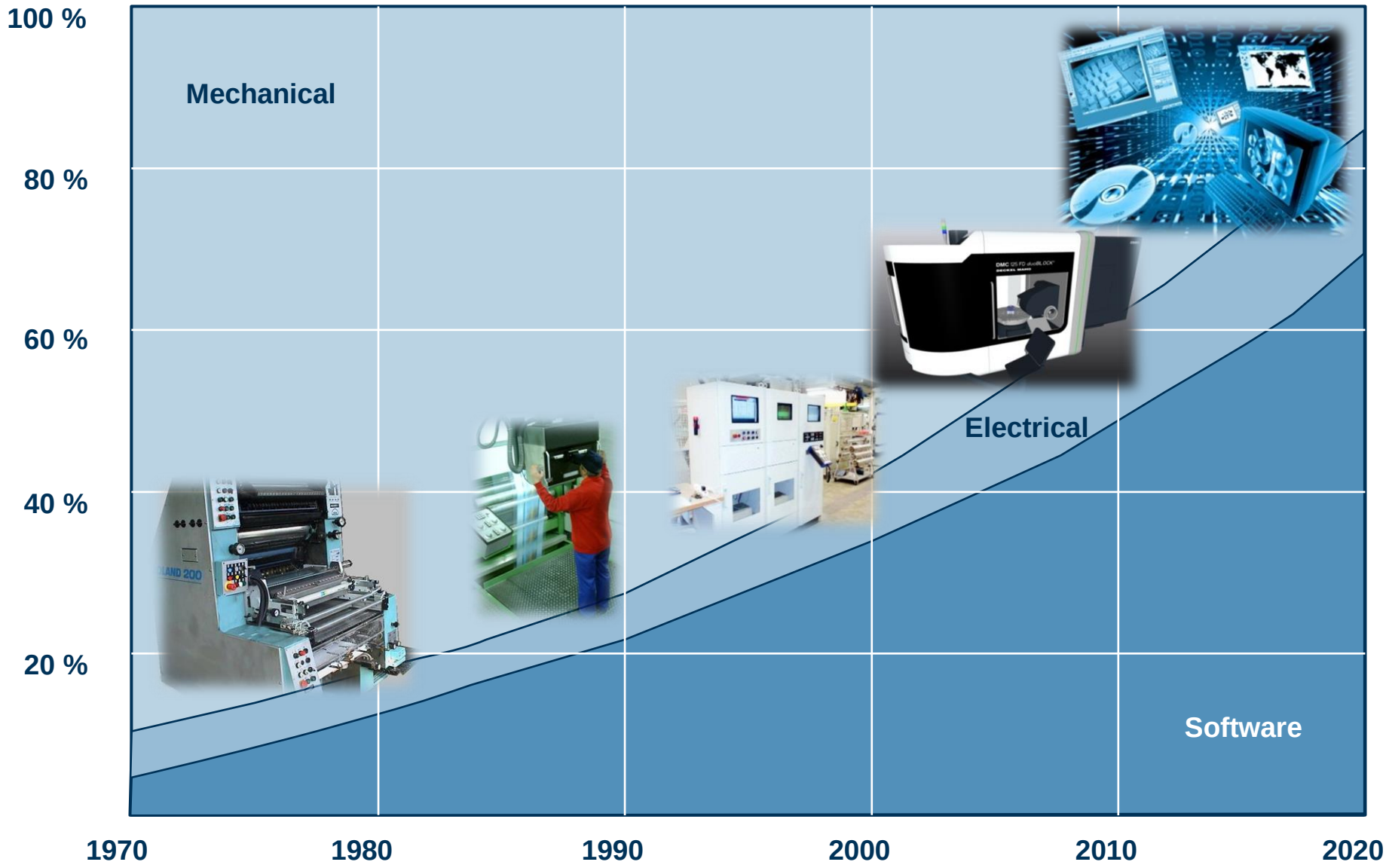
Overall aim of Systems Engineering application



- Control complexity
- Balancing missing experience
- Avoid expensive prototypes
- Achive development and research targets
- Minimize risks of damage
- Fulfil customer requirements

Systems Engineering aims to comply with the technical and economic interests of a project.

Effort shift within the development of technical products



Reference to Glas, Kohen, McKinsey

Systems Engineering Challenges

- **Achieving balance between inherent conflicts**
  - System Functionality and Performance
  - Cost and financial Profit (ROI)
  - Development Schedule (Time to Market)
  - Development Risk (Probability of Success)
  - Value versus Cost (Mission Effectiveness)
- **System Optimization**
  - Elements not optimal to achieve best balance at system level
  - Ultimate system purpose must prevail against conflicting considerations
  - Long-term considerations may drive technical decisions
- **Customer Interface**
  - SE must think ahead to the next customer and next application
  - SE must “challenge” all requirements

