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Course material in systems engineering: concept definition based on transactional and user-centered Systems of Systems with a focus on value proposition

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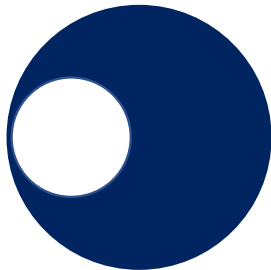
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Course material in systems engineering: concept definition based on transactional & user-centered System of Systems with a focus on value proposition



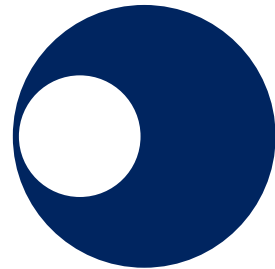
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Introduction





Place of this course in engineering training

This course will introduce concepts, processes, architect roles & models prior to the routine technical processes V-diagram (Vee-diagram)

Course Participants

Professionals or MSc students with background in Systems Engineering (SE) interested in extending the scope of their conception & practice by hybridizing their design skills with strategy creation





Conceptual purpose

Clarifying our knowledge about conceptual design, and more precisely:
concept definition

From the Concept of operations (**ConOps**, ISO/IEC/IEEE 29148: 2011)
to Operational Concepts (**OpsCon**, ANSI/AIAA G-043A-2012)

Methodological purpose

Bridging routine SE concepts, processes, architect roles & models with
strategy engineering & design thinking, i.e. a user-centric framework

Top-down approach

We will start with general considerations on systems thinking, and end with practical rules explaining how to architect operations

Please note!

No practical exercises are included in this course material

No detailed description of how to map our approach in this course to the routine Vee-diagram

1. What are the system thinking fundamentals relevant to this course?
2. How to apply them to operation conceptual design?
3. How to design the preliminary Business Model Canvas (BMC) & the capability roadmap (CAPAROD)?
4. How to use the Stanford design thinking process to clarify users' experience (UX) & user-centric value?
5. How to define high-level requirements & architect the related preliminary Systems of Systems (SoS) in operation?
6. How to articulate the activities presented in this course to the Vee-diagram?

Strategy & design hybridization attitudes & rules
Teamwork principles



Input

1. Strategic change expectation
2. As-Is ConOps (if it exists)



Activities

1. Apply system thinking to operation conceptual design
2. Design the preliminary BMC & CAPAROD
3. Clarify UX & user-centric value
4. Define high-level requirements & architect the preliminary SoS in operation



Outputs

1. BMC & CAPAROD, parts of the organization strategic plan
2. User Journey Map (UJM), part of the stakeholders' requirements
3. SoS in operation, i.e. OpsCon, other lifecycle concepts

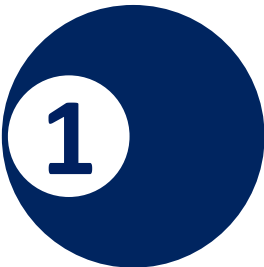
System thinking
Design thinking framework
Strategy tools

SE framework
Creativity tools
Modeling techniques



Part of the course	Concepts, methods or models	Outcomes
1. What are the system thinking fundamentals?	Systemism, system inquiry, system of models (SoM)	Systemic concepts & models put into the engineering practice
2. How to apply them to operation conceptual design?	UX, stakeholder, SoS, User-centered Sos (UcSoS), transactional SoS (tranSoS), as-is vs. to-be reasoning	Concept definition framework of reference
3. How to design the preliminary BMC & CAPAROD?	Strategy leaf (PESTLE) & synthetic (SWOT) models & pivot models (BMC, CAPAROD)	As-is ConOps analysis & to-be preliminary BMC & CAPAROD

Part of the course	Concepts, methods or models	Outcome
5. How to use the Stanford design thinking process to clarify UX & user-centric value?	Stanford design thinking process, user journey map (UJM), empathy map (EM),	Pain points clarification & directions for to-be OpsCon
6. How to define high-level requirements & architect the related preliminary SoS in operation?	SoS in operation scenario, SysML diagrams (uc, seq)	Preliminary OpsCon to be transferred to downstream SE based on the Vee-diagram



System thinking fundamentals

Content

Back to system thinking fundamentals before getting into the core content of this engineering course

Key words

Systemism

System thinking

System inquiry

Model

System of Models (SoM)

Definition

Mario Bunge, 2004 (1919-2020)

World view, i.e. universal ontology, that “[...] considers the cosmos as a supersystem composed of all systems subject to change and subject to laws [...] it postulates that every concrete object and every idea is either a system or a component of a system”

This universal proposition has epistemological & practical consequences

Bunge's proposition

“As the universe is a system, so must be our knowledge about it [...] if there are no orphaned or wandering objects, our knowledge cannot be a simple juxtaposition of separate parts, it must be a system”

Modelling consequence

If we codify our knowledge with models, then we must conceive a system of models (SoM) enabling relational unification between the different models referring to parts of our knowledge

Methodological consequence

If we produce parts of knowledge with specific methods, then we must conceive our methodology as a system made of different methods

Case in this course with the aim of unifying SE, design thinking & strategy creation methodologies

Operative consequence

If our practices refer to different modalities or contents, then we must conceive a practical framework of reference that is also systemic

Fortunately, this is inherently the case with SE!

System specificities	Systemism: the system...
Holism	...is a whole entity
Hierarchy	...can be broken down, syn. has different layers
Association	...is based on horizontal relations between constituents
Genericity	...is unique, but related to concrete instances or occurrences
Circularity	...exhibits behaviors explained by the circular causality, e.g. Jay R. FORRESTER's models
Pluralism	...is understood from complementary points of view, models, theories, disciplines, etc.

System specificities	How to describe...
Holism	...the boundaries of the system studied?
Hierarchy	...its hierarchical structure?
Association	...its net internal structure?
Genericity	...its generic, specific or particular forms
Circularity	...the feedbacks between its constituents?
Pluralism	...the way we unify points of view, models, theories, disciplines?

System specificities	In engineering	In strategy
Holism	The technical system to design is a black box immersed in an environment	Strategy analysis of the organization studied has both external & internal features
Hierarchy	Product breakdown structure of the technical system to design	Top-down deployment of strategic decisions
Association	The technical system to design has integrative constituents, e.g. base, platform, skeleton, skin, network	Strategy analysis considers the net of organisations, e.g. innovation 'ecosystems'
Genericity	It is abstract, but it is embodied in different concrete solutions	It combines general business architecture patterns & contingent approaches
Circularity	It is controlled via closed loops	It considers the cycles between what is acquired and what is learned at an organizational level
Pluralism	It is displayed using different diagrams, e.g. SysML diagrams	It considers the points of view of all the organization's functions, e.g. marketing, finance, purchasing, R&D, human resources



Beware of anthropomorphism!

There is a risk of conceiving the system as a pure self-sufficient entity, then as a being

Strong vs. weak systemism

We can conceive our knowledge as a system without agreeing with the strong ontological postulates of Bunge's Systemism

We don't know if the Universe is a system, but we do know that systemics is useful (Rescher, 2012)

Process

Transformation of our intuition that the phenomenon of interest is a system into an acceptable model on which to base our future conceptions or actions, e.g. plan, design, engineer

The phenomenon may be an observed fact or a conjecture

Best practices

Practice inter- or trans-disciplinary work

Practice teamwork

Use of systemic glossary (terms) & models

Case of SE

Next slide

“4.1.46. System. Combination of interacting elements organized to achieve one or more stated purposes.

Note 1 to entry: A system is sometimes considered as a product or as the services it provides.

Note 2 to entry: In practice, the interpretation of its meaning is frequently clarified by the use of an associative noun, e.g., aircraft system. Alternatively, the word “system” is substituted simply by a context-dependent synonym, e.g., aircraft, though this potentially obscures a system principles perspective.

Note 3 to entry: A complete system includes all of the associated equipment, facilities, material, computer programs, firmware, technical documentation, services and personnel required for operations and support to the degree necessary for self-sufficient use in its intended environment.”

Encephalocentric view of knowledge

There is a direct relationship between the brain (thought) and the world (reality)

What is prior?

Never-ending debate between idealism, deduction, conception, theorization, formalization on the one hand, and realism, induction, production, empirical inquiry on the other

Consequence

The model is either a by-product of theory, or a prerequisite for studying reality in depth

Coutellec & Schmid, 2022

Main limit

Why do we have to model facts before they occur & theorize them?

Example of the Club of Rome's MEADOWS's report, based on scenarios developed from FORRESTER's system dynamics

Limits in design

What if the concrete solutions don't exist yet?

Why do the designers draw, then produce & exchange diagrams?

Why is CAD so important in design offices?

Illustrate a description, an explanation or a plan

Include individuals with no formalization background

Facilitate the consensus between design actors

Facilitate the interface between the user and the computer

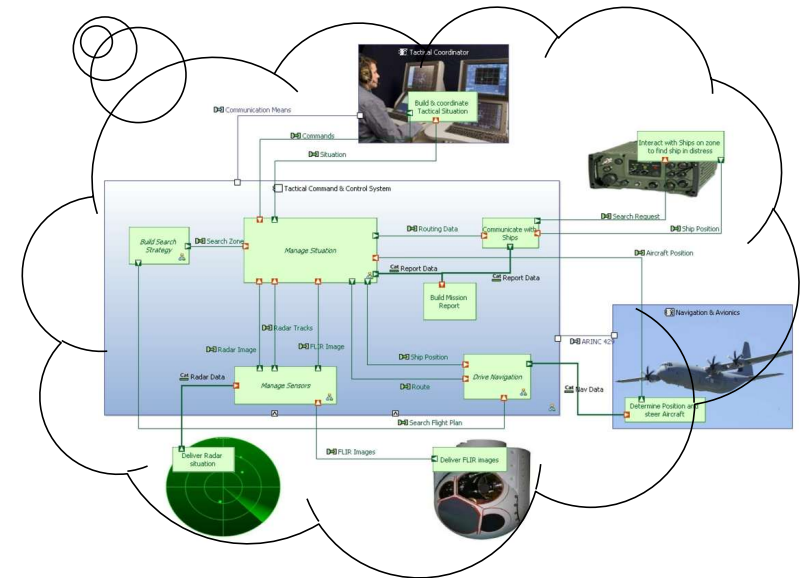
Codify knowledge

Leverage & systematize the learning

Etc.

During the system inquiry, we may all conceive the system of interest differently (pluralism)

Practical maxim: the more you draw & explain to people what you mean, the more likely it is that you will find agreement & consensus





System of models (SoM)

Consequence of pluralism

If several points of view, or more generally: domains, then models, can be considered form the system studied, how can they be architected?





Our proposal

Net of models or more generally: SoM

- Leaf model **L.** Source of the net
- Synthetic model **S.** Association or aggregation of models packaging in the same domain
- Pivot model **P.** Model between domains

Consequence

Hybridizing strategy, SE & design thinking means creating and using pivot models between these domains



Domains

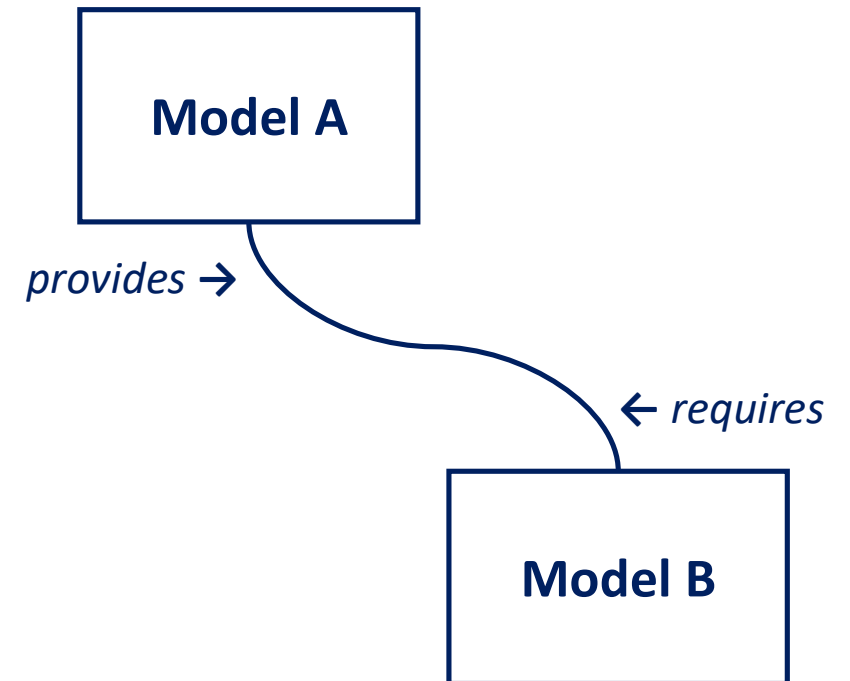
Domain ST
Strategy model

Domain SE
SE model

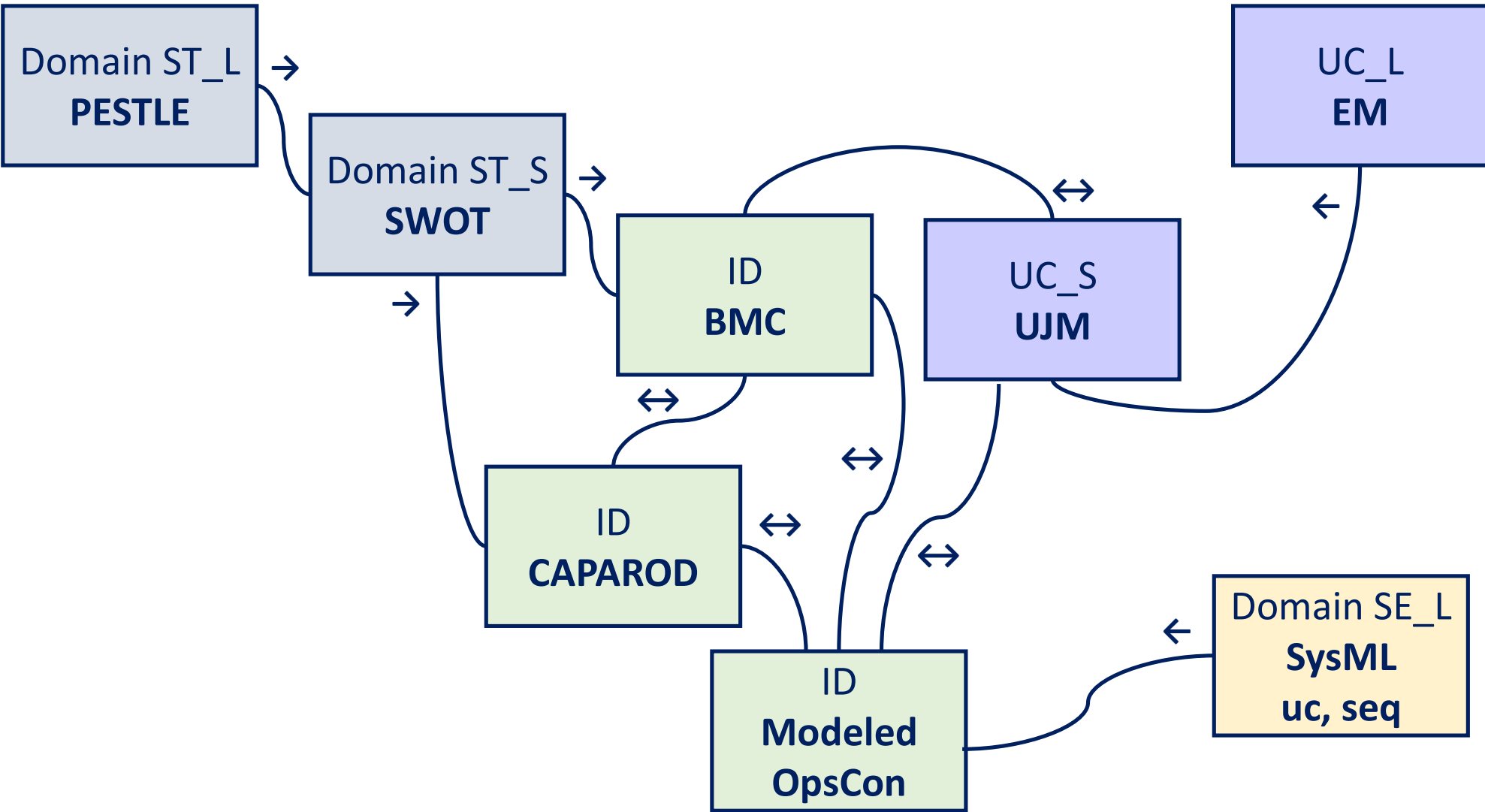
Domain UC
User Centered model

Interdomains ID
Pivot model

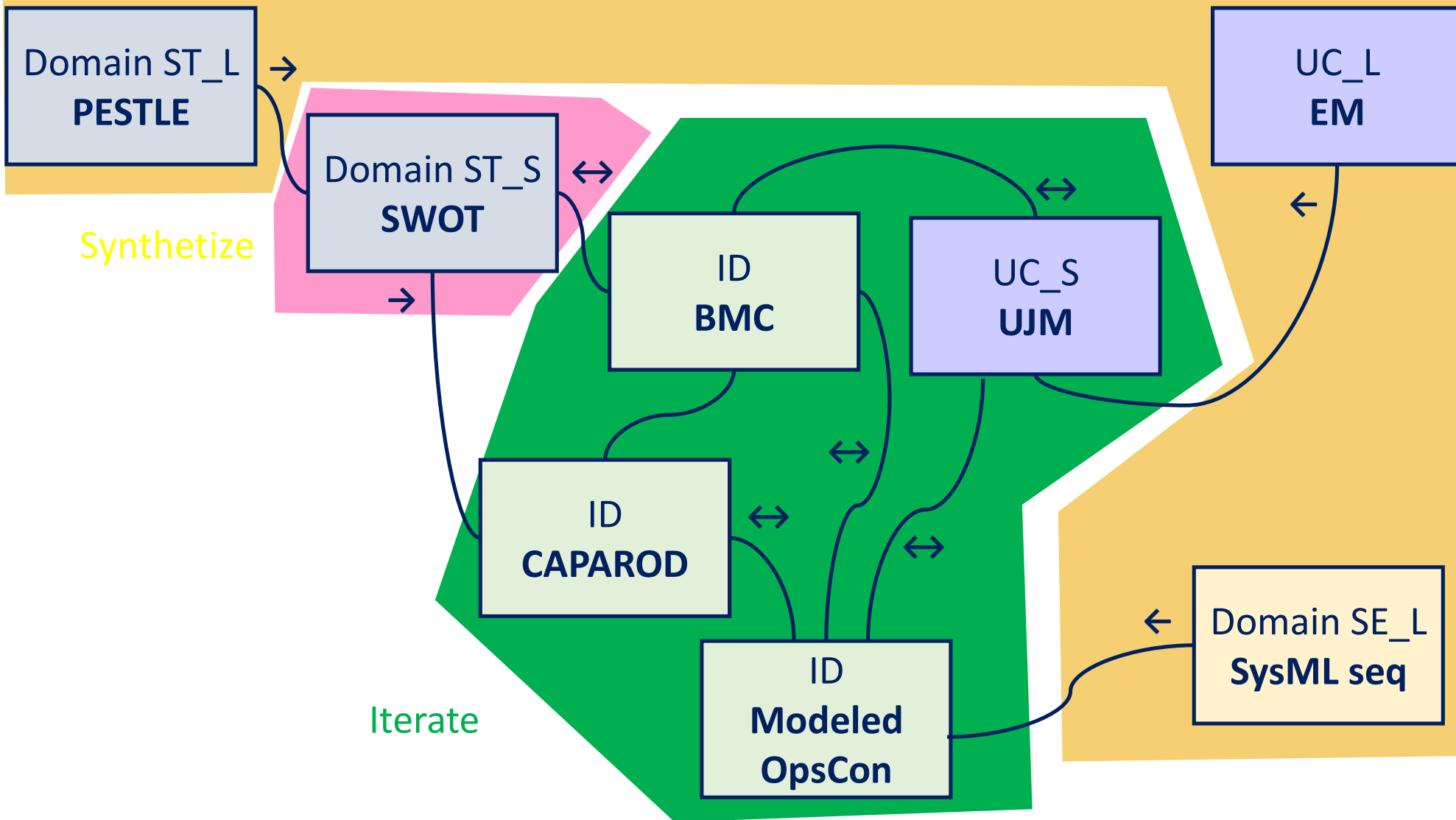
Relations



Example of SoM



Add variables & data





Matrice-based representation

	PESTLE	EM	SysML uc,seq	SWOT	BMC	CAPAROD	UJM	Modeled OpsCon
PESTLE	-	0	0	0	0	0	0	0
Empathy Map	0	-	0	0	0	0	0	0
SysML Use Cases, Sequence diagrams	0	0	-	0	0	0	0	0
SWOT	1	0	0	-	1	0	0	0
Business Model Canvas	0	0	0	1	-	1	1	1
Capacity ROaDmap	0	0	0	1	1	-	1	1
User Journey Map	0	1	0	0	1	1	-	1
Modeled OpsCon	0	0	1	0	1	1	1	-

Link with part 2

SE & concept definition implement systems thinking fundamentals in the upstream design of complex technical artifacts, i.e. operation conceptual design



2

Systemic concepts of operation conceptual design





Content

Clarify what the concept definition is when we consider the operation as a key design entity

Key words

Concept definition

System definition

ConOps

OpsCon

Hybridization

User experience (UX)

Systems of Systems (SoS)

As-is vs. to-be reasoning





Definition

Transdisciplinary & integrative approach to enable the successful development, realization, use, & retirement of engineered systems, using systems principles & concepts, & scientific, technological, & management methods

This definition has systemic features

Holism, association & pluralism



Definition

Composition of a structure of the engineered system & the related design process to perform reliable behaviors meeting the requirements or the goals assigned

Consequence

The technical artifact to be designed, the design processes, roles, models or data, the evaluation criteria, etc., can all be architected

This does not mean that there is a single all-knowing, all-powerful architect



Operation in SE

Latin Roots

Operationem (operatio)

Work, effort, task, performance...

Definition

Operation is a key design entity

Two instances or occurrences

Downstream or conceptual design

Concept of Operations (ConOps)

Upstream or solution design

Operational Concepts (OpsCon)





User-oriented design entities

ConOps & OpsCon can provide services to users, which implies, on the offer side, suppliers, specific technical solutions & leadership

ConOps & OpsCon

Document aligning stakeholders' vision



ConOps & OpsCon remain ill-defined object of dissensus, misunderstandings & idle debates!

ConOps avoids technical matters, whereas we are in engineering, even if we integrate elements of strategic analysis

ConOps or OpsCon are conceived as communication tools, even though modeling is one of the pillars of system thinking, then SE

Main objective

Shift certain entities or models to upstream design

To-do list

1. Clearly distinguish between concept definition & system definition
2. Tidy up strategic the models packaging in the strategy domain (domain ST)
3. Elaborate our conceptualization of who the user is
4. Consider the mirroring between enablers, i.e. suppliers allied and under the same leadership & technical principle solutions



Concept Definition (CD)

problem space exploration

→ generation of alternative concepts

vs.

System Definition (SD)

solution design

Two main activities of CD

Business & Mission Analysis (BMA)

Stakeholder needs definition

Table of Contents

- ⊕ Part 1: SEBoK Introduction
- ⊕ Part 2: Foundations of Systems Engineering
- ⊖ Part 3: SE and Management
 - Systems Engineering STEM Overview
 - Model-Based Systems Engineering (MBSE)
 - ⊕ Systems Lifecycle Approaches
 - ⊕ System Lifecycle Models
 - ⊕ Systems Engineering Management
 - ⊕ Business and Mission Analysis
 - ⊕ Stakeholder Needs Definition
 - ⊕ System Architecture Definition
 - Detailed Design Definition
 - System Analysis
 - System Realization
 - System Implementation
 - System Integration
 - System Verification
 - System Transition
 - System Validation
 - System Operation
 - System Maintenance
 - Logistics



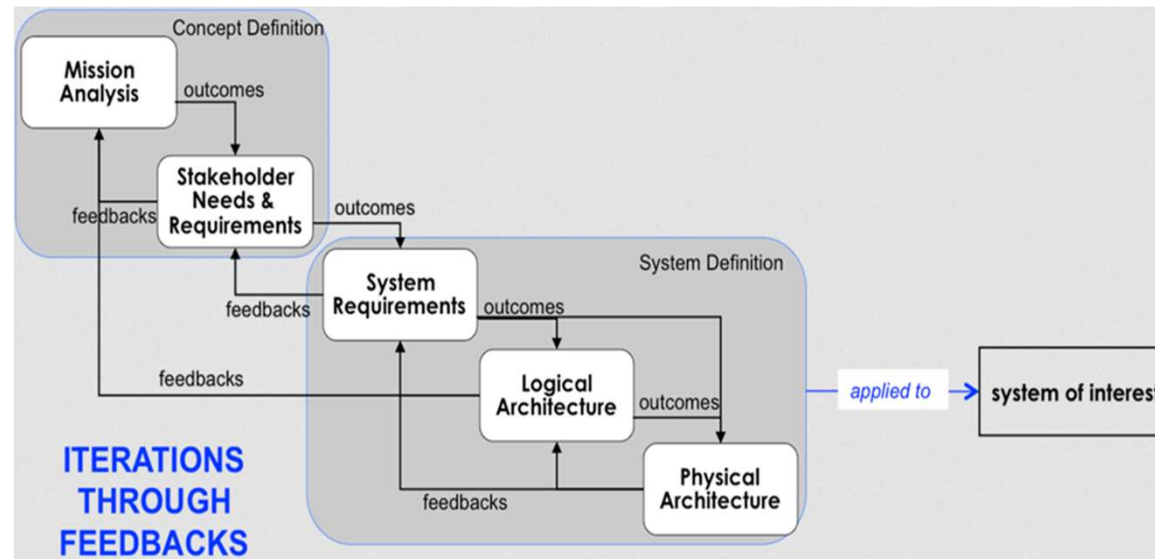
Iterations between **CD** & **SD**

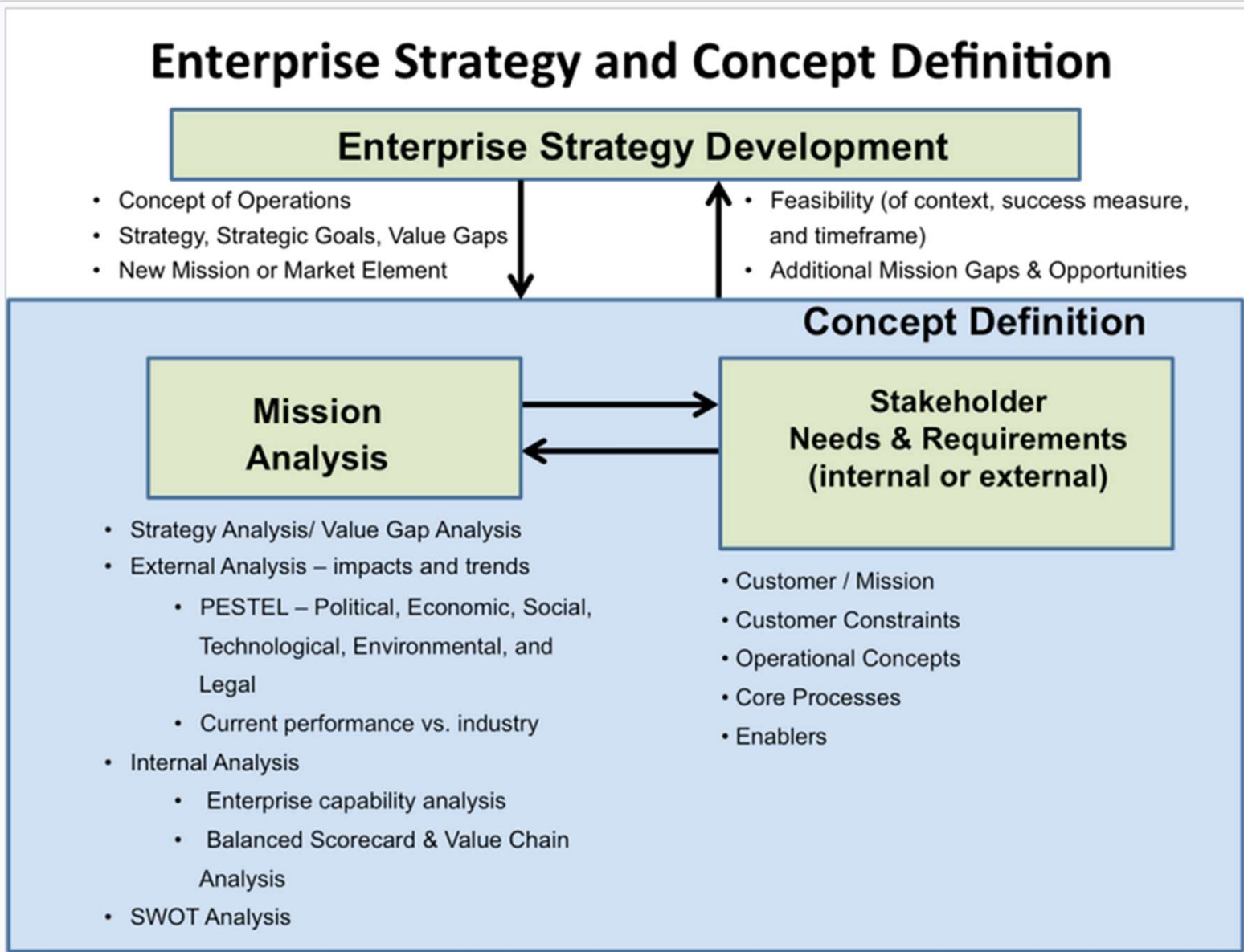
Early phase of the design project
(Faisandier, 2012)

Key points

SE standards & practices are mainly focused on **SD** processes

However **CD** is a key upstream design process







Enterprise Strategy and Concept Definition

Enterprise Strategy Development

- Concept of Operations
- Strategy, Strategic Goals
- Value Gaps
- New Mission or Market Element

BMC
CAPAROD

- Feasibility (of context, success measure, and timeframe)
- Additional Mission Gaps & Opportunities

Concept Definition

Mission Analysis

- Strategy Analysis/ Value Gap Analysis
- External Analysis – impacts and trends
 - PESTEL – Political, Economic, Social, Technological, Environmental, and Legal
 - Current performance vs. industry
- Internal Analysis
 - Enterprise capability analysis
 - Balanced Scorecard & Value Chain Analysis
- SWOT Analysis

Stakeholder Needs & Requirements (internal or external)

- Customer / Mission
- Customer Constraints
- Operational Concepts
- Core Processes
- Enablers

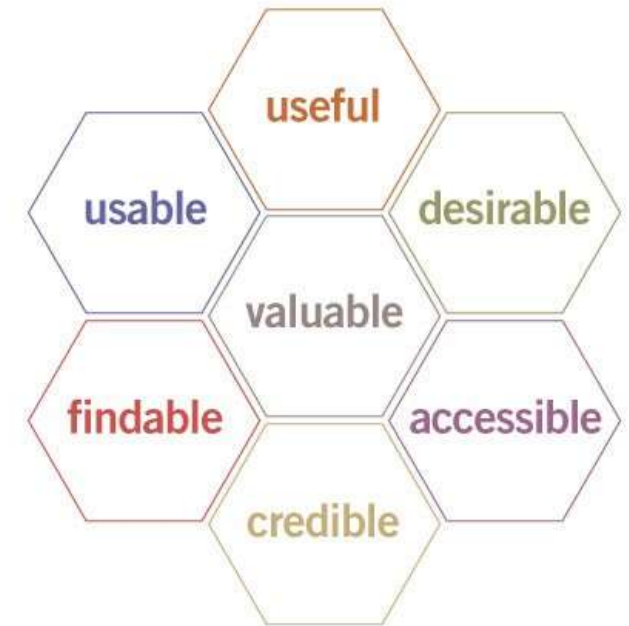
Routine strategy models used at both decision levels

The section “Identifying & Understanding Problems & Opportunities” is rather poor

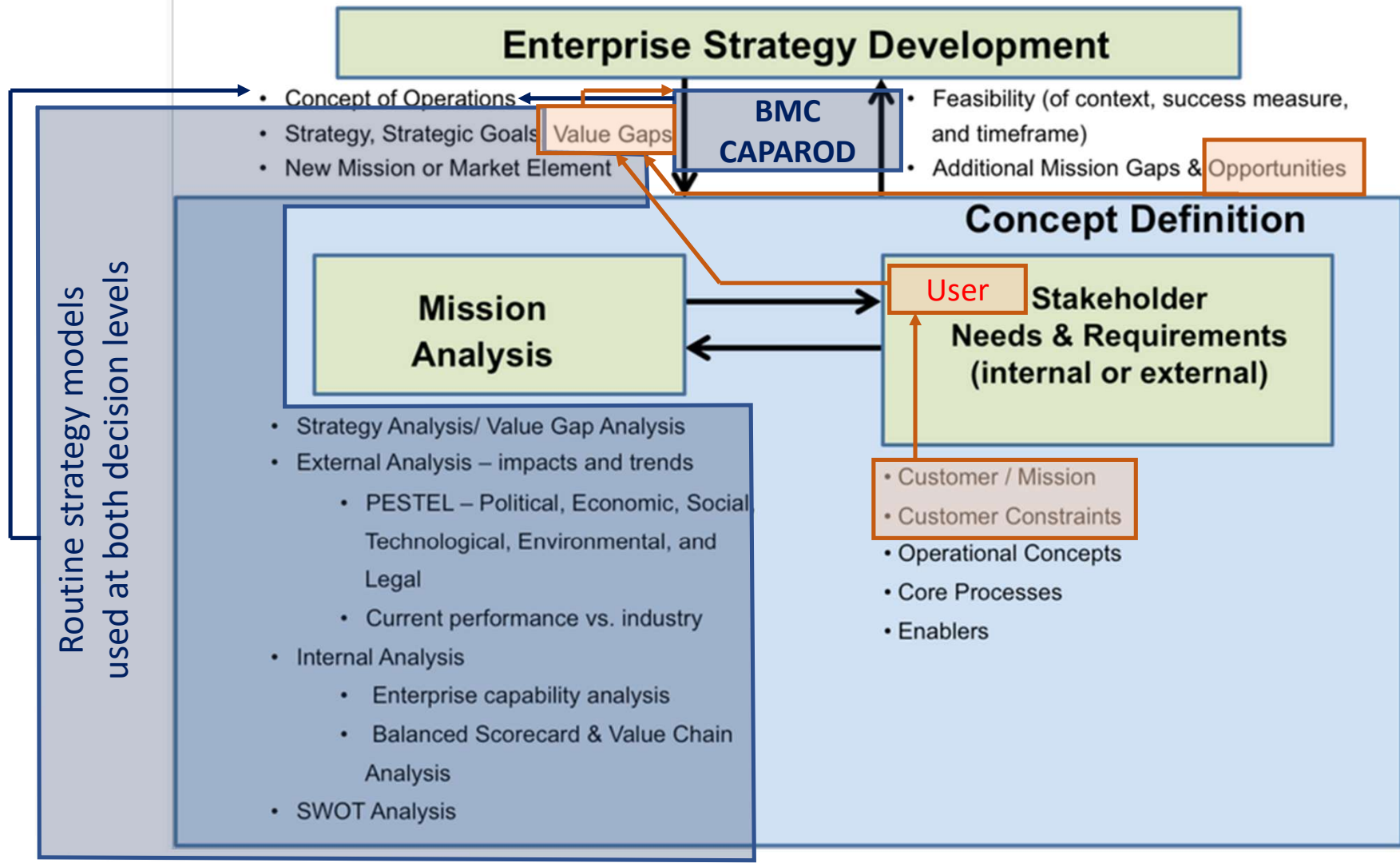
The usage analysis & the analysis of users’ experience, emotions, experience or ‘honeycomb’ are not mentioned

The mapping between SE processes & strategy engineering is not clear

The management toolbox considered is an old-fashion one with no reference to design practices



Enterprise Strategy and Concept Definition



Enterprise Strategy and Concept Definition

Enterprise Strategy Development

- Concept of Operations
- Strategy, Strategic Goals
- New Mission or Market Element

Value Gaps

BMC CAPAROD

- Feasibility of context, success measure, and timeframe)
- Additional Mission Gaps & Opportunities

Concept Definition

Mission Analysis

- Strategy Analysis/ Value Gap Analysis
- External Analysis – impacts and trends
 - PESTEL – Political, Economic, Social, Technological, Environmental, and Legal
 - Current performance vs. industry
- Internal Analysis
 - Enterprise capability analysis
 - Balanced Scorecard & Value Chain Analysis
- SWOT Analysis

User Stakeholder Needs & Requirements (internal or external)

- Customer / Mission
- Customer Constraints
- Operational Concepts
- Core Processes

Allied suppliers & mirrored technical principe solutions

Routine strategy models used at both decision levels

System specificities	SE: the operation to design is...
Holism	...a key design entity, which refers to services provided to users by a whole called SoS
Hierarchism	...a structure whose internal constituents or processes can be break downed
Association	...based on an alliance of circumstance between suppliers under the same leadership
Genericity	...both a conceptual entity (ConOps) and instances of it (OpsCon)
Circularity	...based on a sequence of interactions between the user & the SoS
Pluralism	...an integrative entity whose modeling requires both strategy, design thinking & routine SE models

Key issue

Concept definition means practicing hybridization, i.e. integrating current (as-is) strategy and user-centered design models into the SE framework



Strategy engineering

Blending strategic analysis and SE

Pivot model: BMC

Osterwalder & Pigneur, 2011

From stakeholders analysis to design thinking

Integrating user-centric design to SE, then to strategy engineering

Pivot model: UJM

Rowe, 1991



From one-piece system to extended SoS

The operation requires not a single block, but a SoS made of transactional SoS (TranSoS), user-center SoS (UcSoS) & technical SoS (techSoS) (► out of the scope of this course)

Increase in the functional, transactional & technical complexity of the SoS under consideration

First angle reduction



Strategy



Design



Key issue

How to connect strategy and design?

