KNOWLEDGE MANAGEMENT
for
NONRECURRING PROCESSES

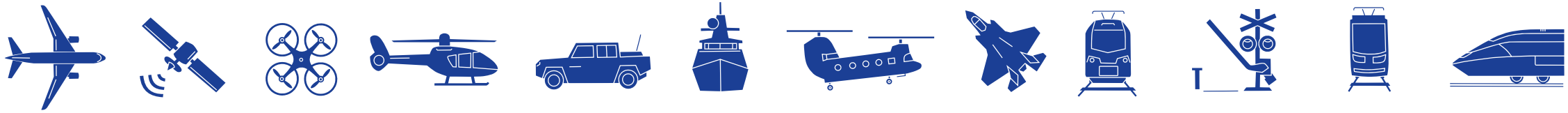
ADSE
CONSULTING AND ENGINEERING

NAG IQ meeting Knowledge Management for nonrecurring processes

8 november 2022

From standards to practical use

Jan Verbeek



www.adse.eu

Topics

- Introduction – the importance of Knowledge Management
- Characteristics nonrecurring processes
- Relevant Knowledge Management theory and basics
- Lessons from Systems Engineering
- Lessons from Lean Development
- Recap

Introduction - ADSE consulting & engineering

Asset Developers

- OEMs
- Suppliers

Governments Regulatory bodies

Asset Owners

- Owners
- Operators
- MRO

Engineering Services

Product oriented services
To design and optimize physical products

Certification and compliance services

Safety oriented services
To ensure compliance to safety regulations

Technical Project Management Services

Project oriented services
To enable succesfull project completion

Consulting Services

Process & organisation oriented services
To define and improve technical processes and organisations

Introduction: the importance of Knowledge Management

Knowledge is the – partly subconscious –
personal ability to perform a certain task or service

This ability is a function of
Information, Experience, Skills and Attitude
that somebody has at certain moment
(ref. Prof Weggeman TUe)

"Yes, I've learned from my mistakes. I've learned if you call them 'missed opportunities' you get in less trouble."

Knowledge that fits our mission, goals and strategy

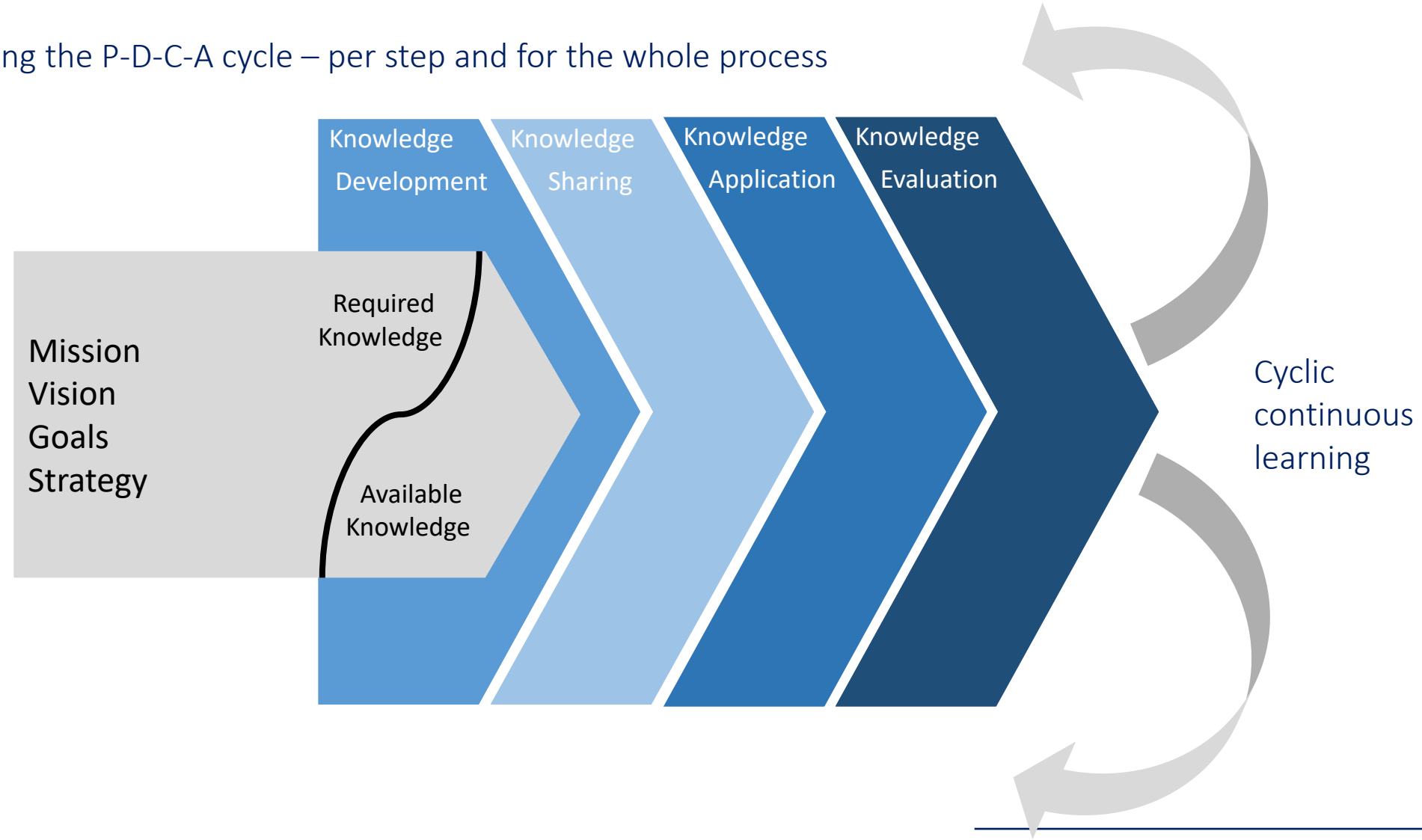
Business continuity requires maintaining and developing Knowledge