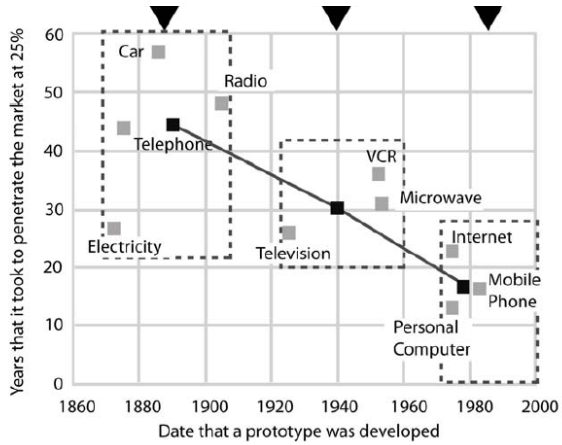
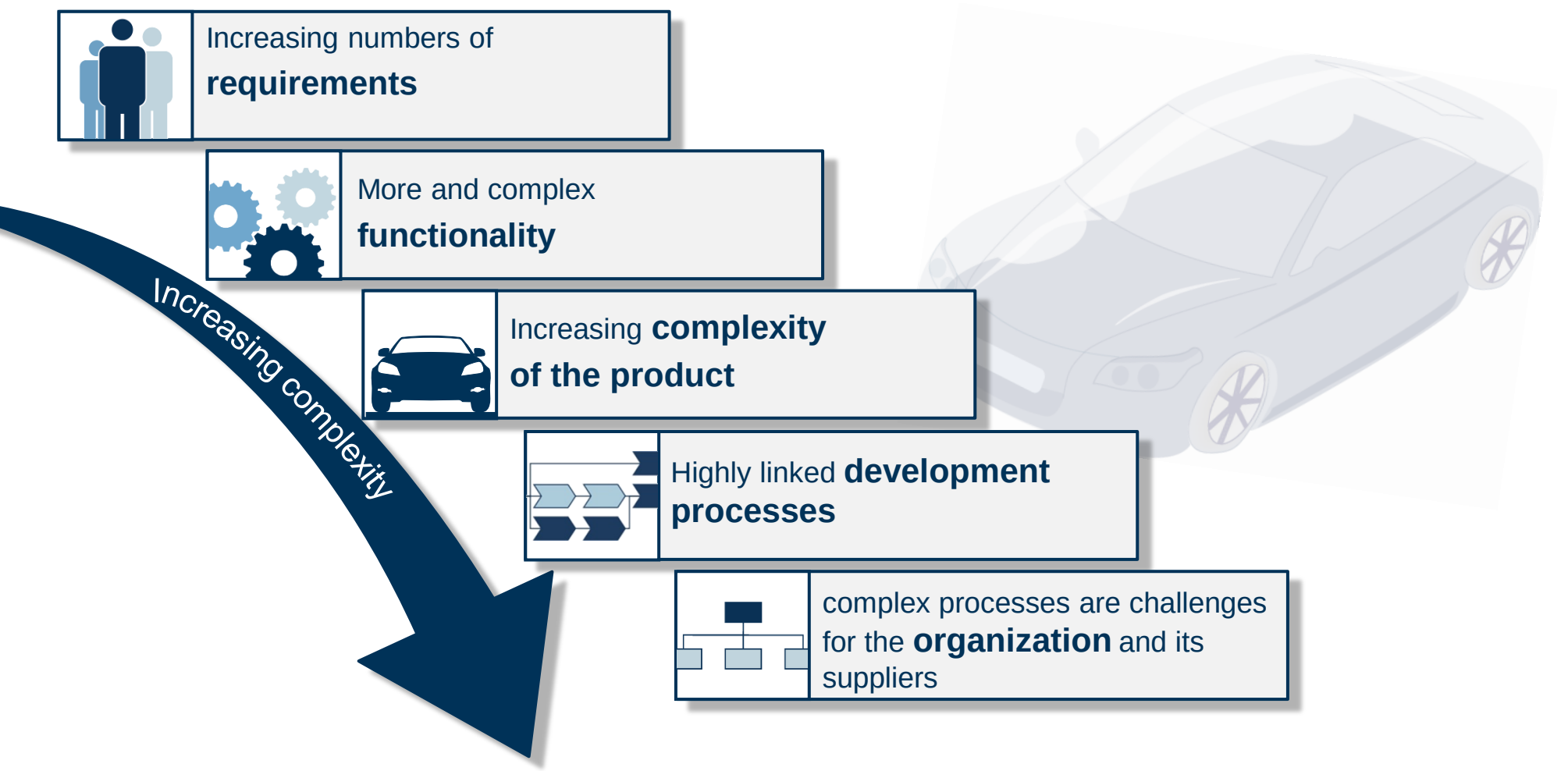


Figure 2-6 Technology acceleration over the past 140 years

Ref: INCOSE, SE Handbook

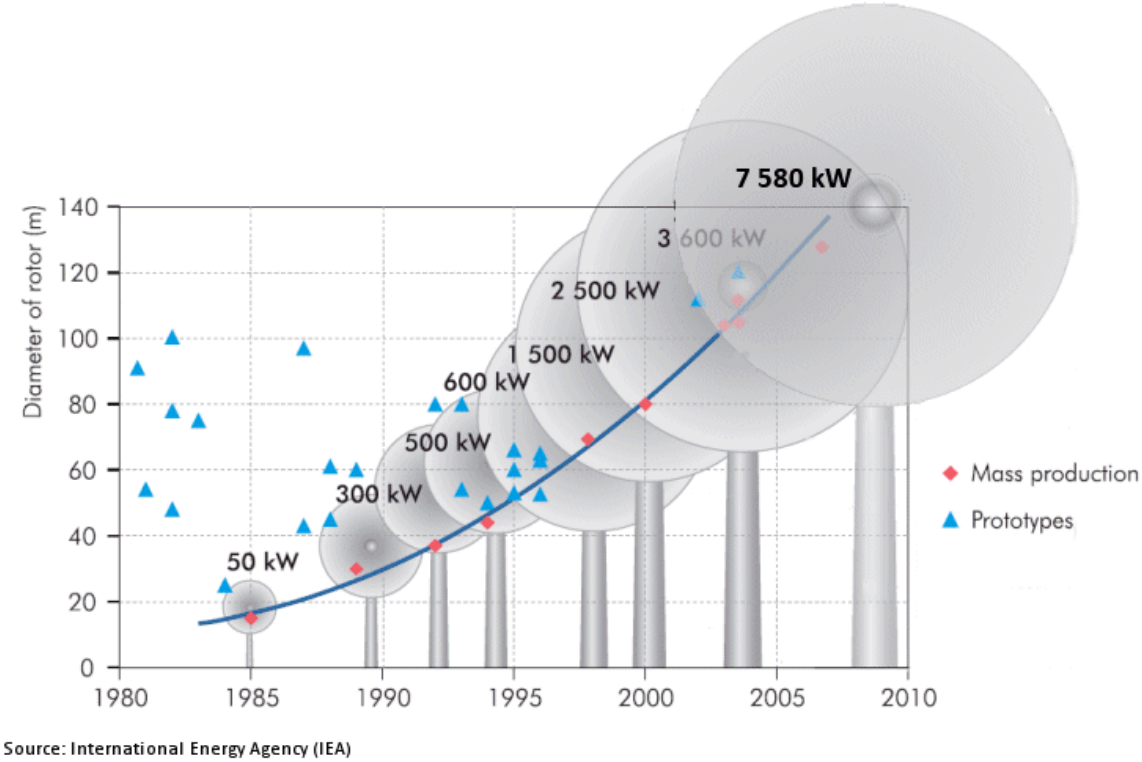
Complexity drivers of Product Development