Routine answer

The strategy considers the context & long-term decision-making, then the design develops satisfactory solutions

Both have their own roles, enablers or models

Nothing is common

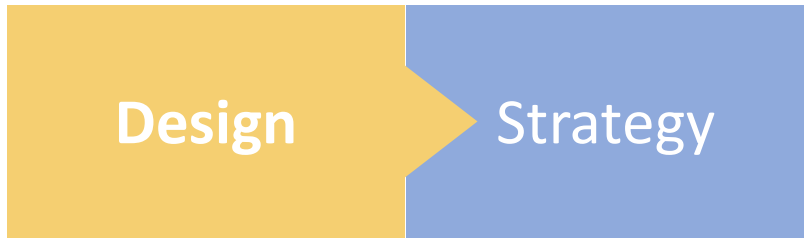




Content

Drive design with engineering considerations in focus, then assess the strategic impact of the technical choices decided upon

Business & mission analysis (BMA) approach in SEBoK



First hybridization practice

Dorst, 2023

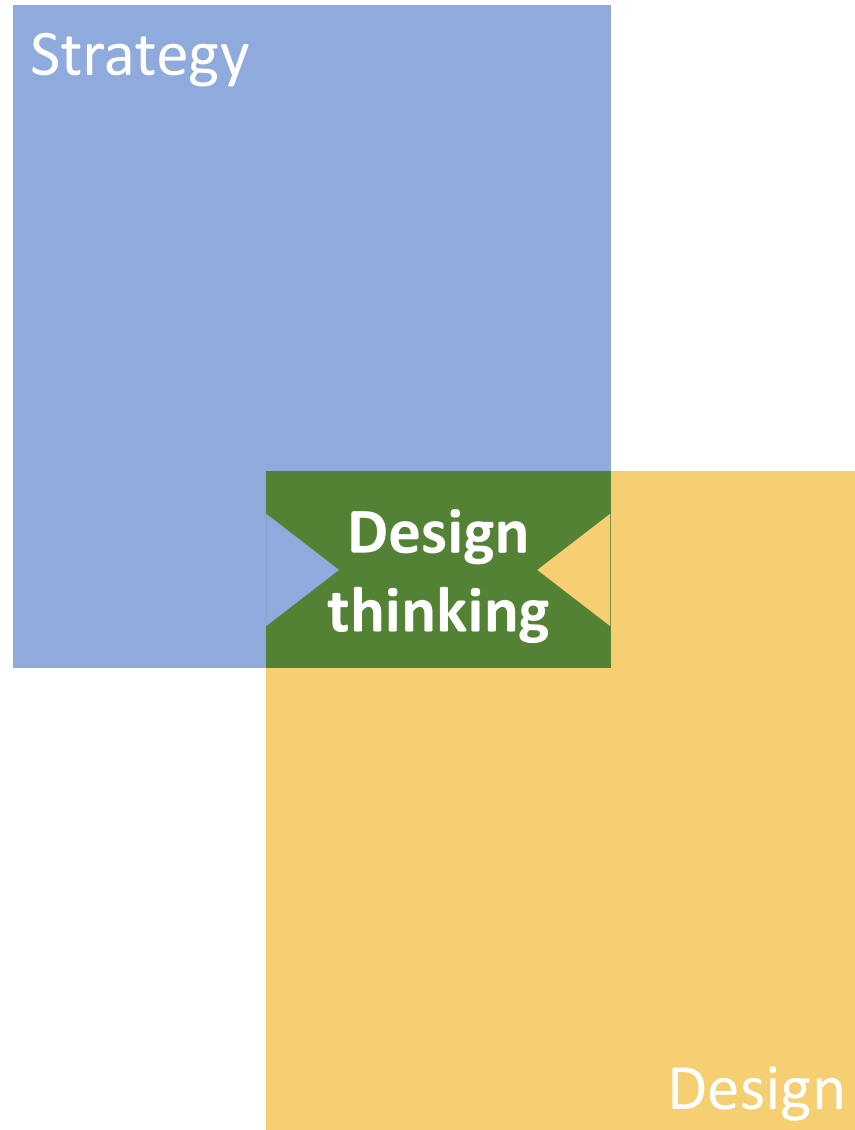
Use some design conceptions or practices to create strategy

Ex. design thinking focused on user's gap value analysis

Unanswered questions

How to deal with complex technical artifacts or organizations?

What to do with proven engineering models?



Engineering answer

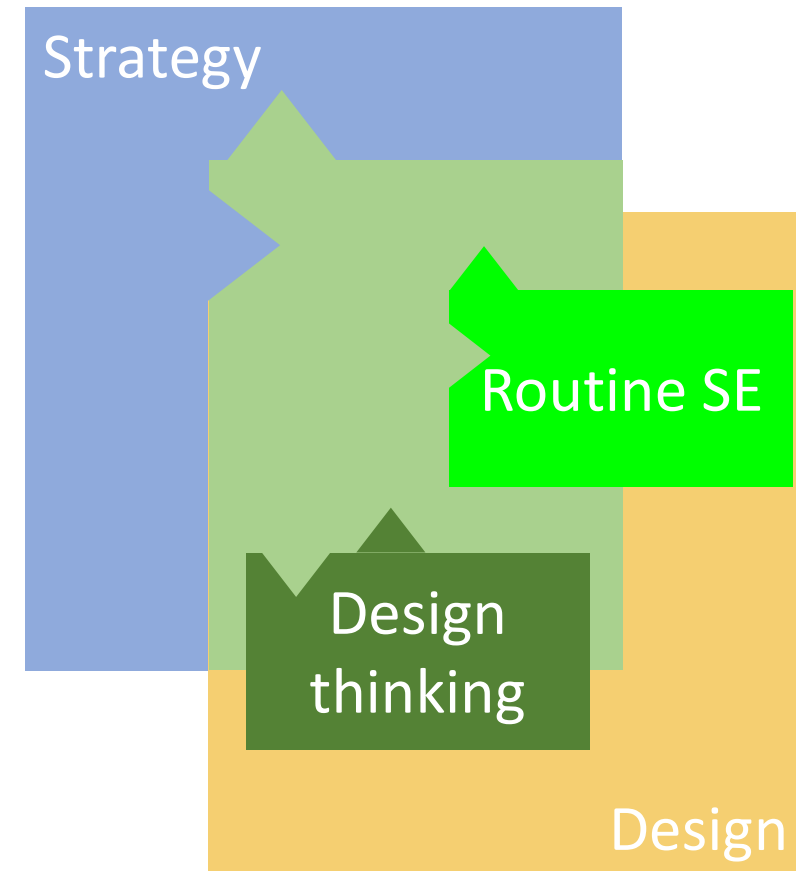
Parts of strategy creation and design practice share the same SE enablers

Derived issue

How do we create an extended SE-based common world between strategy creation and design based on SE?

Inputs: strategy & design enablers

Outputs: key integrative design entities
—e.g., operation in this course—



Second angle reduction



Design thinking



Systems Engineering

Practical maxims of hybridization

1. Think and act as a designer engineering the strategy & the technical artefact
2. Extend the range of alternatives rather than choose between off-the-shelf solutions
3. Decentralize your point of view & consider the external environment of the artefact to be designed
4. Focus on UX
5. Perform an iterative design process
6. Support collaboration in the hybrid team with visual models
7. Create pivot models & patterns

System specificities	SE: the artificial system to design...	DT: the artificial system to design...
Holism	...is part of an environment to understand & map	...is a technical entity that the user experiences concretely
Hierarchism	...is made of various & numerous constituents to architect	...whose internal structure is not the key point, on the contrary of its user interface
Association	...is made of interacting constituents	...supports the user journey map (UJM) & that can induce pain points to eliminate
Genericity	...is unique, but embodied in various solutions	...is always an unique entity understood in the context of users' activities
Circularity	...exhibit behaviors that can be controlled	...is controled by the user
Pluralism	...require different actors, knowledge areas, models, diagrams... to orchestrate	...requires a collaborative agile process in which designers interacts with users

System specificities	Systemism: the system...	strategy engineering
Holism	...is a whole well-bounded entity	...considers the organization of interest shaped by an environment to understand
Hierarchism	...has different layers	...is made of constituents that can be broken-down
Association	...is based on horizontal relations between constituents	...is made of balanced interactions between internal & external entities
Genericity	...is unique, but it is related to several instances or occurrences	...is based on business architecture pattern, but also considers contingency & considers the BMA as an occurrence to assess technical choices
Circularity	...exhibits behaviors driven by the circular causality	...is based on organization control, e.g. decision-making hierarchy
Pluralism	...is understood from complementray points of view	...uses leaf models, e.g., PESTLE, synthetic model, e.g., SWOT, & synthetic models, e.g. BMC

Strategy

Extended SE

SoS Approach

Design thinking

Design

A Step towards SoS



No ConOps without alliance

Content

ConOps are based on alliances between suppliers under the same leadership & an extended net of technical artefacts, then on sociotechnical SoS

Roots of 'alliance': bond, union, unity, marriage, combination...

Alliance

Formal strategic agreement between suppliers to cooperate for a successful operation

Possible alliance pattern: the nodal or pivot Company of Interest (CoI) plays the role of leader



Existence of 3 types of SoS

User centered SoS

UcSoS

UcSoS \supset Sol

Transactional SoS

TranSoS

TranSoS \supset Col

Technical SoS

TechSoS

TechSoS \supset Information Technology (IT)

► Out of the scope of this course



Latin roots

Trans, through

Transactio, bargaining, agreement, trade, business...

Definition in this course

Relationship generating both rights and duties

TranSoS

System contributing to the UcSoS by combining different players and different types of transactions



One delimited to one delimited

Direct & mutual transaction

Ex. individual contract, barter, bargaining

One delimited to many delimited

Distributed transaction

Ex. order from a superior, sector regulation

Every delimited to one delimited

Focal transaction

Ex. contest, collective action, alliance

Everybody to everybody

General transaction

Ex. law

- UcSoS is made of a service flow both based on...
- ... a direct & mutual transaction between the user (U) & a front service provider (P)
 - ... a derived focal transaction between P & sub-contractors (S) providing required services, products, resources... (alliance)
 - ... a distributed relation between U,P, S and a regulator (R) indicating what is compliant according to a specific normative framework, e.g. market places regulation
 - ... a general transaction (law) governing all the previous transactions

	SE: the operation to design is...	Our proposal: the operation to design...
Holism	...a key design entity, which refers to services provided to users	...refers to a flow of services provided to users by the SoS as a whole (UcSoS)
Hierarchism	...a structure whose internal constituents or processes can be break downed	...is based on SoS capability packaging services, internal processes, resources, technical parts
Association	...based on an alliance of circumstance, forming a technical SoS	...is based on mirrored UcSoS, TranSoS & TechSoS (▶ out of the scope of this course)
Genericity	...both a conceptual entity (ConOps) and instances of it (OpsCon)	...is both a ConOps and OpsCon
Circularity	...a sequence based on decision rules controlling the course of action	...has the UJM as main services flow
Pluralism	...a key design integrative entity	...a key design integrative entity displayed with visual models

Key Idea

Our extended approach combines modalities

Temporal modalities

Now (\square) vs. in the future (\diamond)

Assessment modalities

Necessary (\blacksquare) vs. possible (\blacklozenge)

Derived reasonings

As-is reasoning

Look back, statement, diagnosis, etc.

To-be reasoning

Creation, planning, etc.

Table of modalities 1 | 4

Now
□

In the future
◇

Necessary ■

<p>□ ■ As-is case 1</p>	<p>◇ ■ To-be case 1</p>
<p>□ ◇ As-is case 2</p>	<p>◇ ◇ To-be case 2</p>

Possible ◇

Table of modalities 2 | 4

		Now □	In the future ◇
Necessary ■	As-is case 1 □ ■ Imperative necessity	To-be case 1 ◇ ■ Fatality, business as usual	
	Possible ◇	As-is case 2 □ ◇ Pure contingency	To-be case 2 ◇ ◇ Branching, open future

		Now □	In the future ◇
Necessary ■	As-is case 1 □ ■ What the current ConOps must be	To-be case 1 ◇ ■ What the future OpsCon must be	
	As-is case 2 □ ◇ (out of scope in design)	To-be case 2 ◇ ◇ What the future OpsCon may be	
Possible ◇			

Now
□

In the future
◇

Necessary ■

As-is case 1 □ ■	To-be case 1 ◇ ■
What the current strategy & technical artefact must be	What the future strategy & technical artefact will have to be
	To-be case 2 ◇◇
	What the future strategy & technical artefact may be

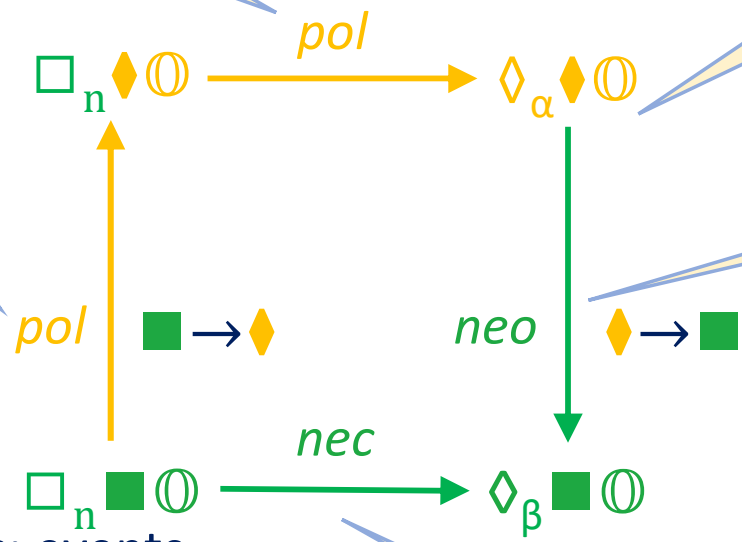
Possible ◇

What can extend the possibilities

What can open possibilities now

what alternatives might be possible

What should drive the change

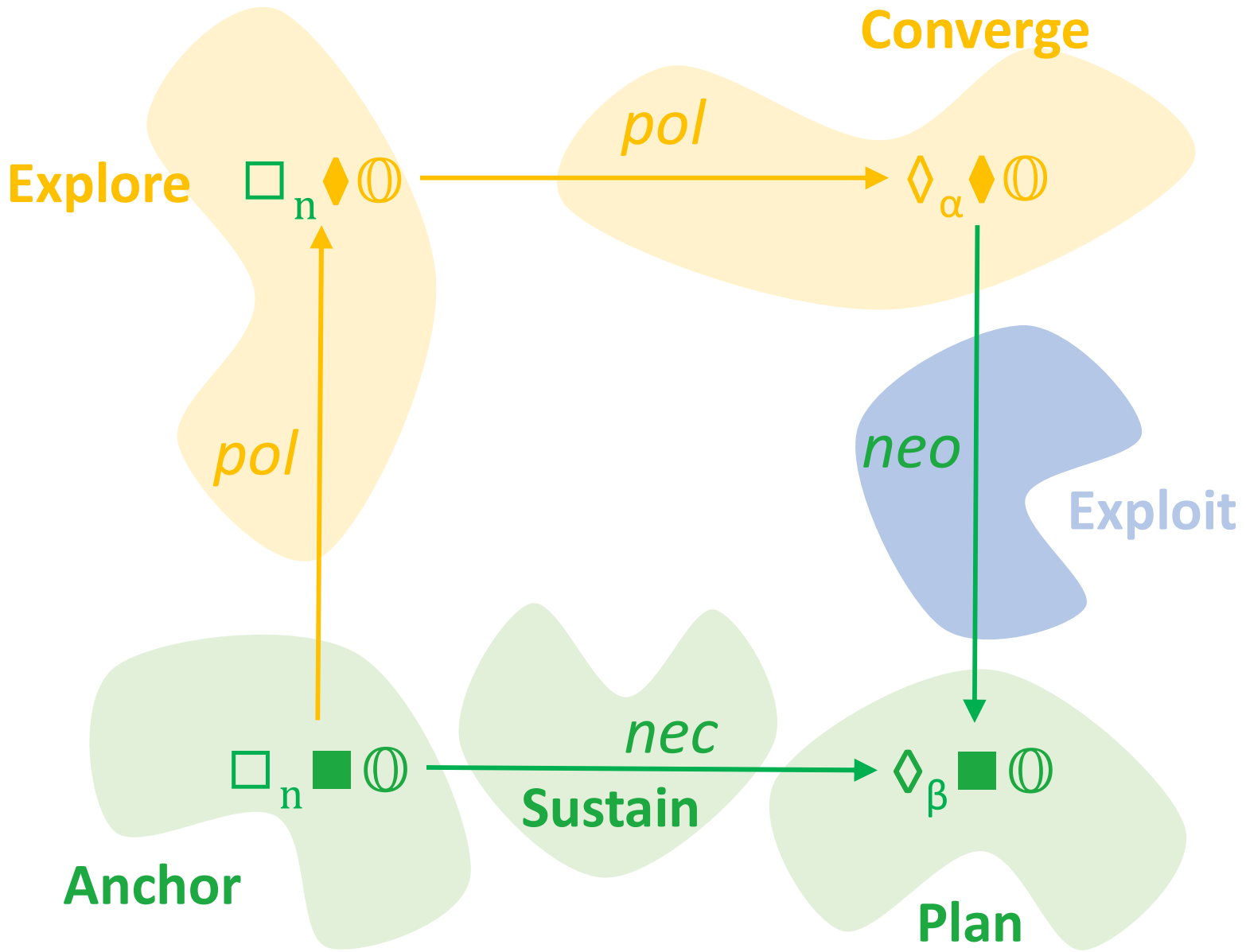


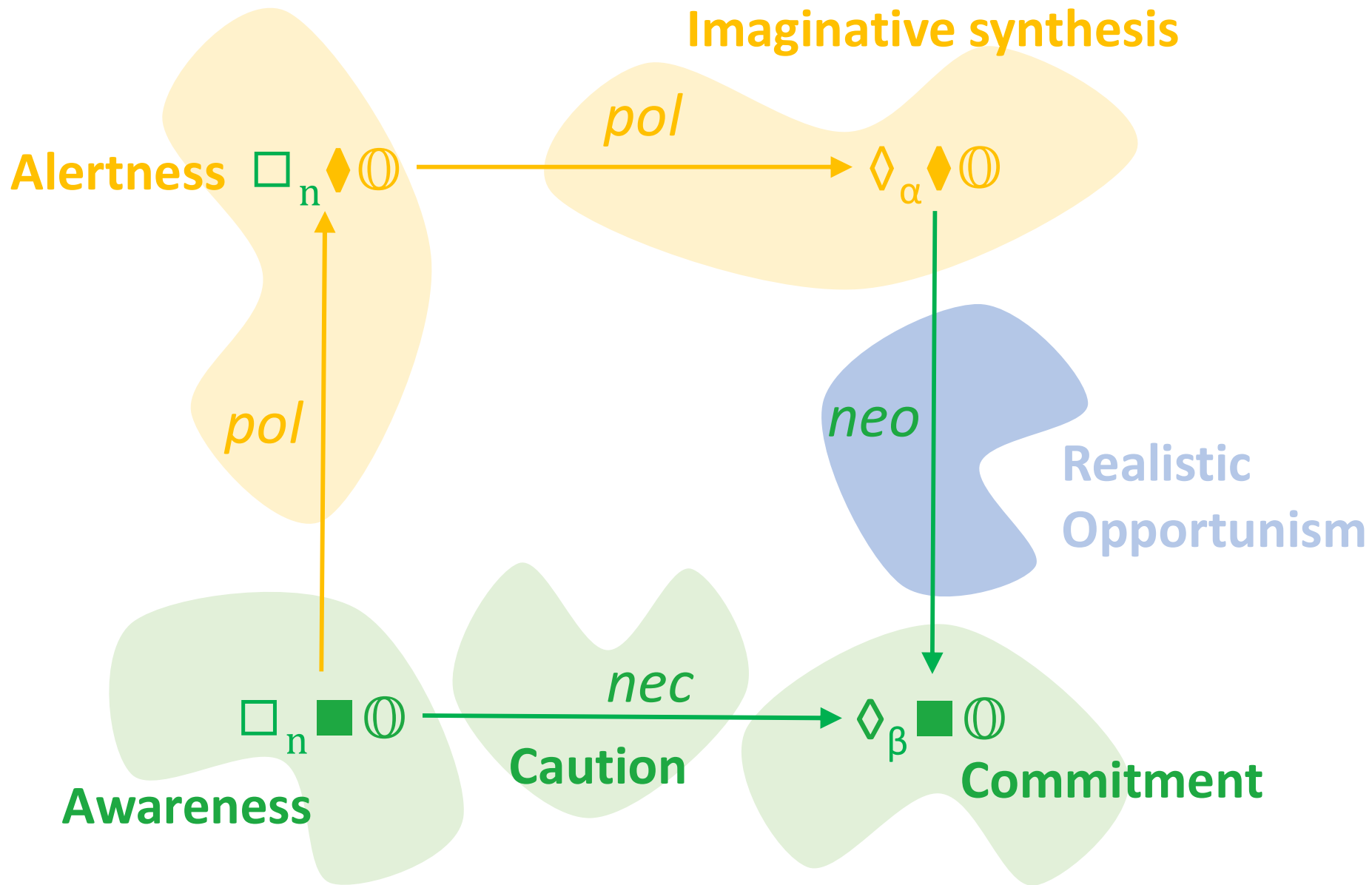
⊙, collection of objects: events, design entities, variables, phenomena...
 current instant: n, now
 future instants: $\alpha=n+1, n+2\dots$ and $\beta=\alpha+1, \alpha+2\dots$

nec, necessity line
pol, possibility line
neo, necessitation line

What must remain

Related cognitive activities





Link with part 3

Apply the framework of reference presented (concepts, as-is / to-be reasoning) to operation concept definition from a strategy point of view



Design the preliminary BMC & CAPAROD



Content

Explain how to design the BMC & CAPAROD

Status: preliminary, refined, validated

Key words

Strategy model

PESTLE, SWOT, BMC

Capability

Capacity

Readiness

What are the first strategy models?

Initially, mnemotechnic to facilitate the intelligence of teams originally integrating top managers most often assisted by consultants

Not rigorous models, but (too...) flexible & implicit visual tools

When were they invented?

Since the 1960s

Who produce & diffuse them?

Consultants of big companies with academic positions

Why use them in this course?

To contextualize the strategy & its key elements into diagnostic documents or figures

In business

Explosion of information technologies (IT)

Development of platform-based business model

Capitalism in partnership

Valorization of the start-up spirit

Praise for the entrepreneurship

In product design

Diffusion of design thinking

Shift from manager to entrepreneur

The current strategy models are no more designed for top managers elaborating long-run plans following a structured decision-making process, they are designed for entrepreneurs



Consequences

- ... Models...
- ... helping to reveal opportunities quickly (alertness)
- ... leveraging disruptive innovations, then imaginative synthesis
- ... rapidly validating imagined options
- ... supporting agile & iterative decision-making process (commitment as soon as possible)
- ... based on visual models, and not only documents



Francis J. AGUILAR (1932-2013) (1967)

Acronym PEST as a mnemonic to refer to the "political, economic, socio-cultural & technological"

External influence macro factors that can impact (inhibit or leverage) the (big) corporate strategy (external strategic or peripheral diagnosis)

PESTLE implementation consists in collectively building a shareable big picture of the company's external environment



Off-centered approach

360° RADAR

Each perspective, domain, package, etc., of PESTLE corresponds to a zone to be scanned in as-is (statement) or to-be reasoning (identification of sources of changes)

Leaf model

PESTLE packages refer to characteristics of the UcSoS & the TranSoS and can be integrated to SWOT (strategy synthetic model), then BMC (pivot model)



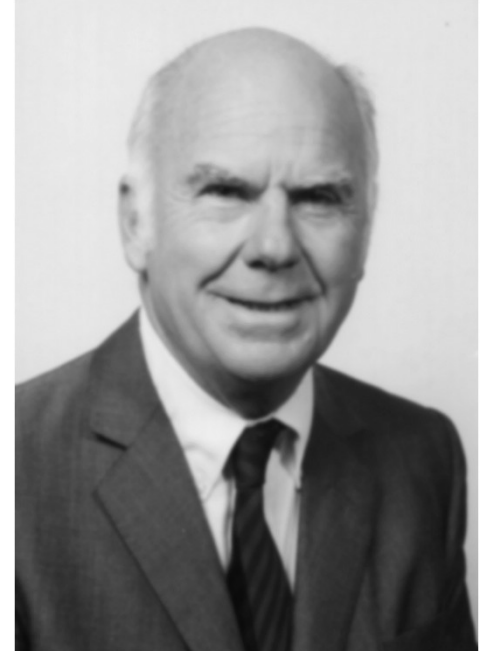
Albert S. HUMPHREY (1926-2005)

About Mid-1960s

Acronym SWOT as a mnemonic to refer to the current strengths & weaknesses and the future opportunities & threats

External & internal statements & drivers to consider in strategy creation

SWOT implementation consists in collectively building a shareable synthetic diagnosis



Degrees of freedom mapping

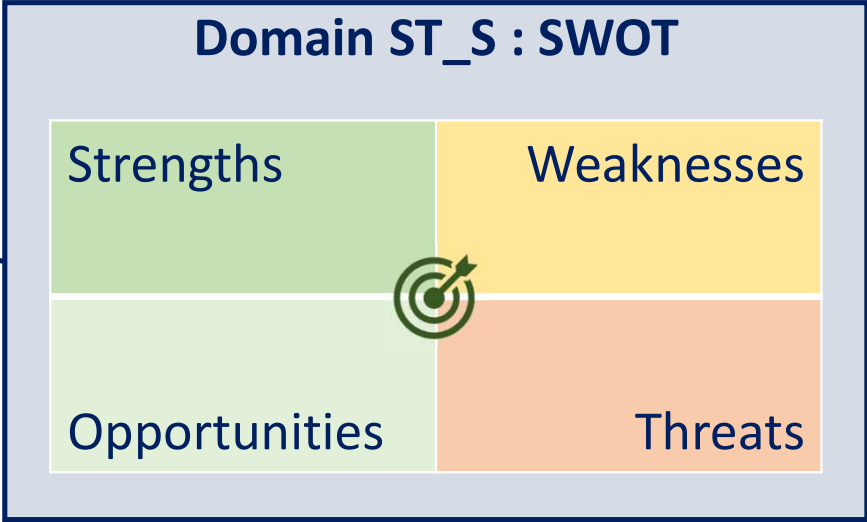
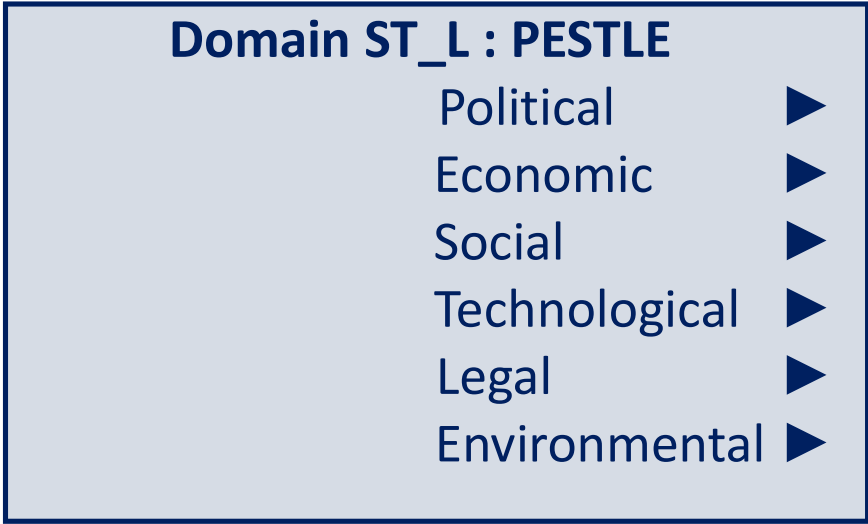
Distinguish between variables of success that can be controlled autonomously (S,W) and those that are independent (O,T)

Safety assessment

Be pessimistic and consider **SWOT** as a model for assessing the reliability of the business model, then verifying it



PESTLE – SWOT Mapping



Origins

Alexander OSTERWALDER & Yves PIGNEUR, 2010

Function

“A business model describes exactly how your company is going to make money. In practice, this means defining what you're going to sell, to which customers, for what purpose, in what way & for what profit”

Use in this course

Pivot model

Ignoring marketing and cost aspects, but elaboration of the user & SoS aspects of the BMC