Knowledge that supports current and future value propositions

It is costly wisdom that is brought by experience [Roger Ascham]

Introduction Knowledge Management Process

- Following the P-D-C-A cycle – per step and for the whole process



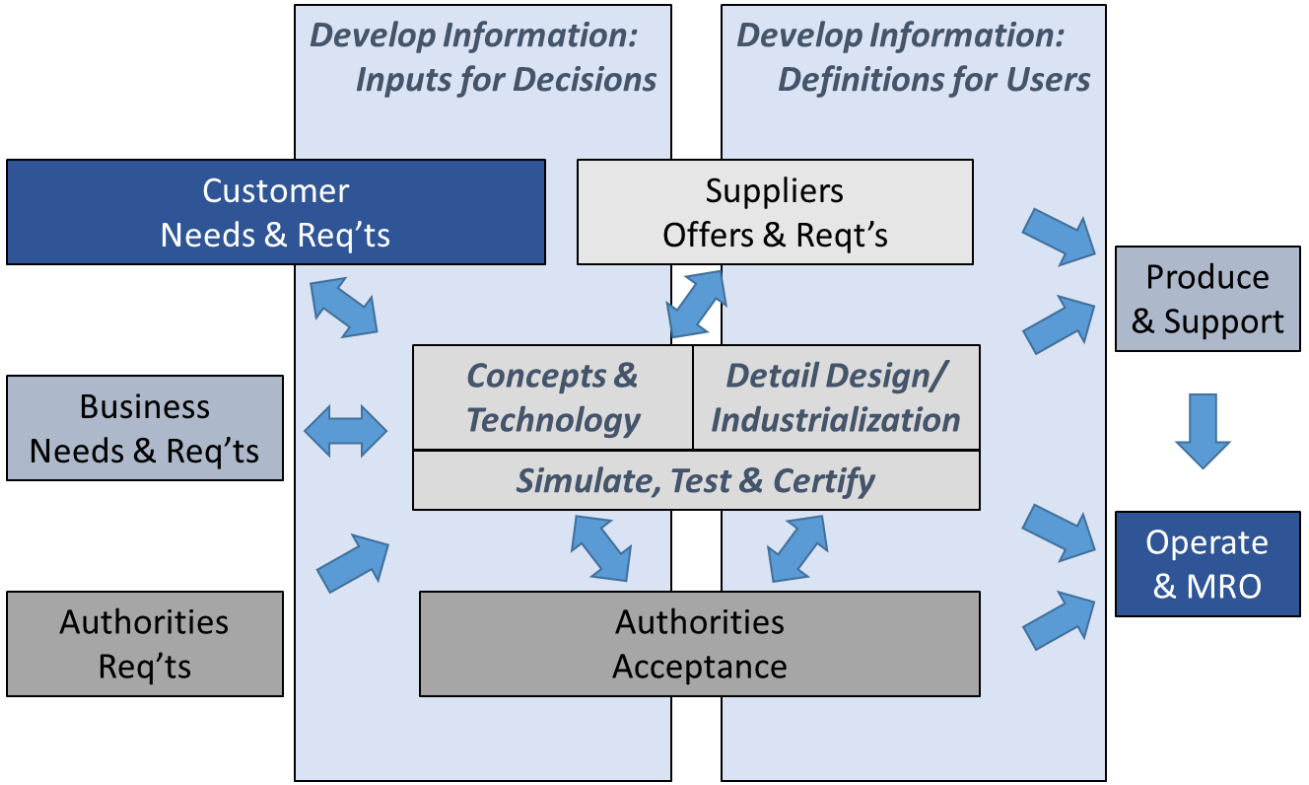
Characteristics of nonrecurring processes

- Definition
  - **Not occurring or happening again**, especially often or periodically.
  - Noting or pertaining to an **income or charge** considered of a nature **not likely to occur or happen again**.

- In the aerospace industry: processes that happen only once, at least for a specific product or program
  - Initial development
    - R&D
    - Product Development
    - Type certification
    - Business development
    - Industrialization
    - Customer support package development
  - Significant changes
    - Variants and version development
    - Modifications and updates
    - Individual sales cases
    - Industrial change (rate change, re-location of production, supplier change)
    - Significant re-organizations and process improvements
    - Additional new services

Product Development characteristics

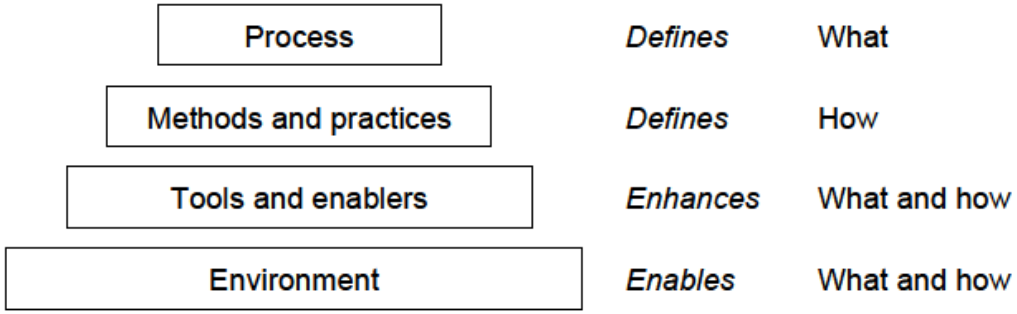
- Product development consists of 2 distinct phases



