Value and Stakeholder Analysis

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PPU231 – Production and Product Service Systems

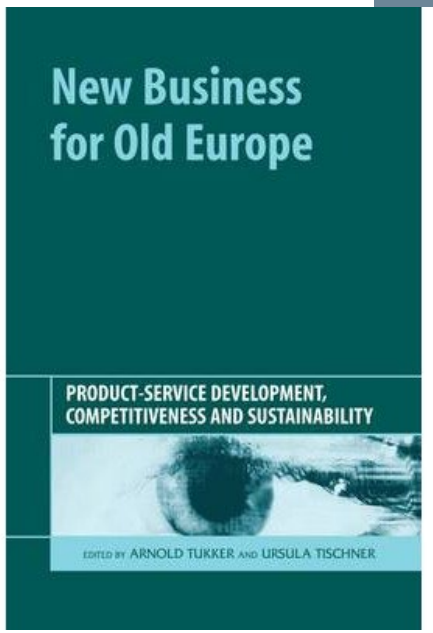
Learning Objectives

- LO1: Describe and apply risk and safety concepts and use engineering tools to analyze, evaluate, and reduce risks
- LO2: Explain, implement and distinguish various prevailing maintenance concepts
- LO3: Recognize and evaluate future maintenance concepts
- LO4: Interpret, describe and evaluate Production and Product Service Systems
- LO5: Demonstrate how existing production systems or products can be designed, developed and provided as Production or Product Service Systems
- LO6: Differentiate, select and develop actions to improve production systems or products during the whole life-cycle.

Readings (Following Course PM)

- , A., Van den Berg, C. & Tischner, U. (2006) Chapter 2 **“Product-services: a specific value proposition”** in : Tukker, Arnold, and Tischner, Ursula, eds. “New Business for Old Europe : Product-Service Development”, Competitiveness and Sustainability. Sheffield, South Yorkshire, GBR: Greenleaf Publishing.
  - ***Introduces one well known model resolving types of Product Service Systems***

- **Isaksson, O., Larsson, T.C. & Rönnbäck A.O. (2009) ”Development of product-service systems: challenges and opportunities for the manufacturing firm”**, Journal of Engineering Design 20 (4), 329-348
  - ***Outlines challenges and opportunities for manufacturing industries***



VALUE

Understanding Value

”Value: defined as the percieved satisfaction of stakeholders’ expectations and needs”

The consumer value the result of a service provided

Combined and provided by a provider

Enabled by the use of equipment/products

Isn’t value the same as cost? Or Price?

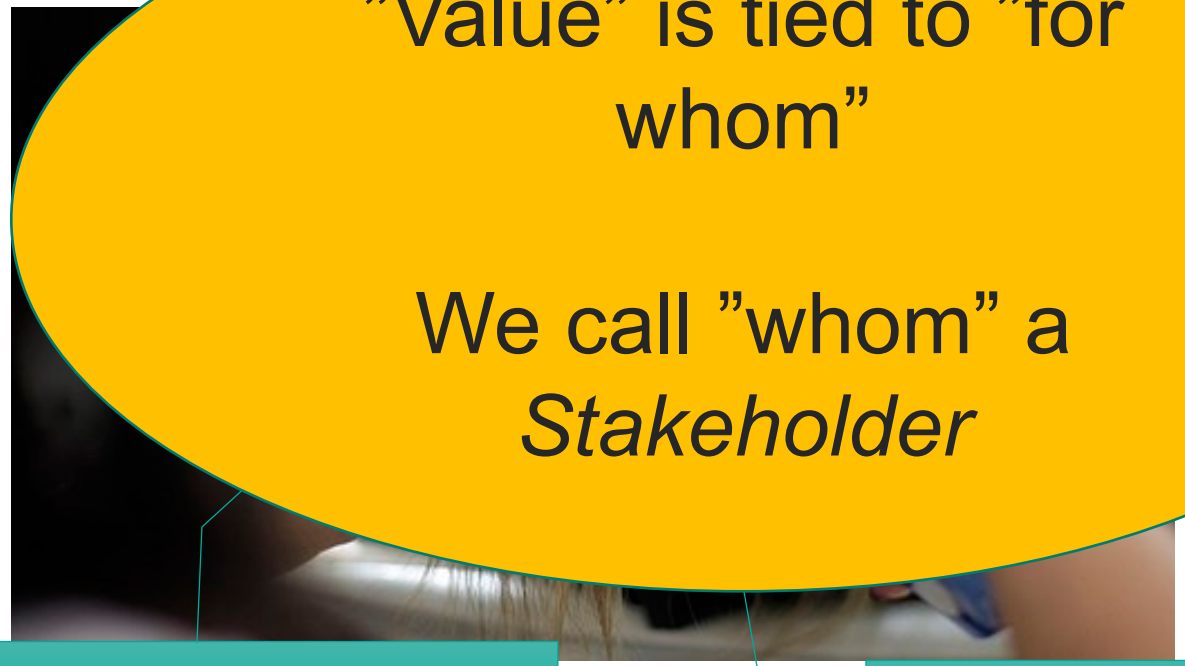
”Value: defined as the percieved satisfaction of stakeholders’ expectations and needs”

Example

- A consumer pays for a product (or service) – where the price paid is a cost for the consumer.
- For the provider/manufacturer the same price is an income, and necessary for revenue and profitability in business
- The VALUE for the consumer, has more to do with to what extent the consumer is happy (satisfied) by paying the price for the specific product and/or service.
- The VALUE for the manufacturer can be if they reach a profit margin, but equally e.g. to achieve another business target, e.g. obtaining a market share

Understanding Value

”Value: defined as the [illegible] satisfaction of stakeholders’ expectations and needs”



”Value” is tied to ”for whom”

We call ”whom” a *Stakeholder*

The consumer value the result of a service provided

Combined and provided by a provider

Enabled by the use of equipment/products

STAKEHOLDER IDENTIFICATION

Stakeholder?

A stakeholder has an interest of the product (or service)

- **What Stakeholders (who) has an interst in a lawn mover?**

Stakeholder?

A stakeholder: Someone who has an interest in the use of the product?

- **What Stakeholders (who) has an interest in a nice garden?**

Step 1: Stakeholder Identification

The owner of the lawn mover

The one maintaining the lawn mover

Suppliers of lawnmover details

Societial institutions

The driver/user of the lawnmover

The one wanting the lawn moved

The owner/shareholder of the lawnmover manufacturer

…

EXPECTATIONS AND NEEDS

What do I expect from a car that I need to use in the winter?

Possible statement from someone planning to buy a car:

Many things, but it has to start even if it is very cold, even down to -30 C

CHALMERS

Stakeholder Expectation

Stakeholder expressed expectations are expectations as expressed by stakeholders. Stakeholder expectations can be of any format, granularity or detail.

- **Example a *Car Owner* may express**
  - ~~**The car must start at -30 degrees C**~~

    ”I want my car to be ready to use regardless of weather conditions!”

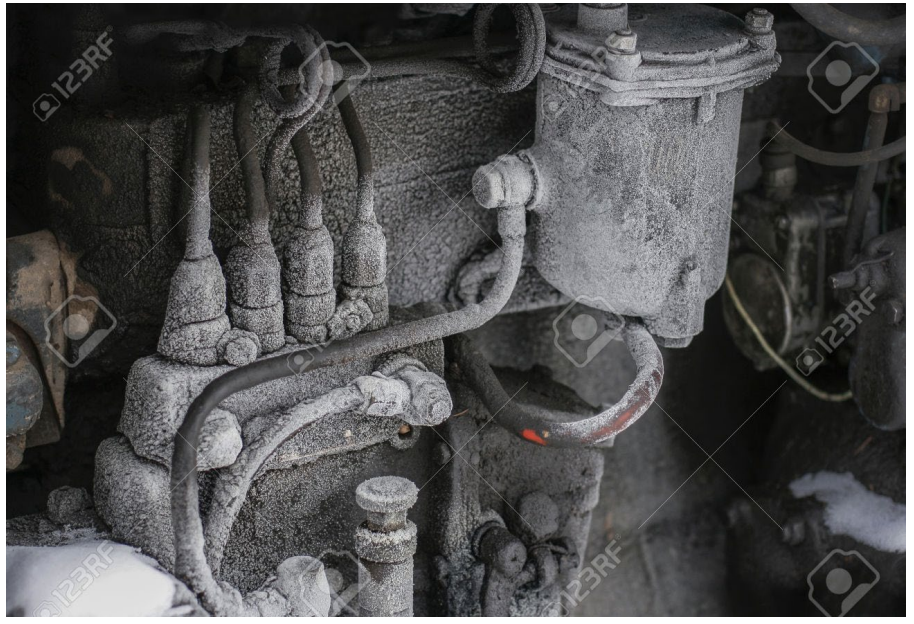
Stakeholder Need

Stakeholder Needs are high-level **statements of problems that need to be solved** by a new or re-used system solution. In a given context these needs will be based on captured and validated expectations of external and internal stakeholders.

Needs are the source for the development of Requirements and are satisfied by improvements along one or several value dimensions.

Example: a *Car Engine Manufacturer* may interpret as

”A car engine must be possible to start at any temperature where the car will be used”



STAKEHOLDER ANALYSIS

Back to the lawn mover- what expectations and needs do the stakeholders have?

Step 2: Stakeholder Expectations and needs?

- **The owner of the lawn mover**
- The one wanting the lawn moved
- The one maintaining the lawn mover
- The owner/shareholder of the lawnmover manufacturer
- Suppliers of lawnmover details
- …
- Societial institutions
- The driver/user of the lawnmover

- Affordable to aquire
- Available when needed
- Modern design
- Low cost to operate
- Attractive on the second hand market
- …

Stakeholder Expectations and needs?

- The owner of the lawn mover
- The one wanting the lawn moved
- The one maintaining the lawn mover
- The owner/shareholder of the lawnmover manufacturer
- Suppliers of lawnmover details
- …
- Societial institutions
- **The driver/user of the lawnmover**

- Sharp and efficient
- Easy to operate
- Manouverable
- Able to adjust to grass type/hight
- ….

Stakeholder Expectations and needs?

- The owner of the lawn mover
- The one wanting the lawn moved
- The one maintaining the lawn mover
- **The owner/shareholder of the lawnmover manufacturer**
  - Low cost of manufacturing
  - Possible to adjust to market needs
  - Fit into the product portfolio
  - Precise life length
  - ….
- Suppliers of lawnmover details
- …
- Societial institutions
- The driver/user of the lawnmover

Stakeholder Expectations and needs?

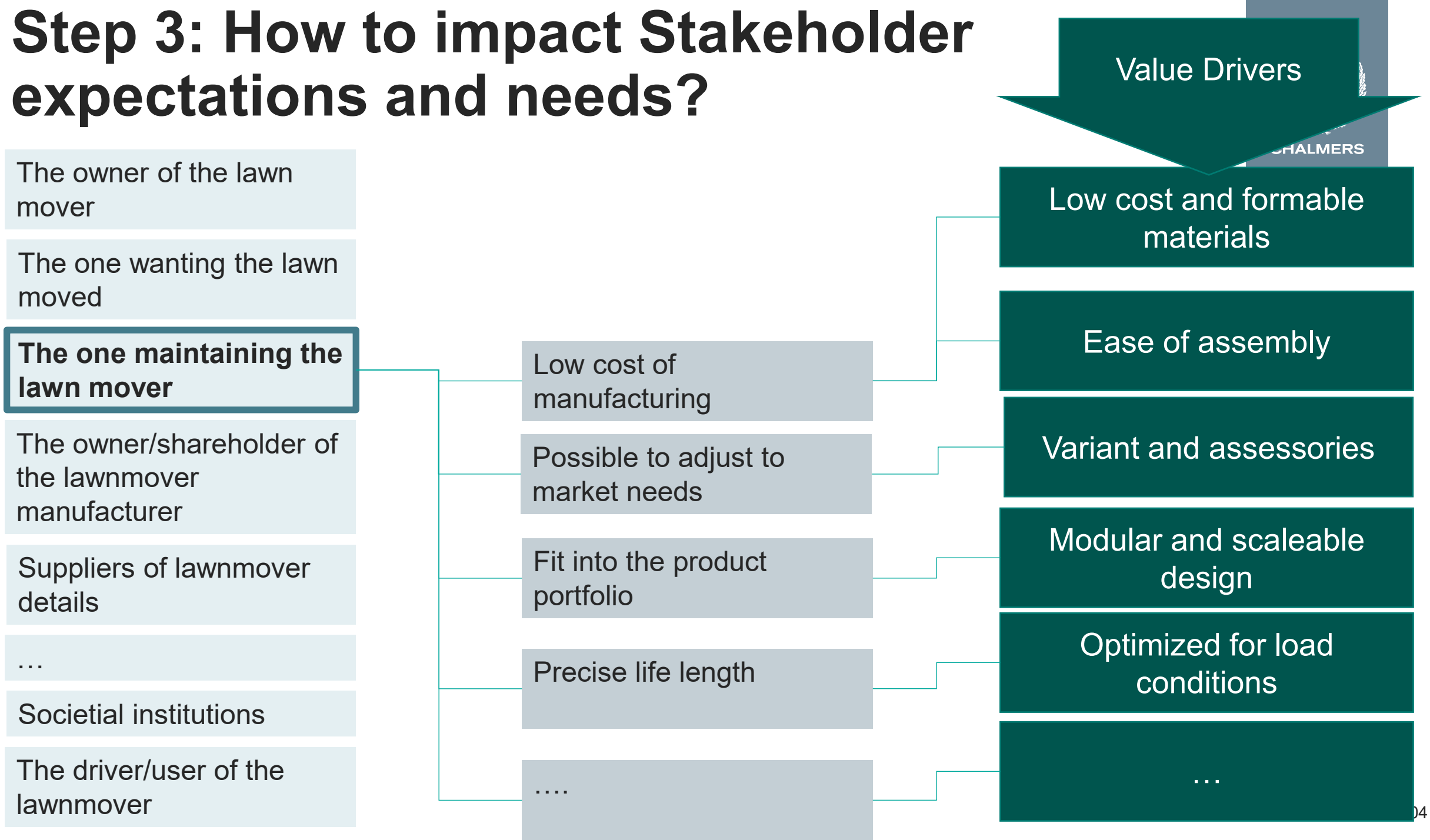
- The owner of the lawn mover
- The one wanting the lawn moved
- **The one maintaining the lawn mover**
  - Spare parts availability
  - Easy to access and replace parts
  - Simple to lubricate
  - Access to maintenance instructions
  - ….
- The owner/shareholder of the lawnmover manufacturer
- Suppliers of lawnmover details
- …
- Societial institutions
- The driver/user of the lawnmover

In summary

Different Stakeholders have Different Expectations and needs!

DESIGNING TO MEET EXPECTATIONS AND NEEDS

Step 3: How to impact Stakeholder expectations and needs?



Value Drivers?

Value Drivers are the factors that a product developer can define, design and deliberately tailor during the development process – that have a direct impact on the Stakeholder Needs (and expectations)

Design – finding a concious compromise!

Satisfying all stakeholders expectations and needs seldom possible…

- **When we assign priorities to stakeholder expectations an needs we get biased set of expectaions to meet. We can label this ”Value Creation Strategy”.**
- **Hence, a specific product may perform differently, when assessed against different Value Creation Strategies.**

Observation!

Undertanding what trade-offs can/need to be made is a goldmine for decision making during development

A (Business) strategy is to set priorities to what needs and expectations to prioritize!