BMC vocabulary

'Matrix" or "template" to describe & display the basic "parts" of the business model

"Typology" to specify the canvas & to focus on strategy key points mostly dependent on typical cases

"Design" techniques & tools

Business "storytelling" to communicate the sense, the essence of the expected business model in a clearer & more tangible way

'Candidate scenarios" to stimulate creativity (what happens if?) & help to project the business

Engineering vocabulary

Template

Architecture pattern

Visual model

Rapid prototyping for validation

Behavior model based on branching structure

"The design attitude [...is an] iterative & disordered approach that the thoughtful quest for new competitive growth models calls for [...]
Uncertain at the outset, the process unfolds in a chaotic & opportunistic way before focusing on a single point"

Osterwalder & Pigneur, 2010

Downstream side “parts”

Marketing domain

- ▶ Customer segments, channels & customer relationships

Upstream side “parts”

Organisation domain

- ▶ Key partners, activities & resources

Nodal constituent

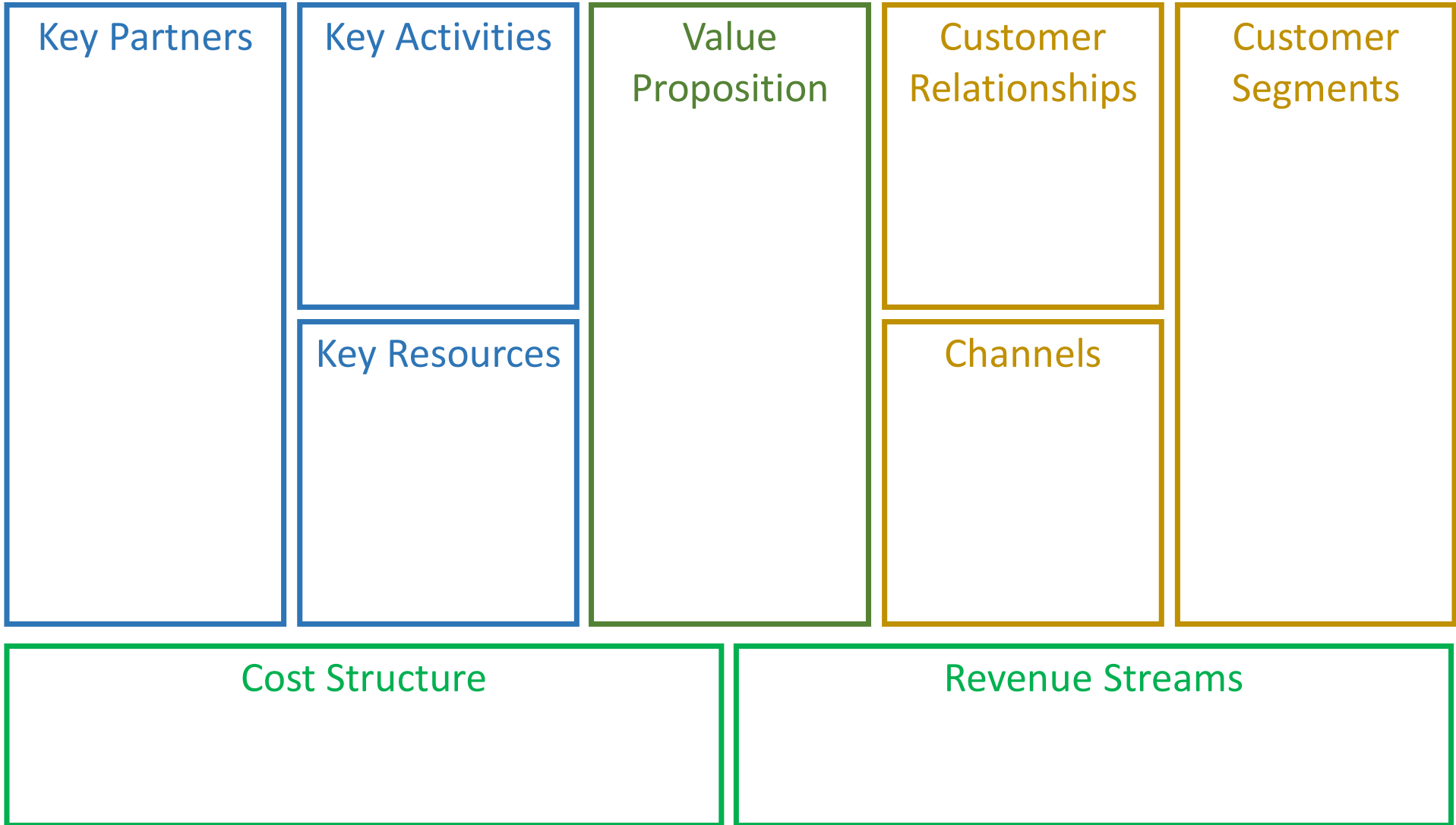
Product domain

- ▶ Value Proposition

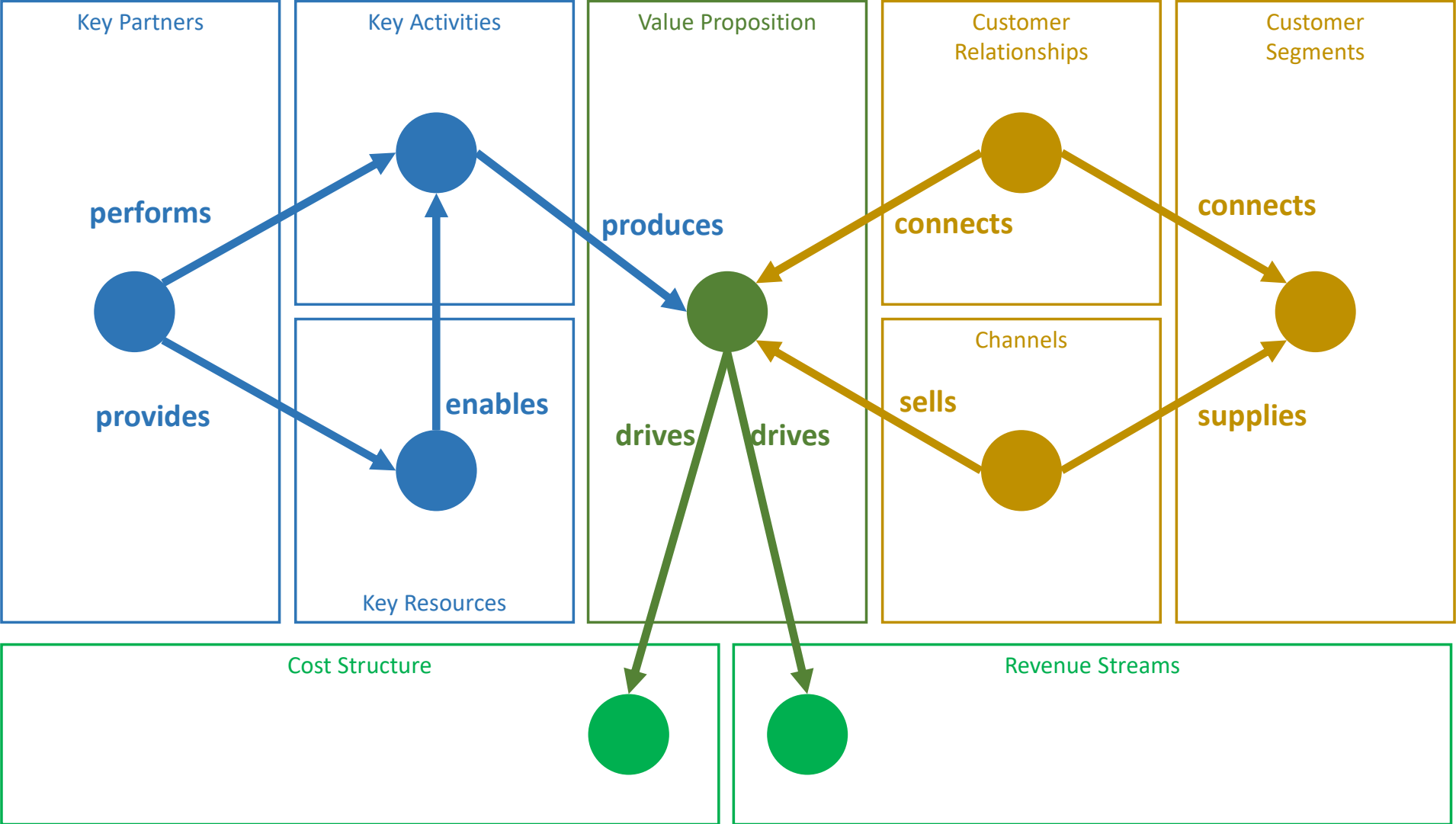
Synthetic constituent

Accounting & financial domain

- ▶ Revenue Streams & Cost Structure



BMC Causal Graph





Key questions

How to Create new products customers want?

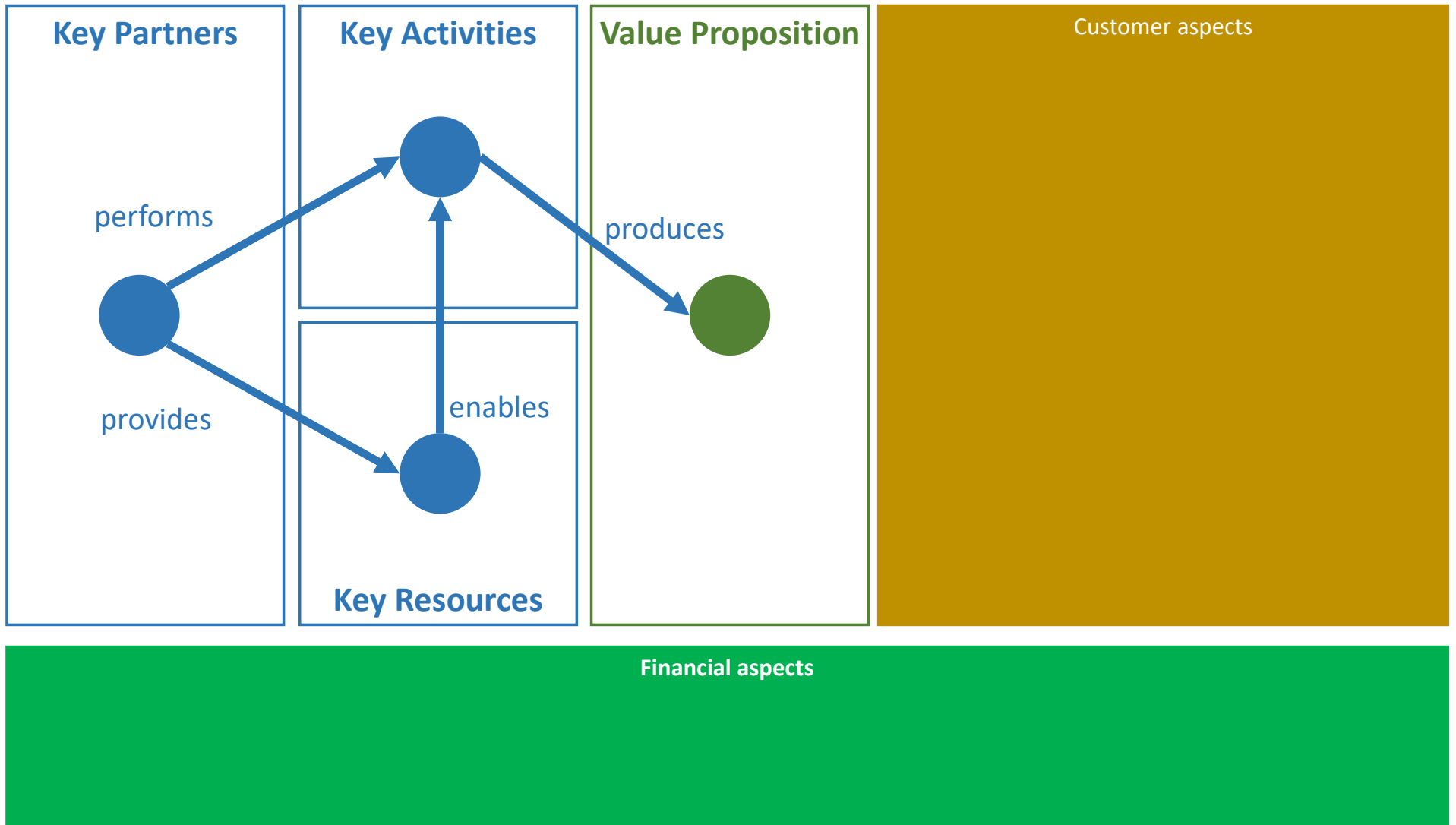
How to test new Business Ideas?

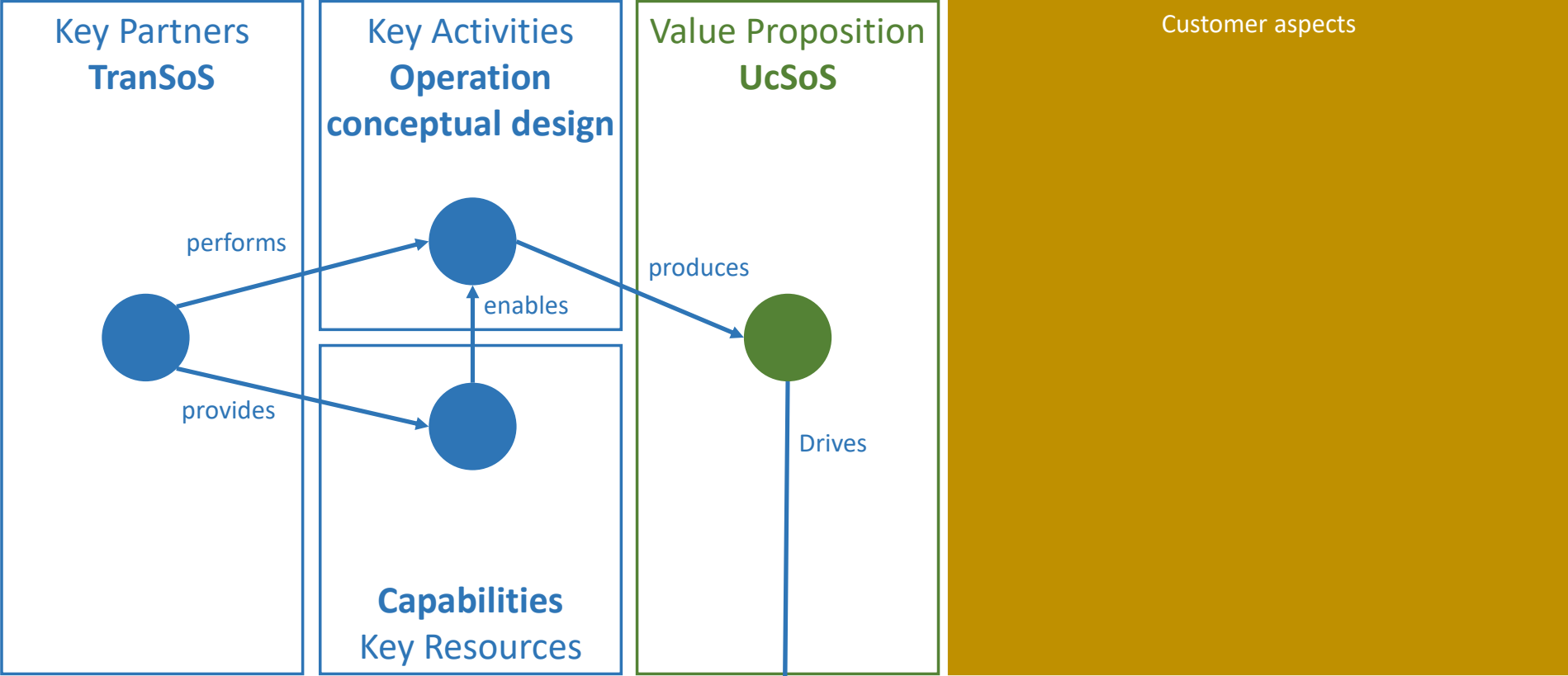
Key role of the value proposition design

Verification : is there at least one meaningful path covering all the parts of the BMC?

Validation : launching a competitive product on the market as soon as possible

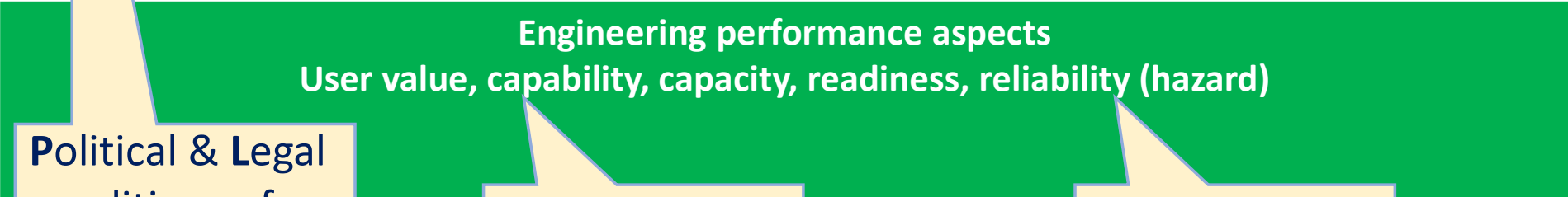
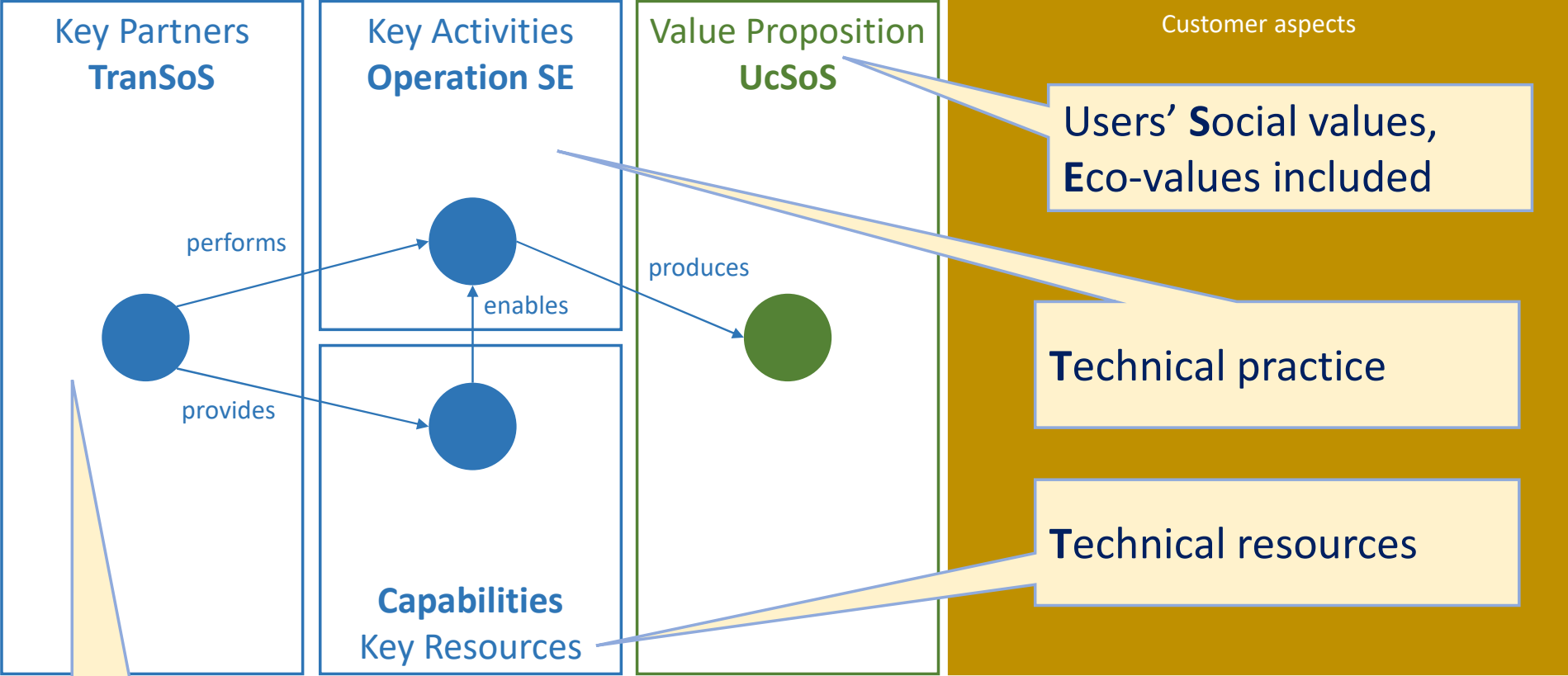






Engineering performance aspects
User value, capability, capacity, readiness, reliability

PESTLE contribution to BMC



Political & Legal conditions of alliances

SWOT mapping

SWOT mapping

Performances box

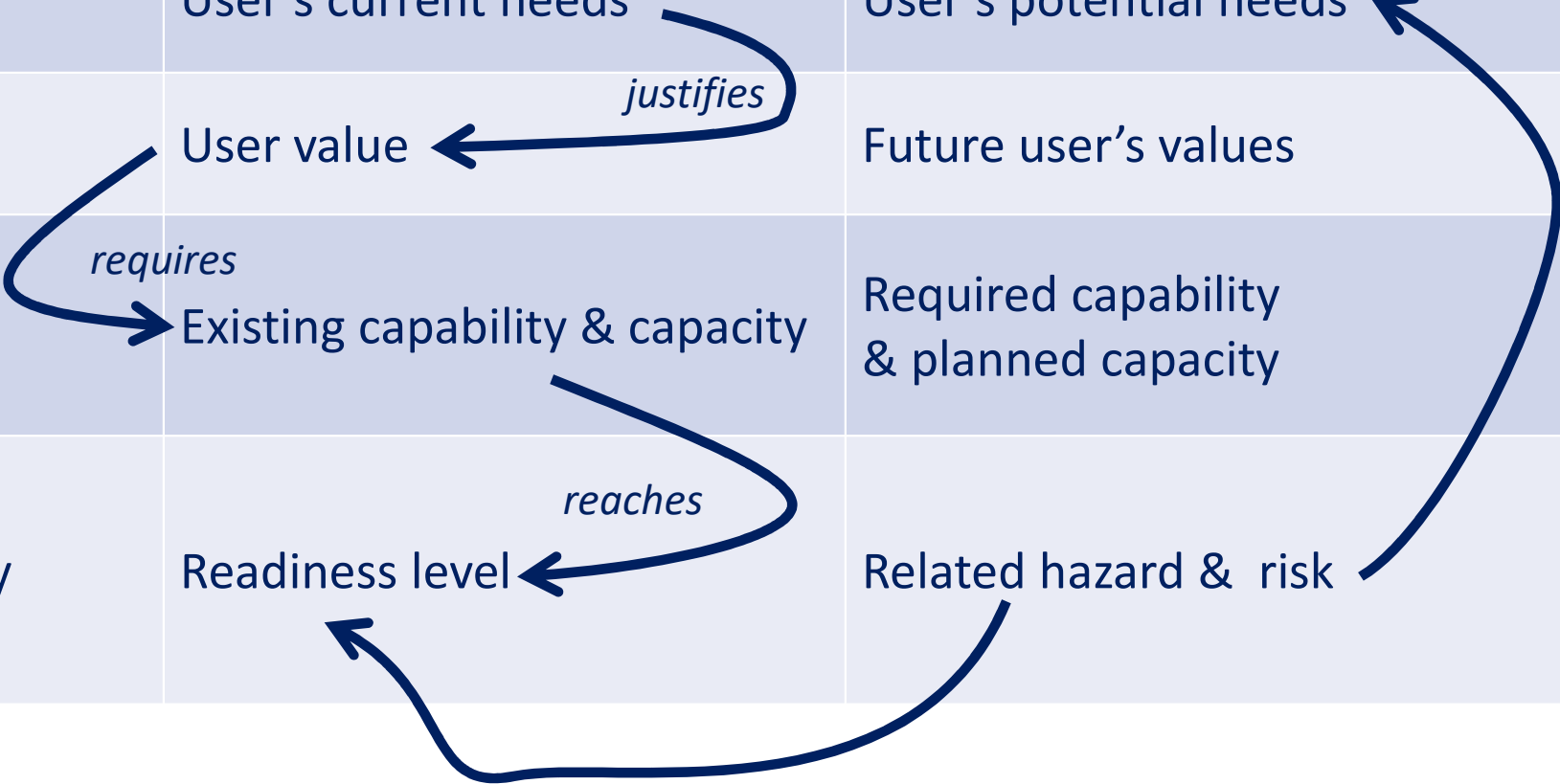
	As-is reasoning Static performance	To-be reasoning Dynamic performance
Input	User's current needs	User's potential needs
Output	User value	Future user's values
Enabler	Existing capability & capacity	Required capability & planned capacity
Controlability	Readiness level	Related hazard & risk

Performances box

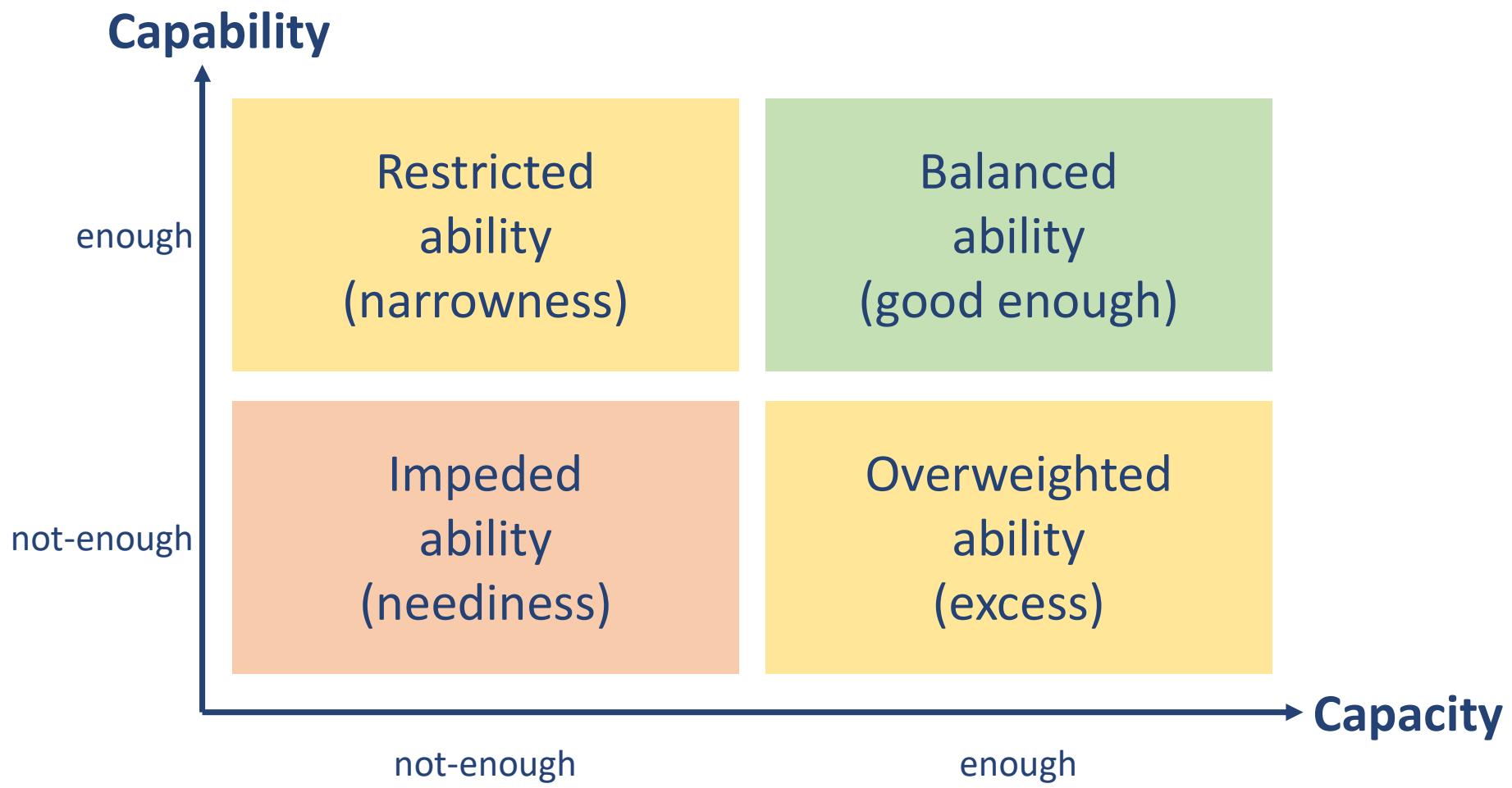
	As-is reasoning Static performance	To-be reasoning Dynamic performance
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Performances box

	As-is reasoning Static performance	To-be reasoning Dynamic performance
Input	User's current needs	User's potential needs
Output	User value	Future user's values
Enabler	Existing capability & capacity	Required capability & planned capacity
Controlability	Readiness level	Related hazard & risk



Capability- capacity trade off



Source

Capability Business Developpement Model

Hosiasluma, 2022

Key definition

Capability, organizational behavior “that encapsulates operational (service), functional (process, function) and physical (resources) elements”

Consequence

The capability is a package that is matter of organization architecture
Urbanization of IT resources

Package

Package the constituents of the capability

Breakdown

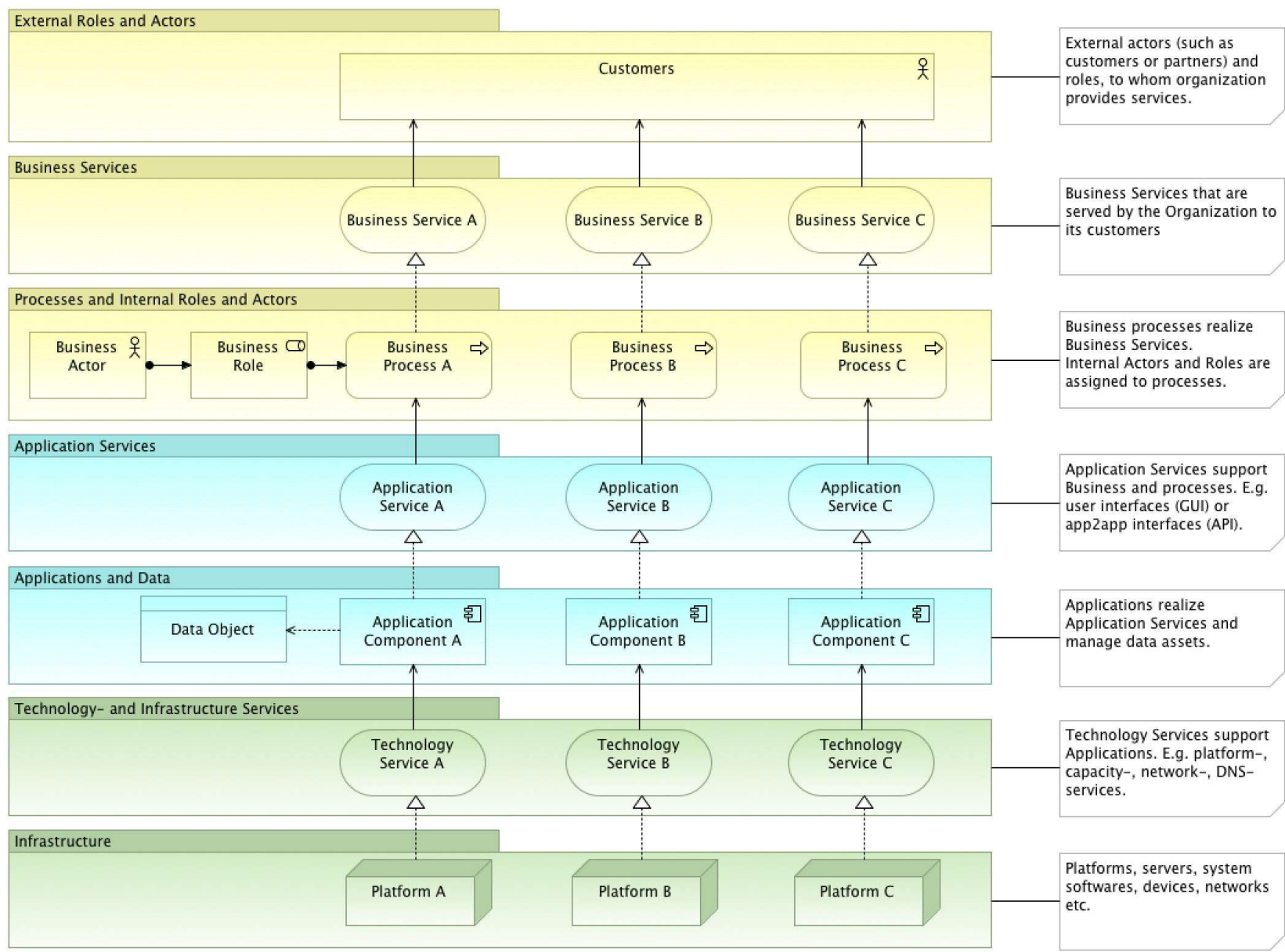
Break down into layers ranging from the user interface to background resources