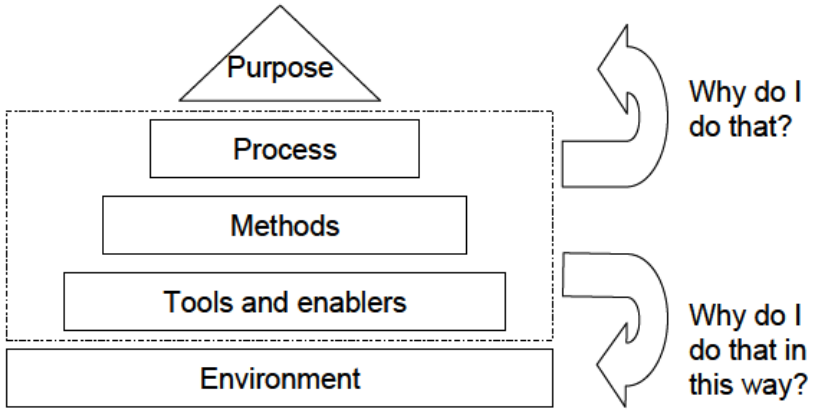
- Successful product development requires sound planning and decision making in the 1st phase – see lessons from Lean Development

Process Development characteristics

- Process development requires an understanding of its building blocks



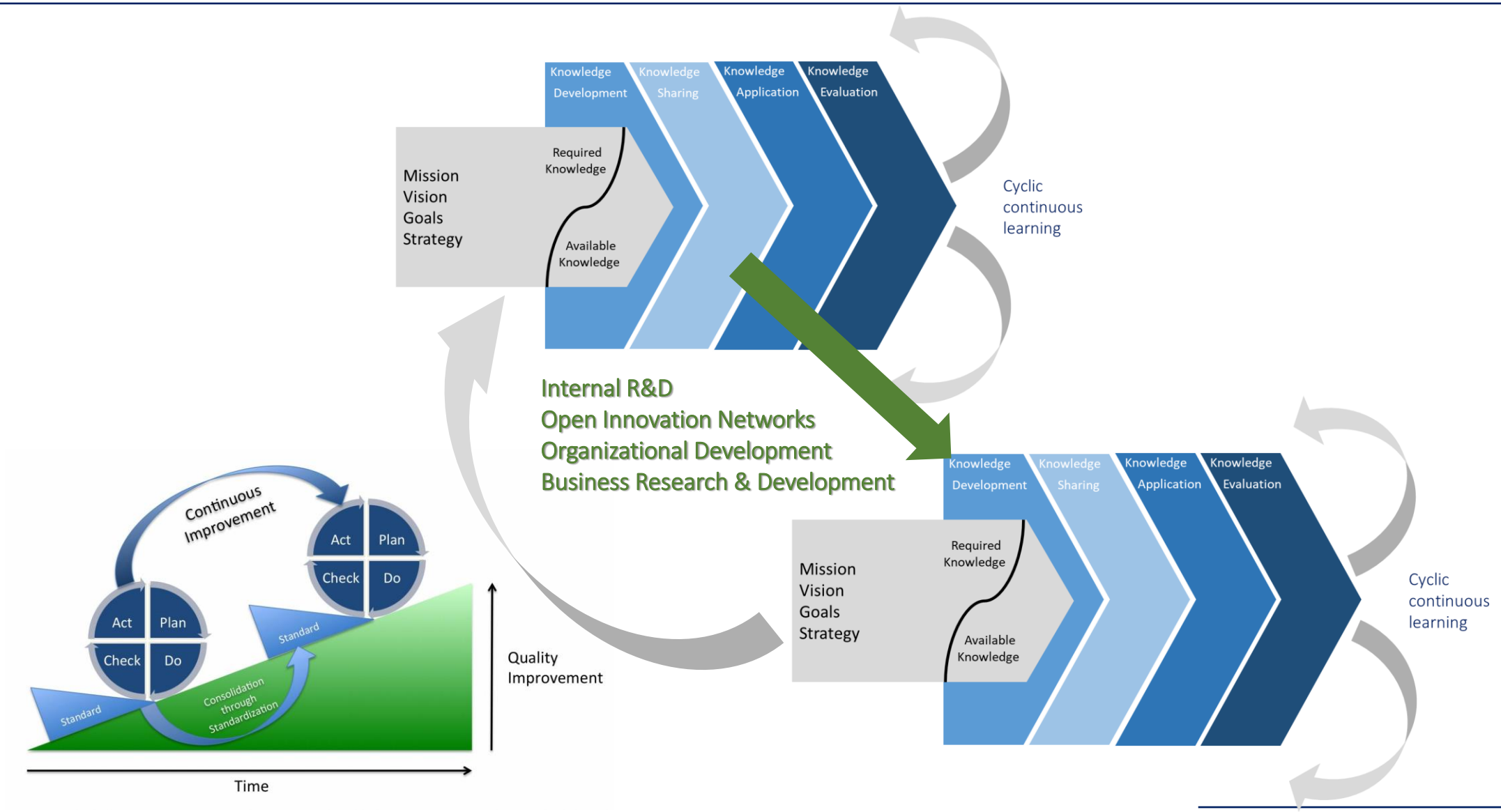
- Process development is required if the purpose and/or the environment of the process has to change



Questions for KM on nonrecurring processes

- *How does Knowledge Management work for a nonrecurring environment?*
- *Engineering and other development work is often experience based so how do you get from standards to practical methods and skills?*
- *What are the relevant KM-processes?*
- *How do you address (personal) knowledge in relation to competencies for teamplay > organisational capabilities*

Knowledge Management for Knowledge Development



Knowledge Development - Technology

R&T projects on new materials, designs and processes >>> create options for future use