UNITY
CONSULTING & INNOVATION



Increasing requirements define complex products by highly linked functions. This requires new and cross-domain concepts of collaboration – based on highly linked development processes and organizations.

Wind energy product development



Source: International Energy Agency (IEA)

- **From 50 kW up to 7MW**
- **Onshore & Offshore**
- **From turbine to windpark projects**

- **Tremendous advances in**
  - Performance
  - Cost efficiency
  - Reliability

Some comparison

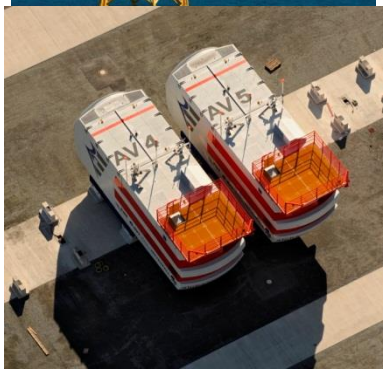
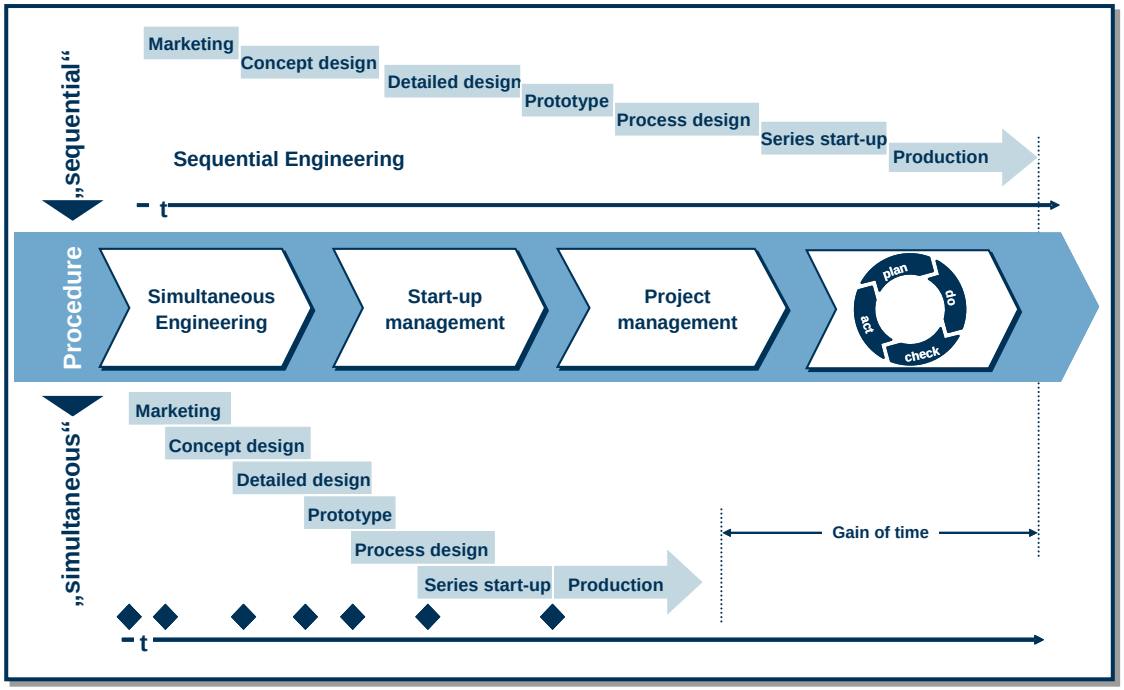


Figure: REpower Systems SE/Jan Oelker

Parameter	6MW	A380
Wing span / rotor diameter [m]	126	80
Weight [tons]	Nacelle approx: 330	260

Development Management
Medical Engineering



By simultaneous engineering, separately acting development and production divisions had to be focused on a mutual start-up. Time, cost and quality targets had to be achieved resp. accelerated substantially.