Platform

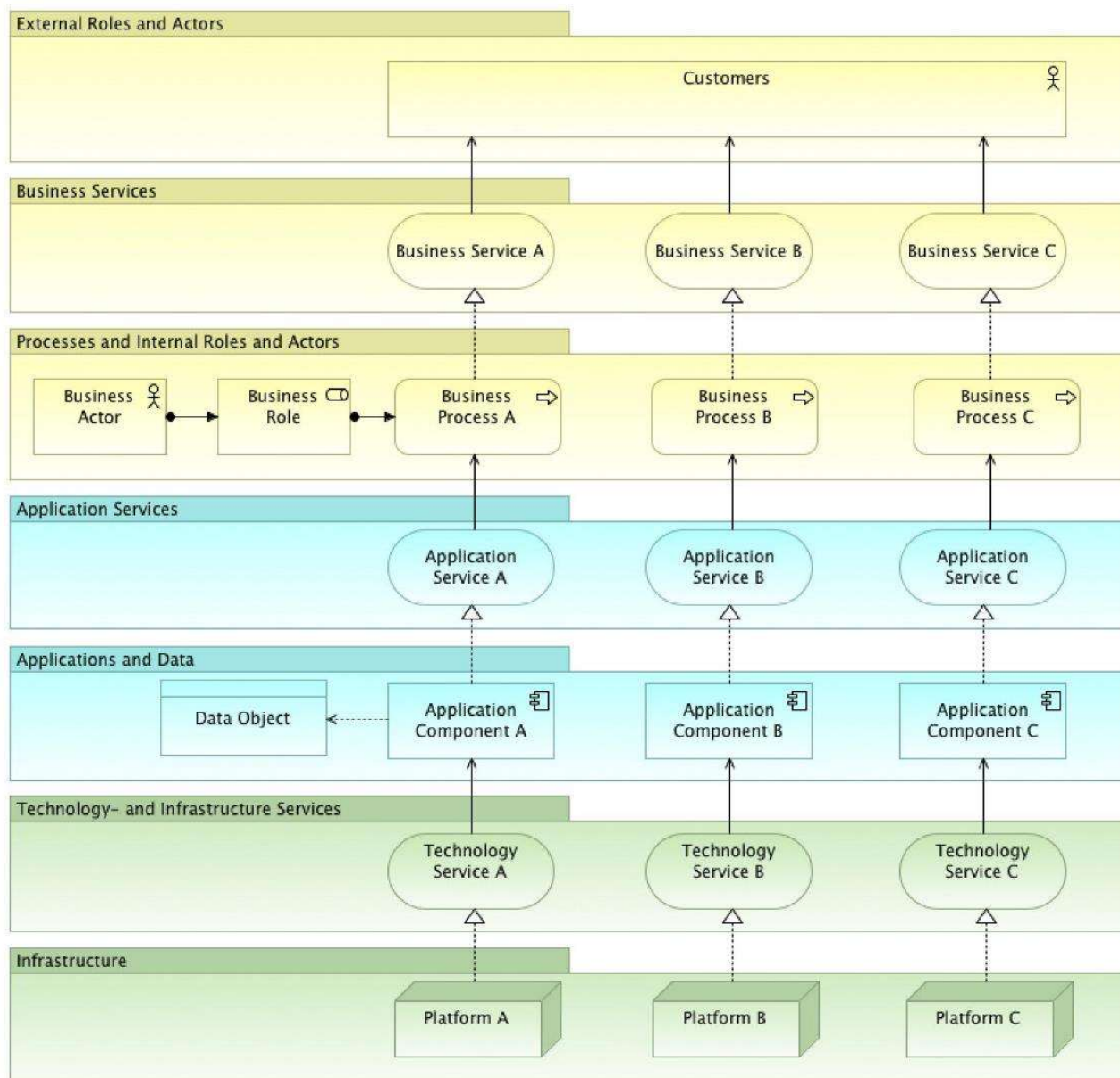
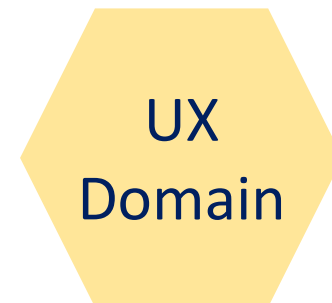
Bound the IT platform on which the capability is based

Reference: platform business pattern in BMC

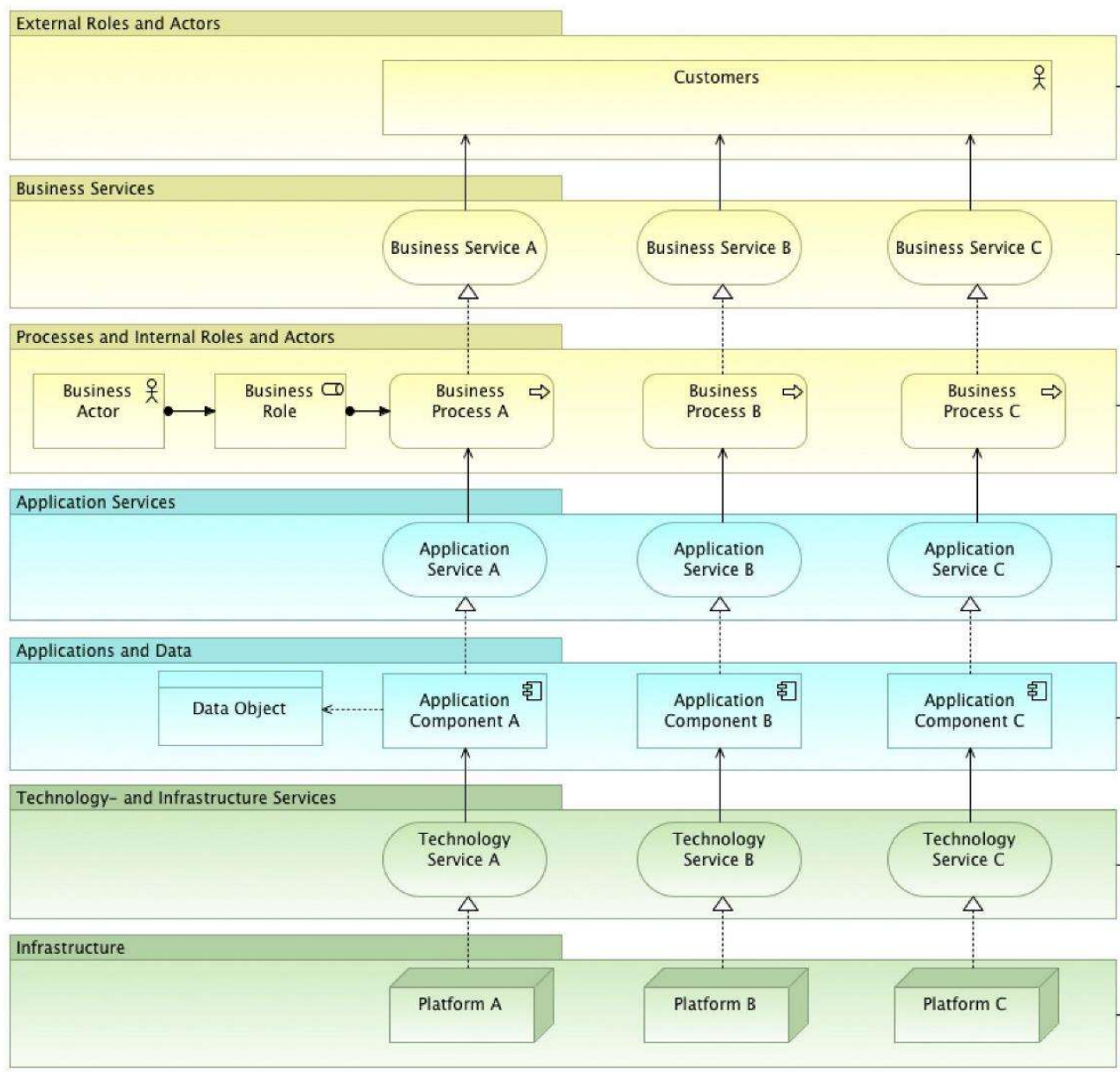
Capability platforming 1 | 5



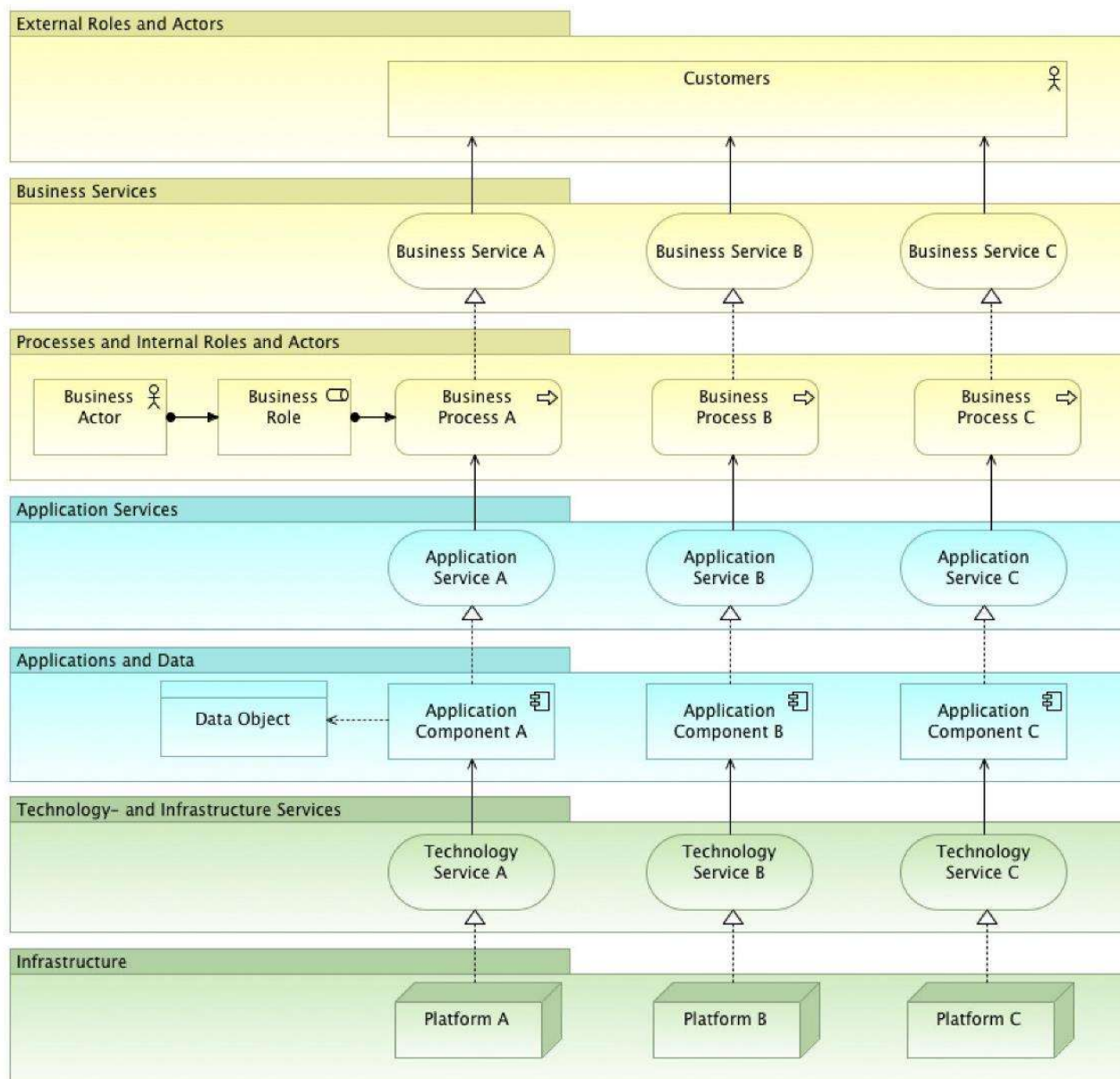
Source ?



Capability platforming 3 | 5

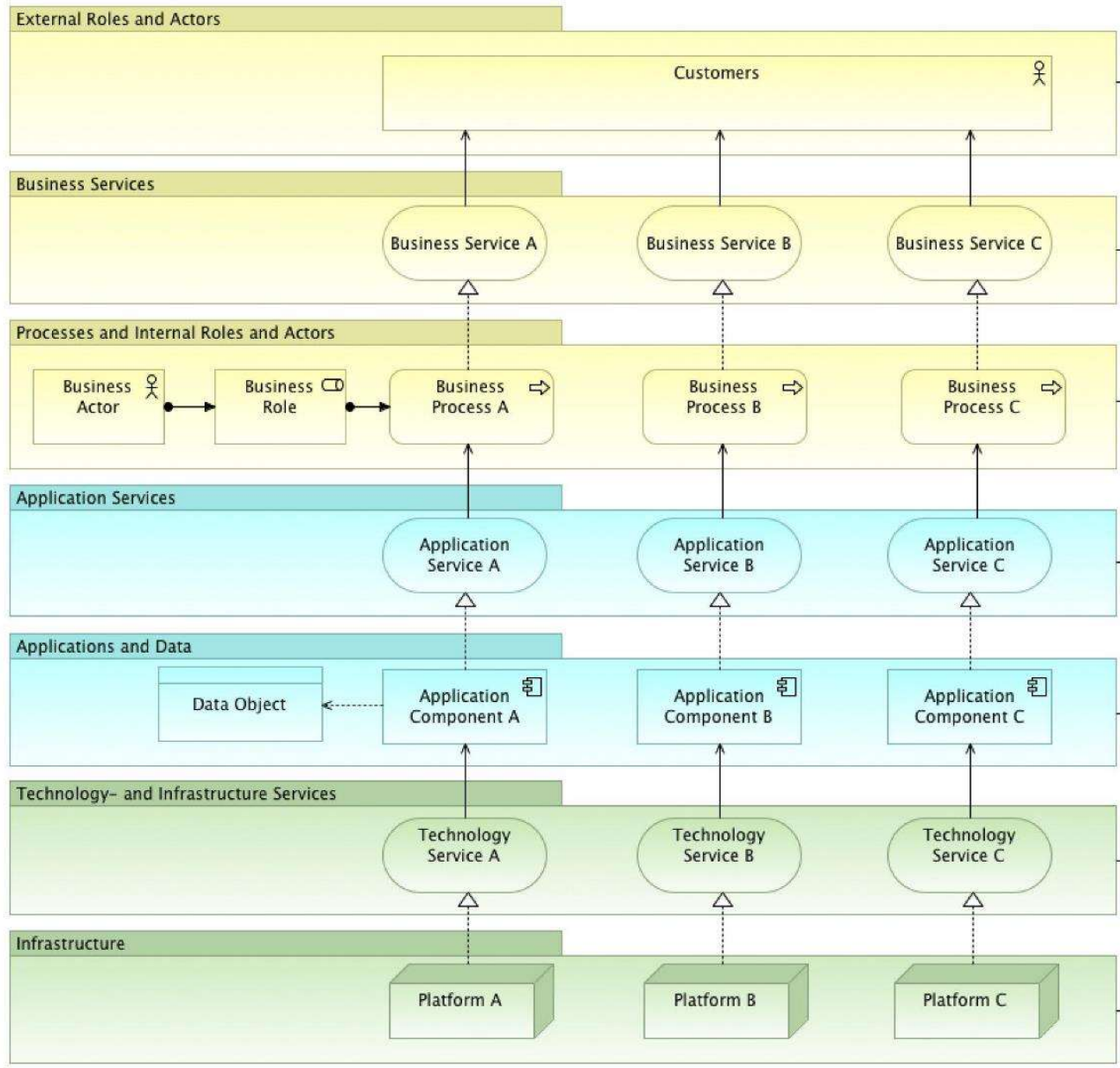


Key performances:
user value
& capability



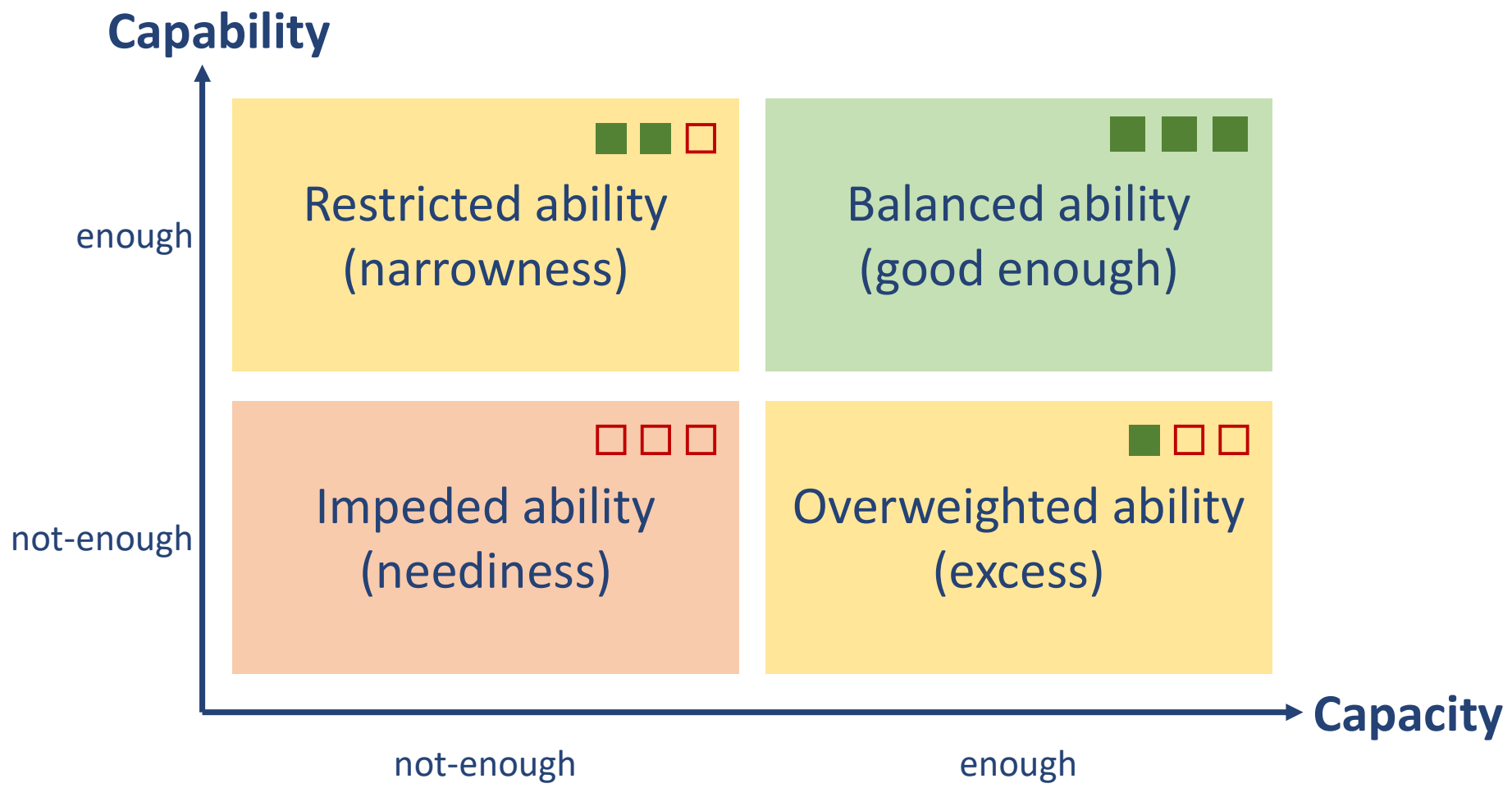
Organisation
as services provider
processes
based on IT pools

Capability platforming 5 | 5

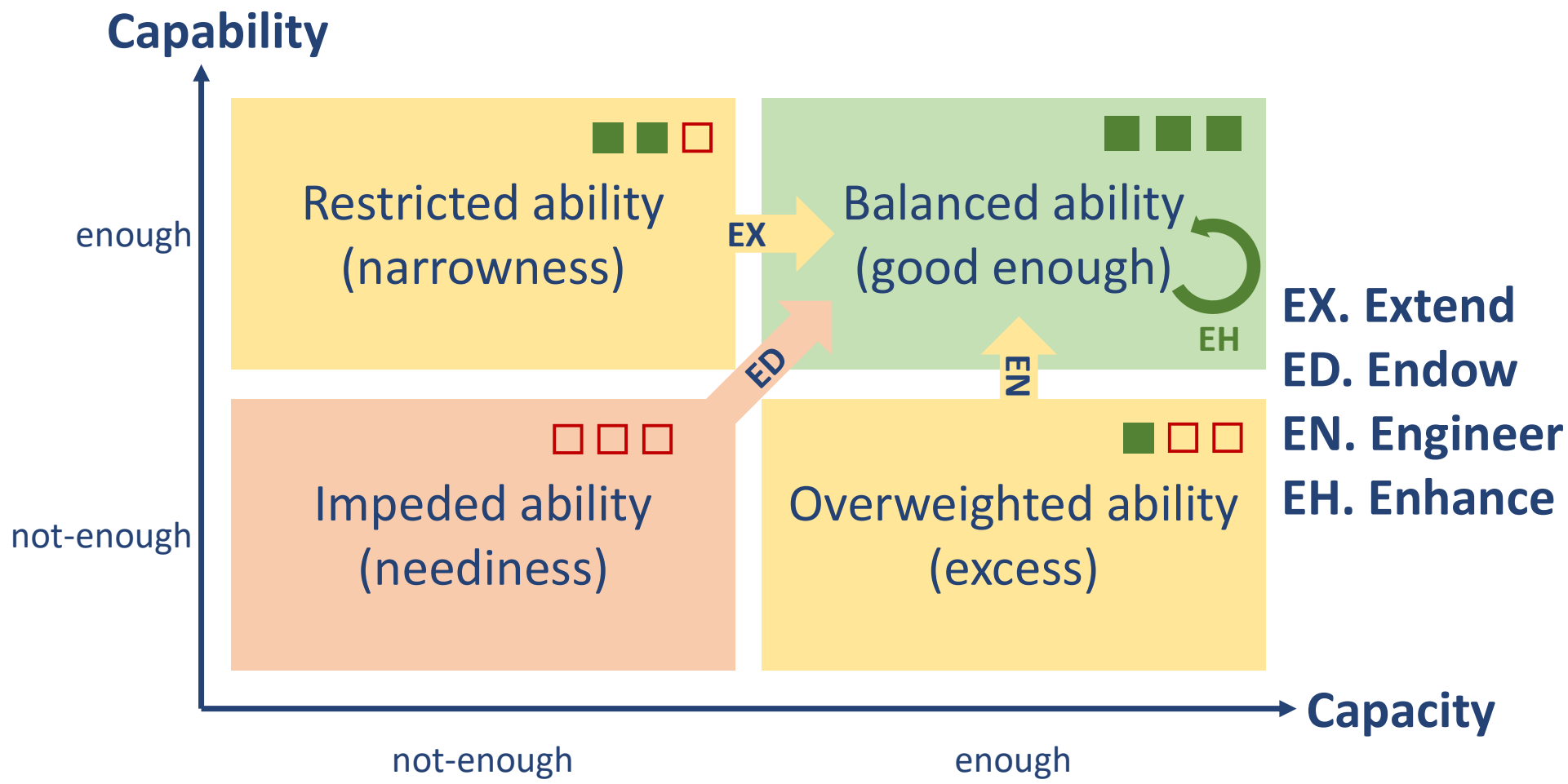


Infrastructure as background resources

Capability readiness levels



CAPAROD directions & gaps



Risks levels

Enhance

Very low

Extend

Low

Engineer

Medium

Endow

High





Direction	Barriers	Levers
EX. Extend	Long-term financial capacity	Massive investments in capacity
ED. Endow	Seed-funding	Frugal growth
EN. Engineer	Culture of abundance & overengineering	Lean project
EH. Enhance	A culture that values the implicit knowledge	Kaizen projects



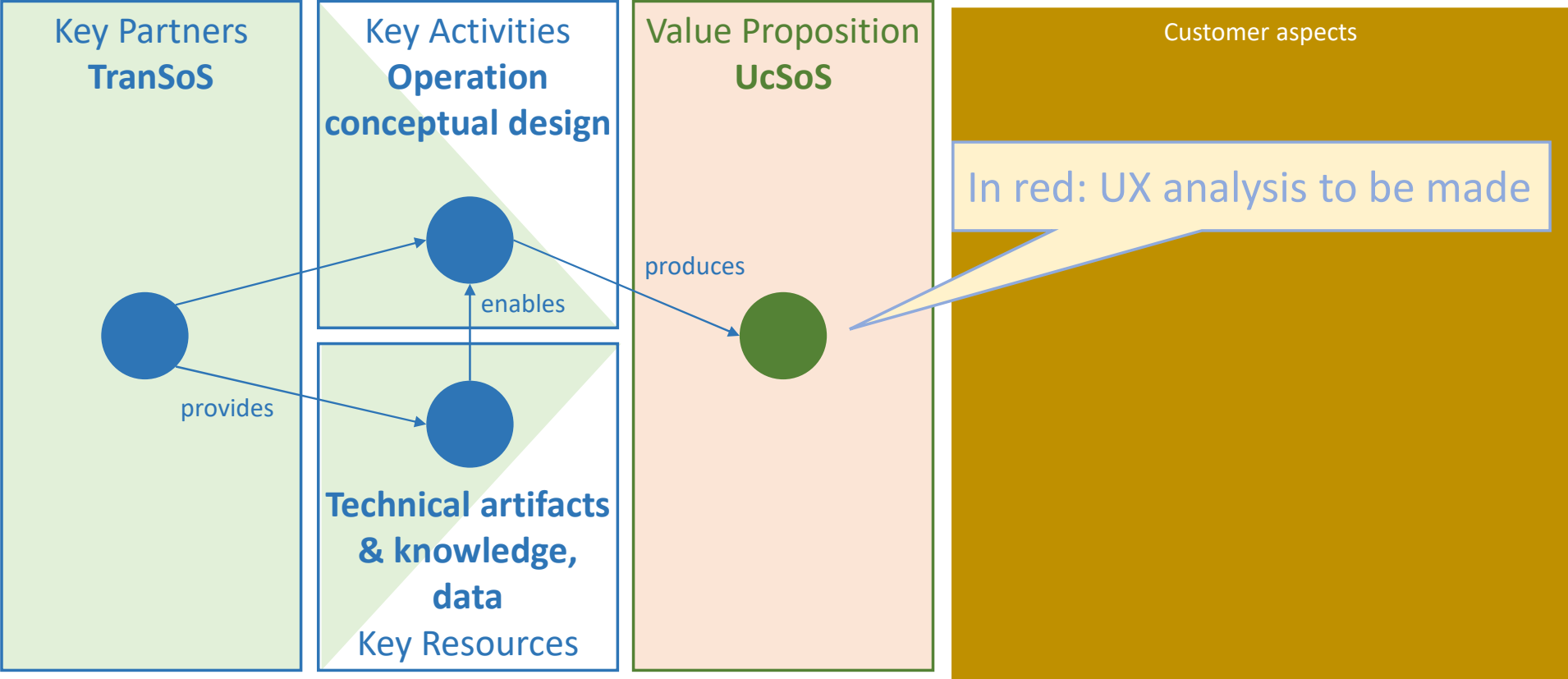
What about knowledge?

Why is not knowledge conceptualized as a resource, whereas data and ITs are?

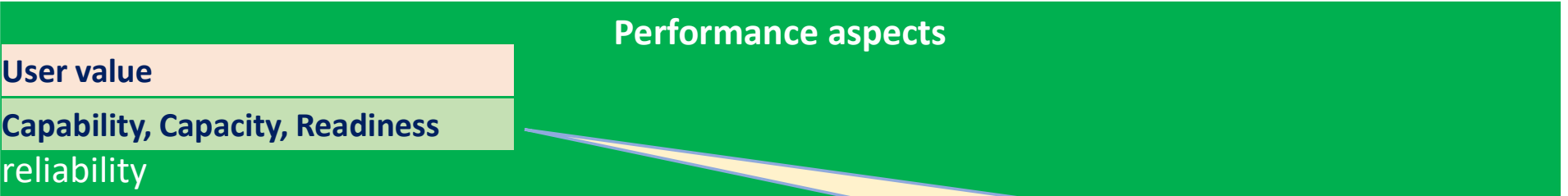
What is the relations between capability dynamics and individual & organizational learning?

What are the human and cognitive foundations of capability (individuals and groups' competences, know how)?

To summarize



In red: UX analysis to be made



In green: preliminary BMC completed



4

Stanford design thinking process to implement user-centric design

Content

Demonstrate how UX-analysis based on Stanford Design Thinking process is a prerequisite to diagnose the as-is value proposition & to design a to-be one

Key words

Design Thinking

Stanford Design Thinking process

Persona

User Journey Map (UJM)

Empathy Map (EM)



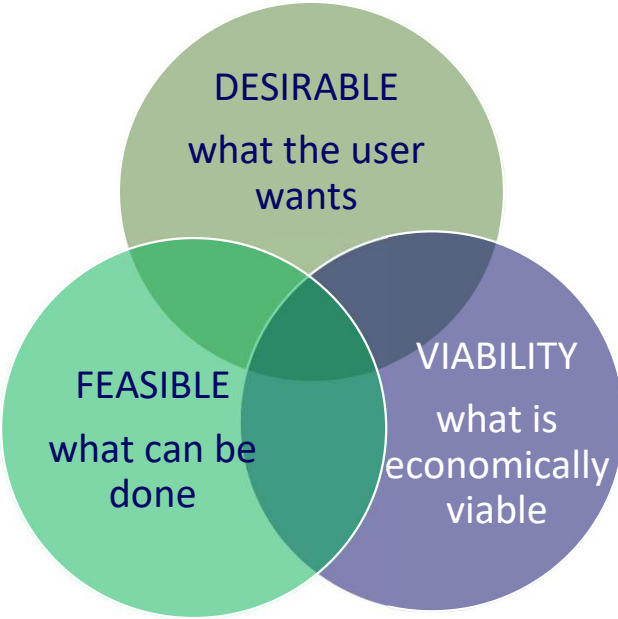
“Human”-centered design approach of innovation based on a co-creation process involving end-user feedbacks

Human \supset stakeholder \supset user

Developed in the 1980s

It enables the development of an innovative product or service that is **desirable, viable & feasible** through a combination of human, economic & technological approaches

Mainly: simple B2C products or services



SE alone

Stakeholders' needs defined & analyzed by the contractor

Balance between service & cost (value engineering) (Miles, 1985)

Importance of architecturing, tracing & preparing validation

Technical Vee-diagram

Focus on process compliance

Engineering schemas & computer-based models (MBSE)

Valuing Hi Tech solutions

Design thinking alone

Focus on UX empathized by the designer

Value management

Importance of starting with what is quick and easy to prototype

Agile design process based on frequent iterations

Focus of teamwork creative dynamic

Visual models (maps)