- New generations of existing solutions
- Disruptive concepts

Concept development & evaluation

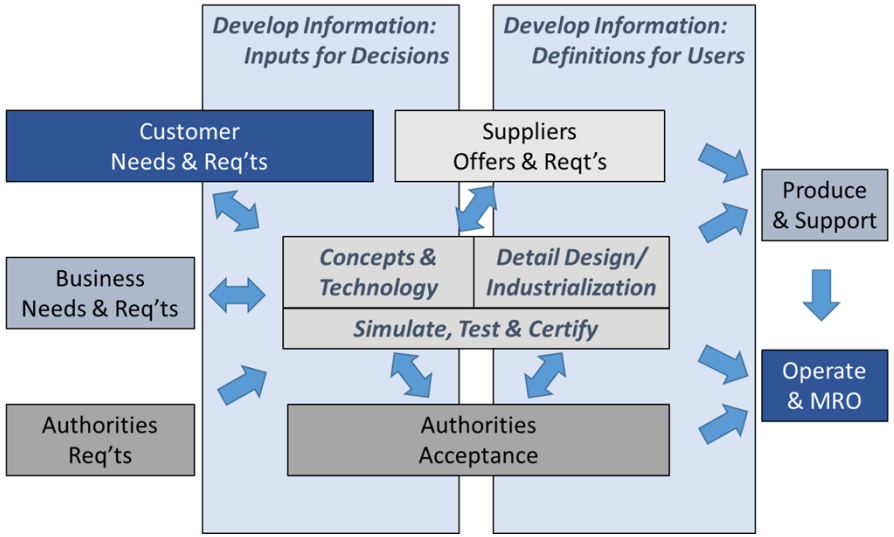
- Concept studies using models and simulations extrapolating on existing knowledge
- Rapid prototyping on integrated systems and component level for disruptive concepts

Feasibility studies

- Are solutions attractive for customers (and society)
- Are solutions technically feasible (and certifiable)
- Are solutions economically viable (competitive)

Standardization

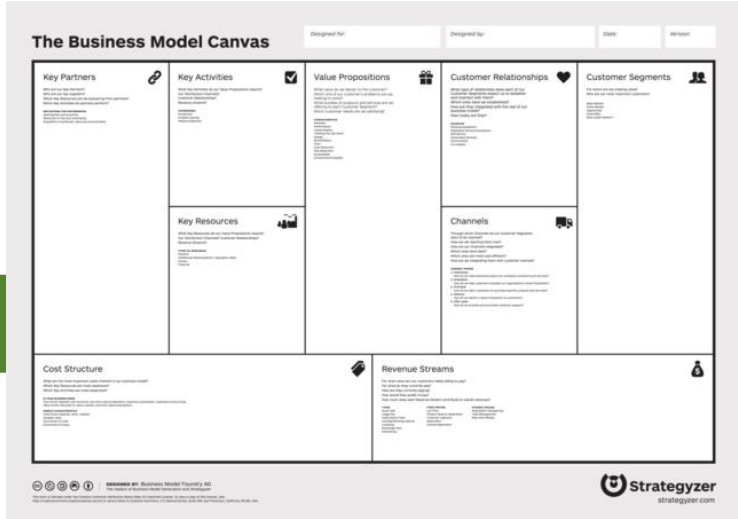
- Design architecture and interface definitions
- Certification baseline (requirements & acceptable MoCs)
- Design standards definition
- Materials & process specifications and qualification

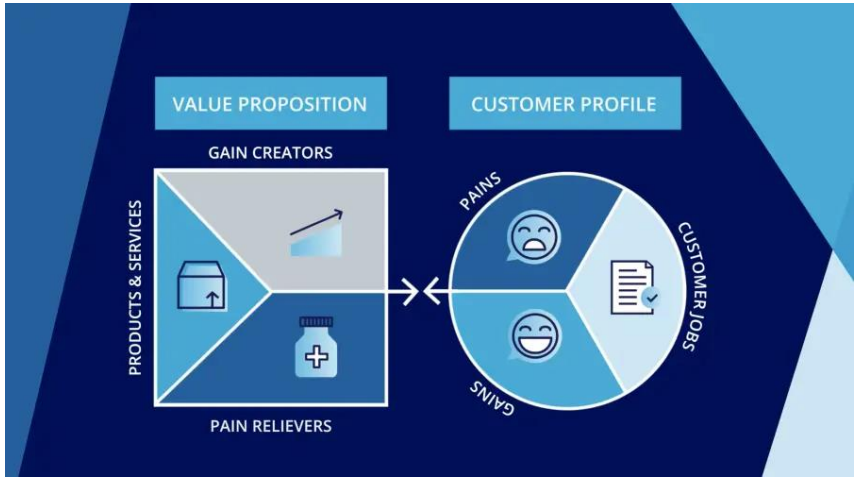


Possibly via international Industry Working Groups (ASTM, SAE, ARINC)