”We want to have a performance optimised product/process”

- may imply that other needs are less prioritised

”We want to maximize up-time and availability”

- may imply that performance cannot be optimised

We call such strategy ”the value creation strategy –VCS”

MORE ON VALUE DRIVERS

What need to be designed?

The attributes and criterias (**Value Drivers**) that have an impact on the Stakeholder Expectations and needs are of differenct character.

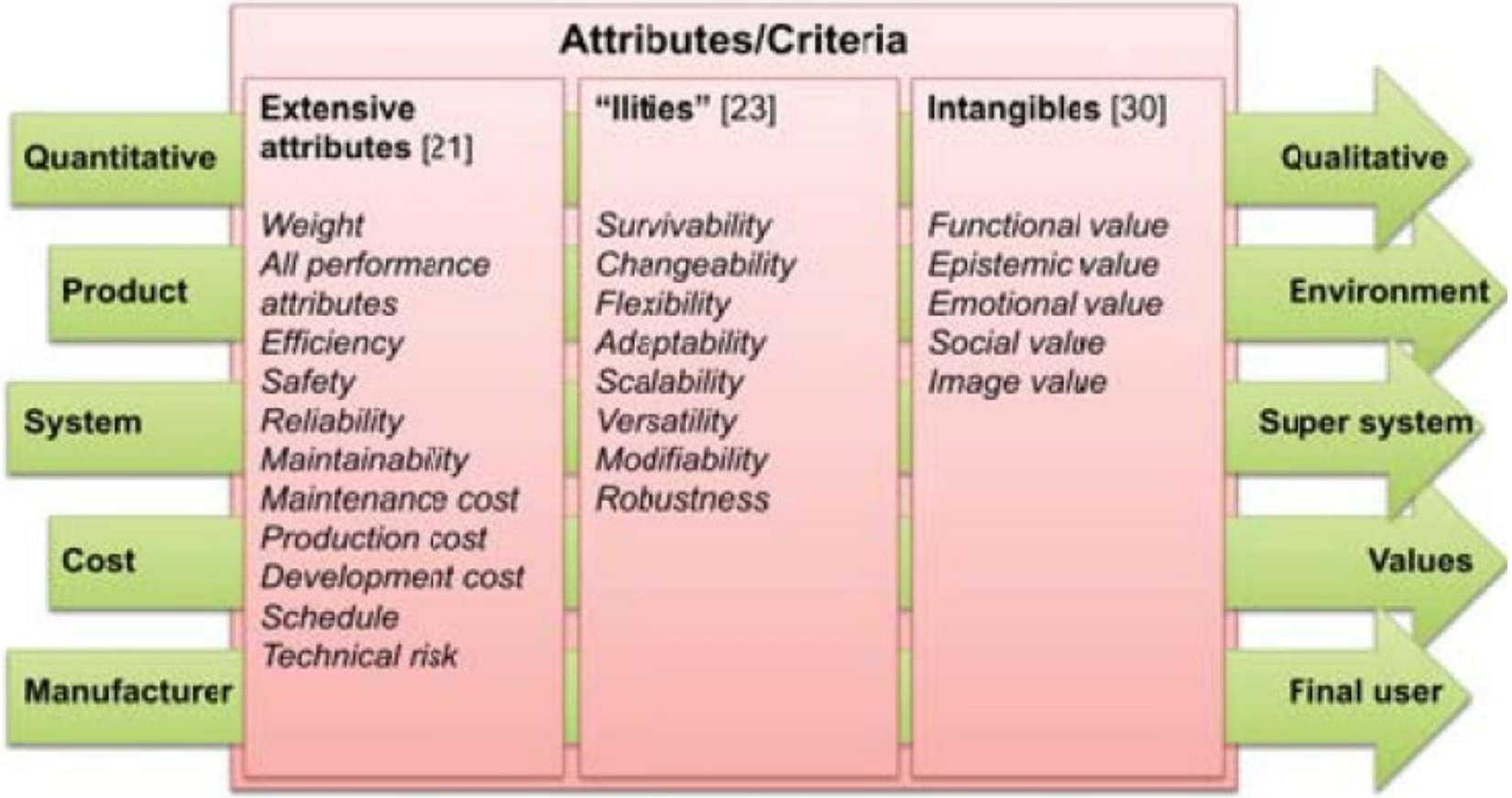


Figure 1: Attributes/Criteria for Value-driven assessments

Extensive attributes

Extensive attributes are well establised and often quantifiable, ”suitable” for classical product development. E.g. Weight, performance, Efficiency, Product Cost etc.

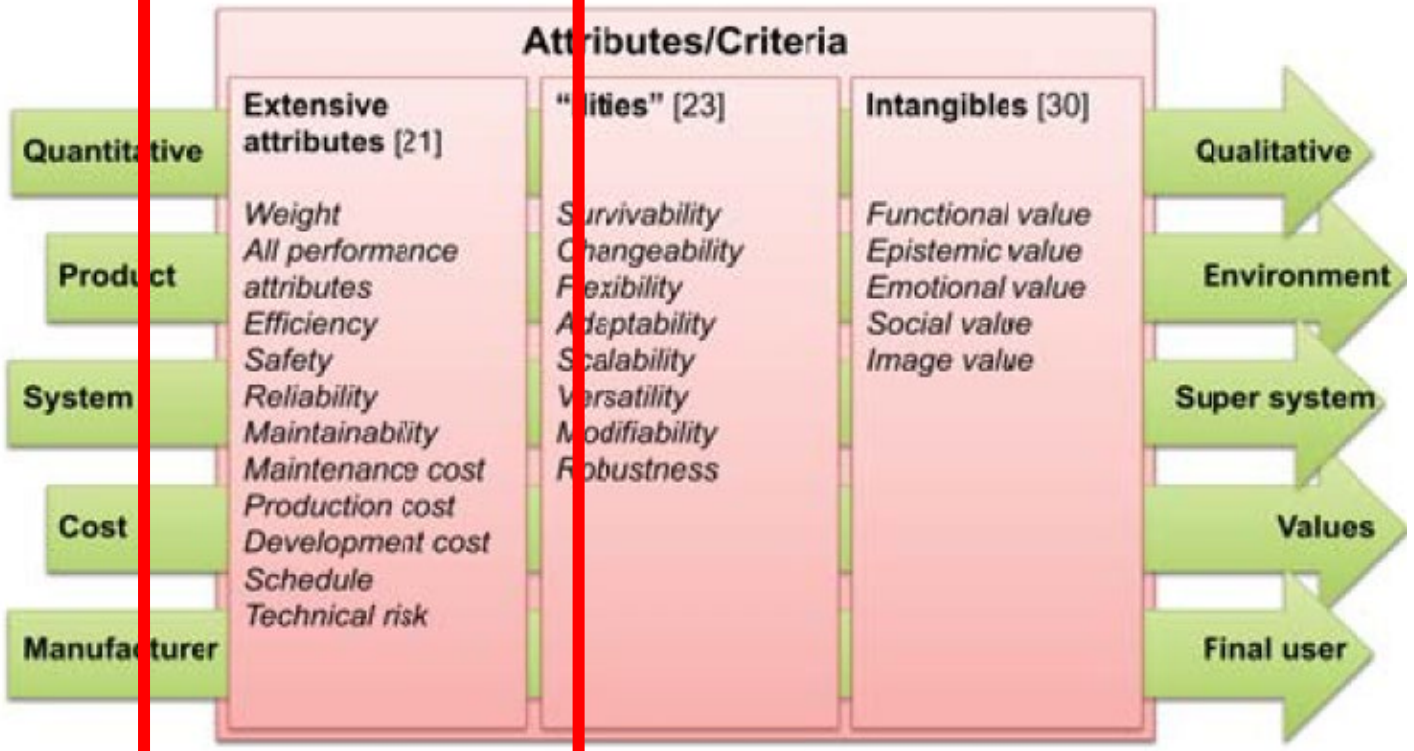


Figure 1: Attributes/Criteria for Value-driven assessments

[21]Collopy, P., Horton, R. (2002): Value Modeling for Technology Evaluation, AIAA-2002-3622, American Institute of Aeronautics and Astronautics.

”-ilities”

”ilities” characterizes behaviour of the product in use situations, such as Changeability, Maintainability, Resilience etc. Quantification may be possible to define but often relative and context dependent.

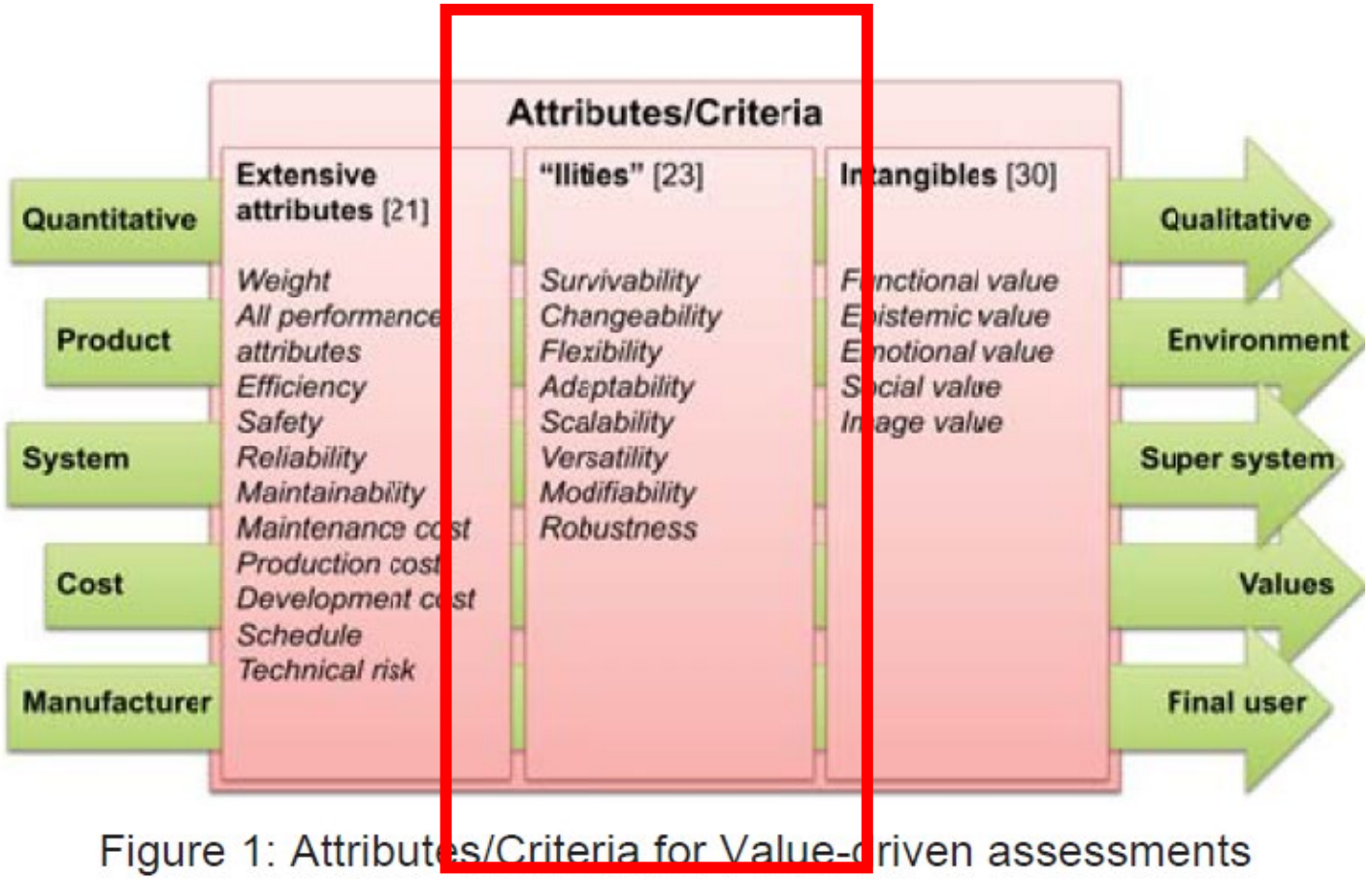


Figure 1: Attributes/Criteria for Value-driven assessments

[23] Ross, A., Hastings, D., Warmkessel, J., Diller, N. (2004): Multi-Attribute Tradespace Exploration as Front End for Effective Space System Design, Journal of Spacecraft and Rockets, Vol.41, No.1, pp. 20-28

Intangibles

Intangibles are closely related to user perceptions and preferences. Such properties are often important, yet typically difficult to quantify. A challenge is to correcly defie, interpret and deal with intangibles in engineering.

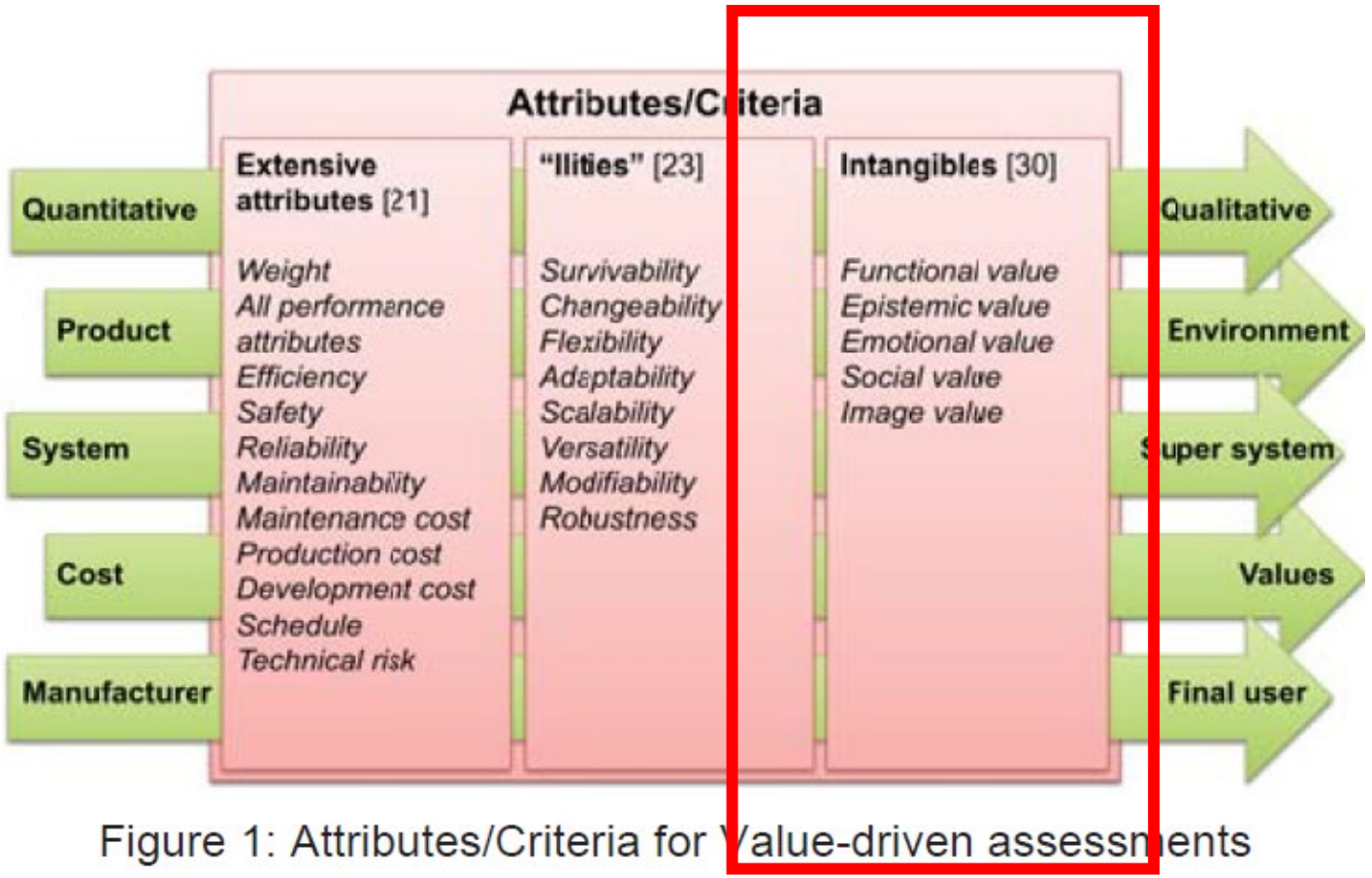


Figure 1: Attributes/Criteria for Value-driven assessments

[30] Swartz, T.A., Bowen, D.E., Brown S.W. (1992): Fifteen years after breaking free: services then, now, and beyond, Advances in Services Marketing and Management, Vol. 1, pp. 1-21.