Valuing usable solutions

Strategy

BMC-focused
User, then
tranSoS
sketched

Stakeholders'
needs & requirements

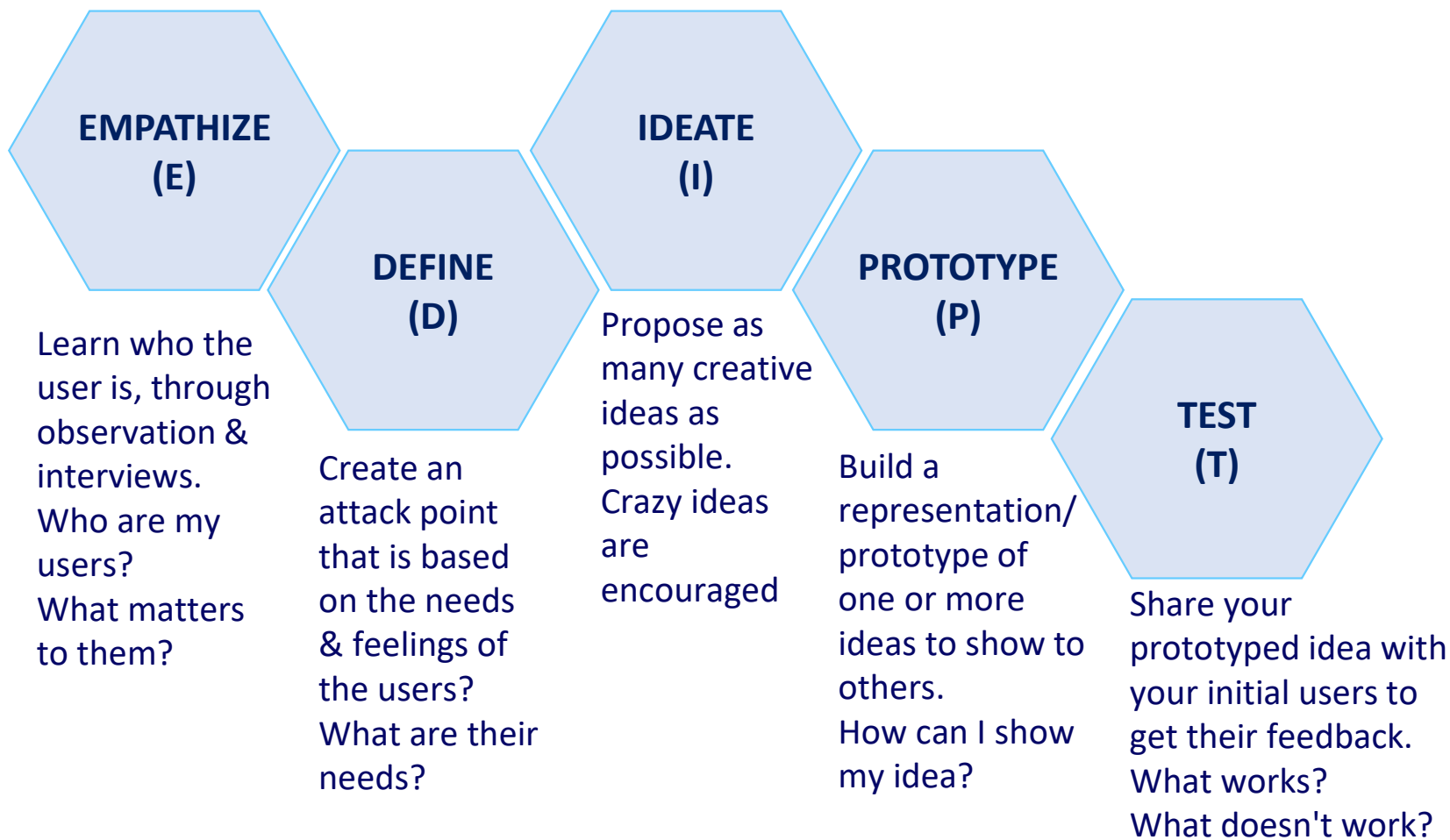
Routine SE

User's needs elicitation
then UcSoS detailed

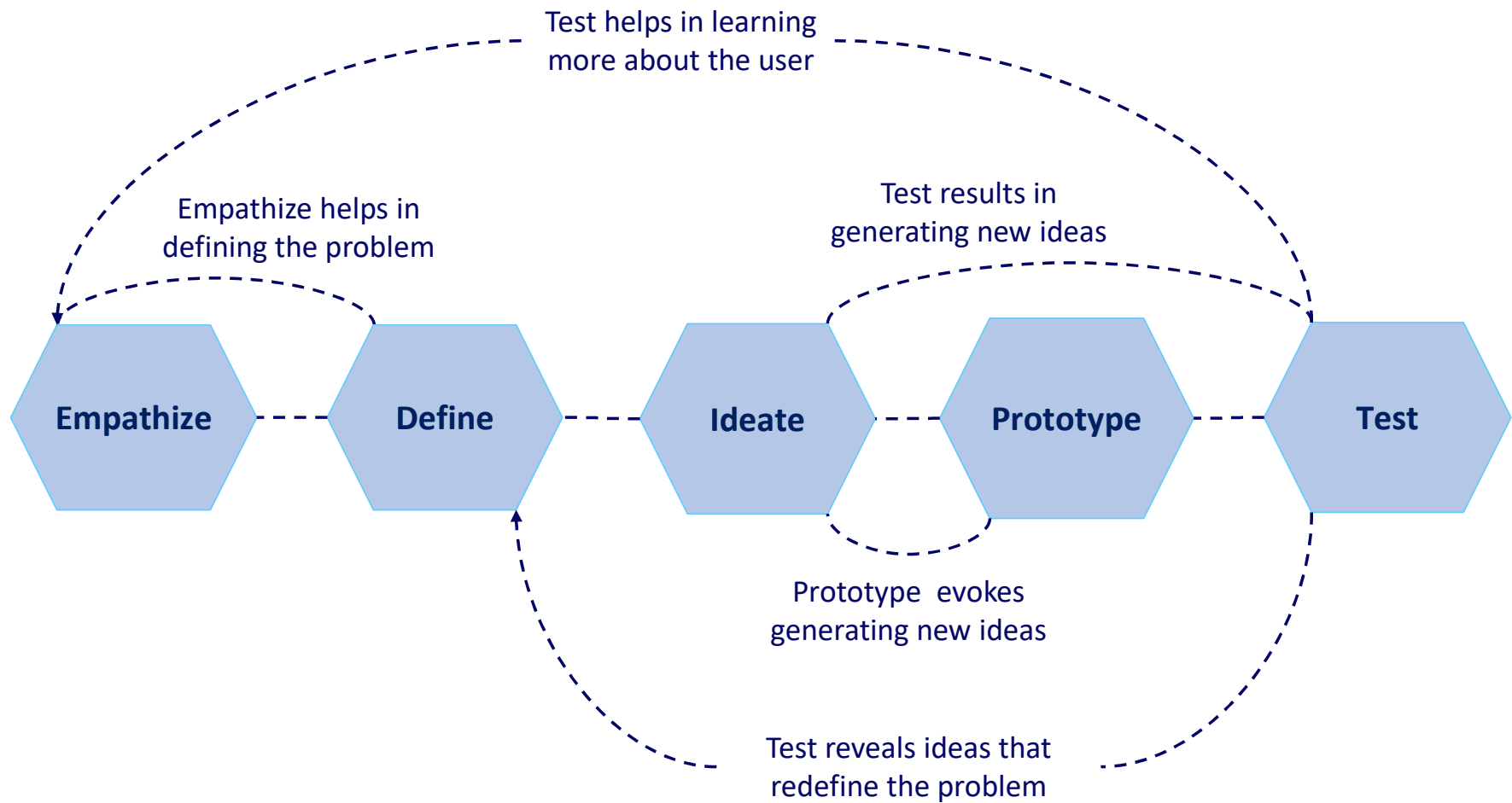
Design thinking

Design

Stanford Design Thinking Process (SDTP)



An Iterative Process



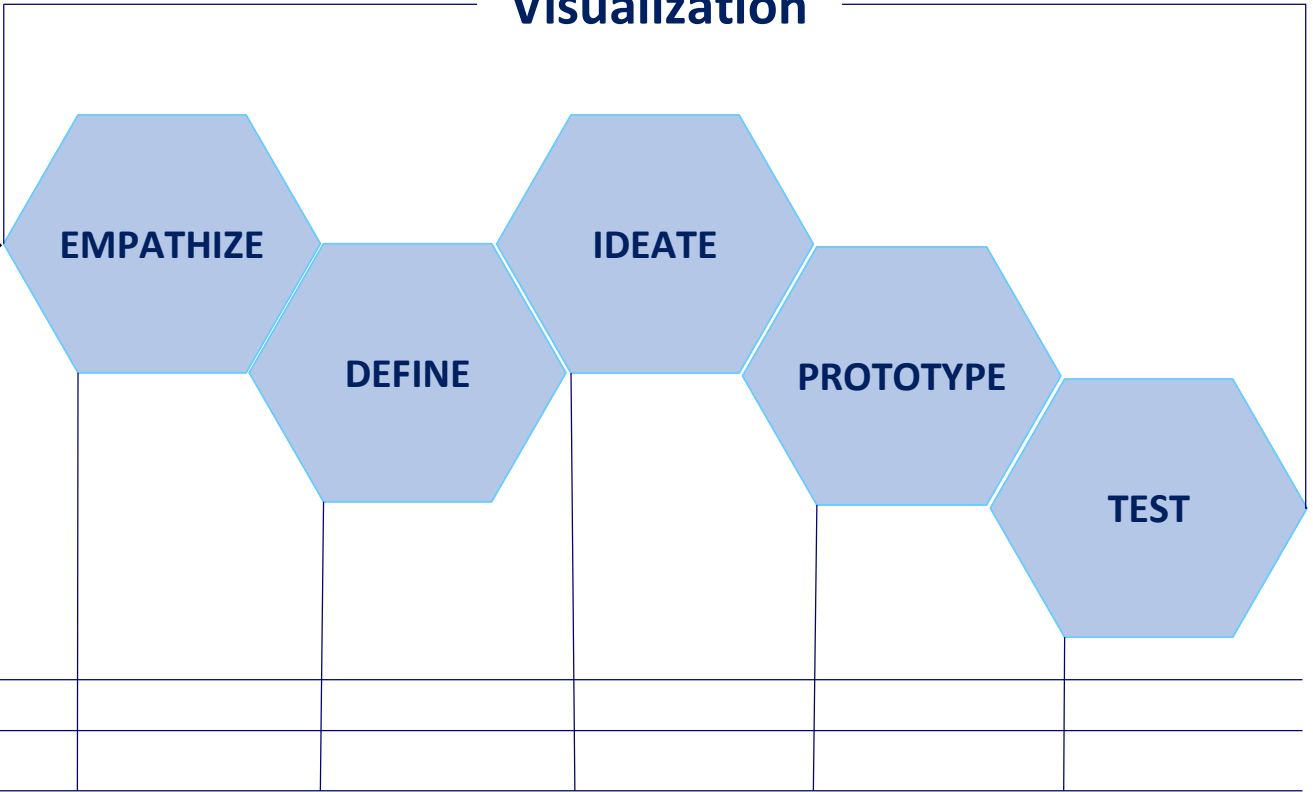
Conduct the STDP Process

Starting point

PROJECT RECORD	
Project description	
Initial objective	
Target users, stakeholders	
Expected results	
Success indicators	



Visualization



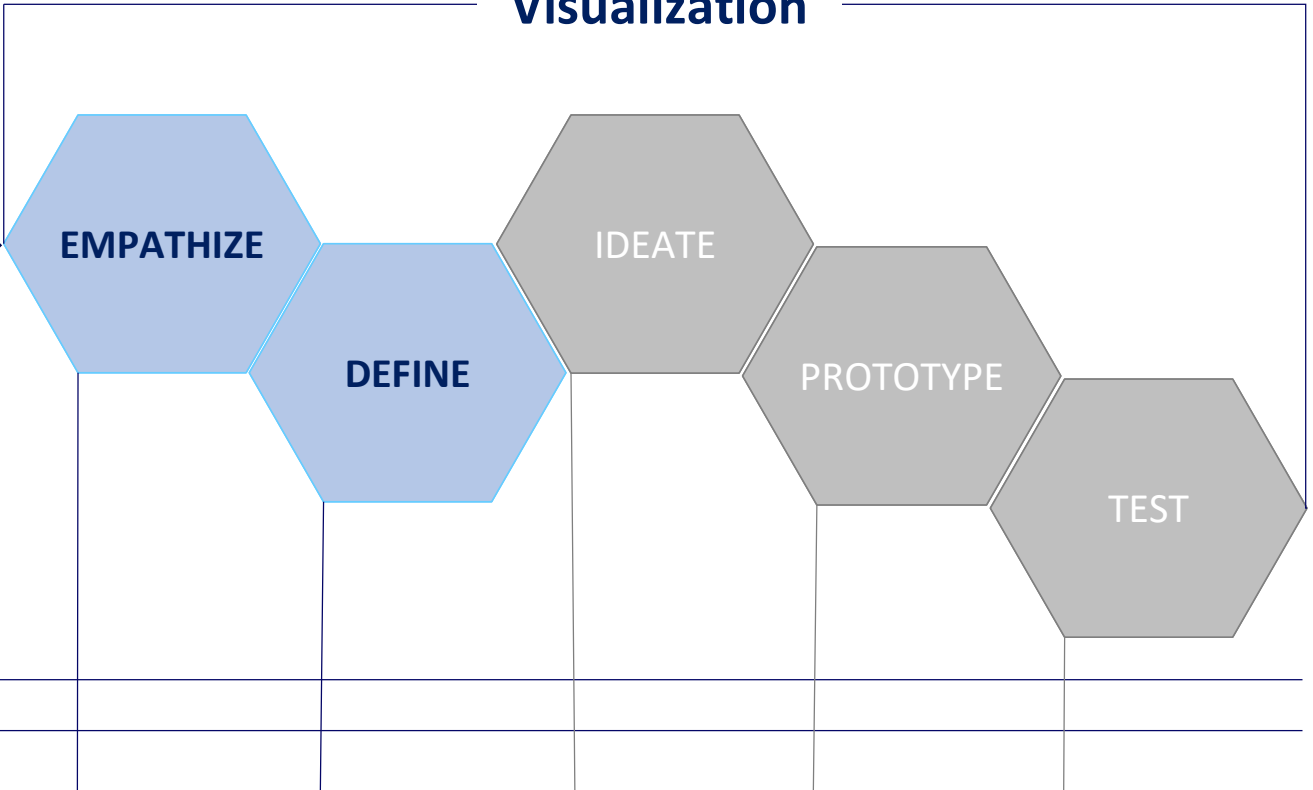
Focus of this course

Starting point

PROJECT RECORD	
Project description	
Initial objective	
Target users, stakeholders	
Expected results	
Success indicators	



Visualization



Step 1 of SDTP

EMPATHIZE (E)

Learn who the user is, through observation & interviews.
Who are my users?
What matters to them?

DEFINE
(D)

IDEATE
(I)

PROTOTYPE
(P)

TEST
(T)



Objectives

Understand UX & user's emotions

Look at what is happening. Describe the current reality. Clarify what the problem is

Look for what is emotionally true for the user, & what he/she wants to do

Focus on the present to discover hidden attitudes

Enablers

Data collection: interviews, direct observation, camera

Models: Persona, empathy map (EM)

Deliverables

Validated models



Design vs. use



Design



Usage

Most problems in product design are due to the differences between designers' & users' vision!



Origins

Borrowed from Latin *persona*

Face, appearance, mask used in ancient theatre to denote a character or, more generally: social role, type...

Use in Design Thinking

To give a detailed view of the types of user, which the strategy engineering does not provide

Emphasis on individual, hedonistic, cultural... aspects driving the user's value

A persona groups key observations into a specific & distinct character

To create a persona, the design team must have already unpacked its field observations

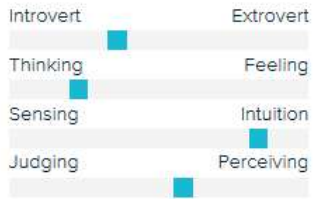
User Persona Type



"A quotation that captures this user's personality."

Age: 1-100
Work: Job title
Family: Married, kids, etc.
Location: City, state
Character: Type

Personality



- Trait 1
- Trait 2
- Trait 3
- Trait 4

Goals

- A task that needs to be completed.
- A life goal to be reached.
- Or an experience to be felt.

Frustrations

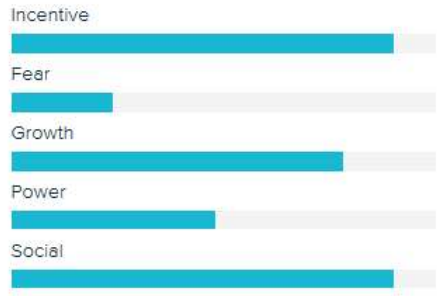
- The challenges this user would like to avoid.
- An obstacle that prevents this user from achieving their goals.
- Problems with the available solutions.

Bio

The bio should be a short paragraph to describe the user journey. It should include some of their history leading up to a current use case. It may be helpful to incorporate information listed across the template and add pertinent details that may have been left out. Highlight factors of the user's personal and of professional life that make this user an ideal customer of your product.

Remember - you may modify this template, remove any of the modules or add new ones for your own purpose.

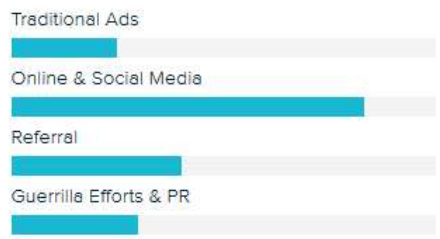
Motivation



Brands & Influencers



Preferred Channels





Example of I.D



Jill Anderson



"I'm looking for a site that will simplify the planning of my business trips."

AGE: 35
 WORK: Regional Director
 FAMILY: Married, 1 Child
 LOCATION: Austin, Tx
 ARCHETYPE: The Frequent Flyer

Organized	Practical
Protective	Hardworking

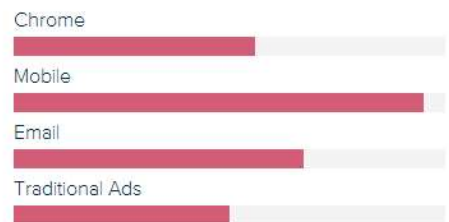
Bio

Jill is a Regional Director who travels 4-8 times each month for work. She has a specific region in which she travels, and she often visits the same cities and stays at the same hotel. She is frustrated by the fact that no matter how frequently she takes similar trips, she spends hours of her day booking travel. She expects her travel solutions to be as organized as she is.

Personality



Preferred Channels



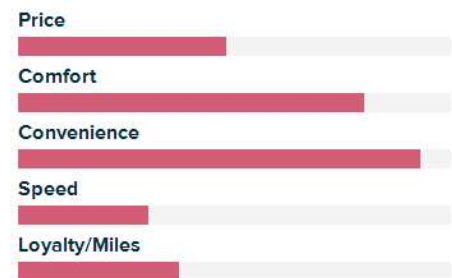
Goals

- To spend less time booking travel
- To narrow her options quickly

Frustrations

- Too much time spent booking - she's busy!
- Too many websites visited per trip
- Not terribly tech savvy - doesn't like the process

Motivations



Brands



Why observe?

Collection of data in real situations

To give access to behaviors that users are not always aware of

How observe?

1. Define the situations to be observed
2. Define the type of observation *in situ* (participant or not)
 - Participant: Immersion in the situation (self-observation)
 - Not: Observation outside the activity
3. Prepare an observation guide (what to note?)





Example



People leaving supermarkets, loaded by shopping bags or carts

Different ages

Rainy weather, Carrying an umbrella too

Crossing the street, subject to danger

Their feelings & needs



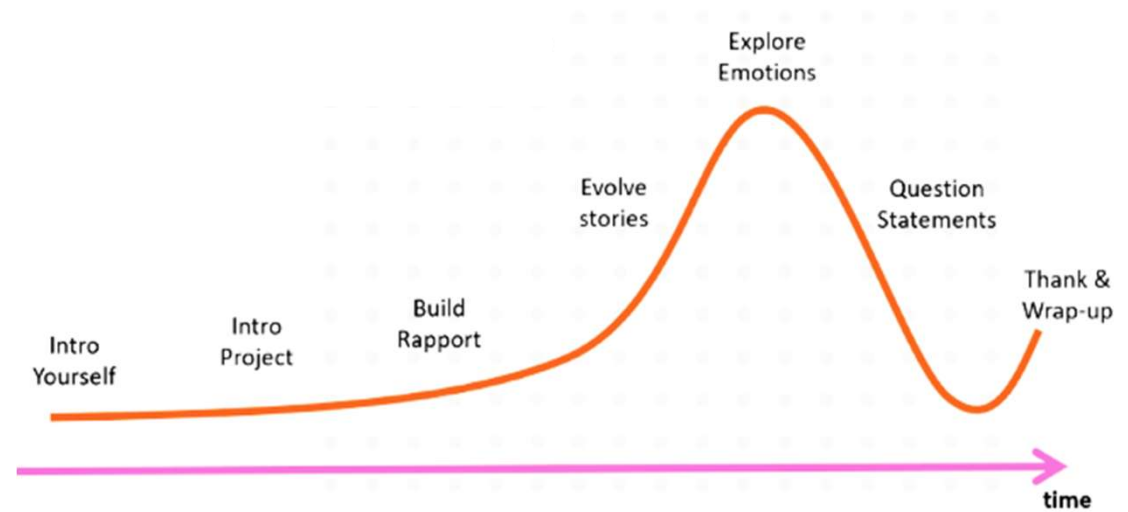


Empathy

Trying to understand how the other persons feel

Understanding the thinking, emotions & motivations of an alter

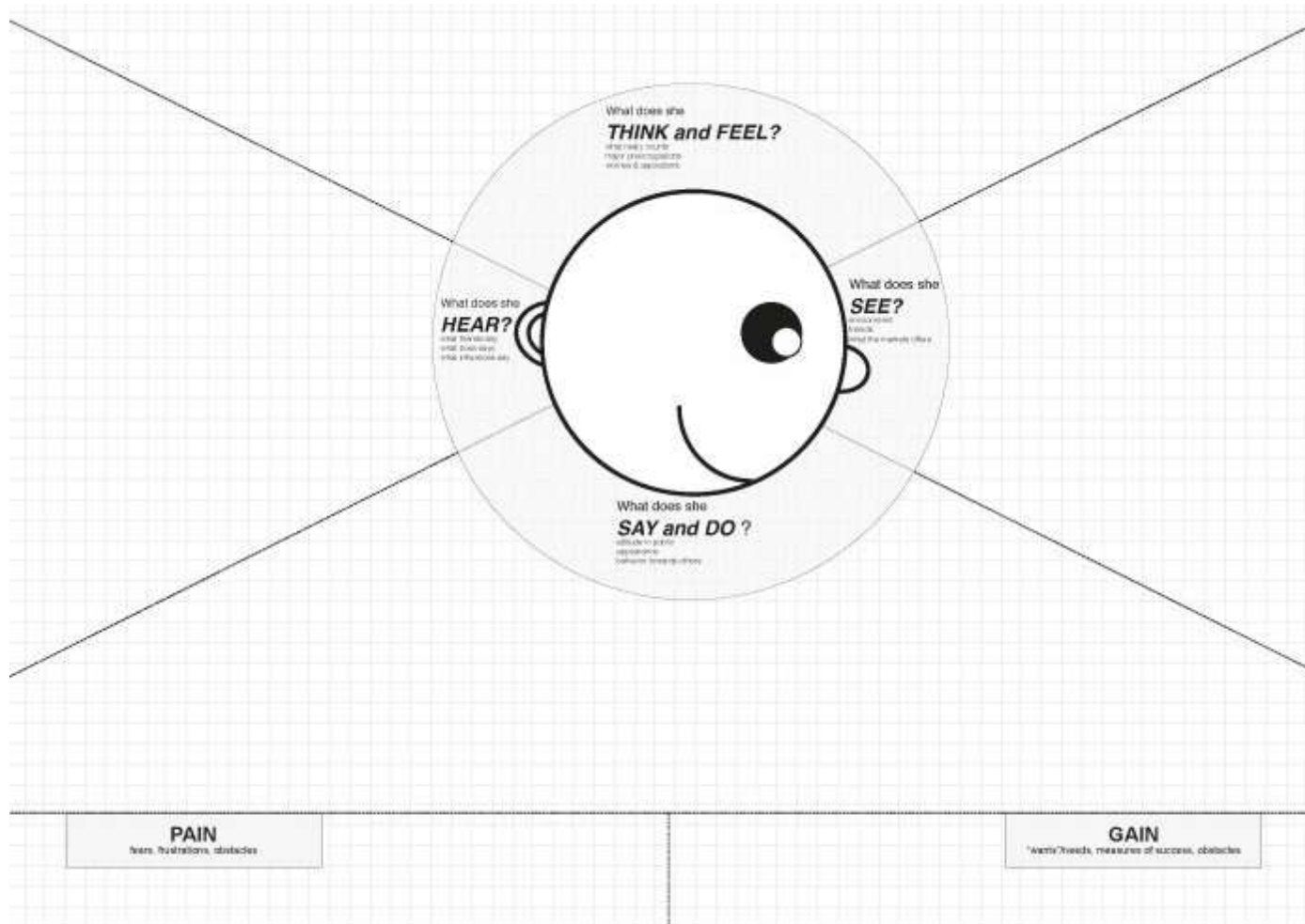
Non-directiveness (limit closed questions)



source : D-School Bootcamp Bootleg



Empathy Map template





Context

We are Office Coffee Machine (OCM) manufacturer

Who are our customers?

Companies, public organizations, societies...

B2B marketing

Who are the end users of our product?

Employees & collective environment





Toy case #1

What are our product specificities?

From 10 to 200 cups of coffee a day

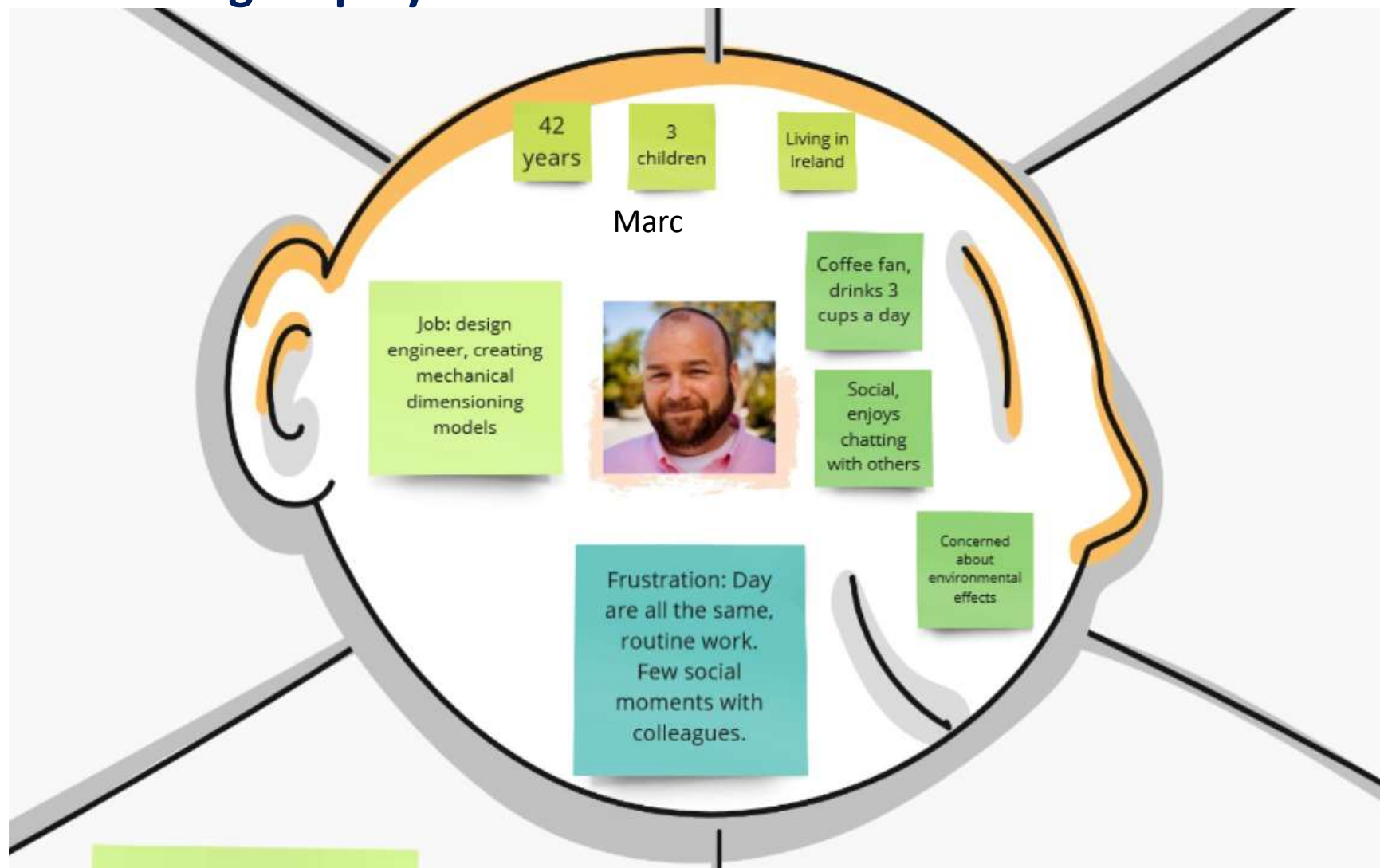
Coffee beans

Design problem

How to encourage unwilling employees to take part in a coffee break with their colleagues



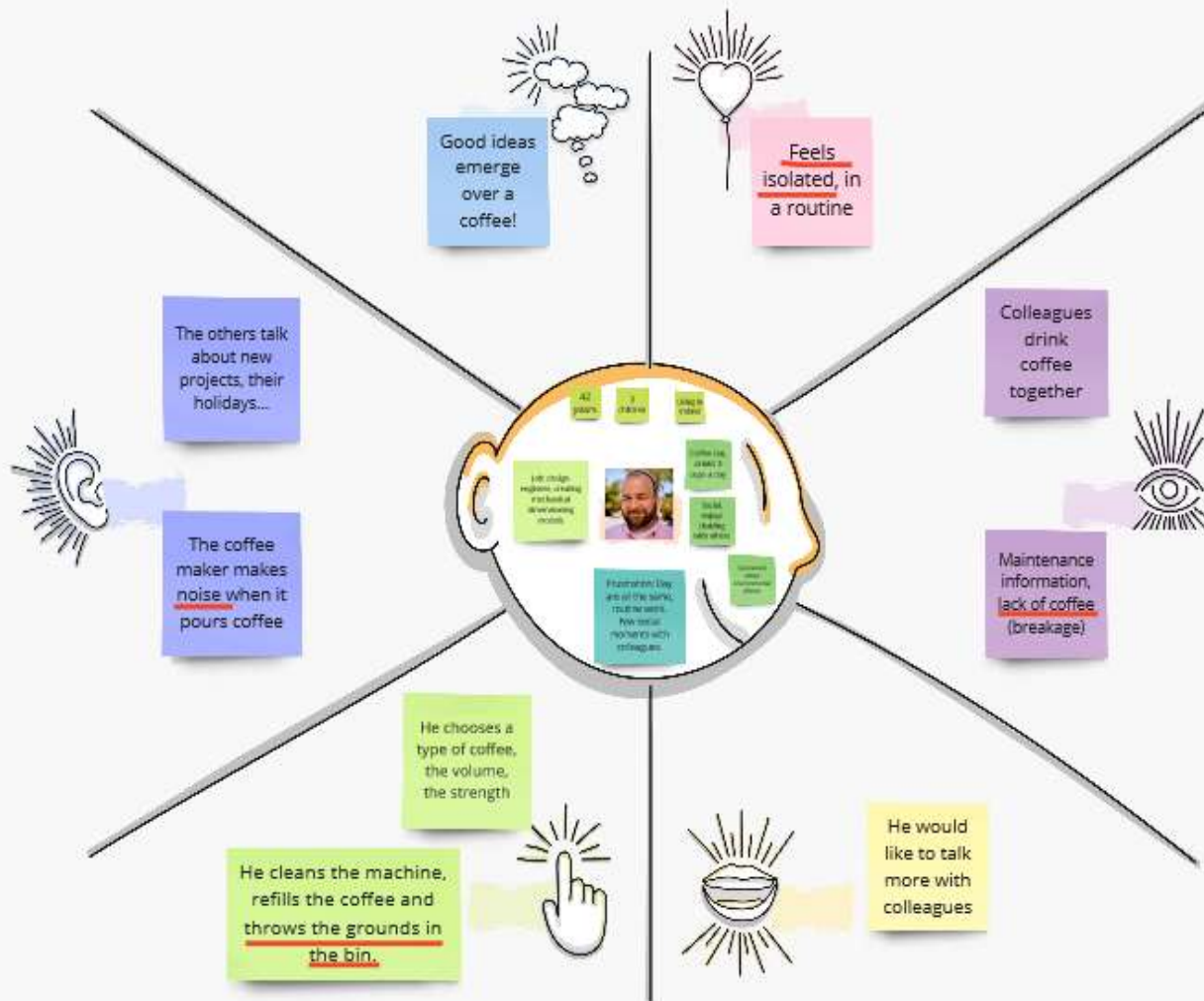
Coffee-drinking employee interview





EM of employee interview

Toy case #1



isolated, not up to date with company news, concerned about environmental impact



He needs to meet people, to be open (outside his office)

He wants to be more active in his working environment

He wants to reduce the environmental impact of his activities



Context

We are provider of peri-urban active eco-mobility services in a medium-sized city with many students.

Who are our customers?

Transportation companies, local authorities...

B2B marketing

Who are the end users of our product?

Urban peoples moving for personal or professional reasons

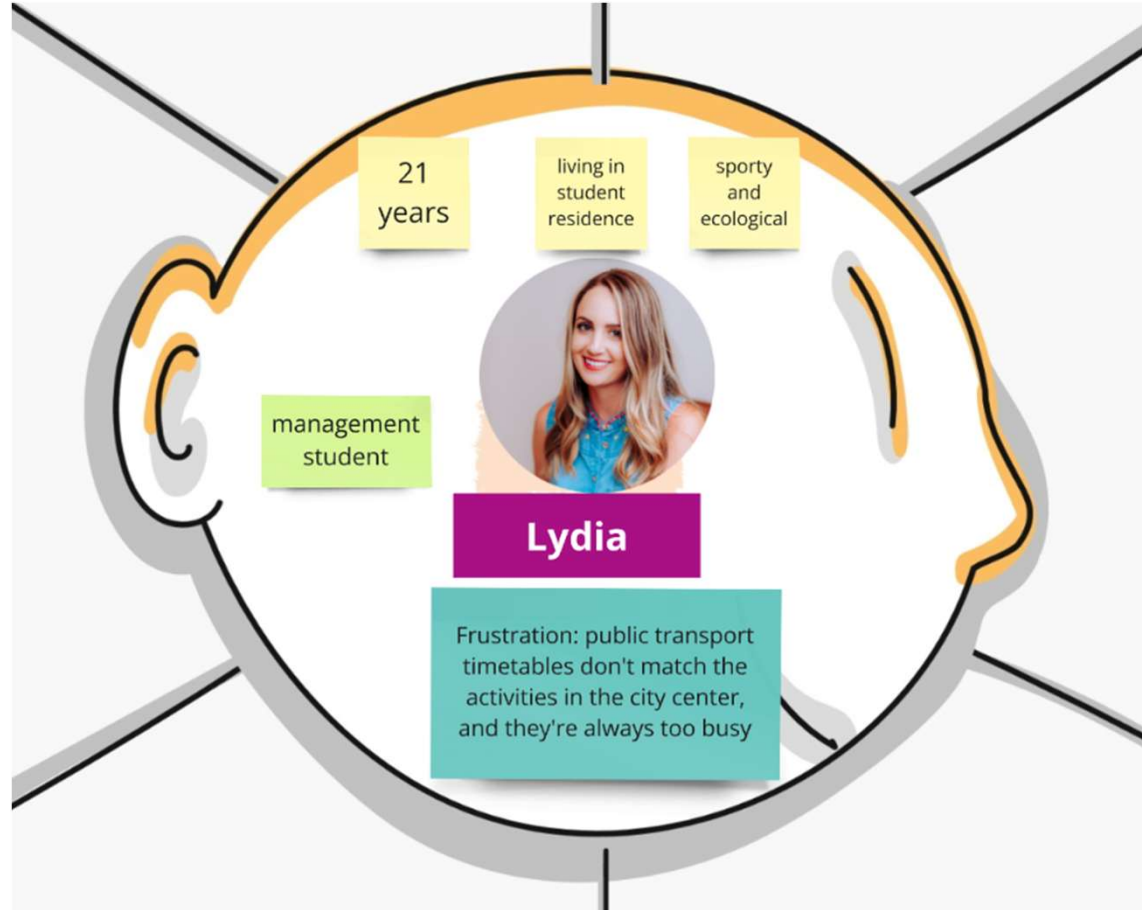
What are our product specificities?