Knowledge Development – Business Development

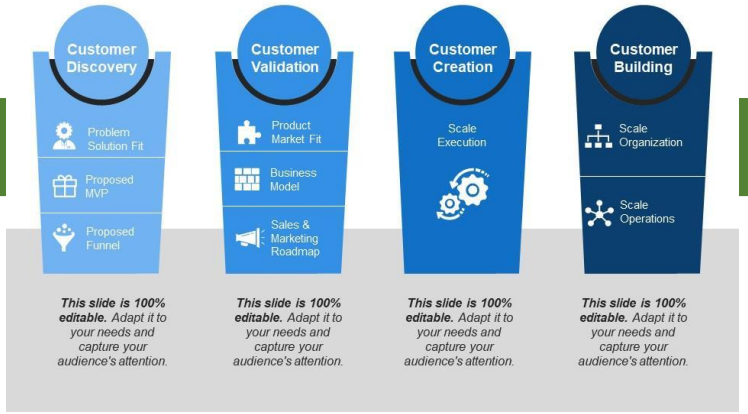
Design

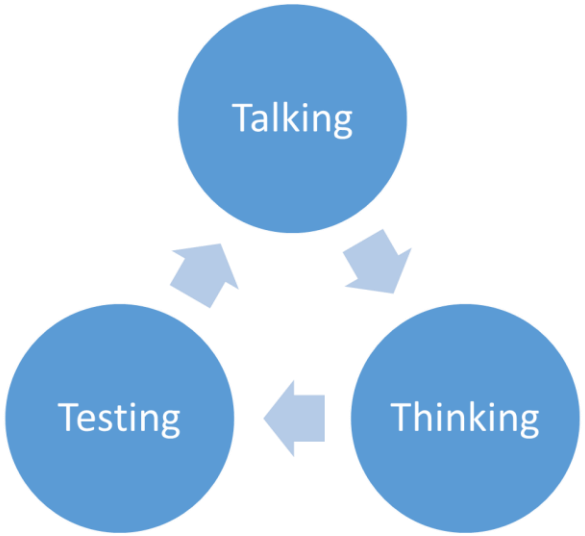




Testing

Customer Development Process With Customer …





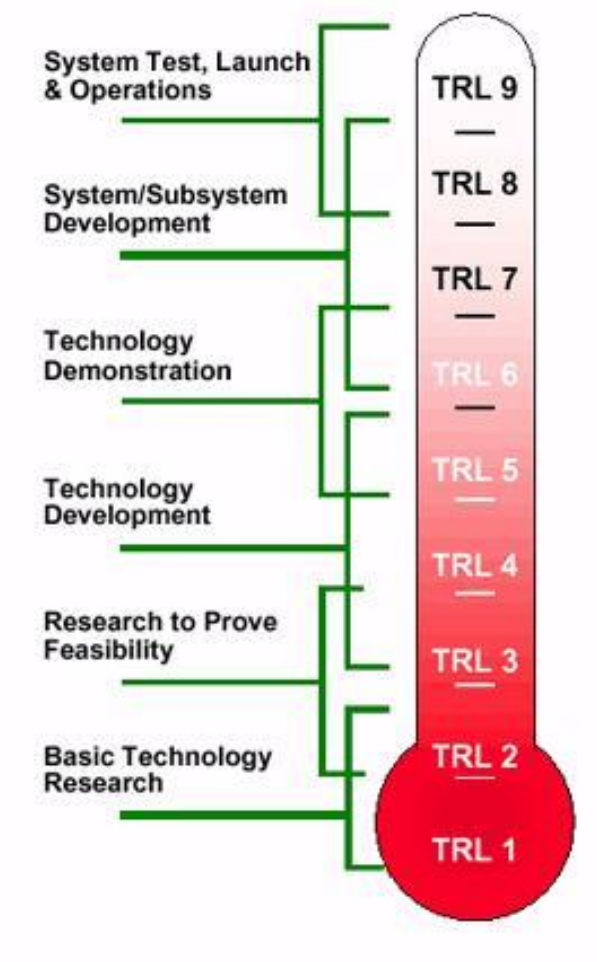
Different ways to measure Readiness (RL) or Maturity (ML) Levels

- Technology Readiness Levels (TRL)
- Integration Readiness levels / Integration Maturity Levels (IRL, IML)

- Manufacturing Readiness levels (MRL)

- Organizational Readiness levels
- Capability Maturity levels (CMM)
- Operational readiness levels

Technology Readiness Levels



Technology Readiness level (TRL): Developed by NASA to describe the maturity of a given technology. With a predetermined checklist the maturity of a technology can be established.

TRL has many limitations:

- Does not provide a complete representation of the (difficulty of) integration of multiple technologies in a system.
- Gives no guidance into uncertainty (risk, cost) that may arise when going up the TRL ladder
- There are no considerations to: integration, interoperability and sustainment of the operational environment
- Does not pay attention to develop related manufacturing capabilities
- Does not include effect of technology on the organizational, human resources etc.
- Does not concern with certification compliance
- And more….

From TRL → Integration Readiness Level (IRL)