MORE USEFUL VALUE CONCEPTS

Stakeholder Expectation - Needs *+ Prio =* *Value Creation Strategy*

Categorised in Value Dimensions

Value Creation Stategy

A Value Creation Strategy (VCS) is a set of prioritized needs. A VCS is typically used as input to finding/developing solutions.

A Value Creation Strategy also allows to select what needs to included and not.

Example: We give prioritize that the engine need to start during all conditions.

We do not include the conditions for the driver and the need to care for visibility (in this specific study..)

Note: A ”Value Creation Stategy” can be seen as a way to organize a ”Mission Statement” (ref PPU085 course)

Categorised in Value Dimensions

Value Dimension

Value dimensions are abstract **high level categories of Needs**. Each need should only have one identified value dimension, for example mission performance, integration ability, product development efficiency and so forth.

- **E.g. ”Availability” is a dimension to the Stakeholder Need of ”a car engine to be possible to start at any tempertature”**
- **Other needs may (probably) also fall under the same category such as ”A driver of a car must always have clear visibility from the driving position”**

*Stakeholder Expectation - **Needs** + Prio = Value Creation Strategy*

Categorised in Value Dimensions

Value Drivers

Value Drivers

Value drivers indicate Key Engineering Characteristics given a specific Value Creation Strategy (i.e. for a specific stakeholder profile and context). They represent proposed directions of investigation since they seem to have a significant influence on the perceived value in a given context. Value Drivers themselves are not attached to a target value or function, but they tend to result in measurable objectives and later, based on these, requirements.

- **Examples for an aircraft engine component of Value Drivers are “Minimum expected life” that impact performance in service, “mass” that impact “take-off weight” or “number of interfaces” that impact how easy a technology/component is to integrated into a system.**

A REAL CASE – A320 NEO
From Expectations to a Value Creation Strategy

Example : Re-engine of Aircrafts

NEO – New Engine Option

Airbus are competing through improving efficiency of their aircraft by introducing new type of engines to their already certified (but not produced…) aircrafts

- **Such replacement require development and re-design of their aircrafts to match the new engines, and vice versa.**

Value Creation Strategy for New Engine Option

Value Creation Strategy – New Engine Option		
Stakeholder Expectation	**Stakeholder Need**	**Value Dimension**
15 % Higher Overall Productivity of Aircraft	Increased Payload	Mission Performance
	Greater Range	Mission Performance
	Reduced Cash Operating Cost	Mission Performance
Minimal Impact to the aircraft	Demonstrate that maximum re-use of components and equipment	Integratation ability
	The more we can simulate behaviour can reduce cost of fligth testing.	Design Process Efficiency
Ensure availability in operation	High compliance of thermal equipment	Availability
Development Schedule is tigth and require quick loops and trade studies	Mature Simulations at early stages Quick Trade Study Loops	Development Process Efficiency

Value Assessment

Value Assessement is about ***assessing to what extend a solution satisfied the needs*** and can be done on all system levels

Value Creation Strategy – New Engine Option			
Stakeholder Expectation		**Stakeholder Need**	**Value Dimensio**
15 % Higher Overall Productivity of Aircraft		Increased Payload	Mission Performance
		Greater Range	Mission Performa
		Reduced Cash Operating Cost	Mission Performance
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Possible to adjust an existing aircraft

High potential but require too much re-design!

Value Assessment (performance example)

Value can be assessed by defining a relation between the Value Drivers and the Stakeholder Needs (or Value Dimension). Most often this require assumptions to be made.

Stakeholder Expectation	Stakeholder Needs	Value Dimensions	Value Drivers
15% higher overall productivity of aircraft	Increased payload	Mission Performance	Weight
	Greater range		Range
			Specific Fuel Consumption

$$MissPerf = \text{range} + \frac{1000}{weight} + \frac{1}{SFC}$$

Prioritize what needs to focus on!!

A Value Creation Stategy can be specified in more detail as a part of the design work.

”Let’s search for concepts for a particular situation and/or part of the entire aicraft”

VCS (362) Pylon Thermal Design		
Stakeholder Expectation	**Stakeholder Need**	**Value Dimension**
15 % Higher Overall Productivity of Aircraft	Increased Payload	Mission Performance
	Greater Range	Mission Performance
	Reduced Cash Operating Cost	Mission Performance
Minimal Impact to the aircraft	Demonstrate that maximum re-use of components and equipment	Integratation ability
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Development Schedule is tigth and require quick loops and trade studies	Mature Simulations at early stages Quick Trade Study Loops	Development Process Efficiency

Identify the characteristics that influences the Needs and that you can ”Design”

The value drivers are unique for a design study!

VCS (362) Pylon Thermal Design		
Stakeholder Expectation	**Stakeholder Need**	**Value Dimension**
15 % Higher Overall Productivity of Aircraft	Increased Payload	Mission Performance
	Greater Range	Mission Performance
	Reduced Cash Operating Cost	Mission Performance
Minimal Impact to the aircraft	Demonstrate that maximum re-use of components and equipment	Integratation ability
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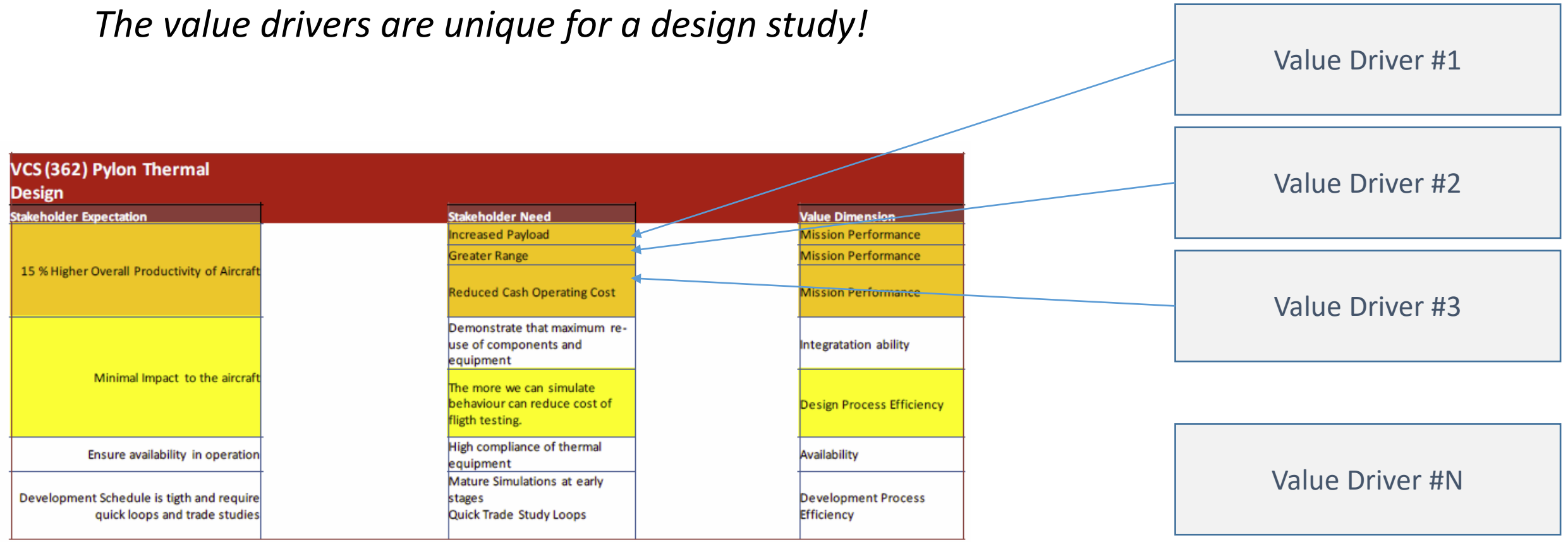


Summary of lecture until now

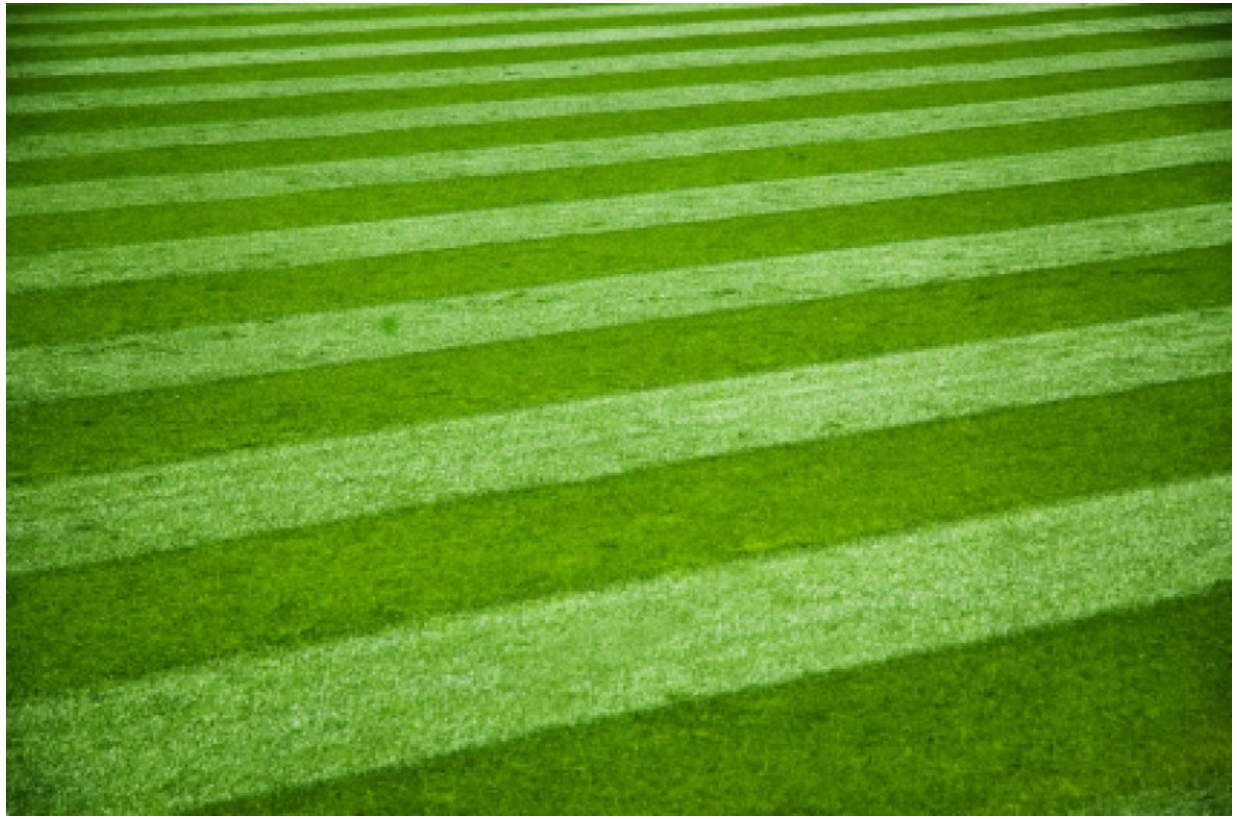
Stakeholders have an interest in the product and/or service and value the ”utility” of the product and/or service

- **A method that cover identifiation of stakeholder, analysing their expectations and needs, and forming a ”value creation strategy” has been presented**
- **The nomenclature used is specific and fit together**
  - **Stakeholder Expectations and Needs**
  - **Value Creation strategy**
  - **Value Dimensions**
  - **Value Drivers**
- **You as a design team / company need to create a ”value creation strategy” for what stakeholders need to prioritise**
- **Next is to analyse these for the bike case, and introduce also a bottom up analysis of what a product actually provide (function) .**

A STEP-BY STEP GUIDE- PREPARATION FOR BIKE CASE ANALYSIS (DONE AT SUPERVISION SESSION)

PSS Project guide

Suggested way of applying onto a PSS product development situation



- **Identify first who are the stakeholders, and what are their expectations/needs?**

STAKEHOLDER OF A BIKE?

EXCERSISE AT SUPERVISION SESSION

Look into the project

1. Create a Value Creation Strategy → Stakeholder Expectations and **prioritized needs**

2. Model Functionality of an existing Product → List of Functions from the existing product

3. Compare List Needs with Functions provided → What functions satisfy Needs and Value Drivers

4. Search for new and alternative PSS solutions

5. Evaluate…

1. Identify Stakeholders, and the Stakeholders Expectations and needs

Example

Stakeholder	Expectation	Needs	Dimensions
User	Easy to operate	Reliable start	Engine performance
		Low effort to control	Manouverability
	Always ready	Reliable Power Source	Engine Performance
		Reliable Parts	Durability
	Good result during all conditions	Always sharp	Cutting Performance

1. Value Creation Stategy – prioritize Needs

Example

Stakeholder	Expectation	Needs	Dimensions
User	Easy to operate	Reliable start	Engine performance
		Low effort to control	Manouverability
	Always ready	**Reliable Power Source**	**Engine Performance**
		Reliable Parts	Durability
	Good result during all conditions	**Always sharp**	**Cutting Performance**

1. Value Creation Stategy – prioritize Needs

Bike

Stakeholder	Expectation	Needs	Dimensions

RANK THE NEEDS FROM THEIR IMPORTANCE ON WHAT YOU WANT TO ACHIEVE!

1. Identify Value Drivers for prioritized Needs

Example

Stakeholder	Expectation	Needs	Dimensions	Value Drivers
User	Easy to operate	Reliable start	Engine performance	
		Low effort to control	Manouverability	
	Always ready	**Reliable**	**Engine Performance**	**Power** **Ignition**
			Durability	
	Good result during all conditions	**Always sharp**	**Cutting performance**	**Blade Sharpness** **Engine Power** **Blade Speed**

A product realises function(s)

Main Function: Cut Grass

Function of Wheel

- Enable movement
- Provide ground clerance

- **More on this by Jakob**

2. Model functionality of an existing product

Identify what functions the current product provide

Excersise on after the break

Product Functions

Cut Grass

2. Model functionality of an existing product

Identify what functions the current product provide

Product Functions

3. Compare List Value Drivers with Functions provided

Value Drivers

Product Functions

Cut Grass

Blade Sharpness

Engine Power

Blade Speed

4. Search for new and alternative solutions

How can we ensure that the **Always sharp** stakeholder need is fulfilled?