Free bikes rental system

Design problem

How can we encourage students to use our active suburban eco-mobility services, especially when the university is located on the periphery of the city?

Student interview

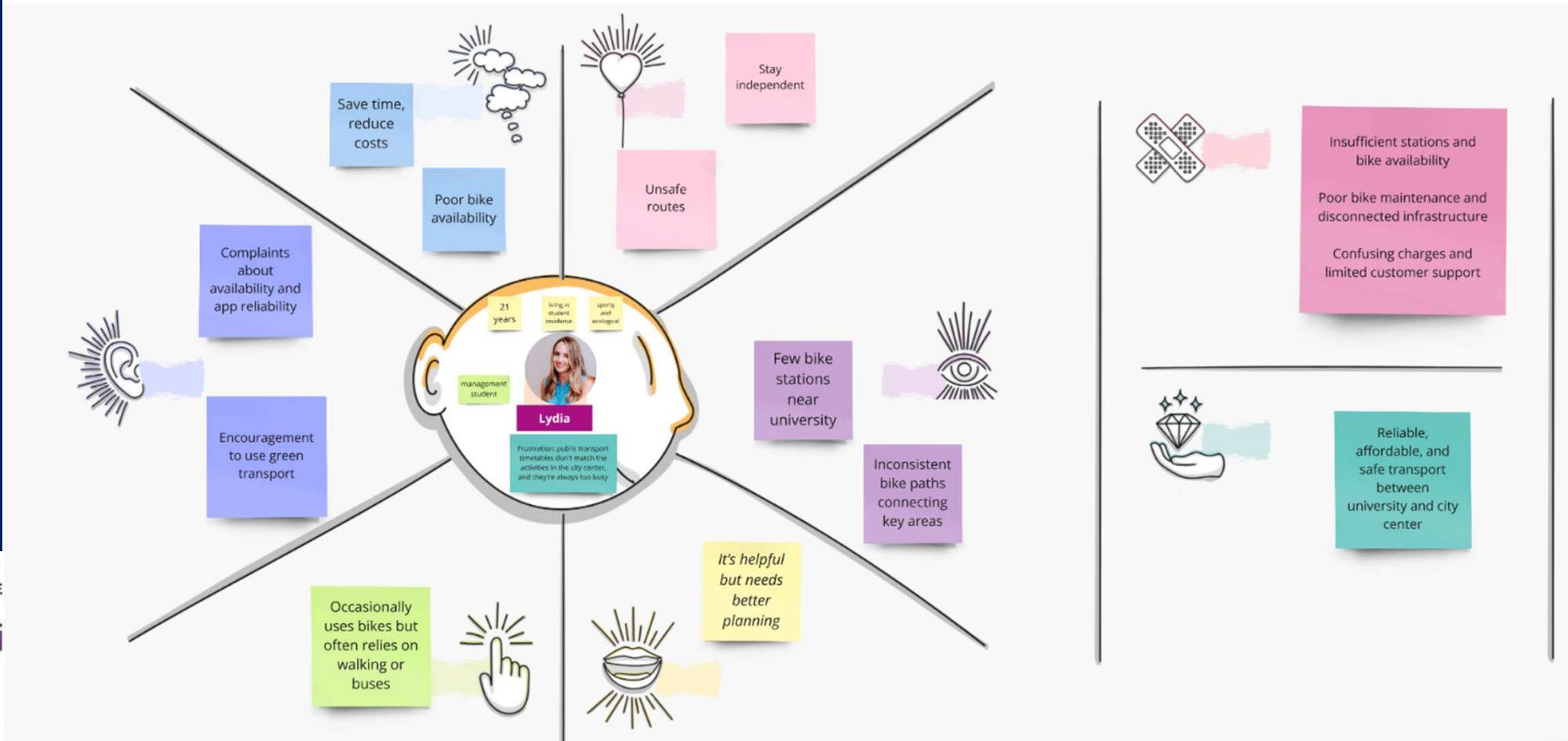


EM of student interview

Creative Commons BY-NC



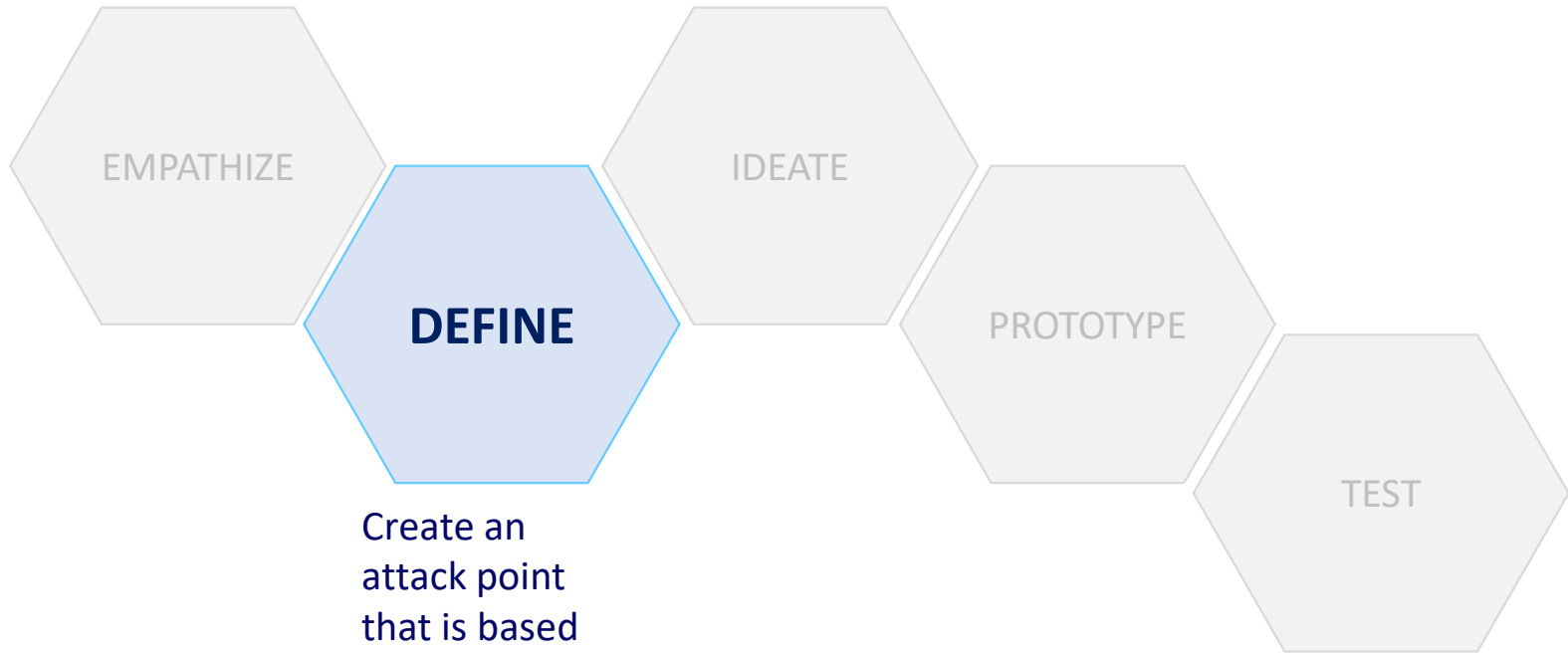
Toy case #2



UNIVERSITÉ DE LORRAINE
 LORRAINE INP Ensgsi NANCY
 ERPI
 SCHOOL OF MANAGEMENT iaelyon JEAN HOUBERT



Step 2 of SDTP



Create an attack point that is based on the needs & feelings of the users?
What are their needs?



Define

Objectives

Develop a thorough understanding of your users & the design space

Formulate explicitly the problem you are trying to solve (from your point of view)

Enablers

User feedback (from EMPATHIZE), workshops, visual management tools: repositionable notes, drawings, five WHYS...

Deliverables

As-is UJM

Focus on specific needs, i.e. pain points to be solved in the to-be OpsCon



Definition

Visual representation to track the user journey as he/she lives through the use of a product or service

Building Process

Record the actual/ideal user experience

For a deeper understanding of their needs, use the 5 WHYs

Empathize with the user. Note the user's positive & negative emotions during the experience

Pay attention to what the user is trying to do with your product, not what he/she says he/she wants to do

Definition

Visual representation to track the user journey as he/she lives through the use of a product or service

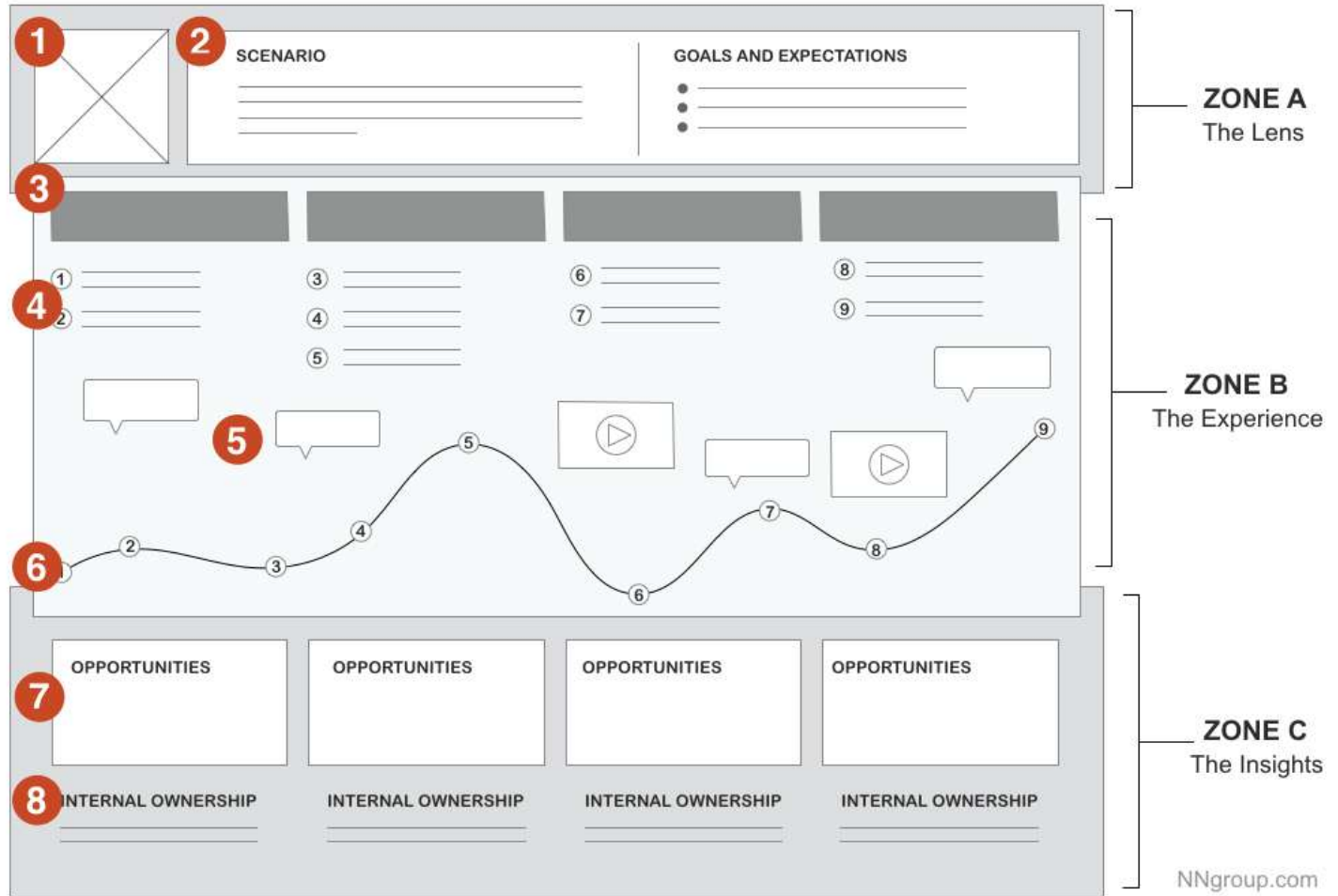
Practical maxims

1. Record the actual vs. ideal UX
2. For a deeper understanding of their needs, use the 5 WHYs
3. Empathize with the user & note his/her positive & negative emotions during the experience
4. Pay attention to what he/she is trying to do with your product, not what he/she says he/she wants to do





- 1. Create Customer Personas
- 2, 3. Define scenario & user expectations
- 4. Create a list of touchpoints (pains)
- 5, 6. Take user emotion & intention into account
- 7, 8. Identify opportunities & validate your UJM





Example

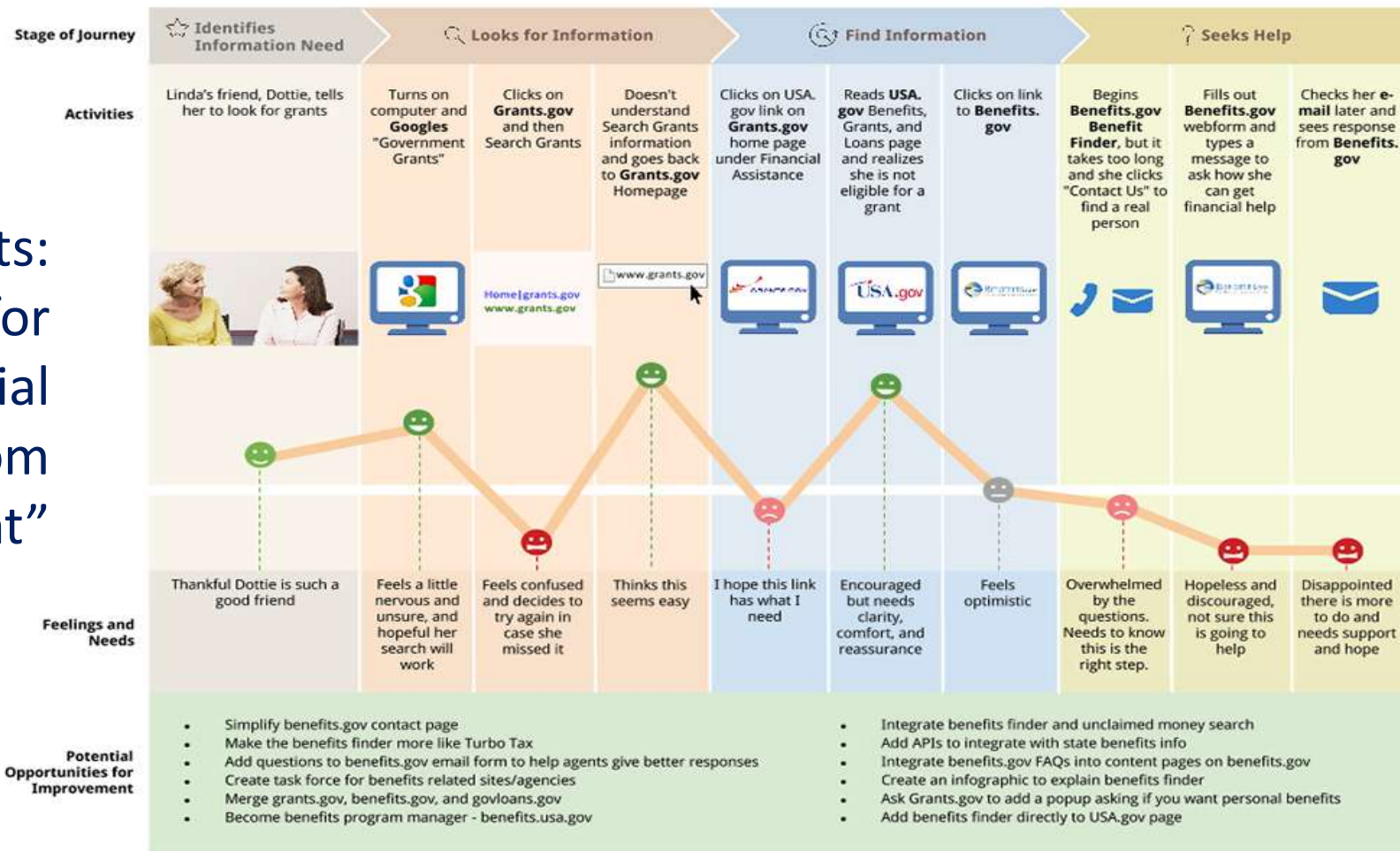


Linda's Journey Map

Browse information or learn more on a general topic



Linda wants:
“searching for
financial
assistance from
the government”





OCM as-is UJM

Toy case #1



Marc

"I want/need to enjoy a convivial moment over a coffee with colleagues"

Age: 42

Family: Married, 2 children (Age 8 & 12)

Household income: \$130,000

Stages	Work at the office	Go out for a coffee break	Prepare coffee	Pour (star) the coffee	Serve coffee and enjoy it
Key Actions	<ul style="list-style-type: none"> • Work on the computer • Need a break 	<ul style="list-style-type: none"> • Go to the coffee room • Have a seat in the room 	<ul style="list-style-type: none"> • Empty the grounds pack • Fill with water • Fill the coffee 	<ul style="list-style-type: none"> • Select the type of coffee • Choose the quantity of coffee • Press start 	<ul style="list-style-type: none"> • Put the cup • Wait • Remove the cup
Touchpoints	TP 1 TP 2 TP 3	TP 1 TP 2	TP 1 TP 2	TP 1 TP 2	TP 1 TP 2
Feelings & Needs	<ul style="list-style-type: none"> • Good thing there's a coffee room! • Need to talk to colleagues • Need to know who's in the room 	<ul style="list-style-type: none"> • Nobody's there • Some colleagues work remotely • 	<ul style="list-style-type: none"> • Feeling guilty about throwing coffee grounds in the bin • Need to check the stock of coffee beans • 	<ul style="list-style-type: none"> • Need to know about machine consumption (water, energy) • Wait for the coffee to brew • 	<ul style="list-style-type: none"> • Feel good and enjoy the coffee • Talk about the different flavours and types of coffee •
Emotions					





Toy case #1

Discussion on rationales



Marc

"I want/need to enjoy a convivial moment over a coffee with colleagues"

Age: 42

Family: Married, 2 children (Age 8 & 12)

Household Income: \$130,000

Stages	Work at the office	Go out for a coffee break	Prepare coffee	Pour (star) the coffee	Serve coffee and enjoy it
Key Actions	<ul style="list-style-type: none"> • Work on the computer • Need a break 	<ul style="list-style-type: none"> • Go to the coffee room • Have a seat in the room 	<ul style="list-style-type: none"> • Empty the grounds pack • Fill with water • Fill the coffee 	<ul style="list-style-type: none"> • Select the type of coffee • Choose the quantity of coffee • Press start 	<ul style="list-style-type: none"> • Put the cup • Wait • Remove the cup
Touchpoints	TP 1 TP 2 TP 3	TP 1 TP 2	TP 1 TP 2	TP 1 TP 2	TP 1 TP 2
Feelings & Needs	<ul style="list-style-type: none"> • Good thing there's a coffee room! • Need to talk to colleges • Need to know who's in the room 	<ul style="list-style-type: none"> • Nobody's there • Some colleges work remotely • 	<ul style="list-style-type: none"> • Feeling guilty about throwing coffee grounds in the bin • Need to check the stock of coffee beans • 	<ul style="list-style-type: none"> • Need to know about machine consumption (water, energy) • Wait for the coffee to brew • 	<ul style="list-style-type: none"> • Feel good and enjoy the coffee • Talk about the different flavours and types of coffee •
Emotions					

Why s/he needs to have a coffee break?

Why s/he needs to join remotely workers?

Why s/he feels guilty?

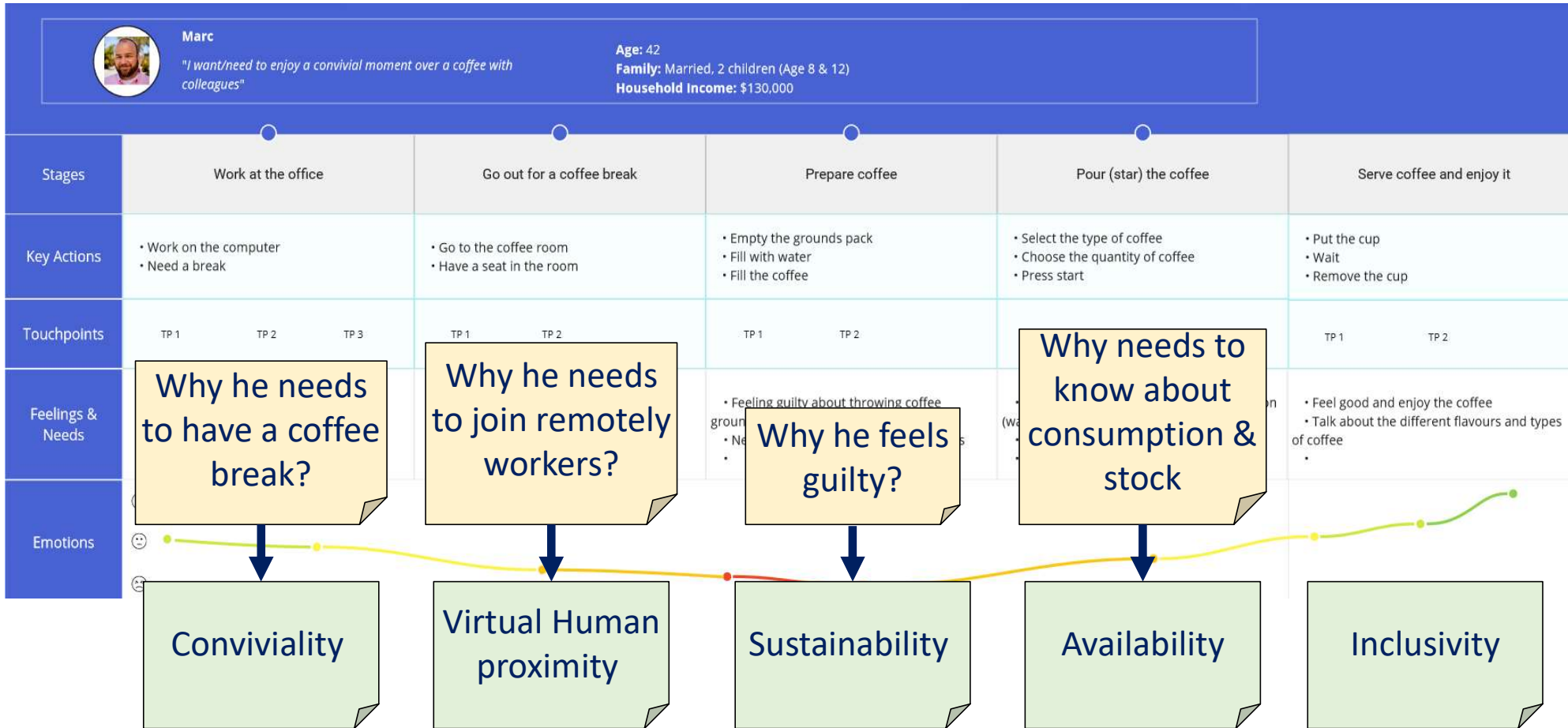
Why needs to know about consumption & stock?



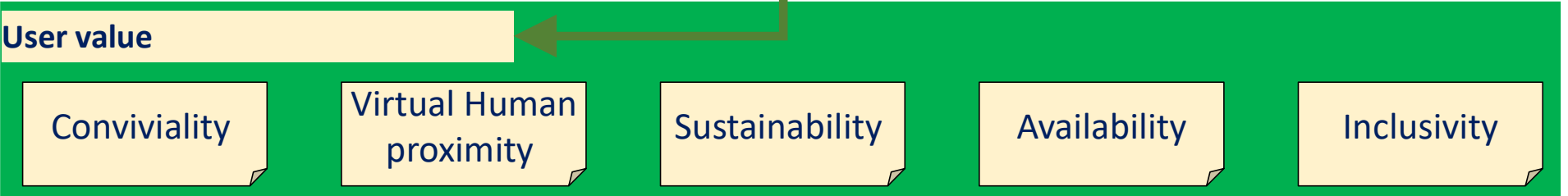
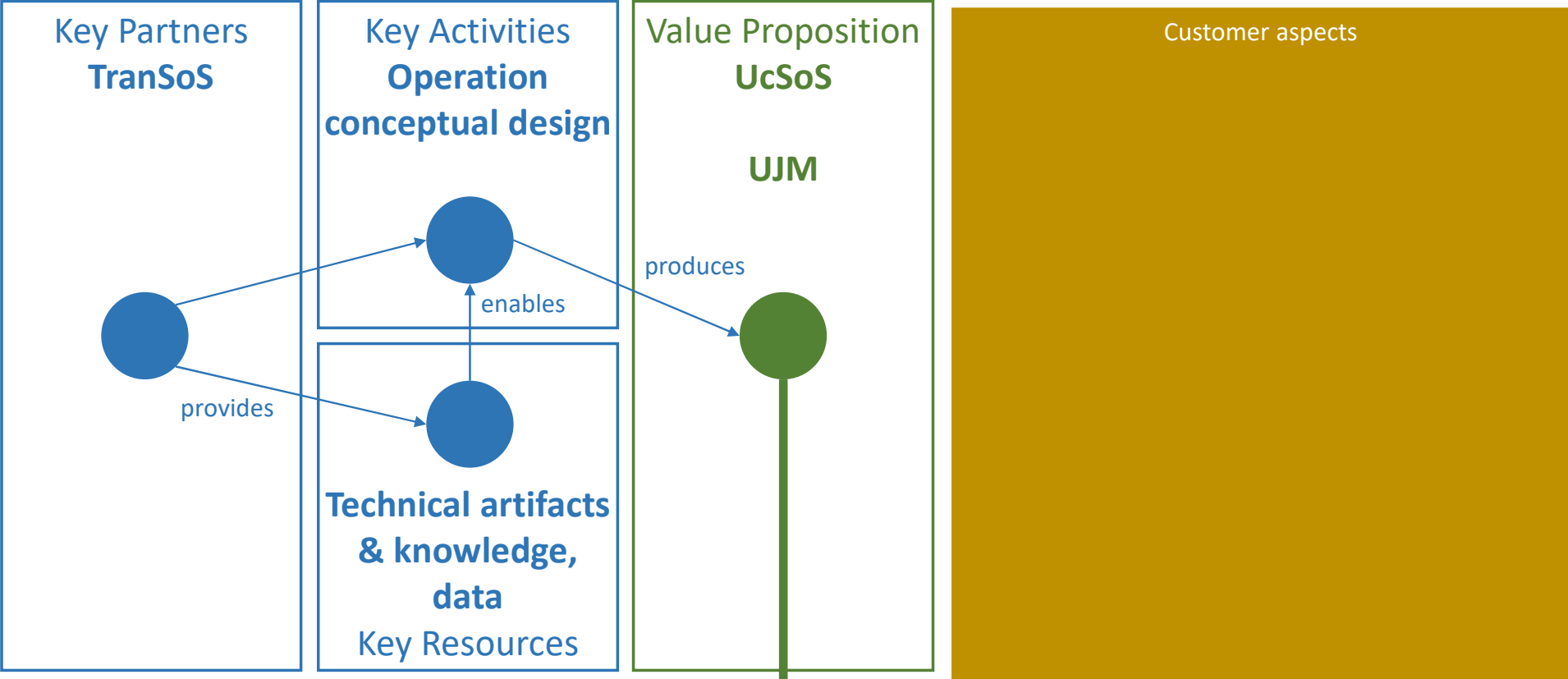