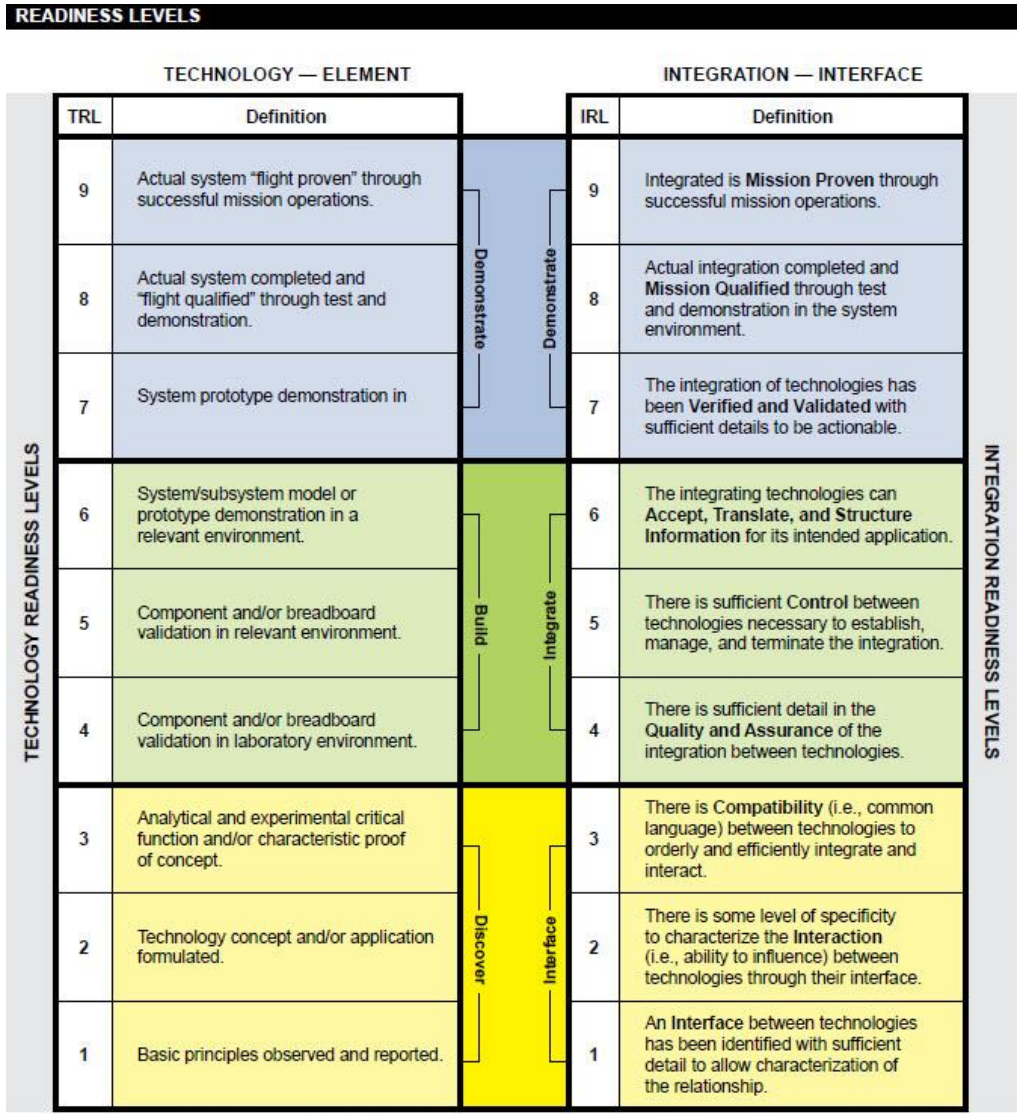


Figure 2. Technology and Integration Readiness Levels

- IRLs describe the integration maturity of a developing technology with another technology, developing or mature.
- Focus on; interface identification to successful integration
- Limited to interfaces between two technologies only

Manufacturing Readiness Levels (MRL)

Level	Manufacturing readiness level (MRL) description
10	Full rate production and lean production practices in place
9	Low rate production , capability in place to begin full rate production
8	Pilot line capability demonstrated, ready to begin low rate production
7	Capability to produce systems, subsystems or components in a production representative environment
6	Capability to produce a prototype system or subsystem in a production relevant environment
5	Capability to produce a prototype components in a production relevant environment
4	Capability to produce the technology in a laboratory environment
3	Manufacturing proof of concept developed
2	Manufacturing concepts identified
1	Basic manufacturing implications identified

- MRL is a measure to assess the maturity of manufacturing process which includes not only design but also optimization of the process (which is why MRL is from1-10)
- Focus on; manufacturing implication, capabilities, achieving full rate production and lean production practices
- There is no explicit focus on quality, a minimum (defined) acceptable quality is assumed.

Operational or organizational Readiness (or Capability Maturity)

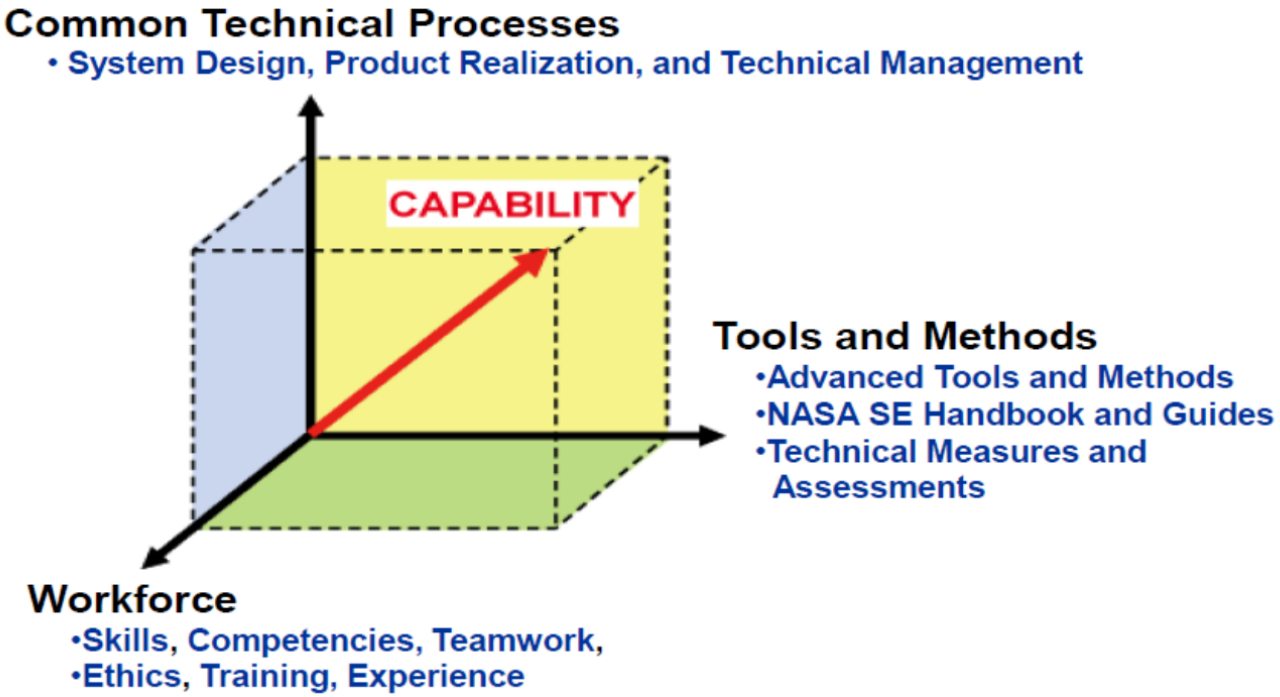
The extent to which an organization is both willing and able:

- To implement and absorb a particular new or innovative technology or process
- To work with a new product or system with new functionality or requiring new operating procedures

Lessons from Systems Engineering

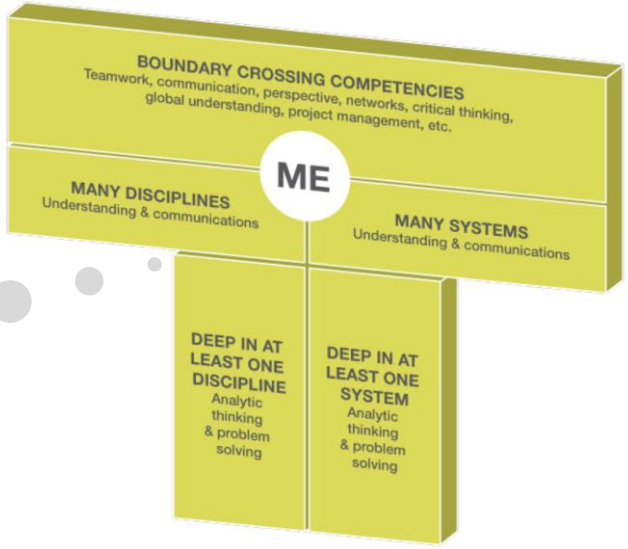
There are 3 axes to determine SE capability maturity:

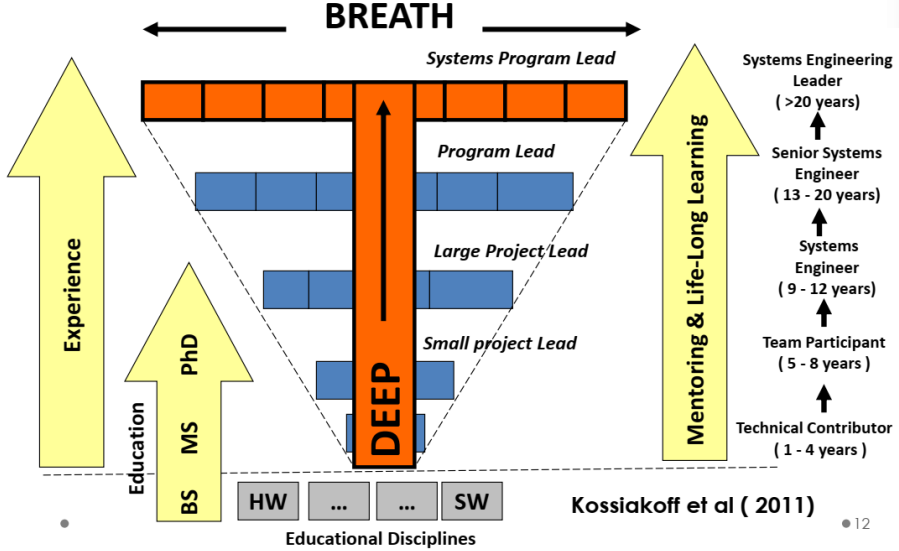
- **Processes** defined and executed, products realised
- **Methods and tools** in place and successfully used
- **People** trained, skilled/competent and engaged in SE processes



Lessons from Systems Engineering

Build your development teams on specialists and integrators





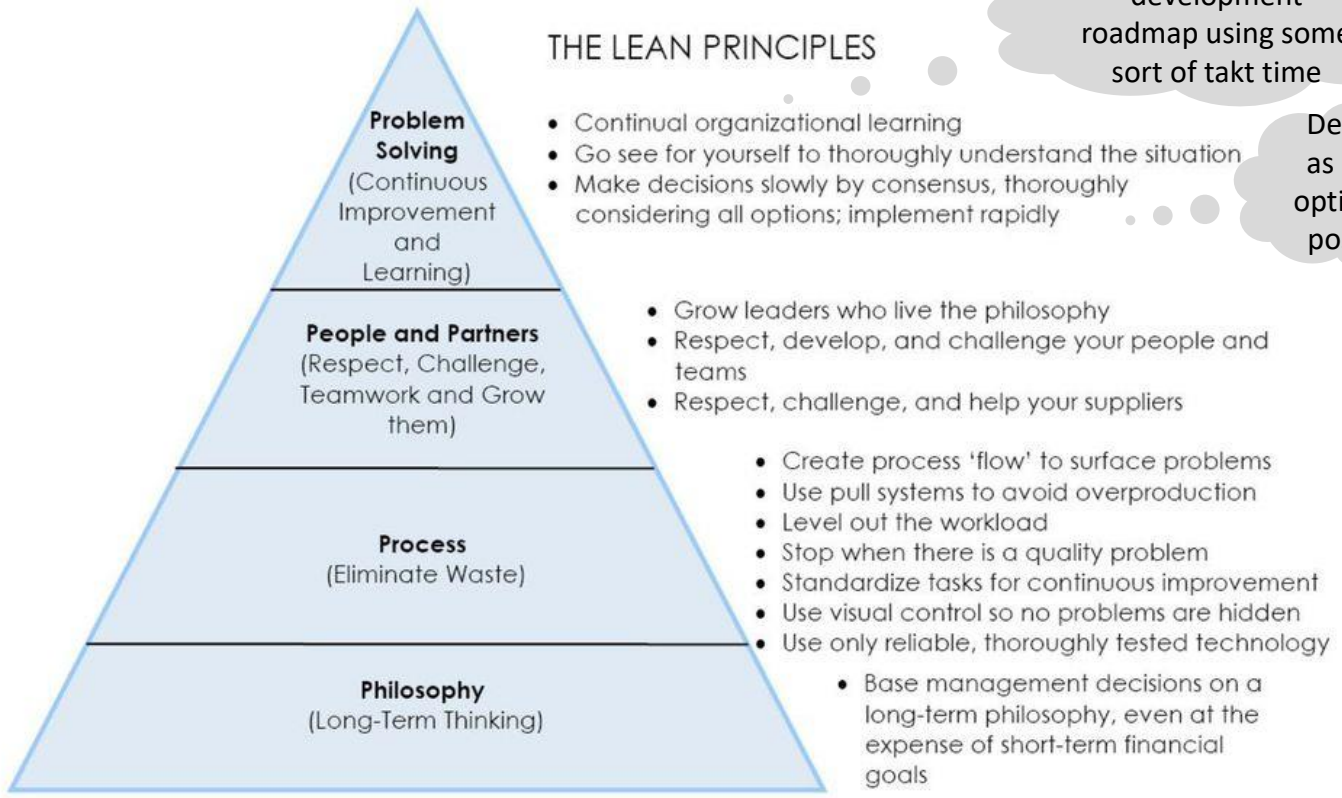
Core Systems Engineering Principles:	Professional:
• Systems Thinking • Lifecycles • Capability Engineering • General Engineering • Critical Thinking • Systems Modelling and Analysis	• Communications • Ethics and Professionalism • Technical Leadership • Negotiation • Team Dynamics • Facilitation • Emotional Intelligence • Coaching and Mentoring
Technical:	**Management:**
• Requirements Definition • System Architecting • Design for... • Integration • Interfaces • Verification • Validation • Transition • Operation and Support	• Planning • Monitoring and Control • Decision Management • Concurrent Engineering • Business & Enterprise Integration • Acquisition and Supply • Information Management • Configuration Management • Risk and Opportunity Management
Integrating:	
• Project Management • Finance • Logistics • Quality	