Client

Medical Filter Technology

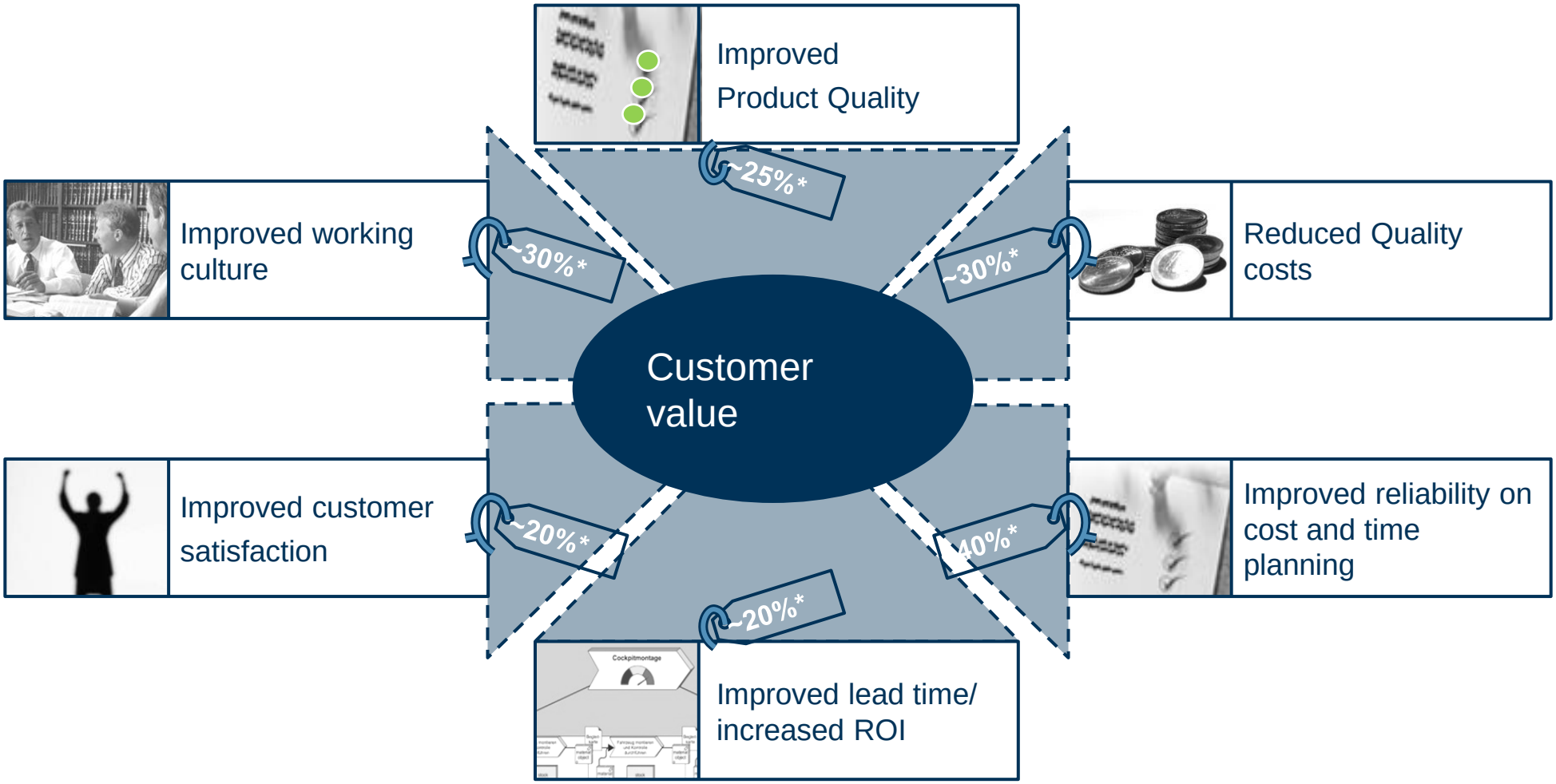
Tasks

- Feasibility study of the project
- Synchronization of development and production organizations and project teams
- Project planning of the venture
- Implementation of Simultaneous Engineering processes and milestones
- Program and project management