Product Functions

Value Drivers

Cut Grass

Blade Sharpness

Engine Power

Blade Speed

Mechanical Sharpner on lawn mower

Sharpening Service

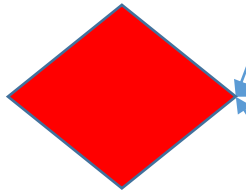
Blade Replacement

4. The solutions may require ”enablers”

Identify key enabling technologies, products, services?

Value Drivers

- **Blade Sharpness**
- **Engine Power**
- **Blade Speed**



- **Mechaincal Sharpner on lawn mower**
- **Sharpening Service**
- **Blade Replacement**

- Product Design Feature
- Sharpness detection
- Service provider
- Maintenance concepts

4. Bundle the concepts into PSS concepts

Note that many service concepts use the life cycle as variation

The ”Always Sharp PSS concept”

Value Drivers

- **Blade Sharpness**
- **Engine Power**
- **Blade Speed**

- **Mechaincal Sharpner on lawn mover**
- **Sharpening Service**
- **Blade Replacement**

- Product Design Feature
- Sharpness detection
- Service provider
- Maintenance concepts

Alternative PSS’s examples (samples..)

Provide Always perfect lawn

Provide Always Sharp Lawn mower

Mow Lawn

Sell Lawn Mower

Provide Spare parts and a sharpner for separate sales

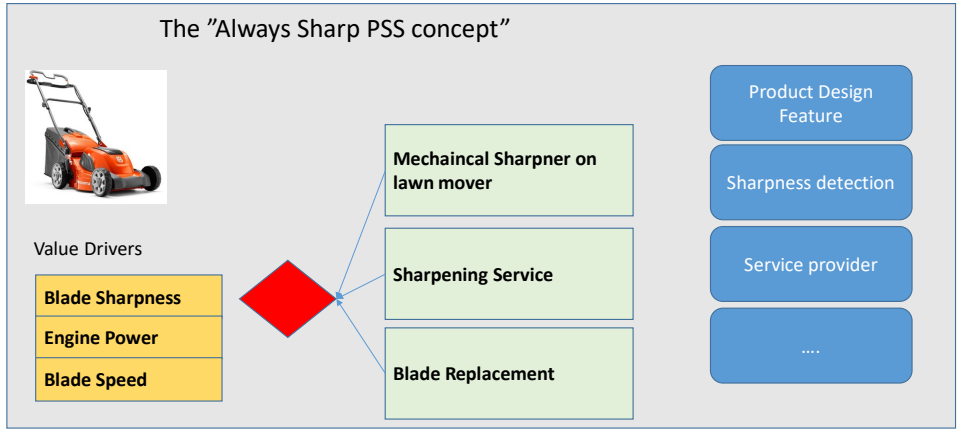
Sharpen

Mow Lawn

Evaluation of PSS

Evaluate satisfaction of Stakeholder Expectations and needs?

Evaluate quantitatively the Life Cycle Cost alternatives



A product solution may be compared to a service alternative solution

Cost evaluated by Life Cycle Cost

- MORE WILL BE PRESENTED BY MASSIMO

Provide Always Sharp Lawn mover

Provide Spare parts and a sharpner for separate sales

Sharpen

Important for Project now

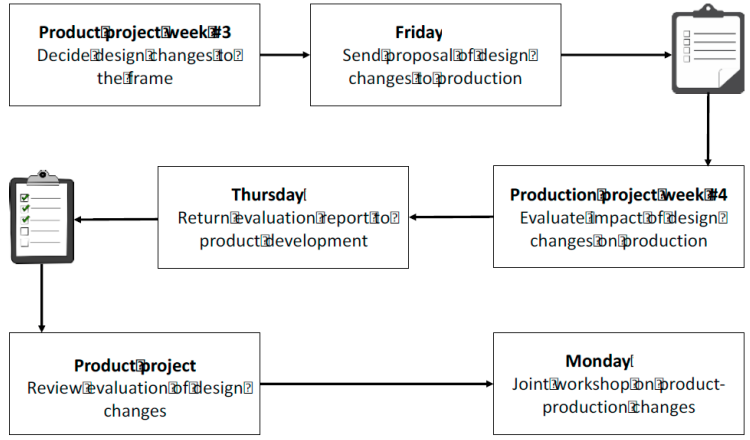
This week – Ensure to Create a **Value Creation Strategy** – and identified Key **Value Drivers**

Identify the **functions** for the bike – especially for the frame

Compare Needs and Value Drivers with functions available -> **identify** new ”enablers” to develop in the PSS offer

Identify and **share a first set of parameters** with production

- **Remember that parameters on the frame –key <u>for your PSS</u> – will need to be shared with the production team**



START OF BIKE ANALYSIS (TO BE DONE IN COMING SUPERVISION MEETING)

Stakeholder	Expectation	Needs	Dimensions

How do Industry Develop PSS solutions?

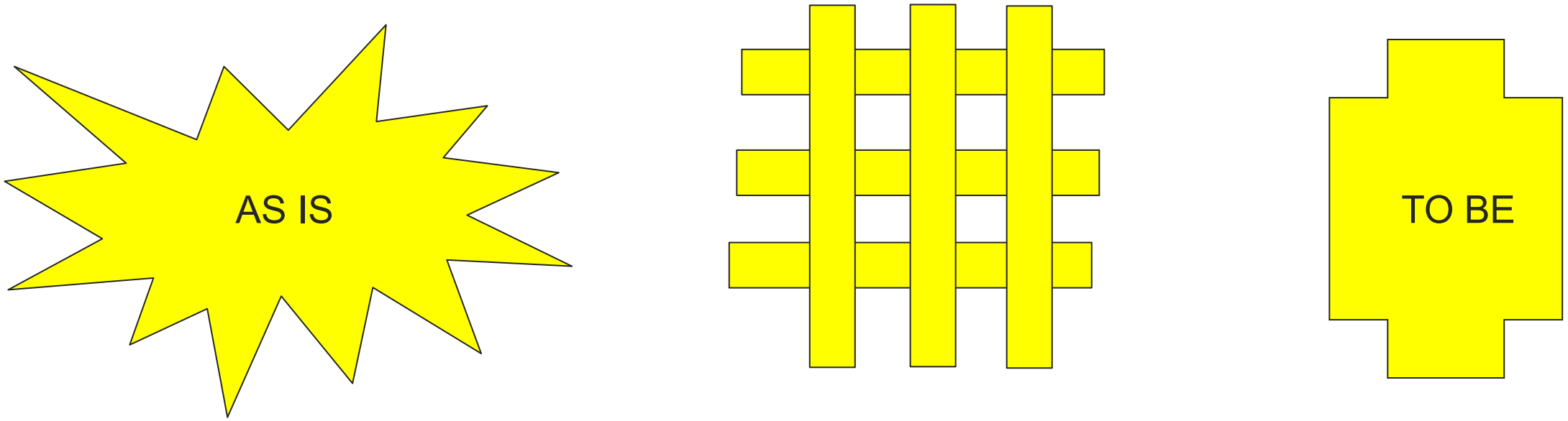
PSS development, industrial examples

- **What ”aids” are available?**
  - Getting a Grip on the PSS – Organise
  - Capture and understand needs
  - Development Process?
  - Can PSS be ”engineered”?
  - How to visualise and evaluate PSS’s?

PSS development, industrial examples

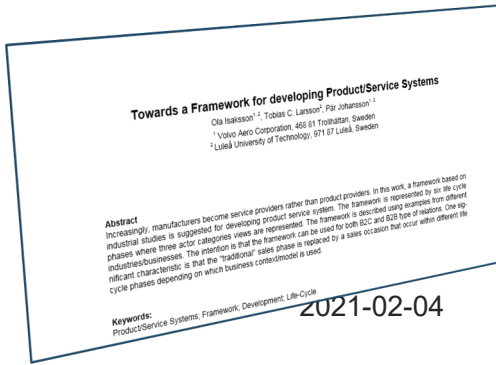
- What ”aids” are available?
  - Getting a Grip on the PSS – Organise
  - Development Process?
  - Can PSS be ”engineered”?
  - How to visualise and evaluate PSS’s?

A Framework – a means to communicate and organize fuzzy situations



Isaksson, Larsson, Johansson (2011), *Towards a framework for developing product/service systems*, 3d CIRP International Conference on Industrial Product Service Systems, Braunschweig

I CANVAS
Files>Reading Material > Extra

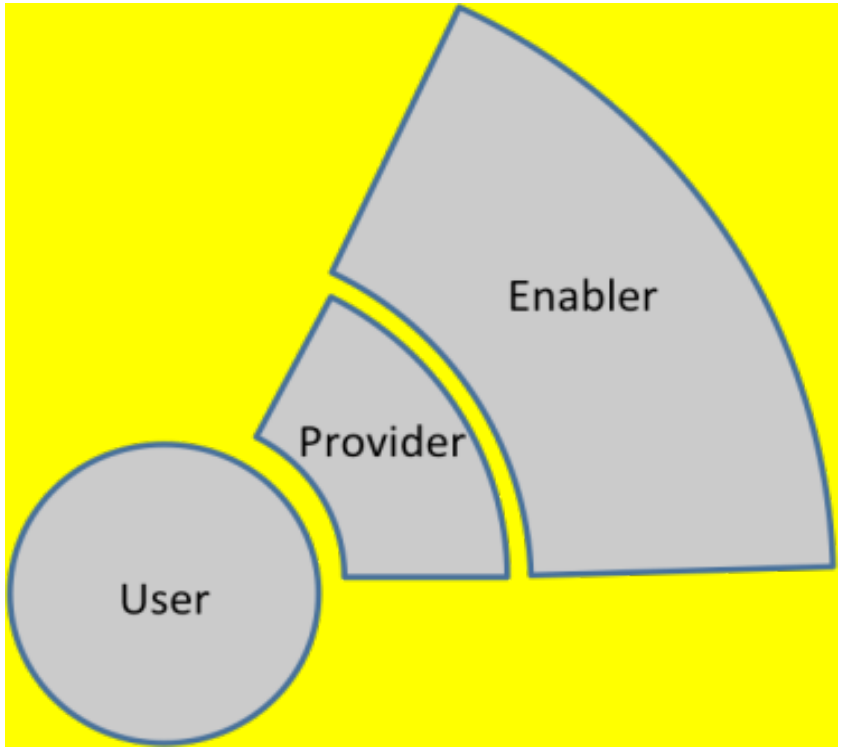

Towards a Framework for developing Product/Service Systems

Ola Isaksson[1,2], Tobias C. Larsson[2], Pär Johansson[1,2]
[1] Volvo Aero Corporation, 468 81 Trollhättan, Sweden
[2] Luleå University of Technology, 971 87 Luleå, Sweden

Abstract
Increasingly, manufacturers become service providers rather than product providers. In this work, a framework based on industrial studies is suggested for developing product service system. The framework is represented by six life cycle phases where three actor categories views are represented. The framework is described using examples from different industries/businesses. The intention is that the framework can be used for both B2C and B2B type of relations. One significant characteristic is that the "traditional" sales phase is replaced by a sales occasion that occur within different life cycle phases depending on which business context/model is used.

Keywords:
Product/Service Systems; Framework; Development; Life-Cycle

1. Define roles

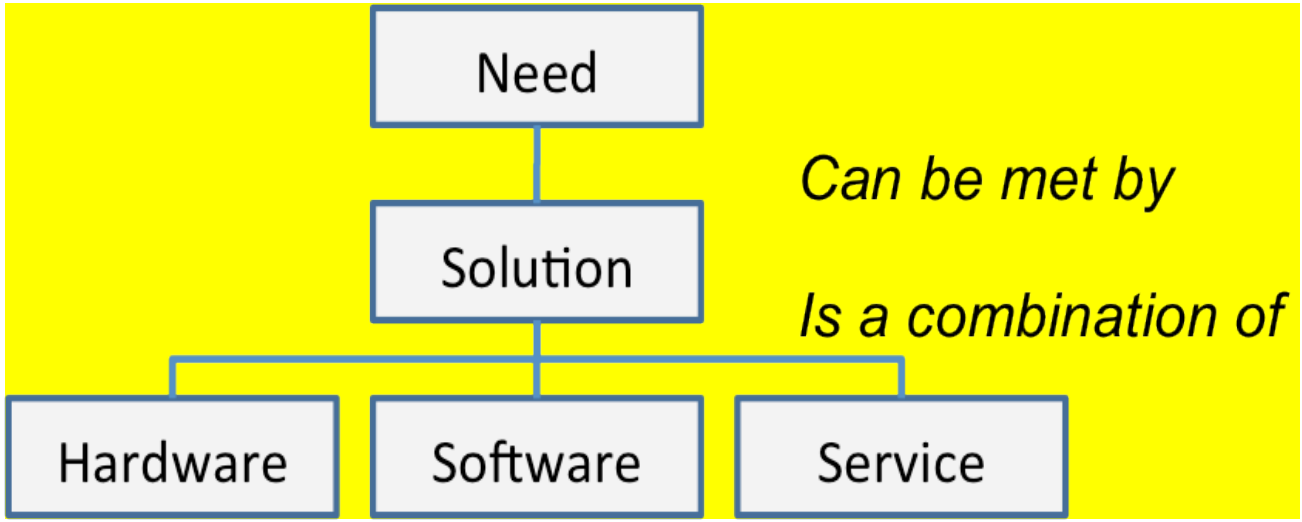


The User the one consuming/using the product-service system

The Provider the one providing the PSS

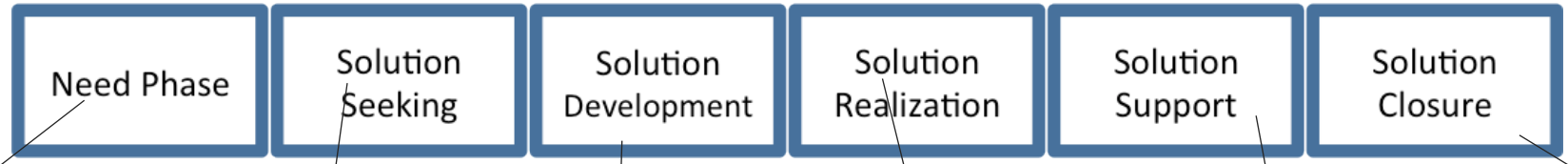
The Enabler is a collective term for suppliers of products, technologies, software, service that enable the value/function offer.

2. Basic relations



*Relation between **Need**, **Solution** and **Solution Components***

3. Organise into a life cycle for PSS



Need Phase: The need phase is where there a user has a needs and expectations.

Solution Seeking: The solution seeking phase is characterized by search for existing solutions, alternative solutions, sub-solutions etc. that may be possible to use.