Pay explicit attention to professional skills and attitude development

Systems Engineering Competency Model - Proficiency Level Table				
COMPETENCY AREA – Category: Competency				
Description: explains the competency and provides meaning behind the title.				
Why it matters: indicates the importance of the competency and the problems that may be encountered in the absence of that competency.				
EFFECTIVE INDICATORS OF KNOWLEDGE, SKILLS, ABILITIES AND EXPERIENCE				
AWARENESS	**SUPERVISED PRACTITIONER**	**PRACTITIONER**	**SENIOR PRACTITIONER**	**EXPERT**
The person is able to understand the key issues and their implications. They are able to ask relevant and constructive questions on the subject.	The person displays an understanding of the subject but requires guidance and supervision.	The person displays detailed knowledge of the subject and is capable of providing guidance and advice to others.	The person displays both in-depth and broad knowledge of the subject based on practical experience. The person is capable of leading others to create and evaluate solutions to complex problems in the subject.	The person displays extensive and substantial practical experience and applied knowledge of the subject.

Lessons from Lean Development

14 Toyota Way Management Principles



THE LEAN PRINCIPLES

- Continual organizational learning
- Go see for yourself to thoroughly understand the situation
- Make decisions slowly by consensus, thoroughly considering all options; implement rapidly

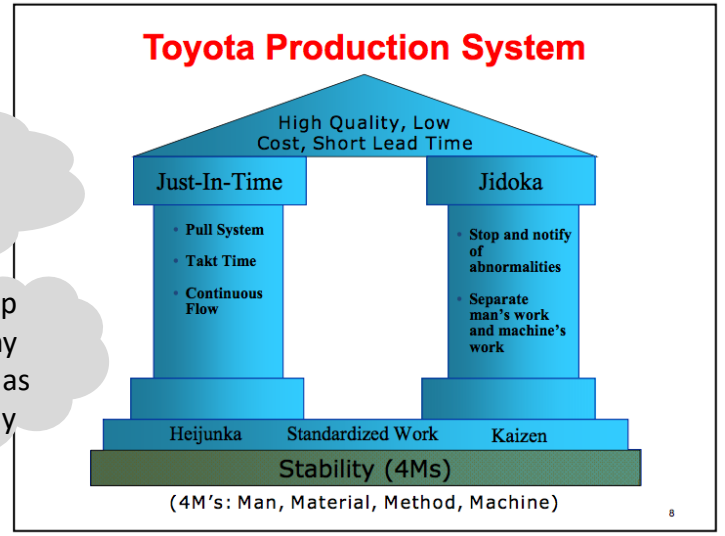
- Grow leaders who live the philosophy
- Respect, develop, and challenge your people and teams
- Respect, challenge, and help your suppliers

- Create process 'flow' to surface problems
- Use pull systems to avoid overproduction
- Level out the workload
- Stop when there is a quality problem
- Standardize tasks for continuous improvement
- Use visual control so no problems are hidden
- Use only reliable, thoroughly tested technology

- Base management decisions on a long-term philosophy, even at the expense of short-term financial goals

Plan your development roadmap using some sort of takt time

Develop as many options as possibly



Recap

- *How does Knowledge Management work for a nonrecurring environment?*
  - *The same as for recurring processes but with a much longer learning cycle*
  - *So take care of continuity in staffing, over subsequent development projects*

- *Engineering and other development work is often experience based so how do you get from standards to practical methods and skills?*
  - *By sharing best practices and lessons learned from previous programs/projects in an honest way*
  - *By securing continuity in teams with seniors and juniors*
  - *By tailoring standards into your own methods suited for the situation/challenges*
  - *By using test & evaluation for learning for continuous learning*

- *What are the relevant KM-processes?*
  - *Define your mission, vision, goals and strategy*
  - *Plan/design the new technology, value proposition, process*
  - *Develop and test using rapid prototypes or simulations/games*
  - *Evaluate and either adjust your vision, goals or strategy or start further iterations*

- *How do you address (personal) knowledge in relation to competencies for teamplay > organisational capabilities*
  - *By addressing cooperation models and team roles as essential parts of developers competences*
  - *By developing and refining cross-functional processes – define interactions during process planning*