Measurable Customer's Benefit

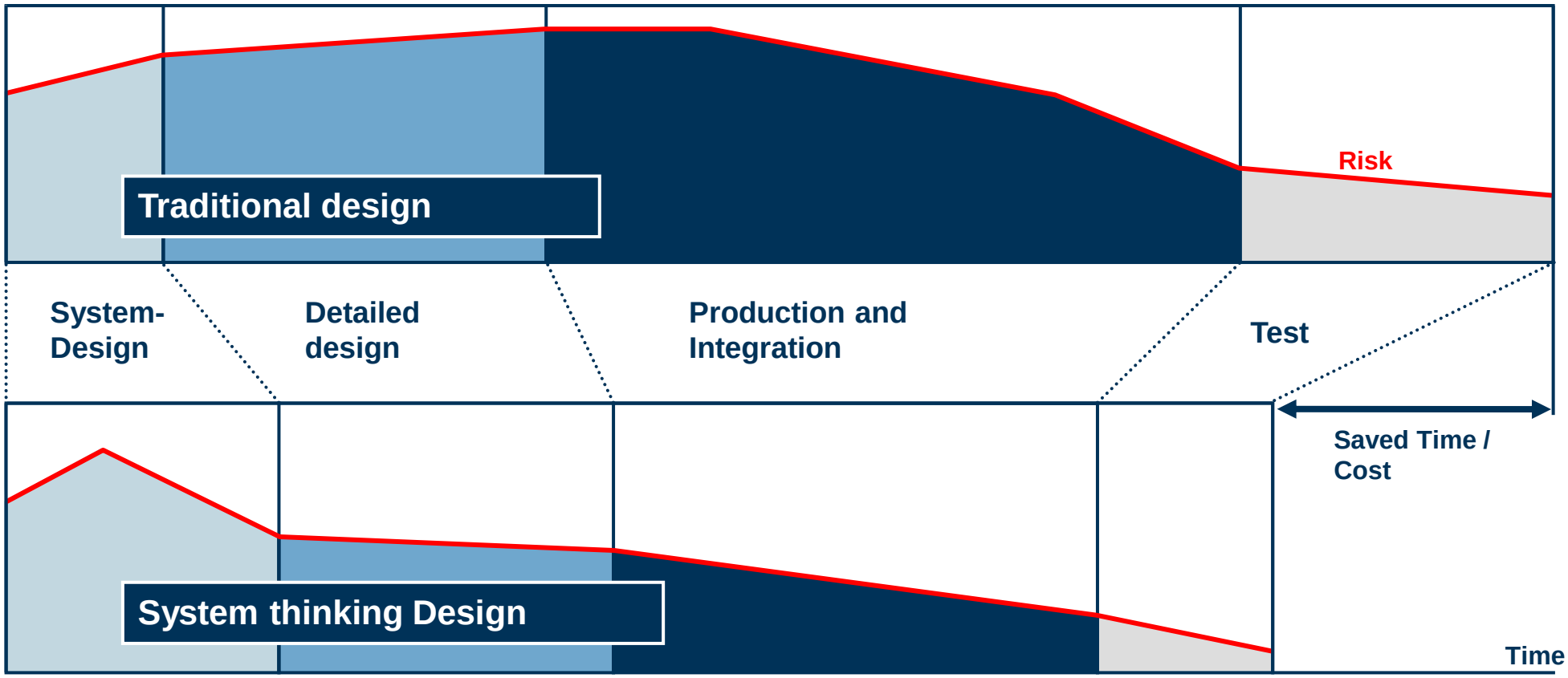
- Synchronized development of products and of production teams and organization
- Establishment of a sustainable organization
- Securing of time, costs and quality
- Reduction of time-to-market by 6 months (one-time savings ~ 4.7 m €)
- Reduction of project- ROI from 2,3 to 1,6 years
- Reduction of product costs (~ 9 m € p.a.)

Customer value by using SE



*Unity experience

Past studies on Value of Systems Engineering



With Systems Engineering time, cost and risk can be reduced.

Quelle: Honour, E. C. 2004. Understanding the value of systems engineering. *INCOSE International Symposium, Toulouse*

[BVH07]: The ROI of SE: Some Quantitive Results

UNITY
CONSULTING & INNOVATION

Cost

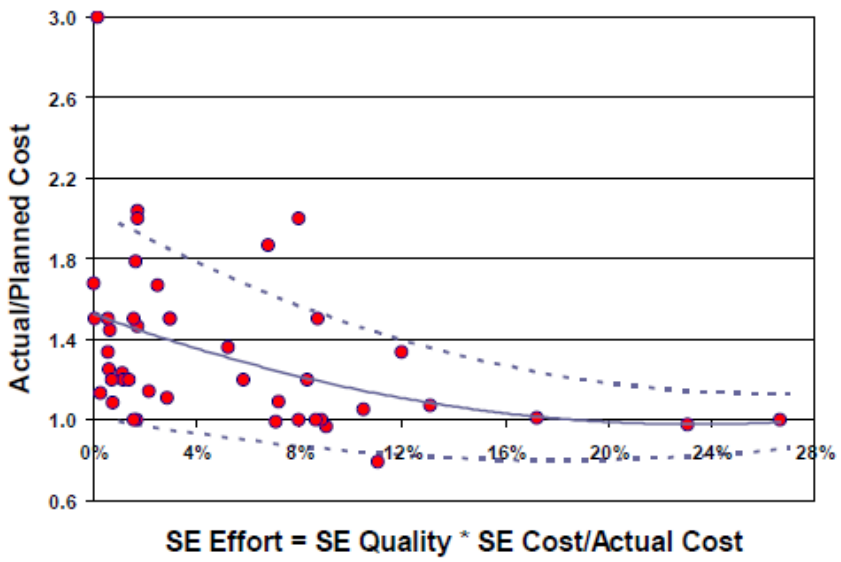


Figure 1. Cost Overrun as a Function of SE Effort

Time

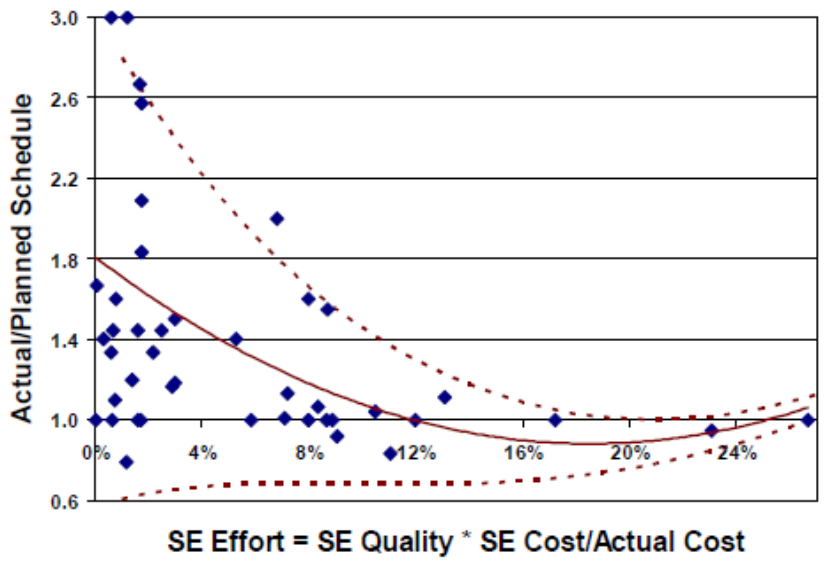


Figure 2. Schedule Overrun as a Function of SE Effort

Figure 1: [BVH07]

figure 2: [BVH07]

http://csse.usc.edu/events/2006/CSSE_Convocation/publications/BoehmROI.pdf

Definition: Systems Engineering Cost

All costs to perform traditional SE tasks, no matter who performs them.