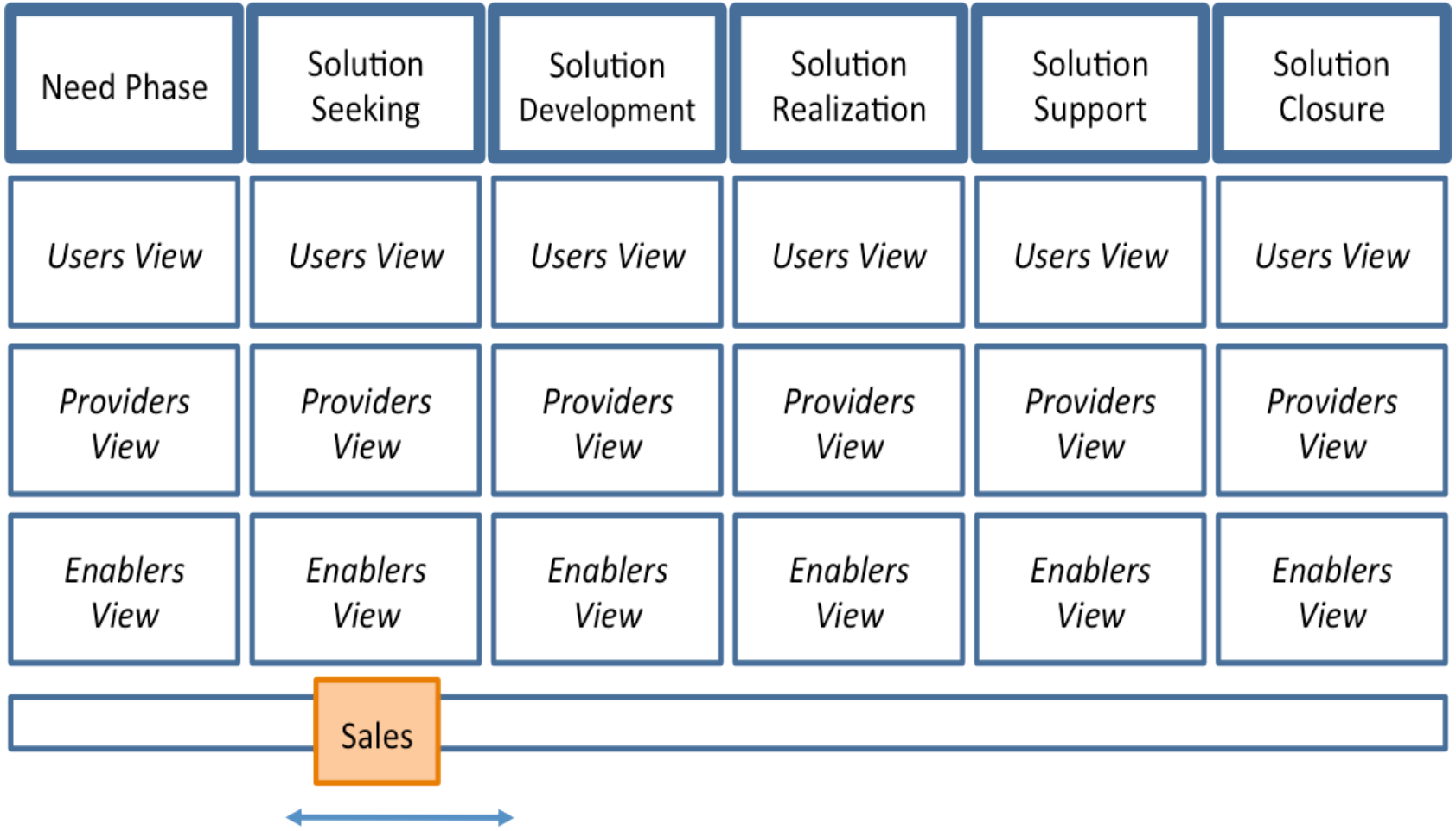
Solution Development: The solution development phase is the coordinated development of PSS components. The solution development phases may include a "traditional" product development process for developing the physical part of the solution.

Solution Realization: This is the most intriguing phase. Solution realization in traditional hardware terms is the manufacturing and delivery of the product.

Solution Support: The solution support phase represent the change in state of a product-service offer.

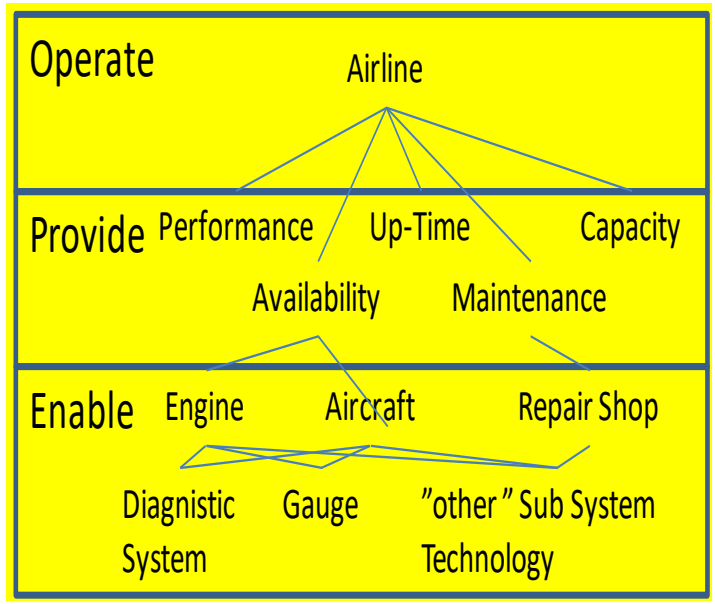
Solution Closure: The solution closure phase covers the end of use, and possible re-cycling state. Input is the product and services in use.

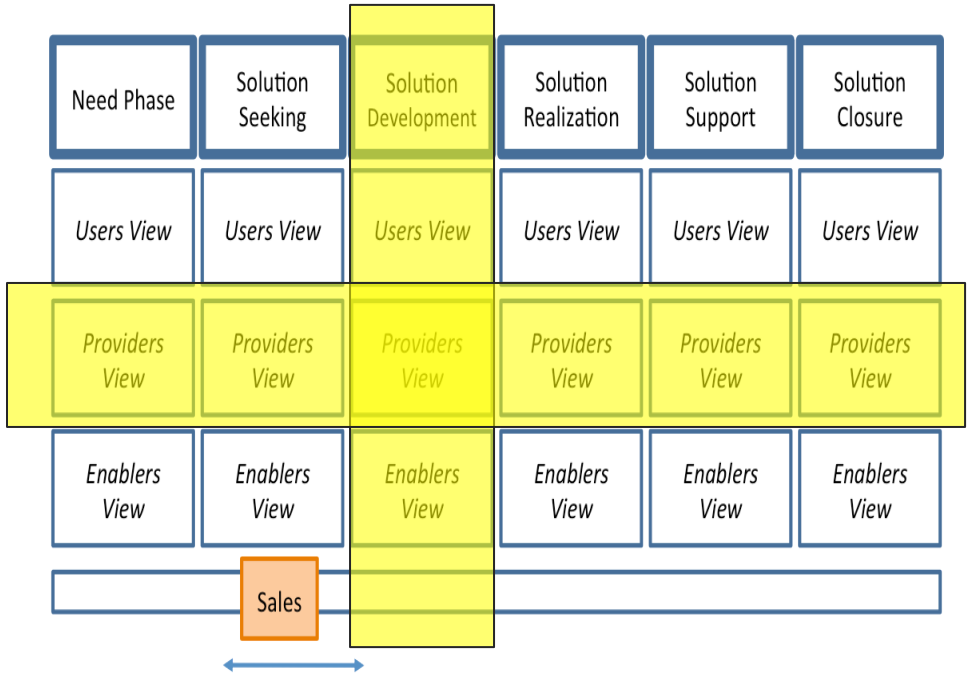
4. Combine into a framework



Use of Framwork

- Focussed questions for each role in each phase





PSS development

- Understand the Value of a PSS
- What need to be ”designed”
- **What ”aids” are available?**
  - Getting a Grip on the PSS – Organise
  - **Development Process?**
  - Methods and Tools
  - Can PSS be ”engineered”?
  - How to visualise and evaluate PSS’s?

(Larger) companies typically organise their development in processes

For product development, processes are often used

- as a decision making process
- as a development logic

Can these processes be used also for PSS development?

Pre-requisits for PSS Process development

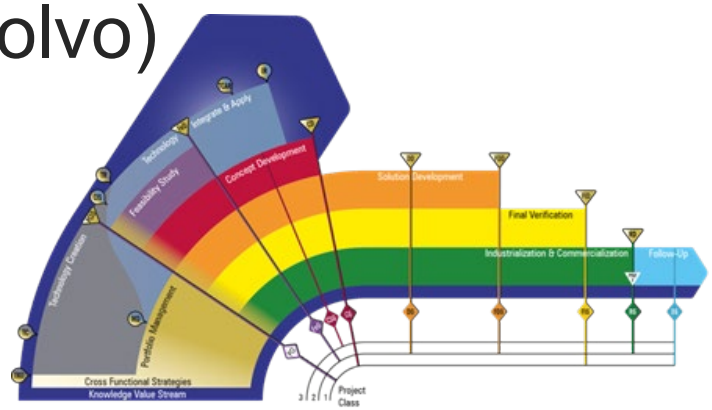
Challenge

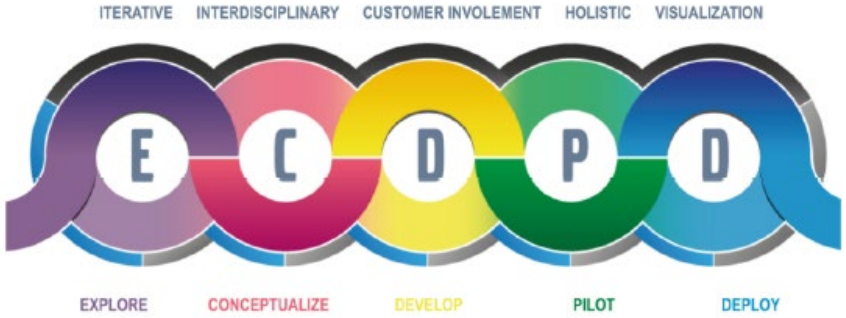
Hardware, Software and Services have

- different life cycles
- different means for verification
- different ways of definition
- different ways to visualize
- different need for disciplinary tools

:: different in (too) many aspects

Product Development (left) vs Service Development (right) (Volvo)





- Product development realize a requirement specification
- Product behaviour can be verified through physical and/or virtual tests
- Can be decomposed and assembled
- Results in a ”hard” product

- A service is consumed and produced simultaneously
- Verified via customer interaction (typically)
- The completeness matter
- ”Soft” product

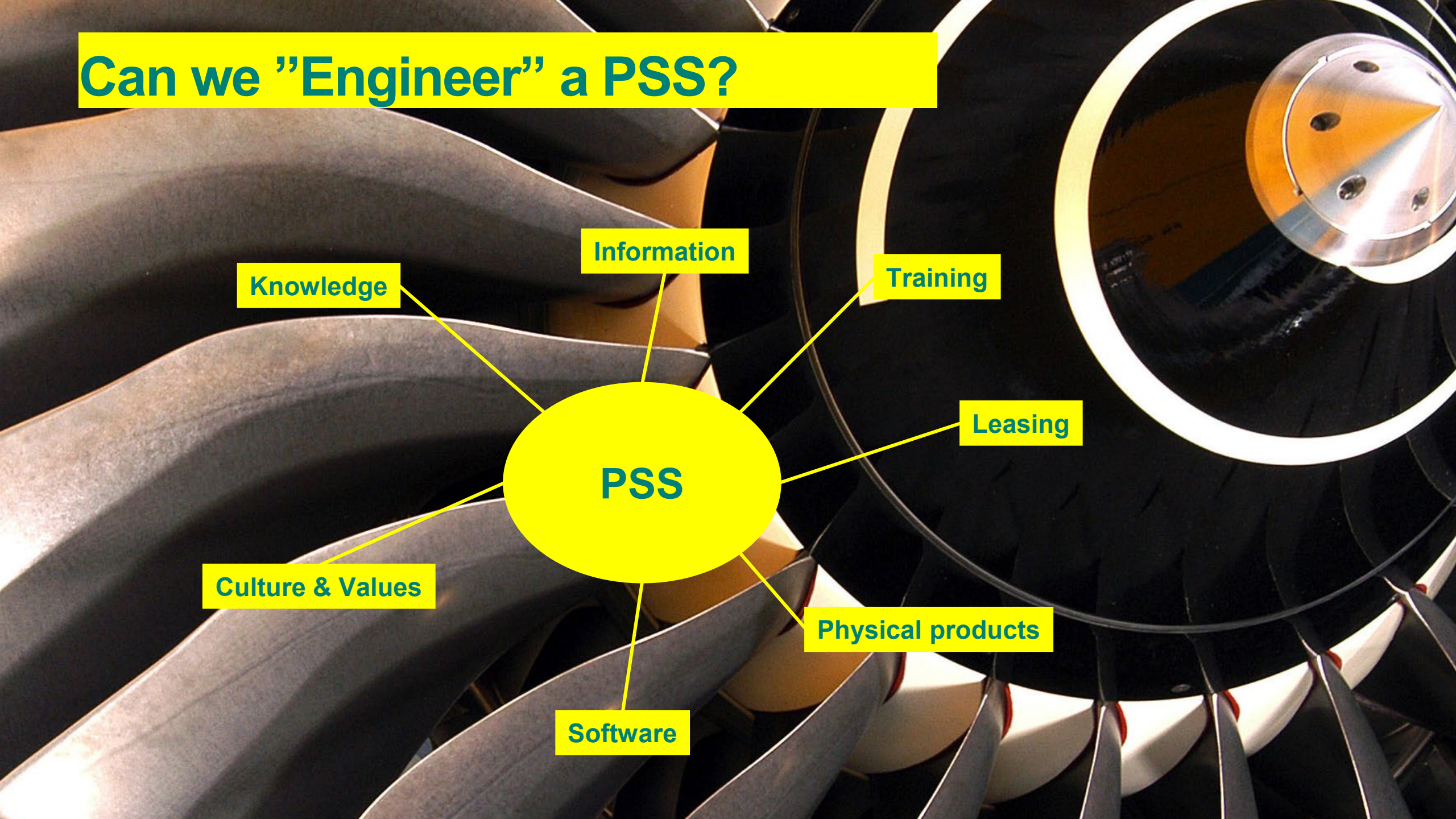
Trend – Manufactures show increasing interest in ”scrum” and ”agile” development methods, as software and services become a larger part of the value of products.