User's value

Toy case #1



From UJM to BMC



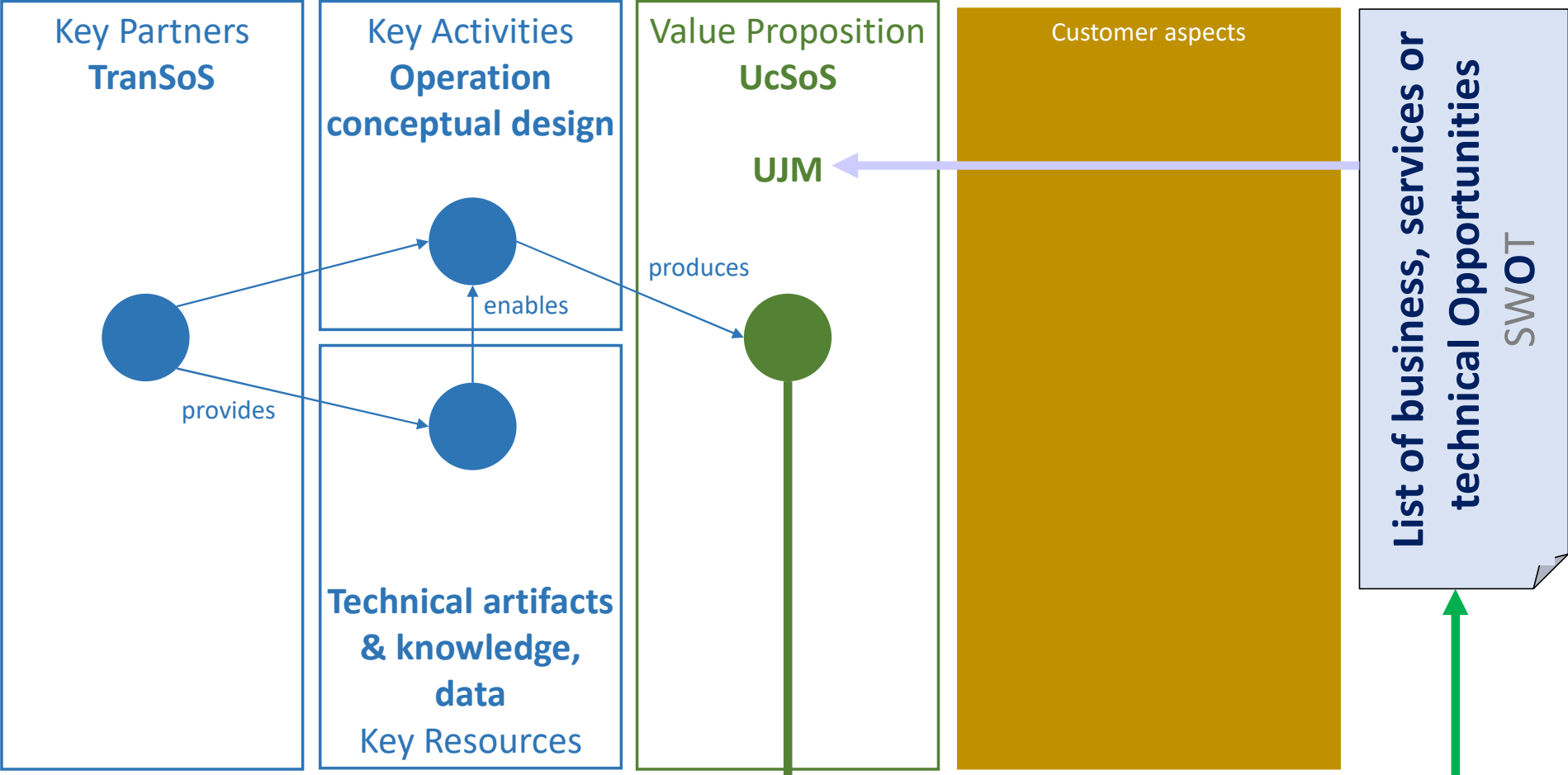


OCM-derived Opportunities

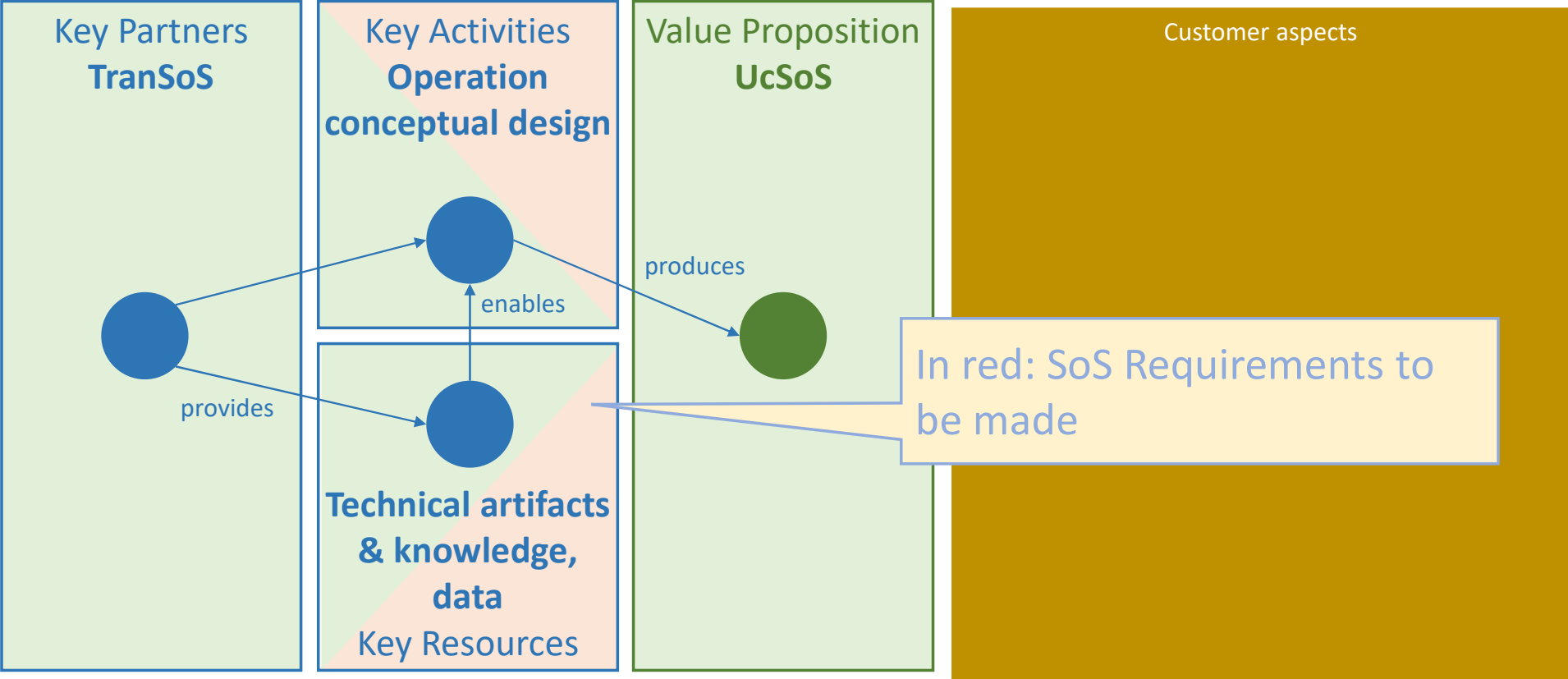
 Marc "I want/need to enjoy a convivial moment over a coffee with colleagues" Age: 42 Family: Married, 2 children (Age 8 & 12) Household Income: \$130,000											
Stages	Work at the office			Go out for a coffee break		Prepare coffee		Pour (star) the coffee		Serve coffee and enjoy it	
Key Actions	<ul style="list-style-type: none"> Work on the computer Need a break 			<ul style="list-style-type: none"> Go to the coffee room Have a seat in the room 		<ul style="list-style-type: none"> Empty the grounds pack Fill with water Fill the coffee 		<ul style="list-style-type: none"> Select the type of coffee Choose the quantity of coffee Press start 		<ul style="list-style-type: none"> Put the cup Wait Remove the cup 	
Touchpoints	TP 1	TP 2	TP 3	TP 1	TP 2	TP 1	TP 2	TP 1	TP 2	TP 1	TP 2
Feelings & Needs	<ul style="list-style-type: none"> Good thing there's a coffee room! Need to talk to colleges Need to know who's in the room 			<ul style="list-style-type: none"> Nobody's there Some colleges work remotely 		<ul style="list-style-type: none"> Feeling guilty about throwing coffee grounds in the bin Need to check the stock of coffee beans 		<ul style="list-style-type: none"> Need to know about machine consumption (water, energy) Wait for the coffee to brew 		<ul style="list-style-type: none"> Feel good and enjoy the coffee Talk about the different flavours and types of coffee 	
Emotions											
Opportunities	<ul style="list-style-type: none"> Make an appointment via company chat Schedule a coffee break 			<ul style="list-style-type: none"> Make an appointment via company chat Those who work remotely can join others for a scheduled hybrid coffee break 		<ul style="list-style-type: none"> Add coffee grounds collector in the room Notification to logistics manager when coffee stock levels are low (e-mail, post-it, sms) 		<ul style="list-style-type: none"> Add monitoring function to the machine Program the start of coffee before Start coffee remotely before 		<ul style="list-style-type: none"> 	

SWOT indirect link

From UJM to BMC, then SWOT



To summarize



In red: SoS Requirements to be made



In green: extended BMC completed



Toy case #2

Peri-urban active eco-mobility service As-Is UJM

<p>Lydia <i>"I need reliable, affordable, safe and sustainable transport between my university and city center"</i> Age: 21 Family: Single Income: \$ 800/month</p>															
Stages	Awareness			Consideration				Sign-up			Use			Return	
Key Actions	Learns about the service via university flyers or peer recommendations			Downloads the app, checks bike availability, and explores the bike routes.				Registers on the app and sets up payment details			Picks up a bike at a suburban station and begins the ride			Looks for a station near campus or along the route to park the bike	
Touchpoints	TP 1	TP 2		TP 1	TP 2	TP 3	TP 4	TP 1	TP 2		TP 1	TP 2	TP 3	TP 1	TP 2
Feelings & Needs	<ul style="list-style-type: none"> This could be a great alternative to the bus Is it safe to ride alone in the suburbs ? 			<ul style="list-style-type: none"> Will this work for my daily schedule? Will it save me money? Are there bike lanes or safe paths on my route? Will there be help if something goes wrong? 				<ul style="list-style-type: none"> This seems easy, but what if there are hidden charges? Will my payment information and account be secure? 			<ul style="list-style-type: none"> This is faster than waiting for the bus! Why is the bike in such bad shape? I don't feel safe on this poorly lit stretch of road 			<ul style="list-style-type: none"> Why is the station full? Now I'll be late 	
Emotions															



Discussion on rationales

 Lydia <i>"I need reliable, affordable, safe and sustainable transport between my university and city center"</i>		Age: 21 Family: Single Income: \$ 800/month				
Stages	Awareness	Consideration		Sign-up	Use	Return
Key Actions	Learns about the service via university flyers or peer recommendations	Downloads the app, checks bike availability, and explores the bike routes.		Registers on the app and sets up payment details	Picks up a bike at a suburban station and begins the ride	Looks for a station near campus or along the route to park the bike
Touchpoints	TP 1 TP 2	TP 1 TP 2 TP 3 TP 4	TP 1 TP 2	TP 1 TP 2 TP 3	TP 1 TP 2	
Feelings & Needs	<ul style="list-style-type: none"> This could be a great alternative to the bus Is it safe to ride alone in the suburbs ? 	<ul style="list-style-type: none"> Will this work for my daily schedule? Will it save me money? Are there bike lanes or safe paths on my route? Will there be help if something goes wrong? 		<ul style="list-style-type: none"> This seems easy, but what if there are hidden charges? Will my payment information and account be secure? 	<ul style="list-style-type: none"> This is faster than waiting for the bus! Why is the bike in such bad shape? I don't feel safe on this poorly lit stretch of road 	<ul style="list-style-type: none"> Why is the station full? Now I'll be late
Emotions						

Why is she looking for a bus alternative?


Why she feels unsafe alone?

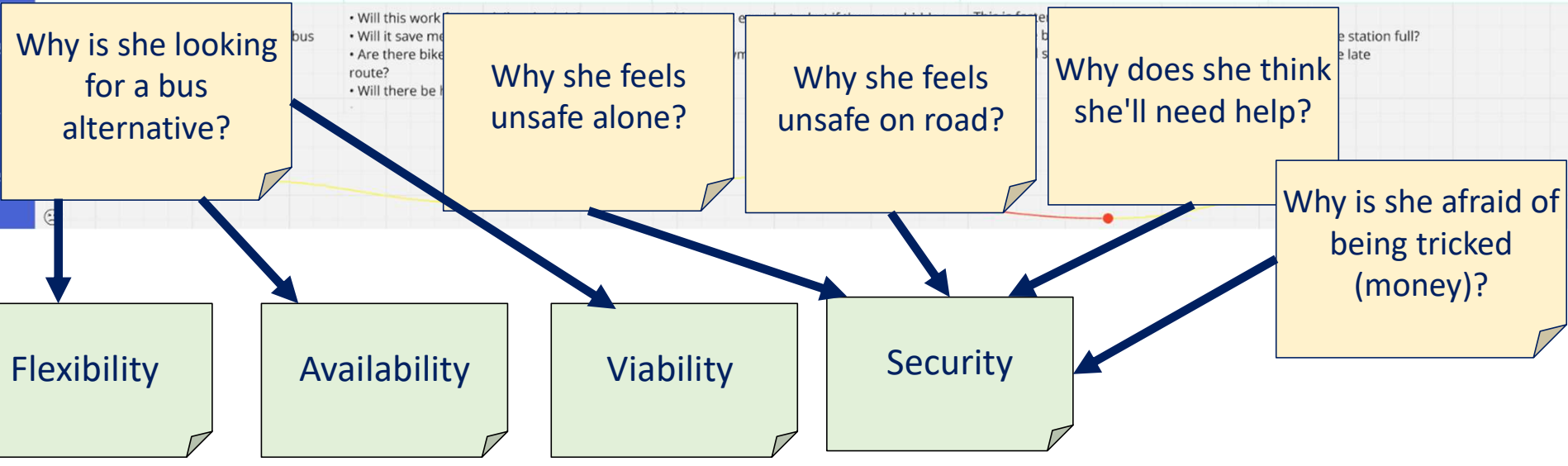
Why does she think she'll need help?

Why is she afraid of being tricked?

Why she feels unsafe on road?

Discussion on rationales


 Lydia <i>"I need reliable, affordable, safe and sustainable transport between my university and city center"</i> Age: 21 Family: Single Income: \$ 800/month															
Stages	Awareness			Consideration				Sign-up			Use			Return	
Key Actions	Learns about the service via university flyers or peer recommendations			Downloads the app, checks bike availability, and explores the bike routes.				Registers on the app and sets up payment details			Picks up a bike at a suburban station and begins the ride			Looks for a station near campus or along the route to park the bike	
Touchpoints	TP 1	TP 2		TP 1	TP 2	TP 3	TP 4	TP 1	TP 2		TP 1	TP 2	TP 3	TP 1	TP 2





Toy case #2

Discussion on rationales

<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">  <p>Lydia "I need reliable, affordable, safe and sustainable transport between my university and city center"</p> </div> <div style="text-align: right;"> <p>Age: 21 Family: Single Income: \$ 800/month</p> </div> </div>															
Stages	Awareness			Consideration				Sign-up		Use			Return		
Key Actions	Learns about the service via university flyers or peer recommendations			Downloads the app, checks bike availability, and explores the bike routes.				Registers on the app and sets up payment details		Picks up a bike at a suburban station and begins the ride			Looks for a station near campus or along the route to park the bike		
Touchpoints	TP 1	TP 2		TP 1	TP 2	TP 3	TP 4	TP 1	TP 2		TP 1	TP 2	TP 3	TP 1	TP 2
Feelings & Needs	<ul style="list-style-type: none"> This could be a great alternative to the bus Is it safe to ride alone in the suburbs ? 			<ul style="list-style-type: none"> Will this work for my daily schedule? Will it save me money? Are there bike lanes or safe paths on my route? Will there be help if something goes wrong? 				<ul style="list-style-type: none"> This seems easy, but what if there are hidden charges? Will my payment information and account be secure? 		<ul style="list-style-type: none"> This is faster than waiting for the bus! Why is the bike in such bad shape? I don't feel safe on this poorly lit stretch of road 			<ul style="list-style-type: none"> Why is the station full? Now I'll be late 		
Emotions															
Opportunities	<ul style="list-style-type: none"> Create targeted campaigns focused on suburban students and highlight nearby stations Highlight safety features (e.g., well-lit stations, emergency support) in promotions 			<ul style="list-style-type: none"> Improve app design with a clear map of stations and availability updated in real-time Provide route recommendations with safe paths and highlight stations in secure 				<ul style="list-style-type: none"> Simplify registration and make pricing transparent with student-friendly subscriptions 		<ul style="list-style-type: none"> Ensure regular maintenance and provide more bikes during high-demand periods Equip bikes with lights, add safety guidelines in the app, and prioritize station placement in safe areas 			<ul style="list-style-type: none"> Add overflow parking options or allow flexible returns (e.g., lock bikes to a nearby secure area) Provide well-lit, high-traffic return stations or allow flexible returns with lockable bikes 		





5

Define high-level requirements & architect the preliminary SoS in operation



Content

How to define high-level requirements & architect the related SoS in operation?

Keywords

High level requirements

Scenario

SoS in operation

System of Interest (Sol)

SysML sequence diagram (uc, seq)



Context

Platform-type business model for the functionality economy

Rent a bike in a city without the constraints of station location existing in the as-is conops

Current UX

Cycling gives me the freedom to get around downtown, but fixed bikes stations induce a restricted freedom in their daily life

Design problem

How to eliminate pain points related to fixed bikes stations?





Stakeholder considered

User

Example of user-centered requirements

Req1. Provide an effective, responsive, low price & comfortable service

Req2. Enable a friendly & optimized ride

Req3. Give a updated & accurate position

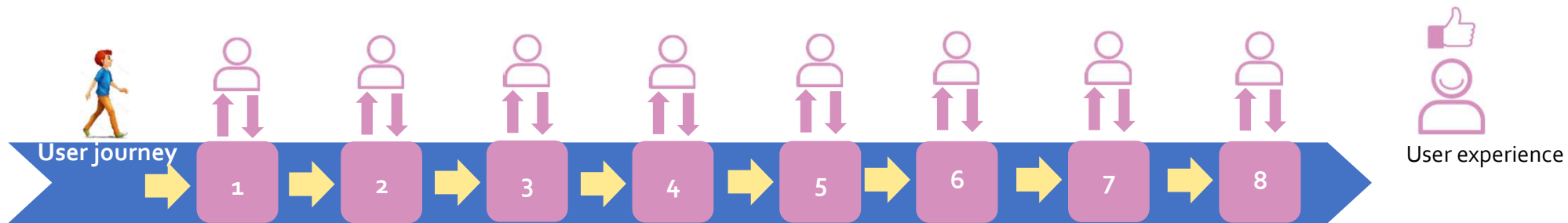
Req4. Communicate with the rental service from anywhere at any time

Req5. Secure bike lock release & unlock

Etc.

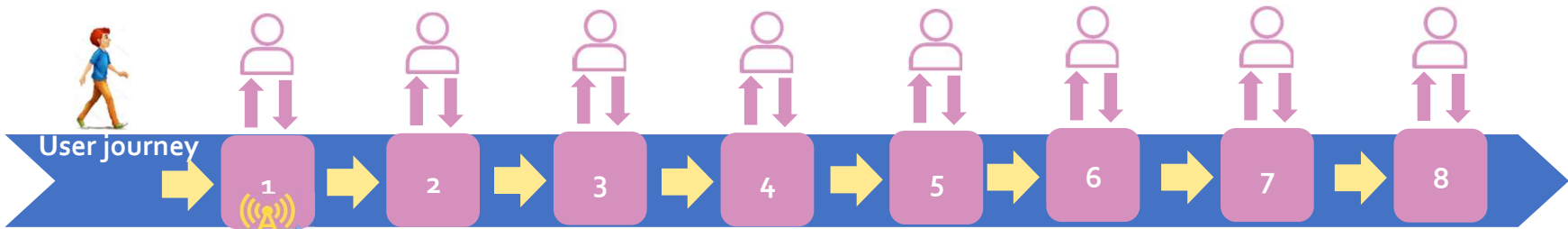


OpsCon: Rent a "freely controlled" bike (no fixed bike station)



1. Download the app, register, log in
2. Geo-locate available bikes
3. Book a bike & receive a code
4. Walk and find the bike with GPS guidance
5. Unlock the bike with the code
6. Ride your bike
7. Lock the bike
8. Pay for the rental (service)

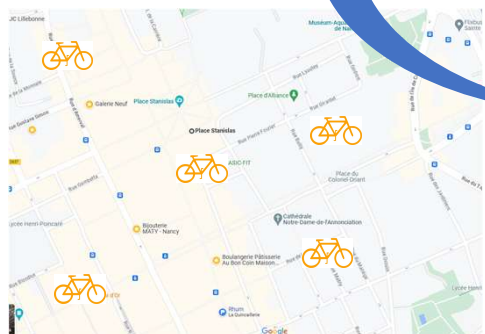
Support services



When I "Geo-locate available bikes", I want to find a bike at less than 500m around me

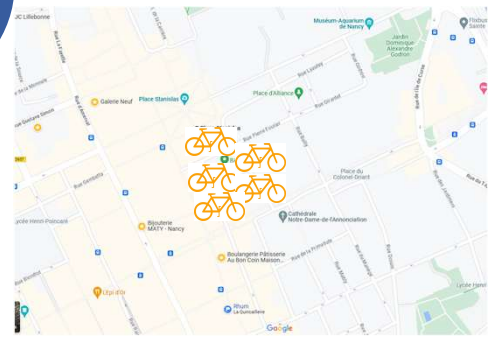


Spread bikes around the city

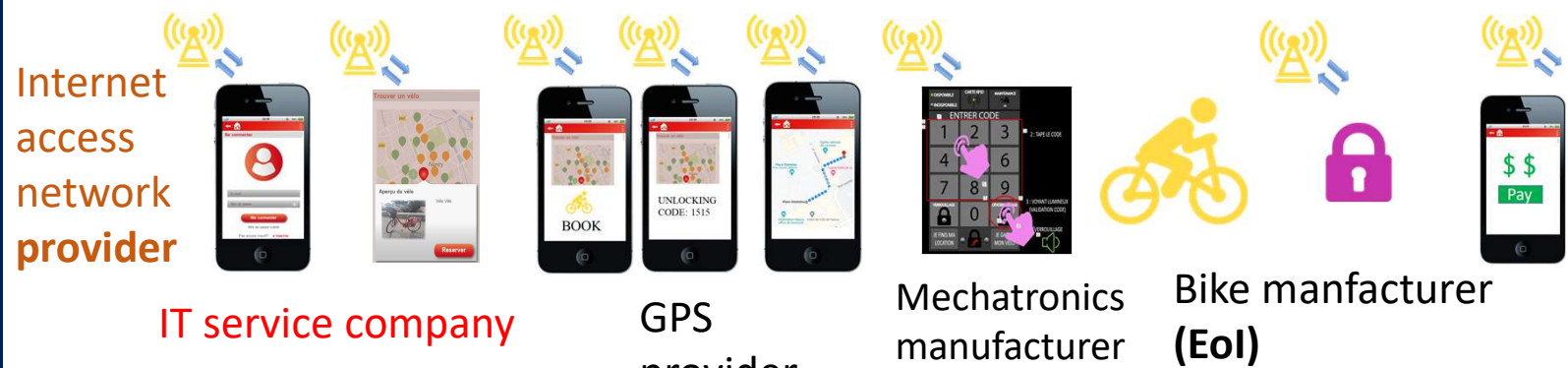
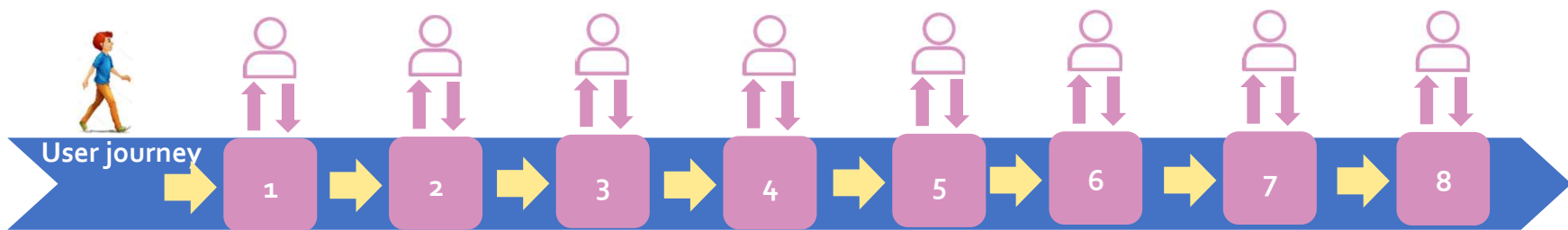


Collect the bike

Analyze data and warn



TechSOS & TranSOS sketched



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162

Using and invoicing the Maps JavaScript API

Google

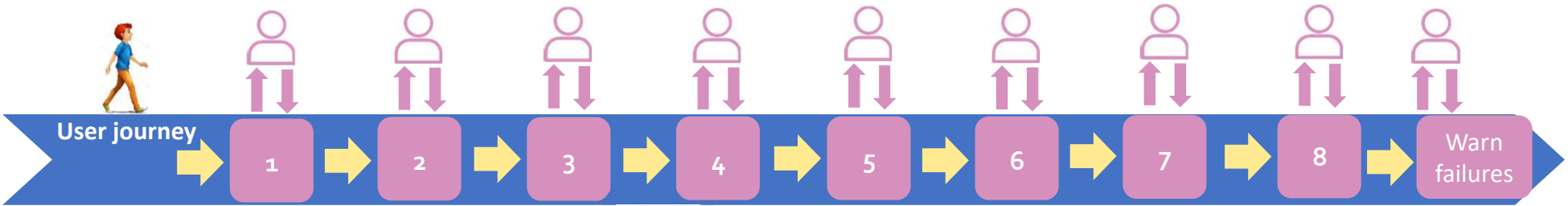
Static Maps*			
API Maps Static	Requêtes	1000	2 \$
Dynamic Maps*			
API Maps Embed	Illimité		Illimité
SDK Maps pour Android	Requêtes	1000	7 \$

Maintenance company

Collect&Spread company

1. Download the app, register, log in
2. Geo-locate available bikes
3. Book a bike & receive a code
4. Walk and find the bike with GPS guidance
5. Unlock the bike with the code
6. Ride your bike
7. Lock the bike
8. Pay for the rental (service)

Support services



Ride the **bike** Lock the **bike** Pay...



Failure

Bring the **bike** back



Maintain the **bike**



Collect the **bike**



Origin

Scena, scene

Both spectators' focal point ('container') & content of the spectacle (the drama the drama happening on stage)

Classical scenario building rules

Unity of...

...roles,

...location,

...action,

...time



Purpose

Make the interactions of the System of Interest (SoI) intelligible
Scenario is then a way to express & analyze OpsCon

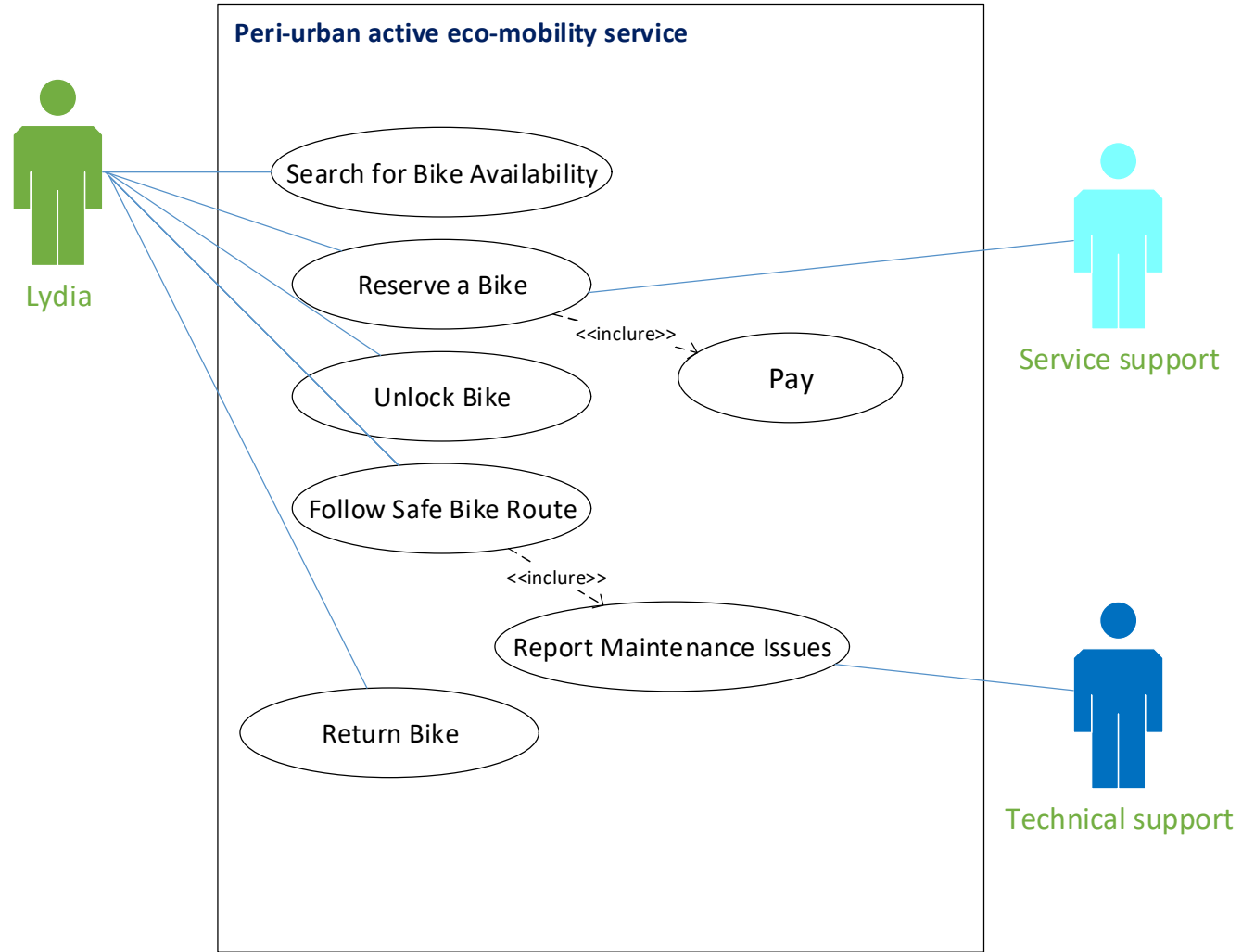
SE models

Use SysML behavior diagrams

Ex. use case (Uc), sequence diagram (seq)



Uc related to the previous UcSOS

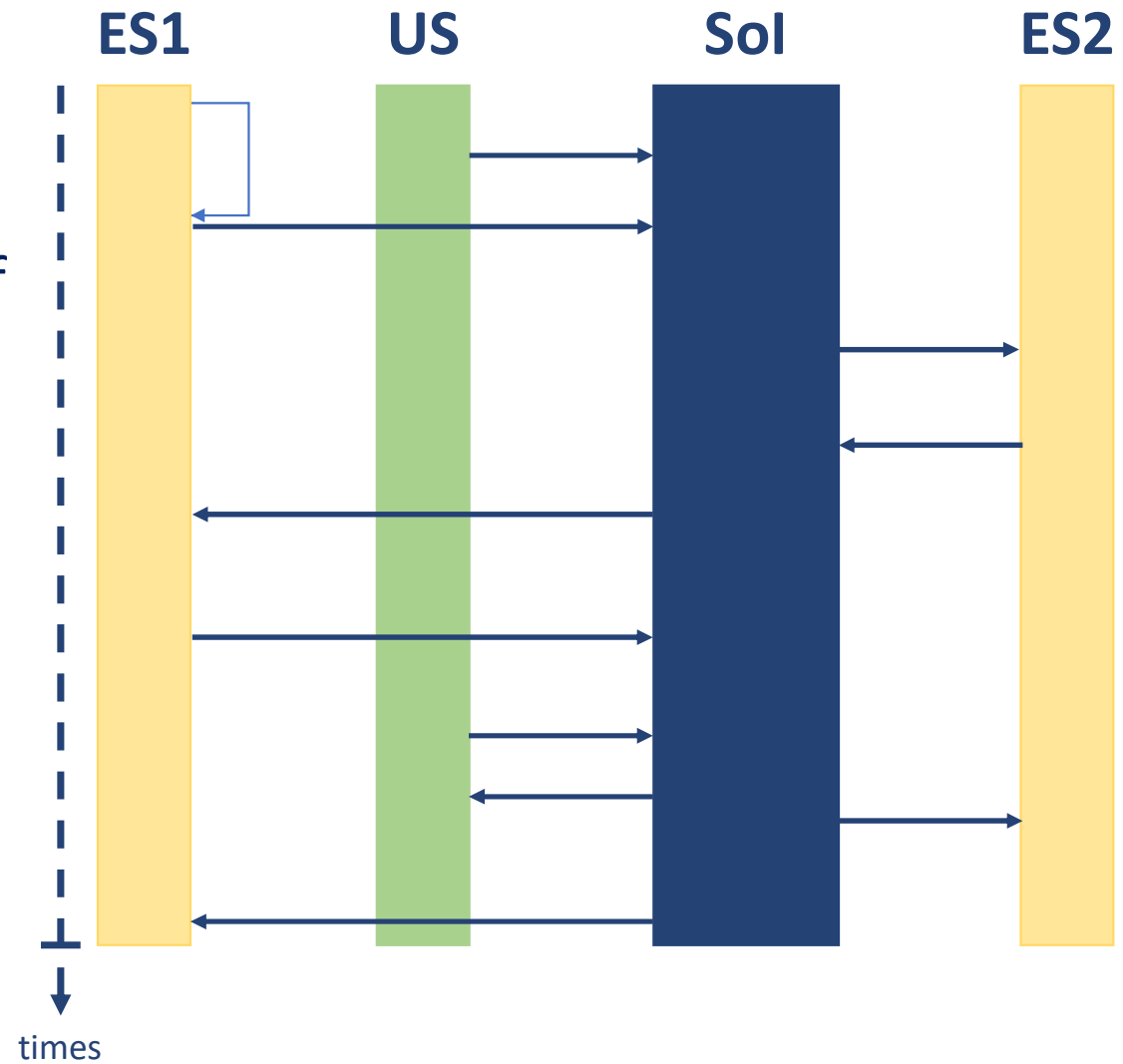


Content

The Sol exists over a period of time as long as it functions by interacting necessarily with external entities (or systems) mapped

User (US)

External systems (ES1..2)



External shaping with seq

RS. Roles shaping

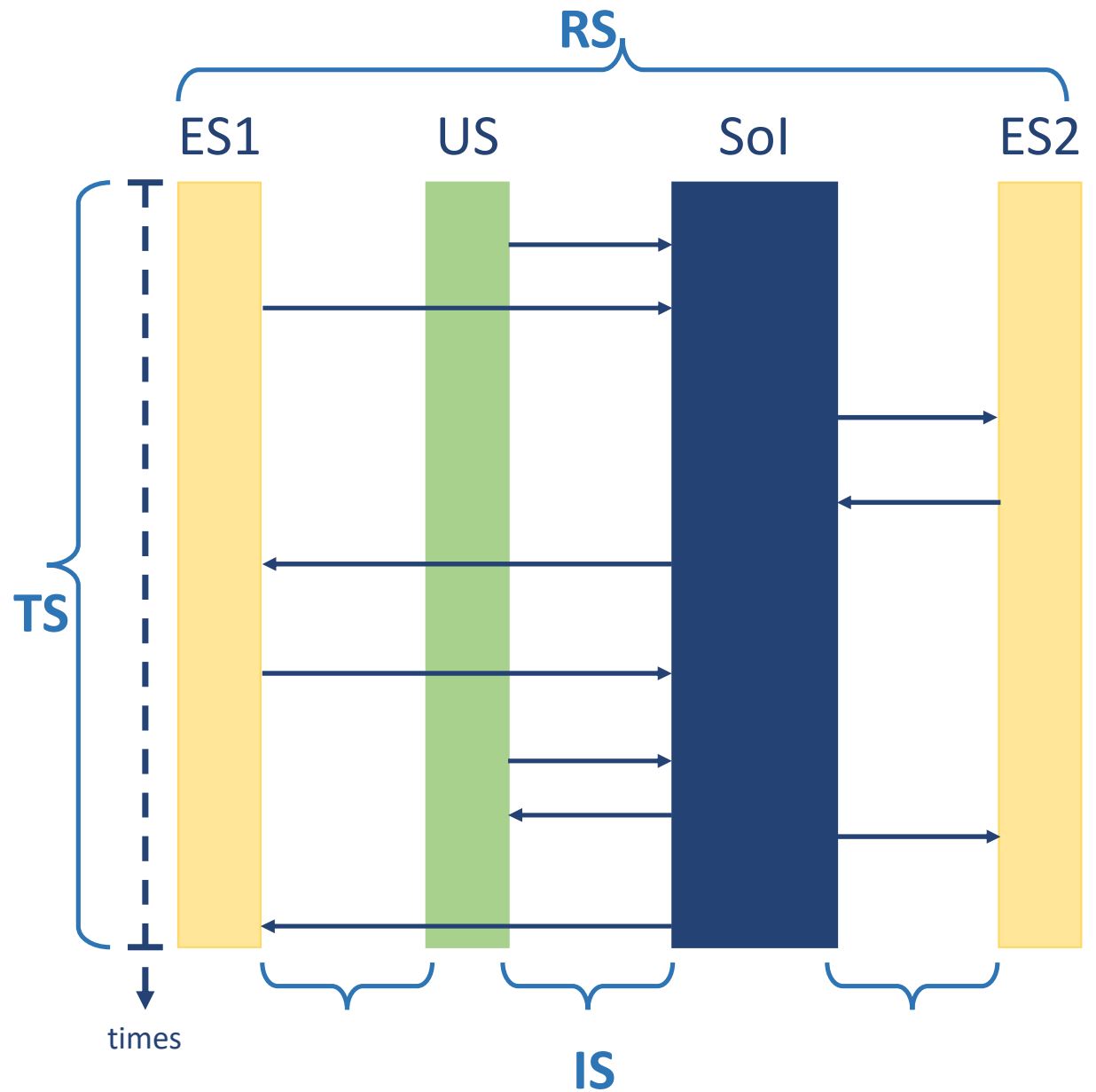
Who? What?