Typical costs:

- Technical management and coordination
- Mission and / or need analysis
- System architectung
- System-level technical anlysis
- Requirements management
- Risk managment
- …and other tasks associated with these

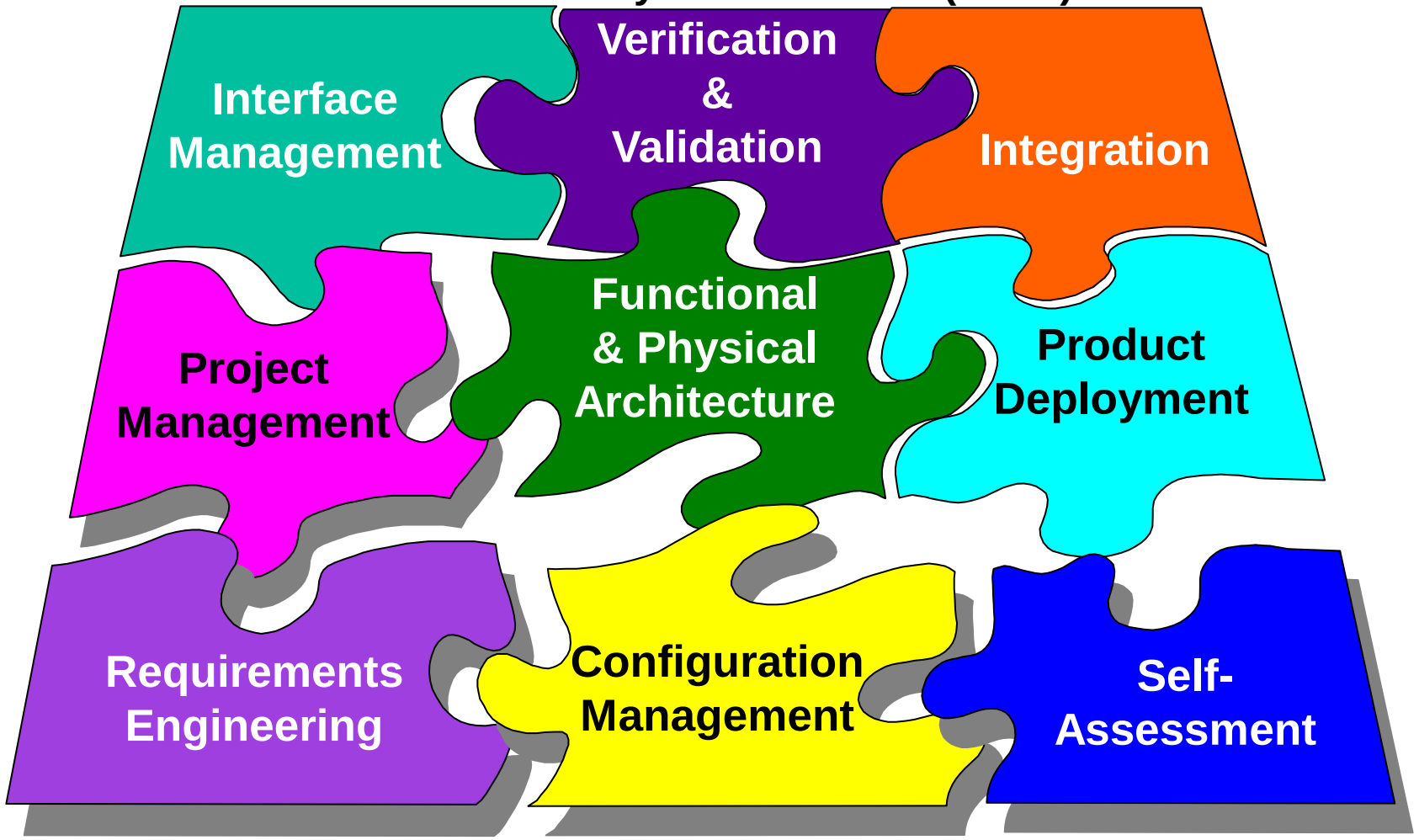
The effort on optimum SE efforf is 15-20% of the project costs.

Quelle: Honour, E. C. 2004. Understanding the value of systems engineering. *INCOSE International Symposium, Toulouse*