PSS development, industrial examples

- ”

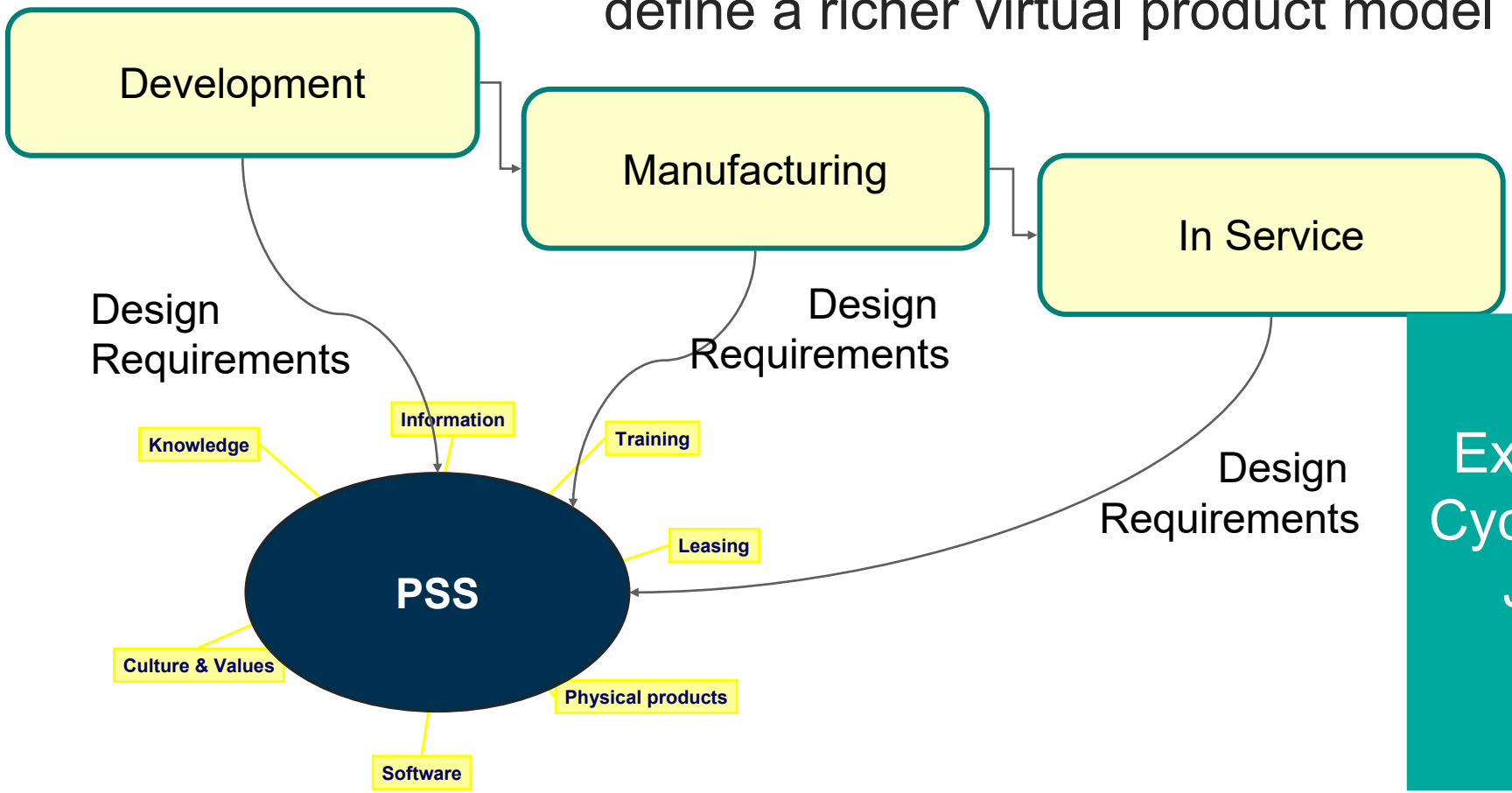
- **What ”aids” are available?**
  - Getting a Grip on the PSS – Organise
  - Development Process?
  - **Can PSS be ”engineered”?**
  - How to visualise and evaluate PSS’s?

Can we ”Engineer” a PSS?



Idea: PSS Design

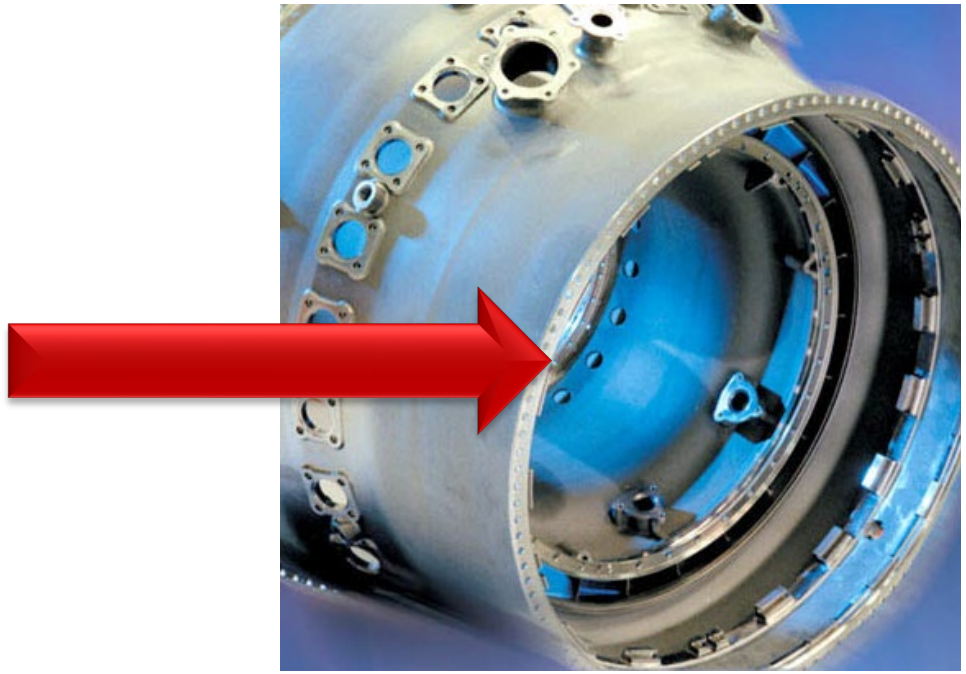
Take a PSS view and adopt the engineering environment to define a richer virtual product model



Expected to Serve in a Life Cycle Availability offer from a Jet Engine Component Manufacturer

Step 1: PSS Design of a Flange

- How to design a “simple” Flange with alternative Manufacturing and Maintenance Concepts



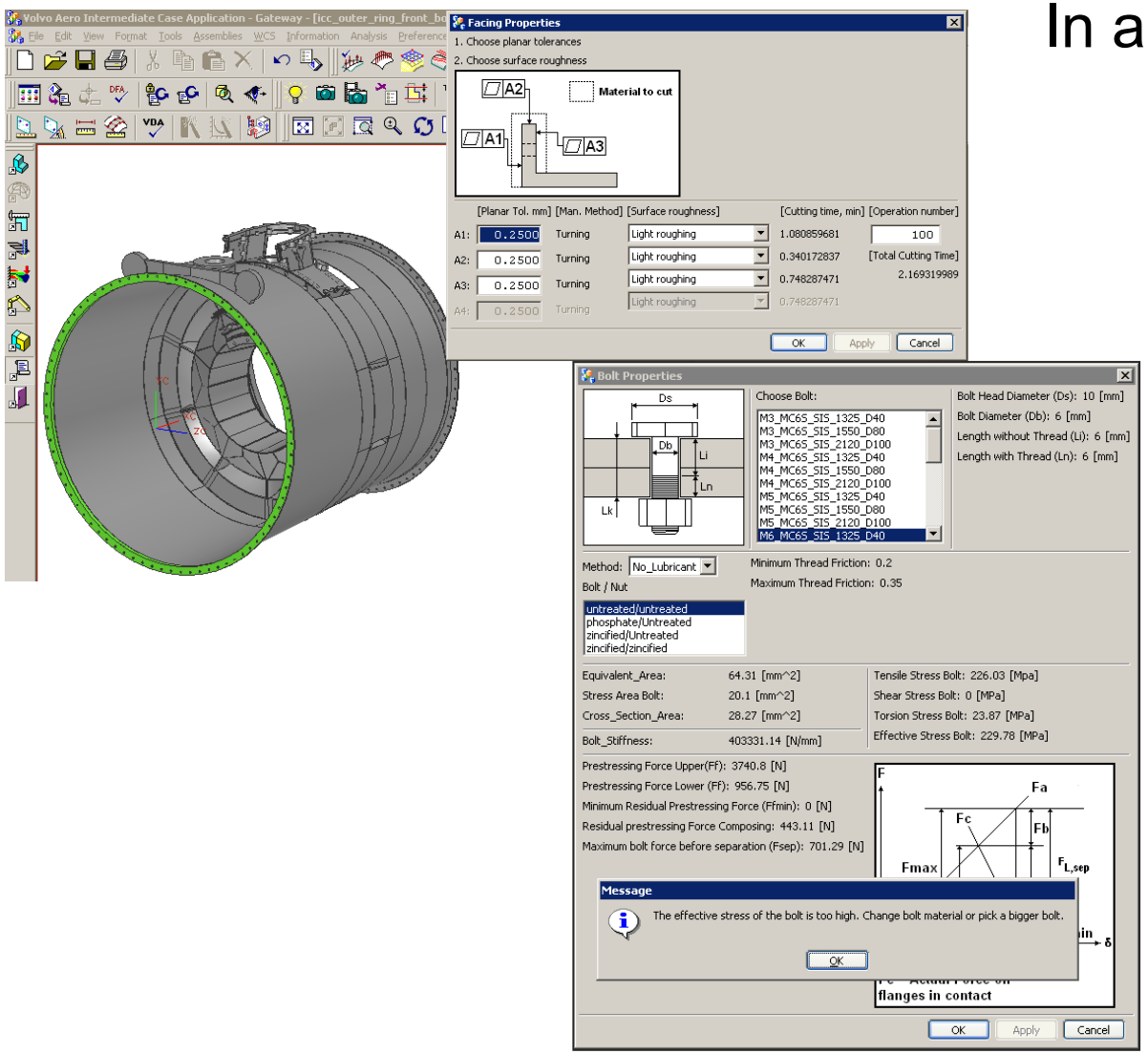
Hardware alternatives

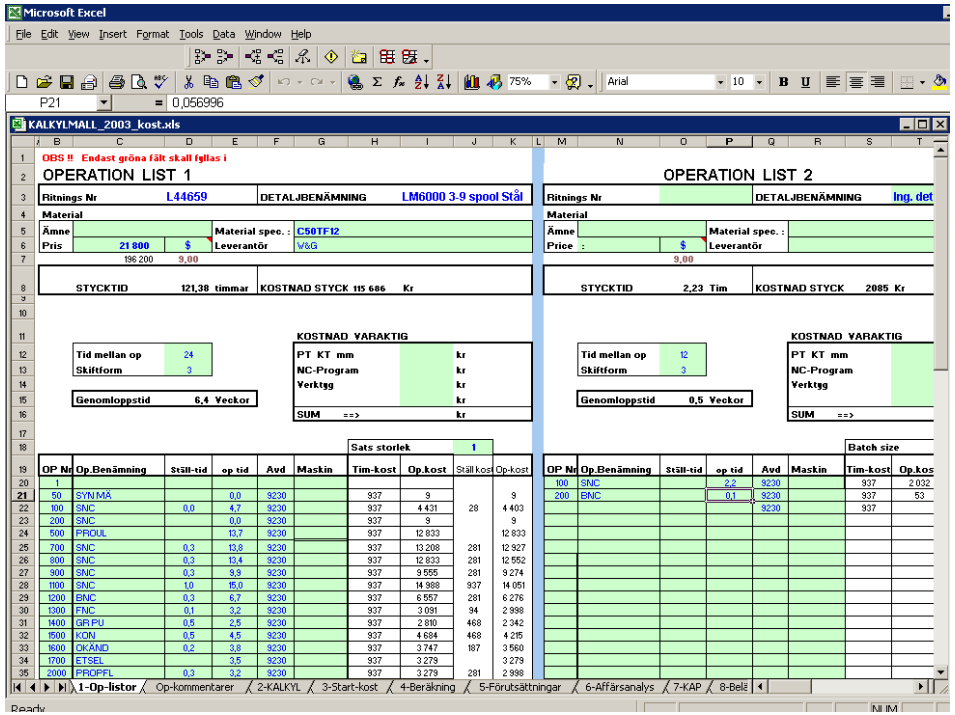
Manufacturing alternatives

Maintenance alternatives

Flange design, cont.

Design knowledge implemented
In a knowledge engineering system

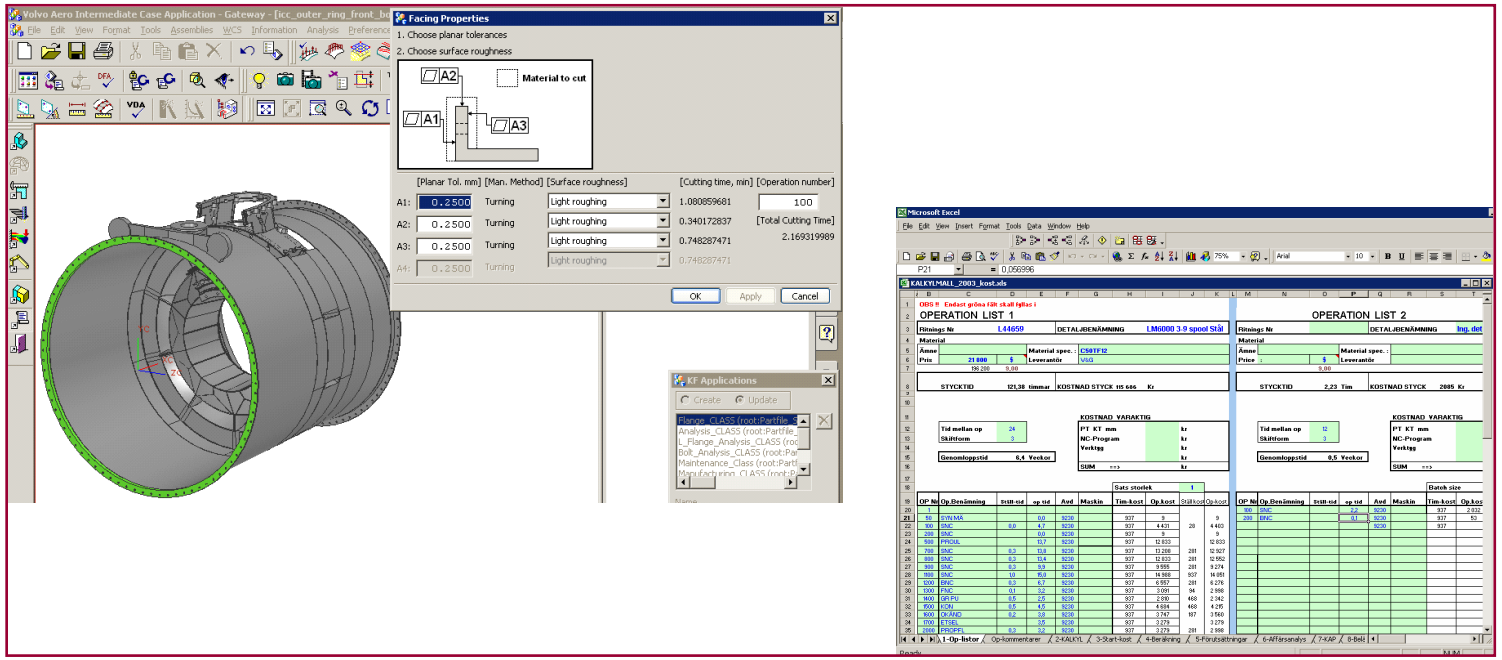




Simulates downstream activities in early phases.