Deployment packages from the INCOSE VSME WG

UNITY
CONSULTING & INNOVATION

- **ISO/IEC 29110 Standards for Very Small Entities (VSEs)**



Ref: INCOSE WG / Prof. Claude Laporte

SE Example: Development Process

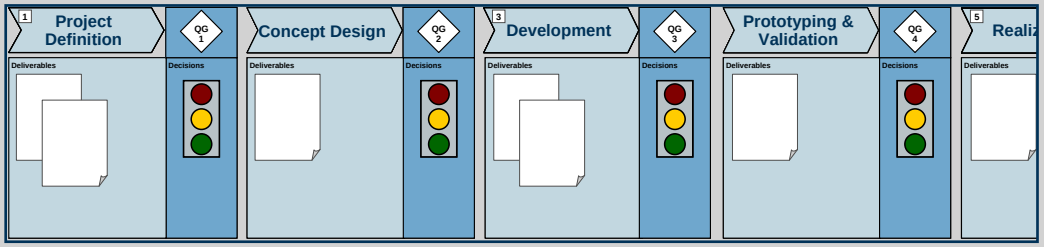
UNITY
CONSULTING & INNOVATION

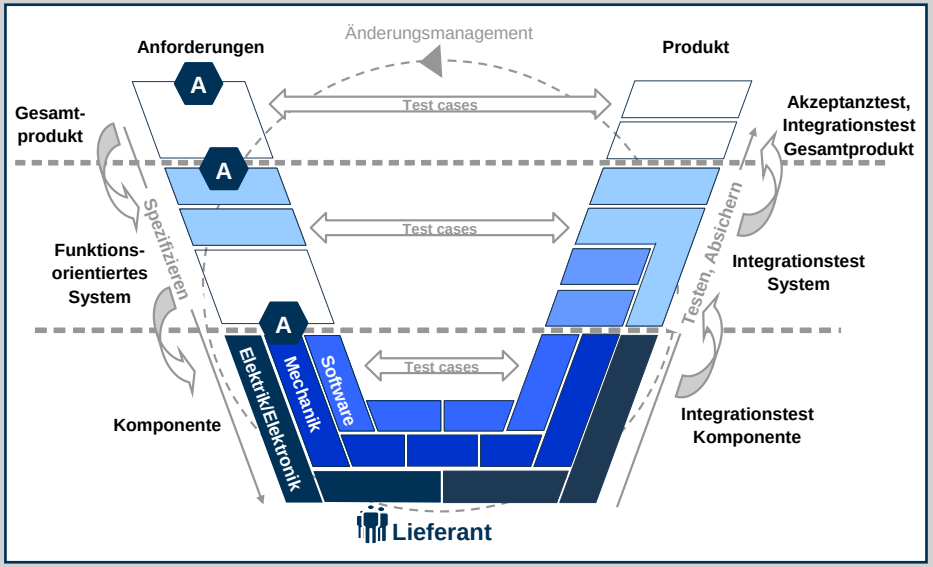
Topics:

- Quality gates from idea creation to market introduction
- Product maturity measurement
- Synchronization of domains
- Preventive quality management
- Component- and function-based testing
- Process interfaces for collaboration with external partners

Approaches:

- Orientation on standards
- Risk assessments
- Virtual Prototyping



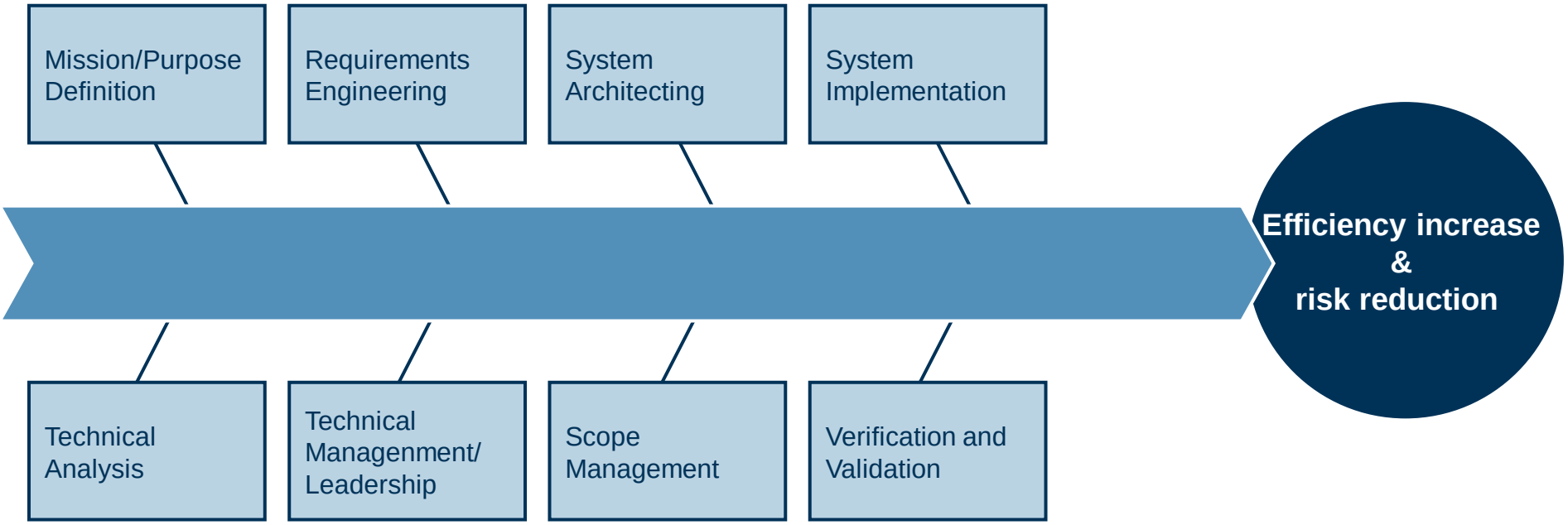


Factors for success: ***Integrated process flows with defined synchronization points***

How to measure the ROI of SE

UNITY
CONSULTING & INNOVATION

Key elements of SE	Aim

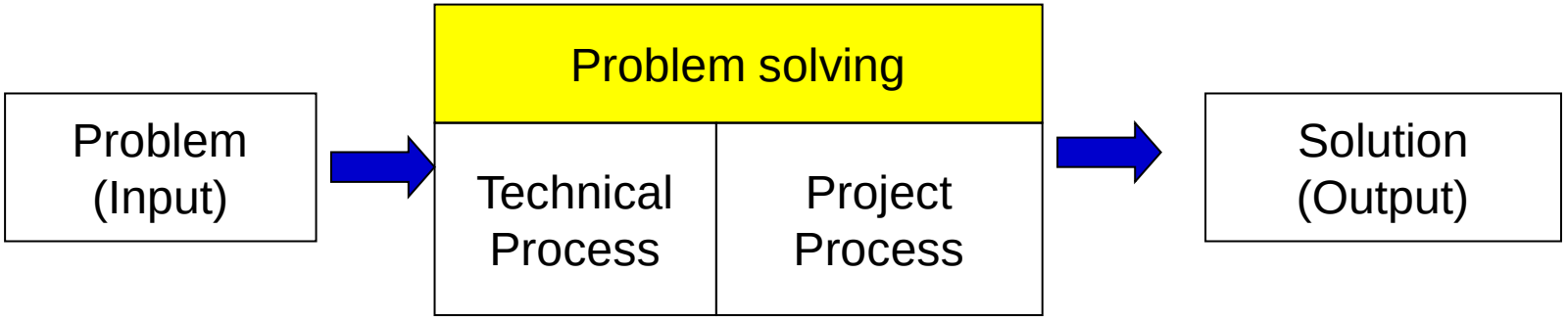


- **Distinguish**
  - Enterprise ROI using SE
  - Project ROI using SE

Assumption: Sum of Project experience is the sum of Enterprise benefit

Problem solving without using Systems Engineering

- **Classical discussions:**
  - Unclear requirements
  - Insufficient skilled persons (limited ressources)
  - No knowledge management
  - Insufficient validation of the concept
  - Wrong tailoring of the enterprise process
  - No re-use possible
  - Wrong effort in requirements management
  - Insufficient configuration management
  - Unclear roles & responsibilities
  - …..



Reference: GfSE Workshop 2013 (ROI project)

SE-ROI – approach „Risk management“

Assumption	Impact (Identification)	Risk	Measures / handling
No requirements managememtn	Unclear requirements	Cutomer come up with new requriements over the life cycle	Workshops with customer; Definition of a requirements process and change process
insufficient knowledge management	Knowledge about the problem in an early phase only be experienced persons	Poor quality, time overrun, Burn-Out	Mixed team and coach or moderator in an eraly phase
Only endproduct validation	No concept validation	No customer solution	Prozessbegleitende Validierung einführen
Wrong tailoring			
Relevant requirements not identified (missing)	Effort on requirements management is wrong estimated		
No configuration control board			
…..			

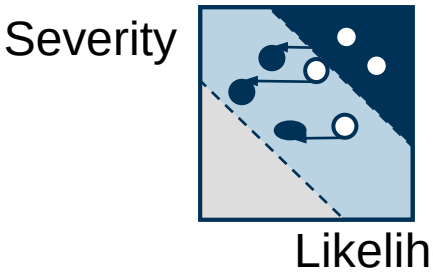
Reference: GfSE Workshop 2013 (ROI project)

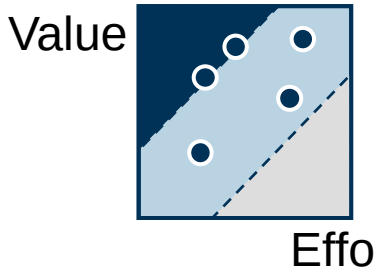
Value of risk reduction versus effort (per project)

No	Prob.	Severity	Like-lihood	Detec-tion	Meas-ure	Sever-ity	Like-lihood	Detec-toin	Delta calc.	Effect
1	Unclear req.	100%	20%	60%	RM Work-shop	100%	2%	80%	Impact *(Sum Impport ance) / Manpo wer to solve	No validatio n
2										
3										

- Delta calculation:

  Effort = Severity* [(likelihood w/o)-(likelihodd with correction)] / Man power





	Severity	Likelihood	
No validation:	100%	10%	10
Rework:	20%	50%	10
			Project: 20

Effort Req. Management: 12

Reference: GfSE Workshop 2013 (ROI project)

Literature and references

- [BVH07] - BOEHM, B.; VALERDI, R.; HONOUR, E.: The ROI of Systems Engineering: Some Quantative Results, INCOSE 2007 – 17th Annual International Symposium Proceedings, San Diego 2007 [http://csse.usc.edu/events/2006/CSSE_Convocation/publications/BoehmROI.pdf]
- [DOU10] - DOUGLASS, J.: CMMI – Is it worth it? – Industry Results, Software Engineering Institute, Carnegie Mellon University, Pittsburgh 2010 [http://www.cmminews.com/2011/pdfs-sessions/138.pdf]
- [ELM11] – ELM, J.P.: A Study of Systems Engineering Effectiveness: Building a Business Case for SE, Software Engineering Institute, Carnegie Mellon University, Pittsburgh 2011
- [HOU04] - Hounour, E.C.: Understanding the Value of Systems Engineering, INCOSE, Pensacola 2004 [http://www.incose.org/secoe/0103/ValueSE-INCOSE04.pdf]
- [REI07] - REITZIG, R.W.; GOLDENSON, D.R.; GIBSON, D.; CAVANAUGH, M.R.: Calculating CMMI-Based ROI – Why, When, What, and How?, 19th Annual SEPG Conference March 26-29, 2007, Austin 2007 [http://www.sei.cmu.edu/library/assets/reitzig_07.pdf
- GfSE Workshop 2013 results from the ROI project

UNITY
CONSULTING & INNOVATION

Thank You for Your Attention!

UNITY is TOP CONSULTANT ▪ www.unity.de