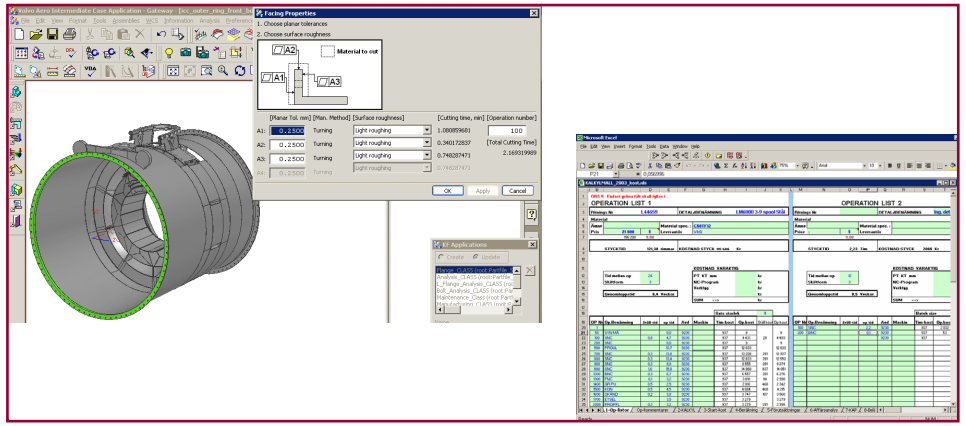
Result Step 1: Engineering Capability Demonstrated

Element of a Modeling and Simulation capability of a ”PSS Product”



Step 2: Apply in an integrated Context

Integrated Product and Manufacturing Design



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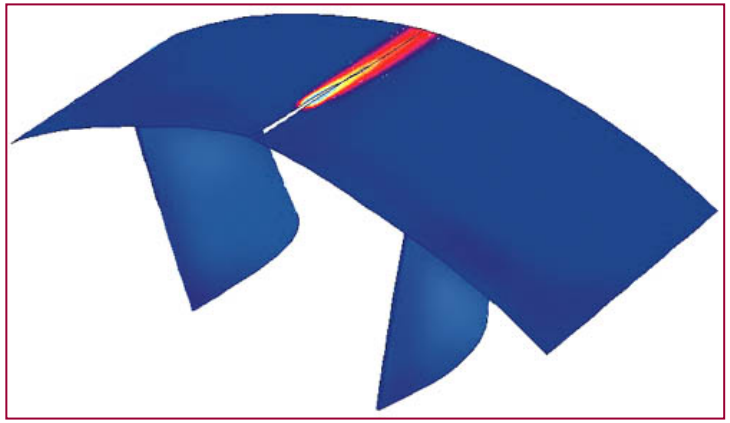
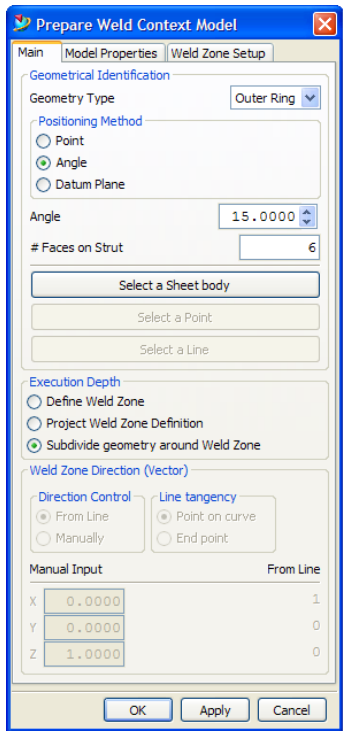
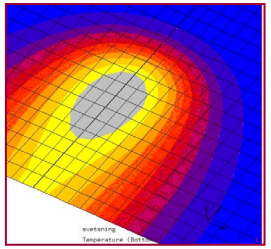
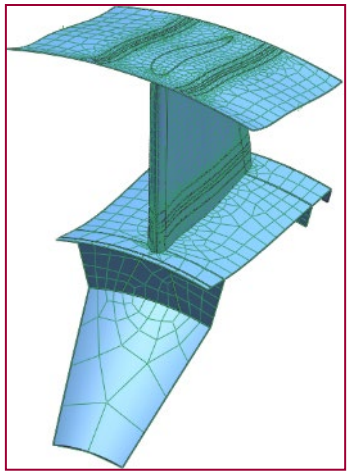


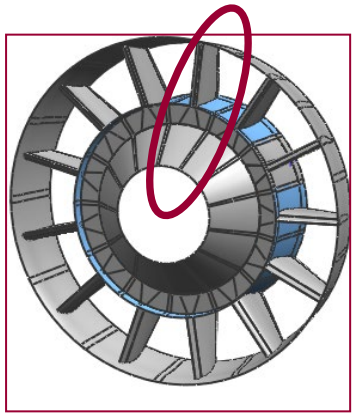
Result Step 2: Two Technologies integrated

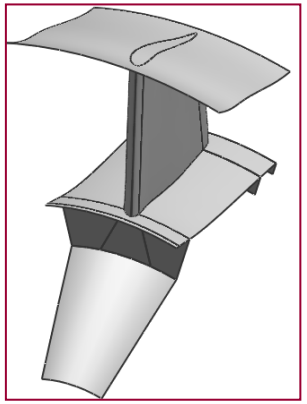


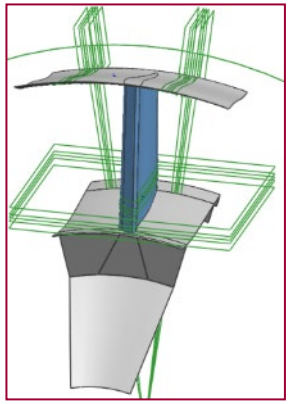
- Integrated technologies demonstrated Capabilities







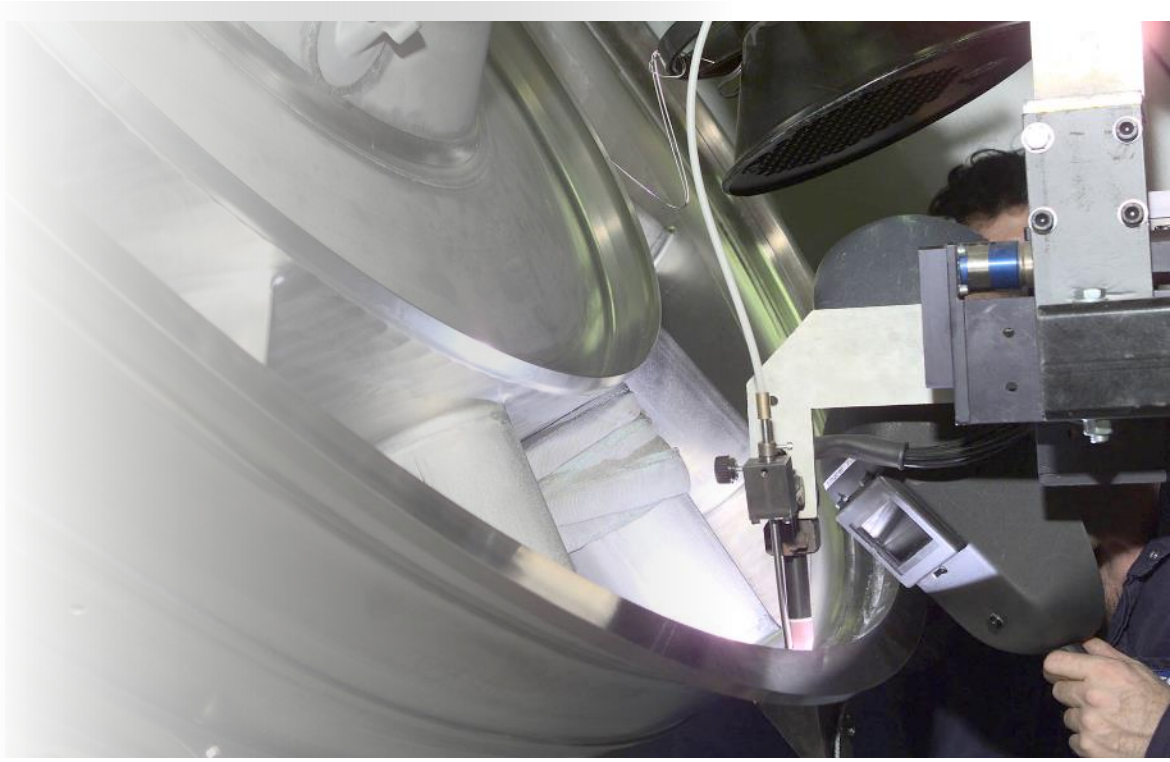




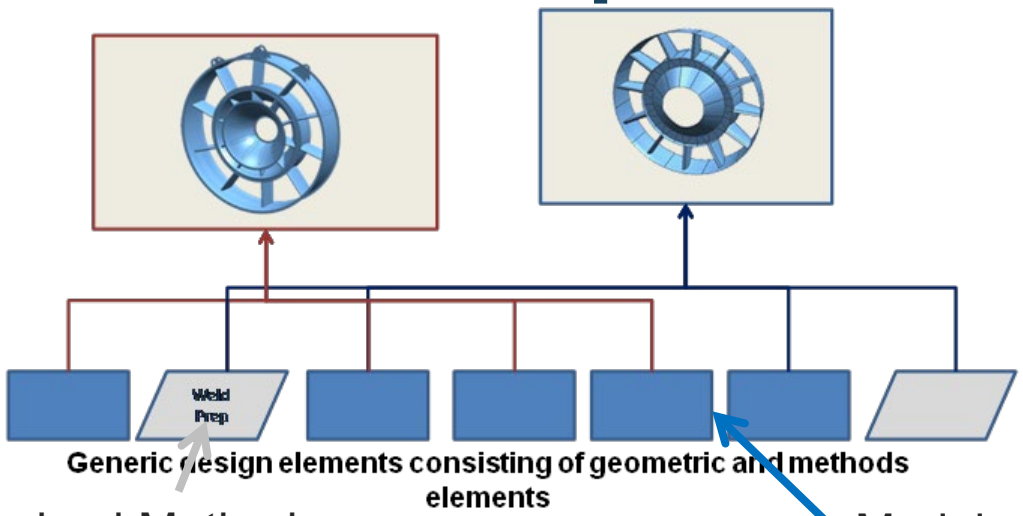
Step 3: Deploy in Business

- The company deploying these technologies for new development, re-design and re-manufacturing design

- Effects:
  - Possibe to re-use established technologies
  - Possible to account for life cycle business drivers
  - Tedious engineering routine work can be automized
  - Possible to model and simulate services together with products
  - More robust products in production

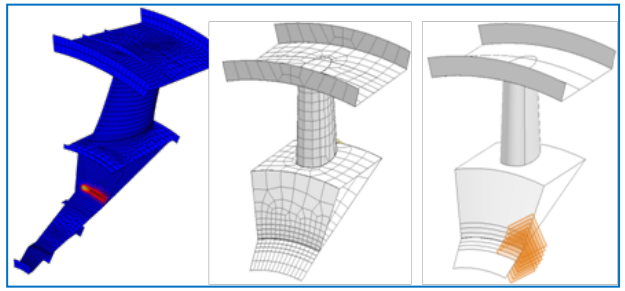


Object Orientation – provide a means to represent services and products alike

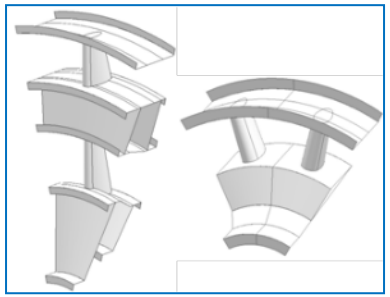


Generate design Studies using pre-defined Method- and Product- elements

Modularized Methods



Modularized Product Elements



PSS development, industrial examples

•”

- **What ”aids” are available?**
  - Getting a Grip on the PSS – Organise
  - Development Process?
  - Can PSS be ”engineered”?
  - **How to visualise and evaluate PSS’s?**

Economic Impact?

“Engine cost remained by far the largest single expenditure, amounting to about 43% of the maintenance spending. Almost three quarters of engine maintenance was outsourced; this excludes materials purchased for the airlines which do work in house”

IATA Airline Maintenance Cost Executive Commentary (2009)

https://www.iata.org/whatwedo/workgroups/Documents/MCTF/AMC_ExecComment_FY09.pdf

The details in material characterisations impact the maintenance strategies

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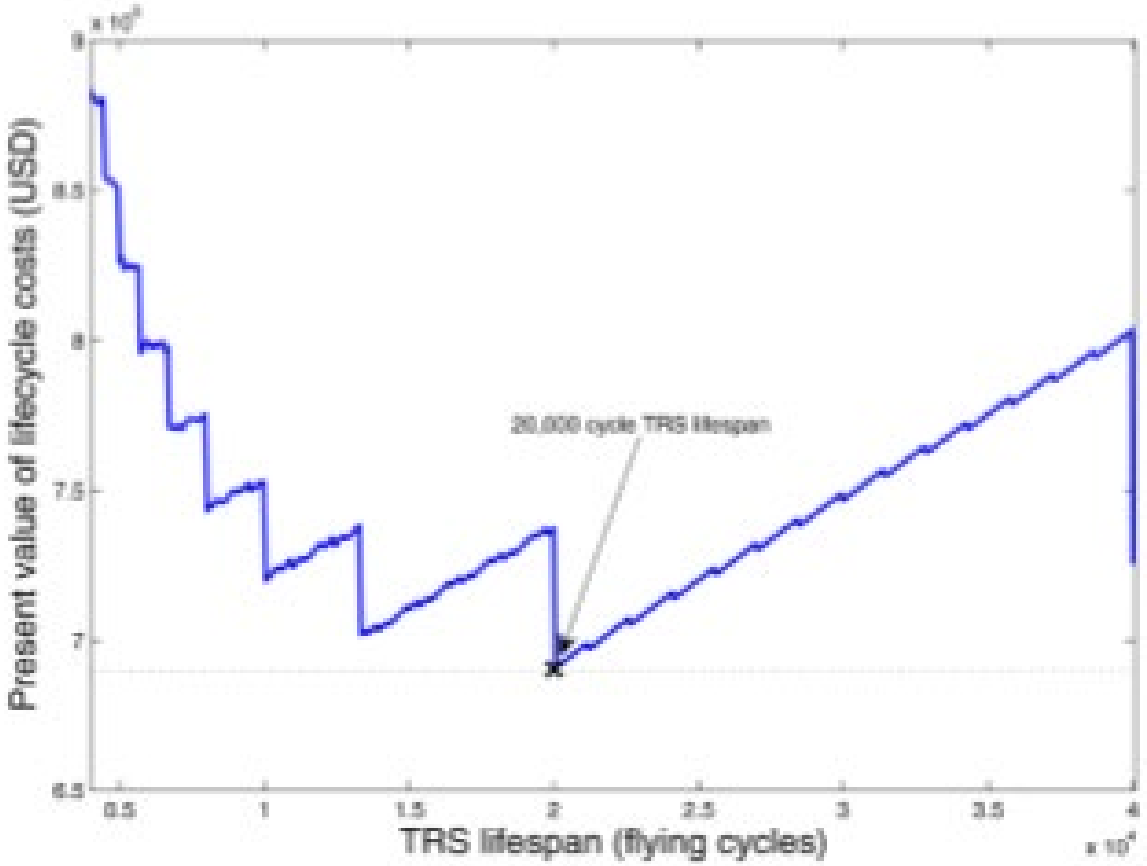
Quantitative Assessment of the Impact of Alternative Manufacturing Methods on Aeroengine Component Lifing Decisions

Static structural aeroengine components are typically designed for full lifetime operation. Under this assumption, efforts to reduce weight in order to improve the performance result in structural designs that necessitate proven yet expensive manufacturing solutions to ensure high reliability. However, rapid developments in fabrication technologies such as additive manufacturing may offer viable alternatives for manufacturing and/or repair, in which case different component lifing decisions may be preferable. The research presented in this paper proposes a value-maximizing design framework that models and optimizes component lifing decisions in an aeroengine product–service system context by considering manufacturing and maintenance alternatives. To that end, a lifecycle cost model is developed as a proxy of value creation. Component lifing decisions are made to minimize net present value of lifecycle costs. The impact of manufacturing (represented by associated intial defects) and maintenance strategies (repair and/or replace) on lifing design decisions is quantified by means of failure models whose output is an input to the lifecycle cost model. It is shown that, under different conditions, it may not be prudent to design for full life but rather accept shorter life and then repair or replace the component. This is especially evident if volumetric effects on low cycle fatigue life are taken into account. It is possible that failure rates based on legacy engines do not translate necessarily to weight-optimized components. Such an analysis can play a significant supporting role in engine component design in a product–service system context.

- An example of how to assess impact of manufacturing methods onto life cycle economic performance

Net Present Value used to Design and evaluate maintenance strategies

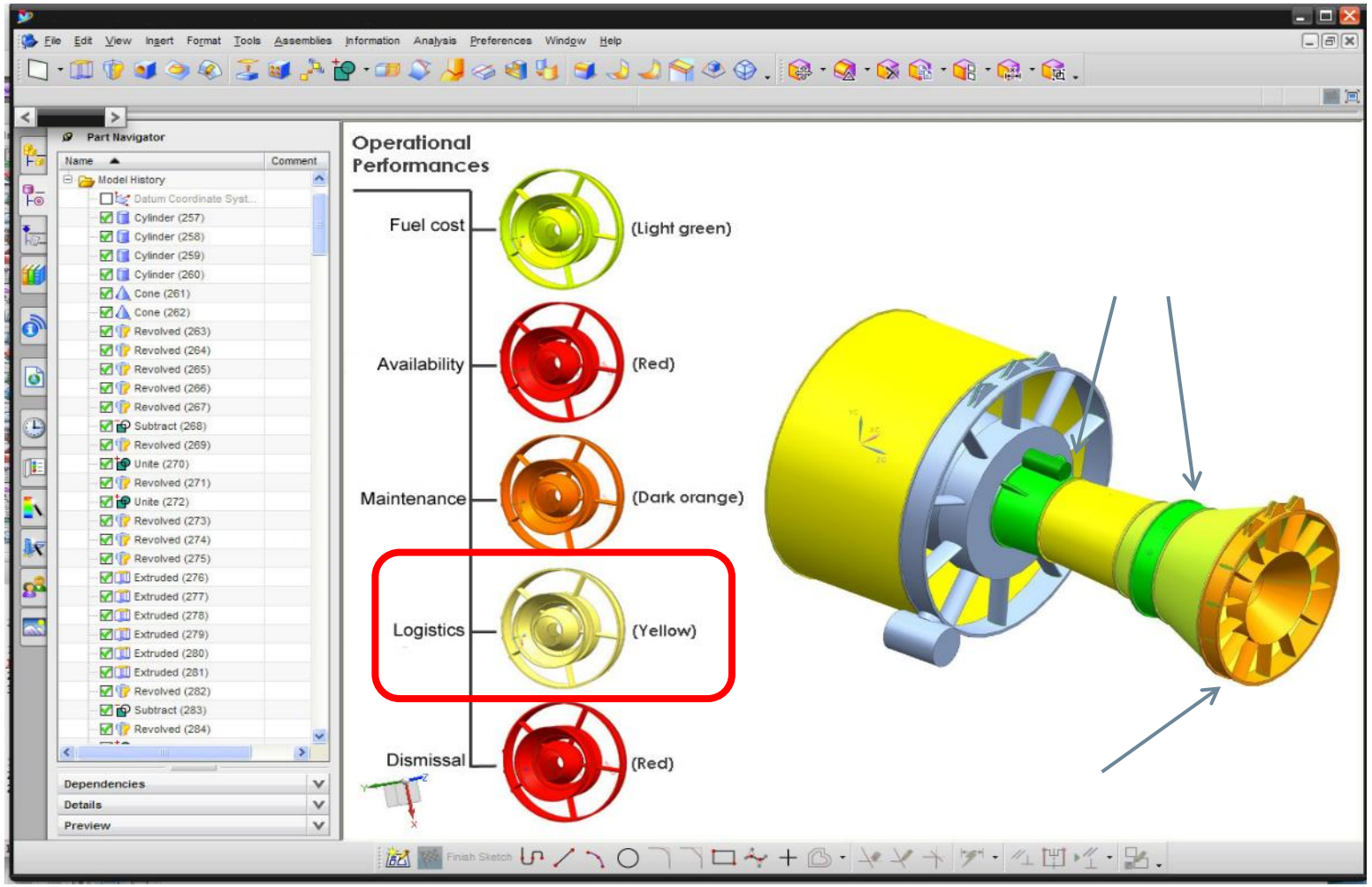


NPV is the difference between present value of cash inflows and the present value of cash outflows.

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0$$

C_T = NET CASH INFLOW DURING THE PERIOD T
C_O = TOTAL INITIAL INVESTMENT COSTS
R = DISCOUNT RATE, AND
T = NUMBER OF TIME PERIODS

Visualisation of value Contributions



- A way to highlight the value of “ilities” and “intangibles” tied to the product

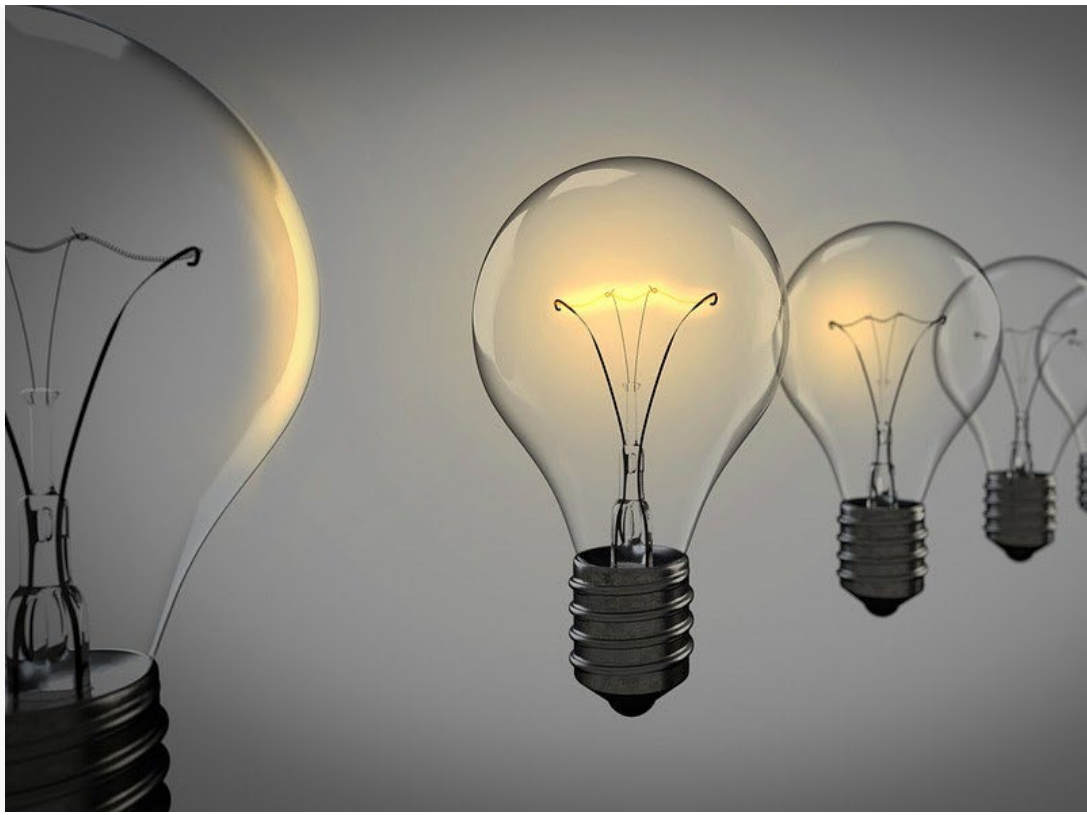
SERVICE THINKING REQUIRE CHANGE IN PRACTICE

Product and Production Service ”thinking”

Is powerful, open up creativity and new business opportunities

But..

- **Most manufacturers are organised for, and have experience from developing and producing tangible products…**
- **PSS often require a shift in thinking, mindset, processes, etc. internal to companies, and often together with external organisations (customers, markets, suppliers)**
- **If a company need to change established practice this imply CHANGE**




IF YOU CHANGE
NOTHING
NOTHING WILL
CHANGE
www.alifelessbeige.com

What to change?

.. Depend (entirely) on the current status vs the wanted status..

- **Check questions**
  - **Does the new PSS imply a change internally?**
  - **Does the new PSS imply a change externally?**
  - **New type of production? New supplie New business models? Change in ownership of solutions?**

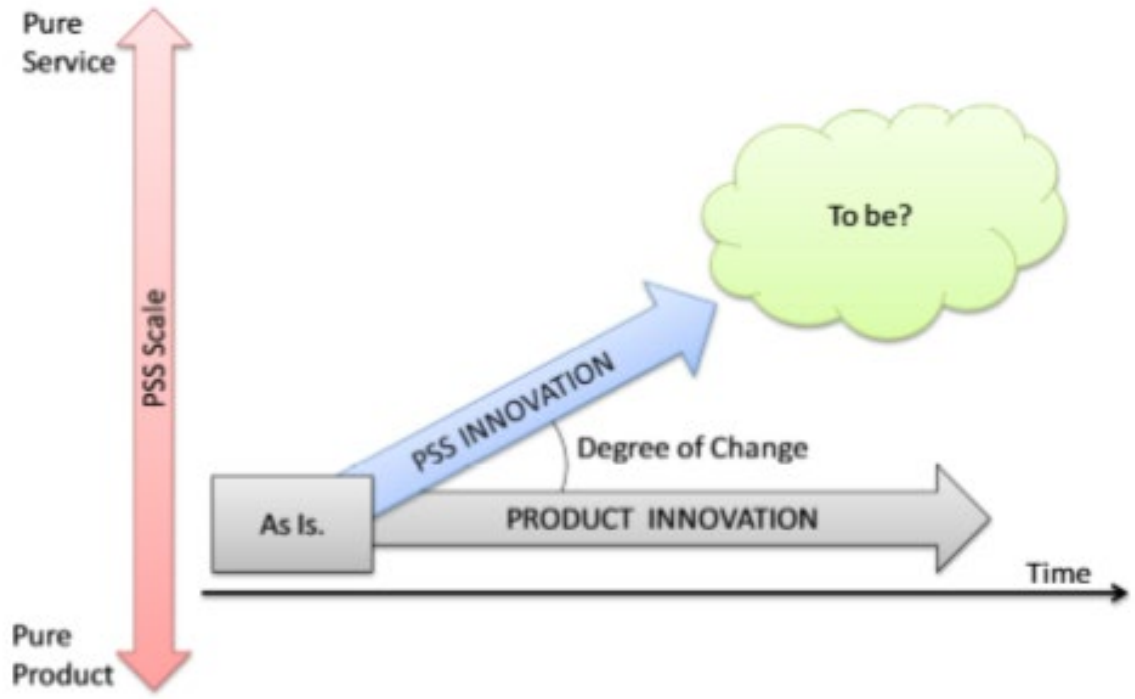


Figure 1: Degree of change needed for PSS innovation

Wallin, J., Developing Capability for Product-Service System Innovation, PhD thesis, Chalmers, 2013
http://publications.lib.chalmers.se/records/fulltext/187502/187502.pdf

How to change?

Organisational transformation (By Kotter[1])

1. **Establish a Sense of Urgency**
2. **Forming a Powerful Guiding Coalition**
3. **Creating a vision**
4. **Communicating the Vision**
5. **Empowering others to act on the vision**
6. **Planning for and crating short-term wins**
7. **Consolidating improvements and producing still more change**
8. **Institutionalising new approaches**

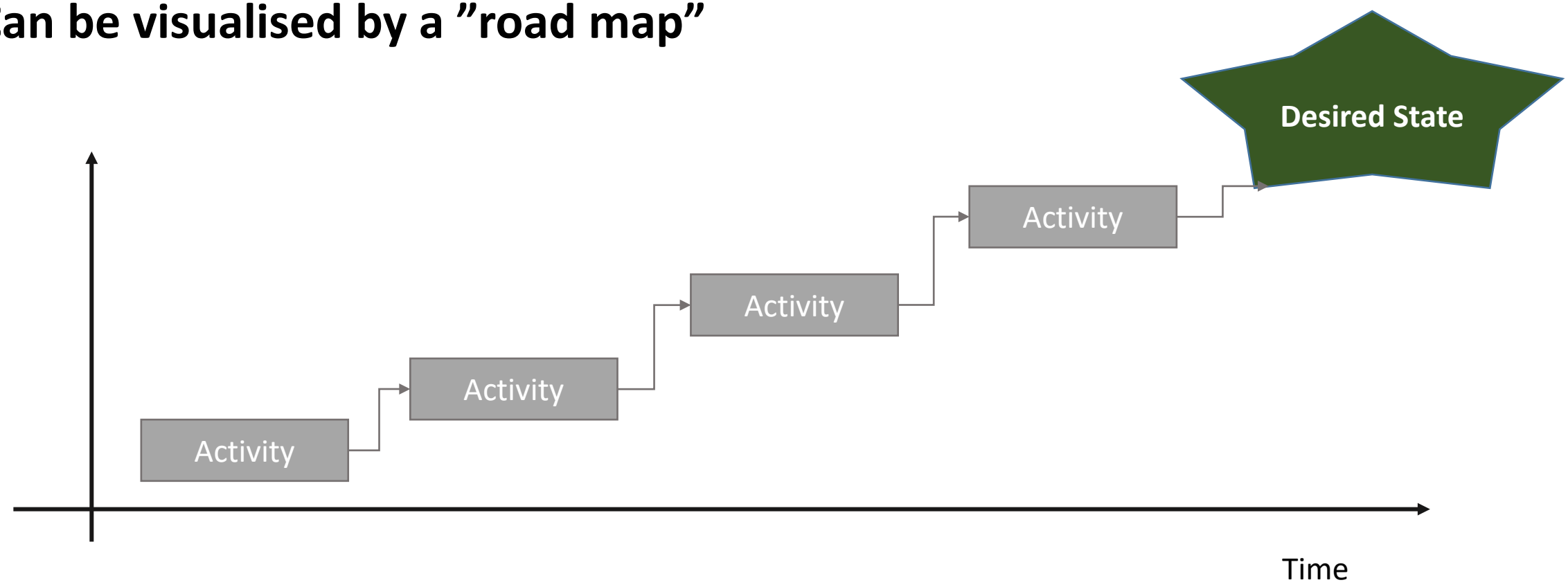
> One chief executive officer deliberately engineered the largest accounting loss in the history of the company.

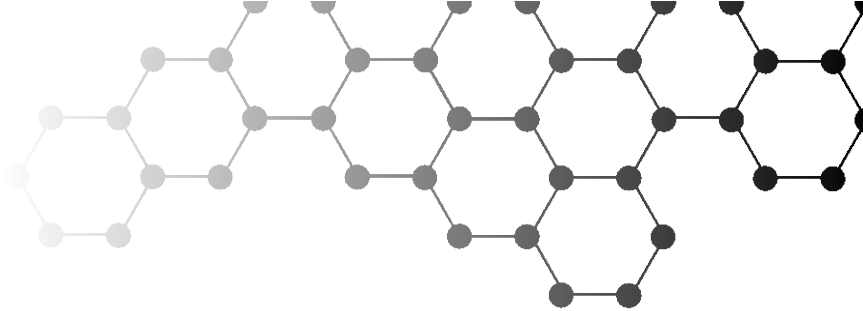
[1]Kotter, J. P., *Leading Change: Why transfomation efforts fail*, Harward Business Review, March-April, 1995

How to change?

”Million $ question”, but open eyes on what to change and concious step wise change activities help

- **Can be visualised by a ”road map”**





Purpose of lecture

Present more details and concepts for Stakeholder Analysis and Value Assessment

- Use for reference

Brief intro to preparing change

Initialize project work

Summary

Understand the needs, compare with existing functionality and generate alternative solutions as different ”bundles” of product and services…

Evaluate how the alternative solutions satisfy **DIFFERENT** stakeholder needs