TS. Temporal shaping

When? How long?

IS. Interaction shaping

From whom? For Whom?



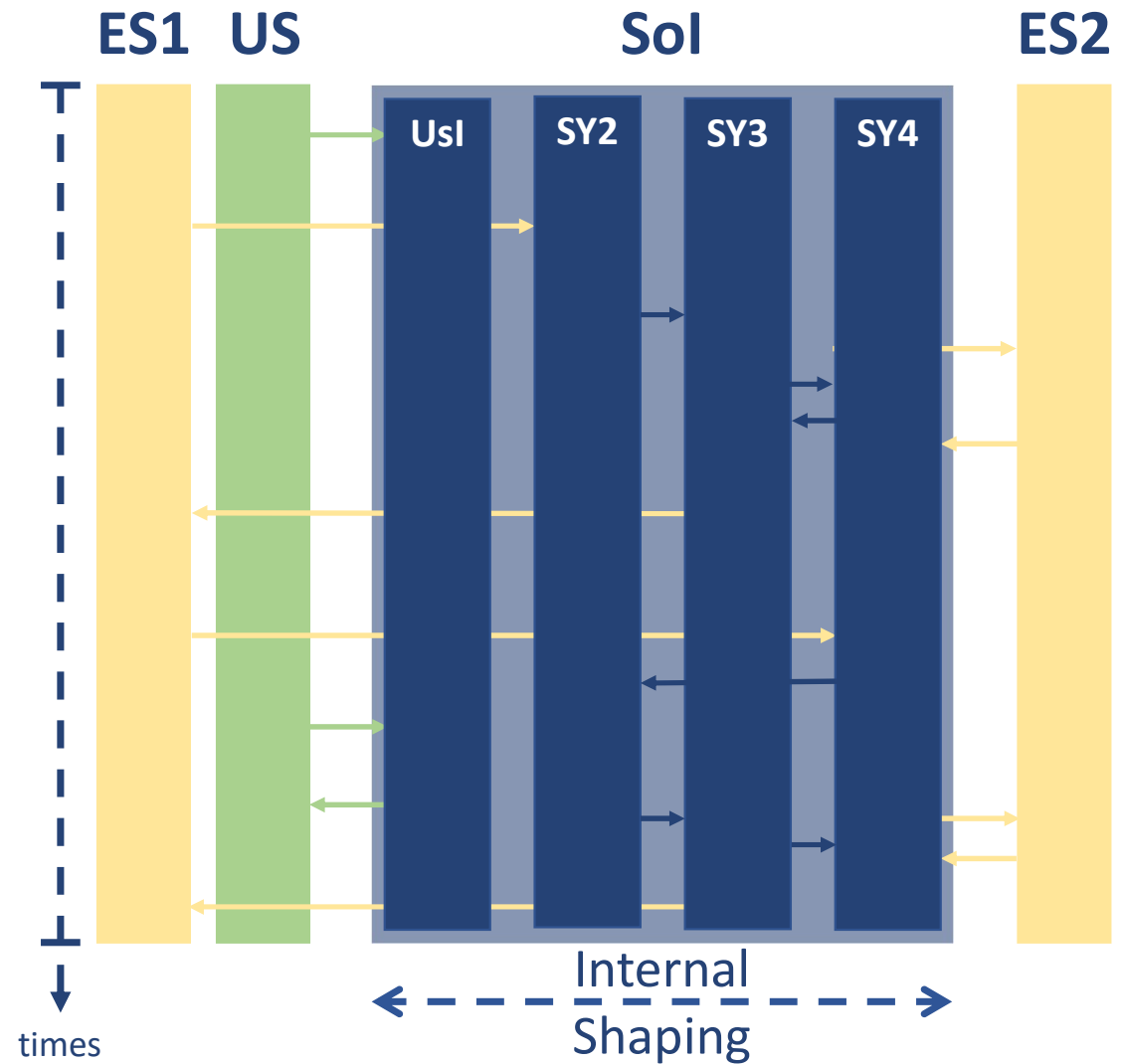
Content

The system studied is a polyphony of interactions

SY1:=Usl, user interface

SY2...4, other subsystems

'Exinternal' shaping



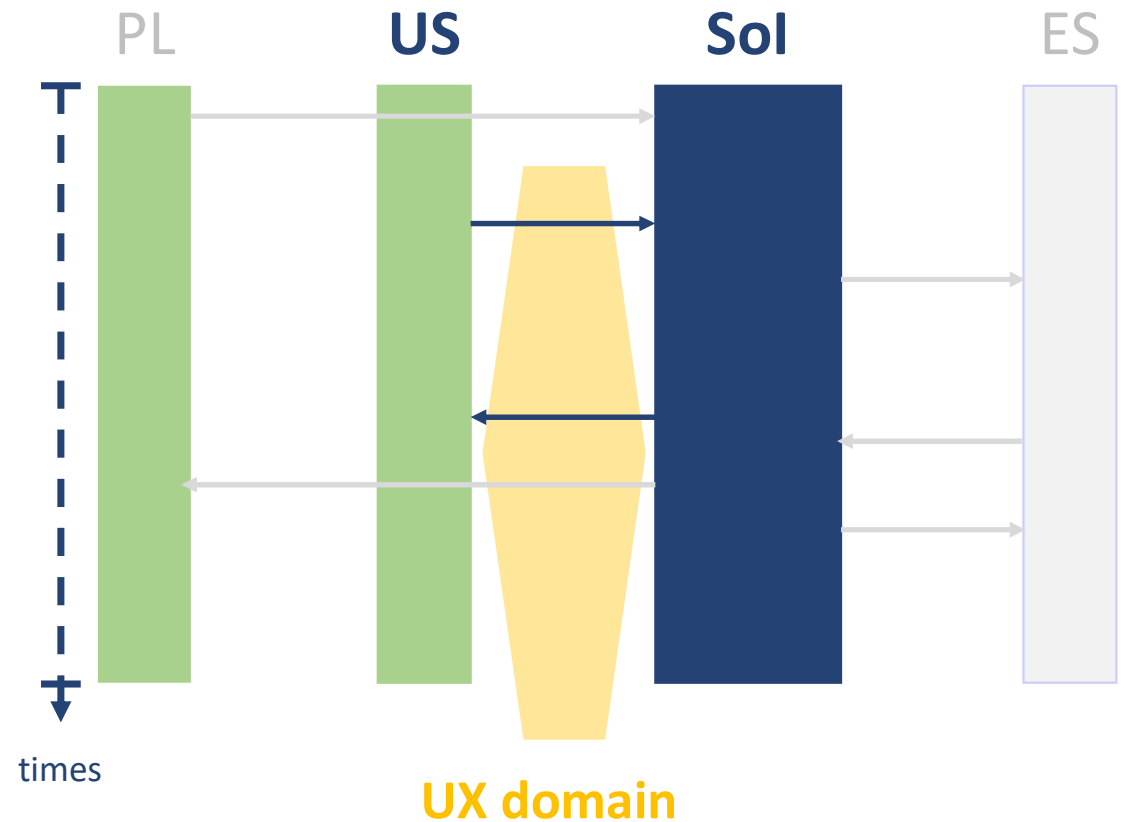
Content

Addressability:
expected service

Effectiveness:
provided service referring to
user's value (see toy cases)

Controlability:
user bargaining

Temporality:
responsiveness



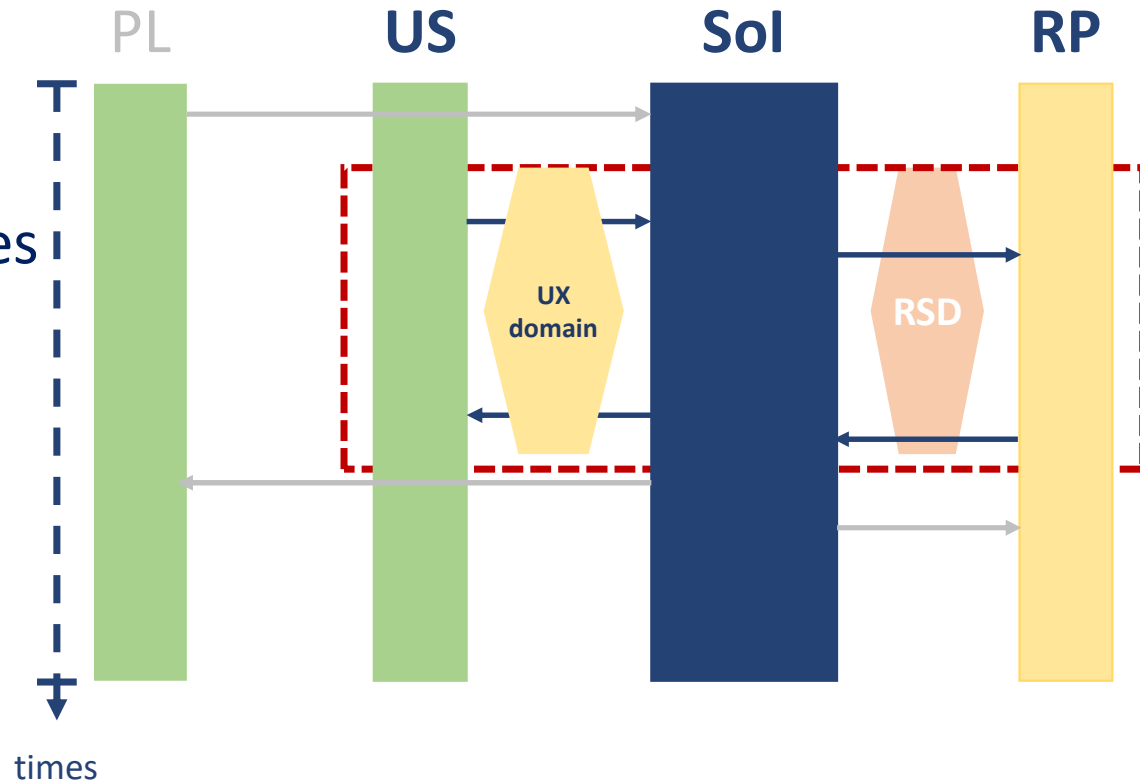
Content

Ability to provide on time the service requested by internal capabilities based on resources

Focus on two service flows:
 $Us \leftrightarrow Sol$, then $Sol \leftrightarrow RP$

Operation performances

System level	Capability
UX domain	Previous slide
RSD	Capacity
Ux & RSD	Efficiency



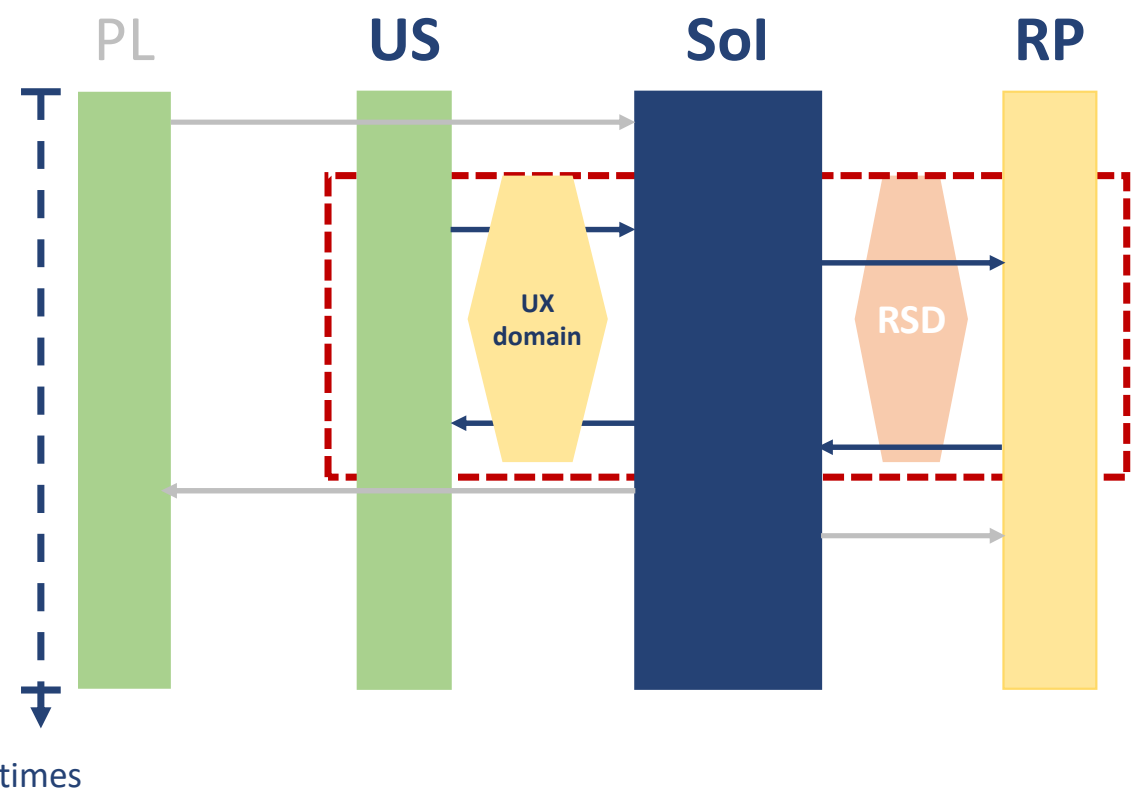
Risk identification

Content

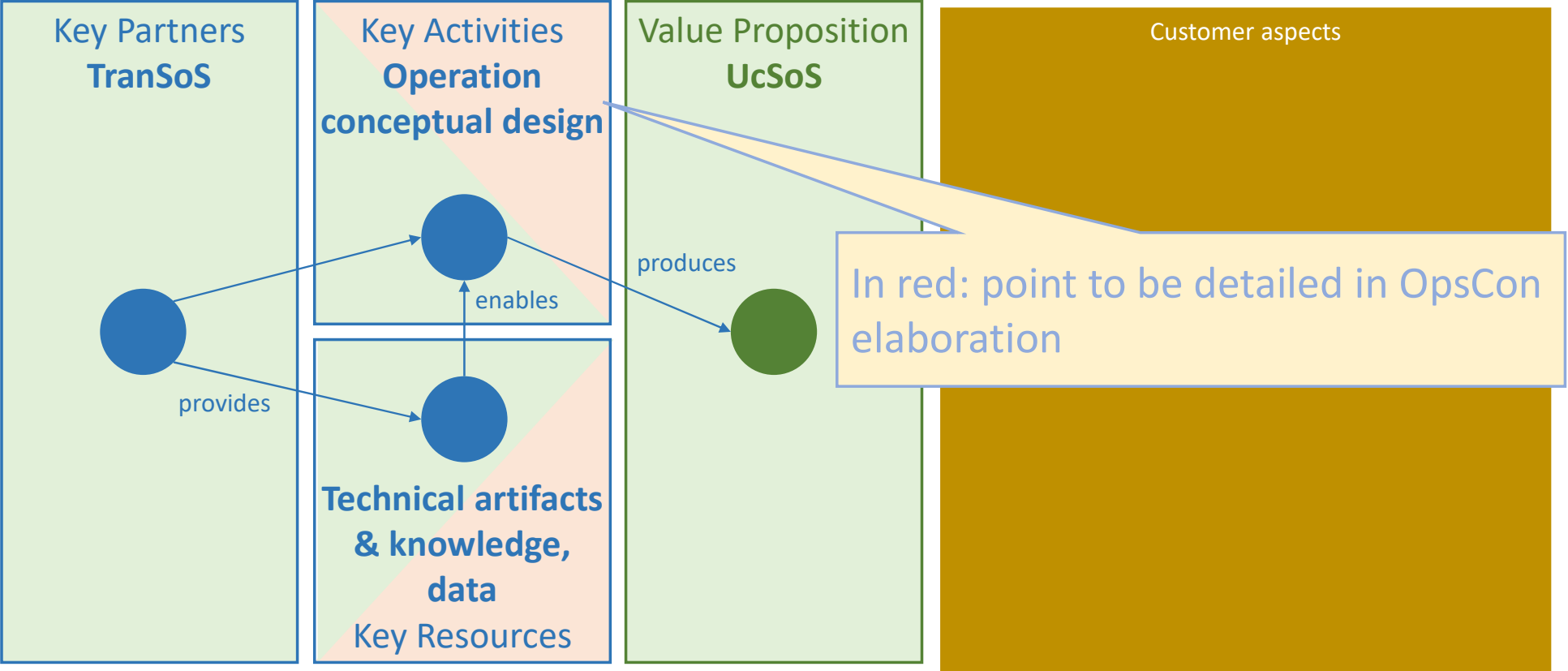
Hazard making service delivery, inadequate, deteriorated or impossible

Operation performances

- System level Reliability
- UX domain User's value
- RSD Manageable rationing
- Ux & RSD Acceptable deterioration



To summarize





Hidden technical Vee-diagram
in this course



Content

How can we shift from a serial vision of the ConOps definition to a structured one?

Keywords

Technical Vee-diagram



Purpose of this part

Content

Make visible the Vee-diagram hidden in the serial presentation of the course

Key words

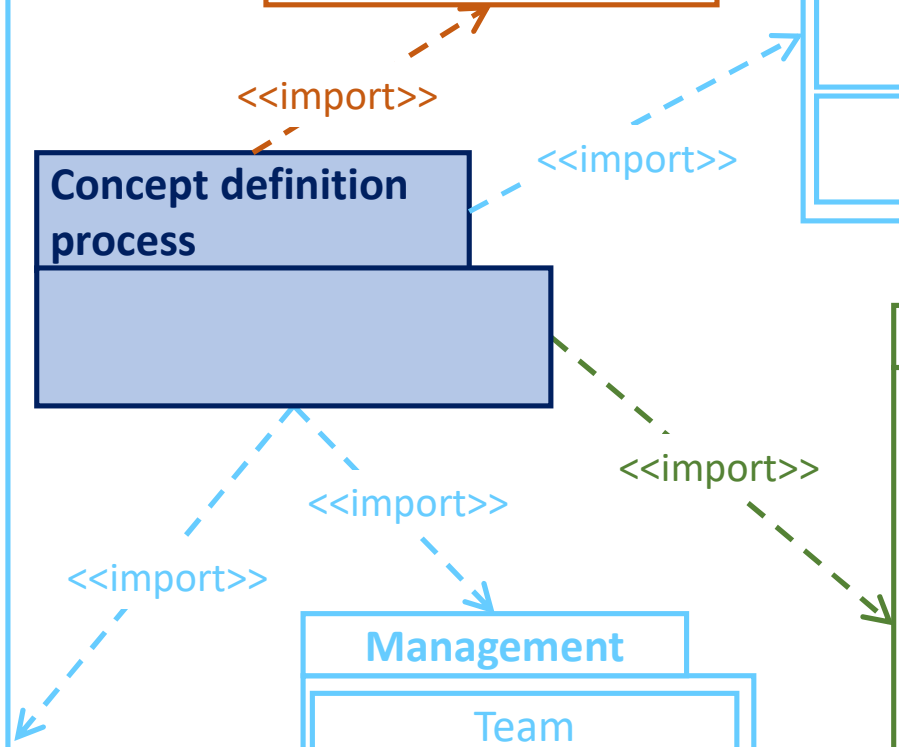
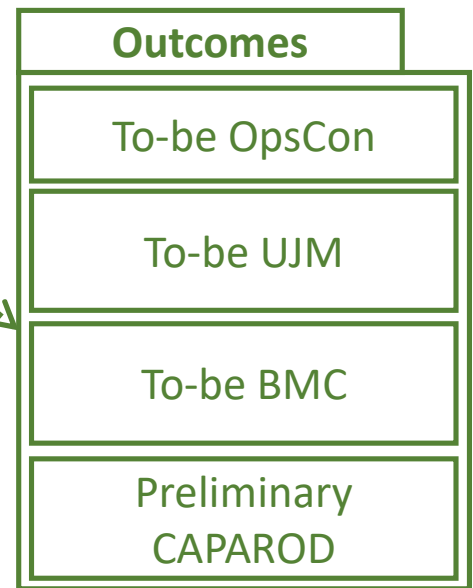
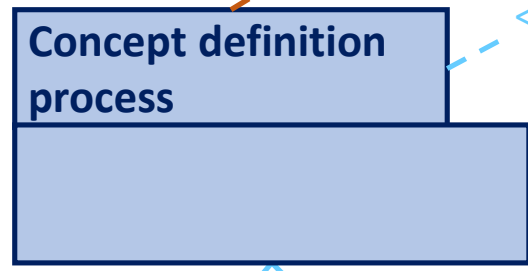
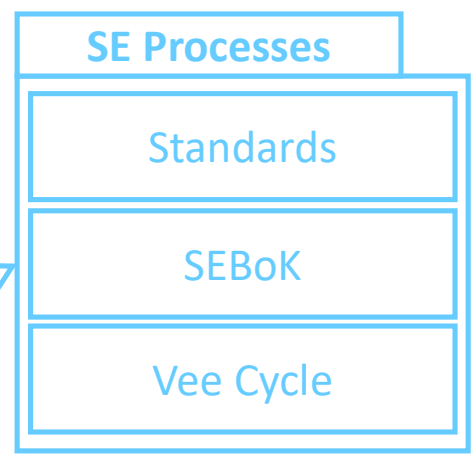
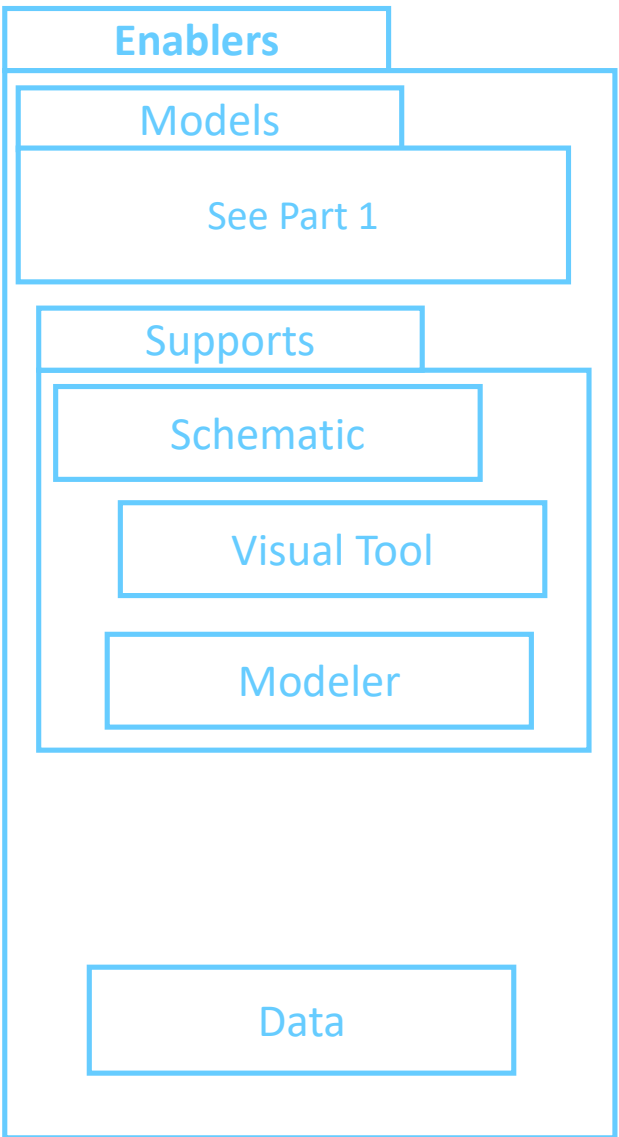
Vee-diagram

Business Process Modeling Notification (BPMN)

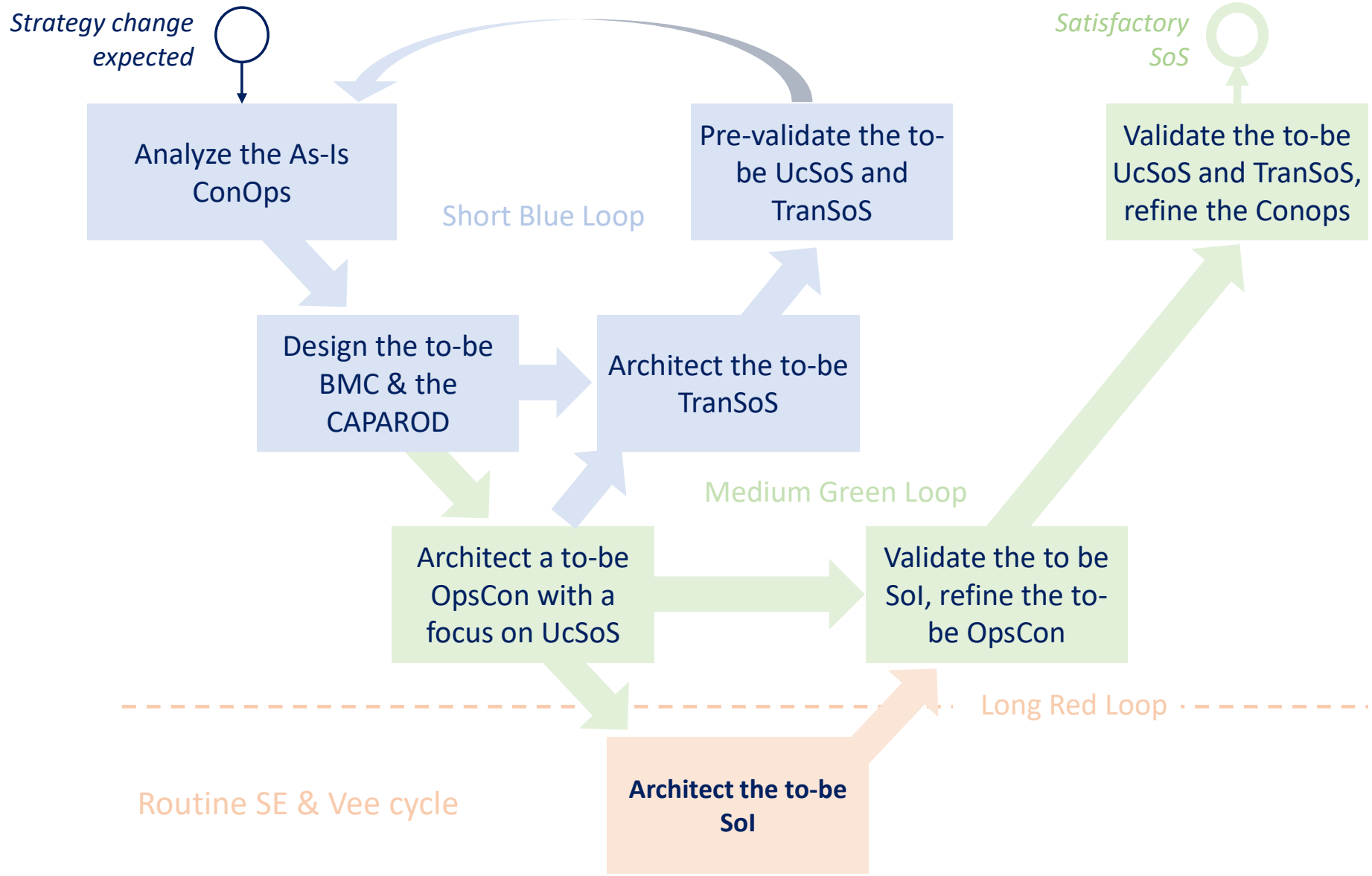
Silo of models



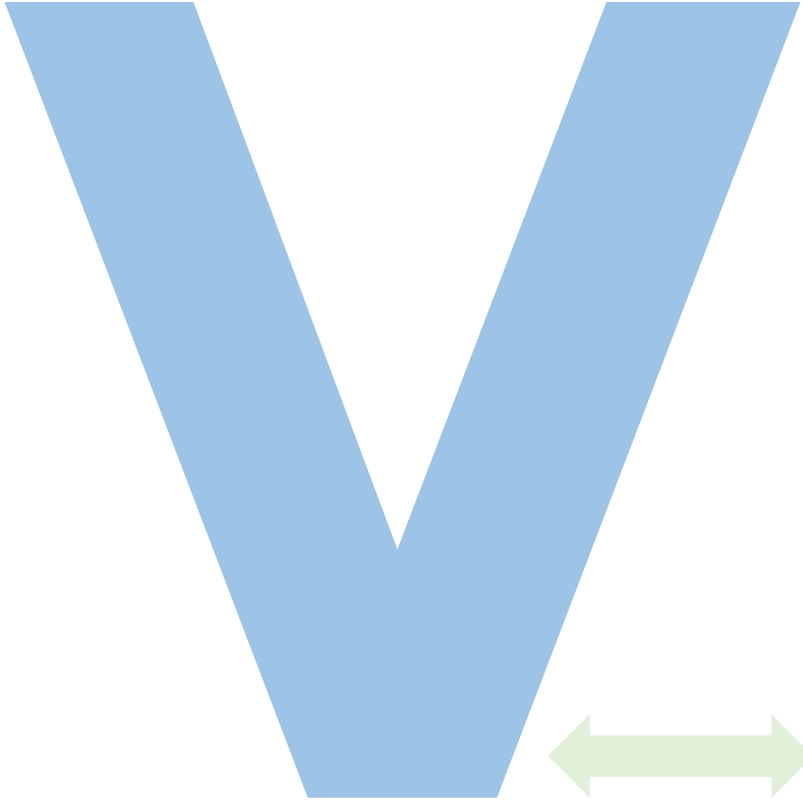
Imported Packages



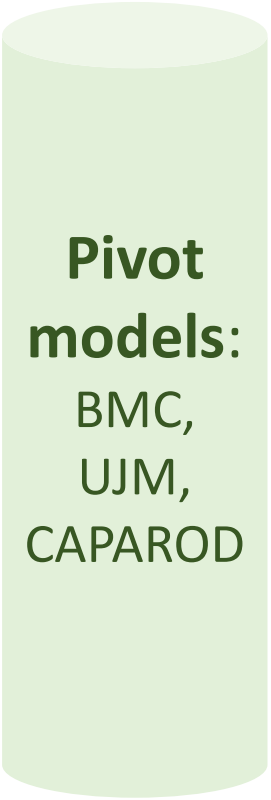
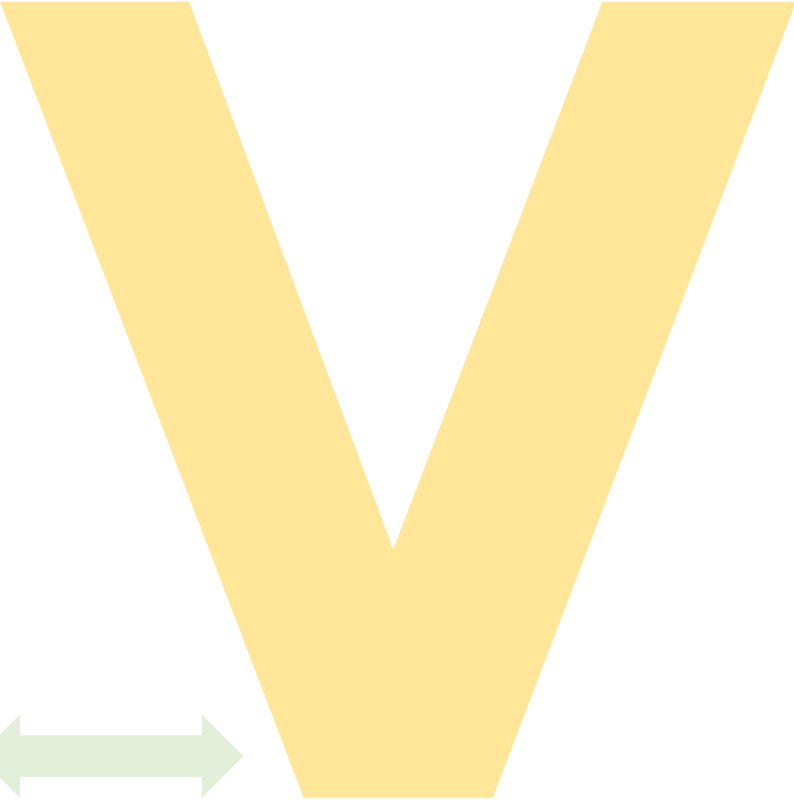
Vee-diagram big picture



TranSoS Vee-diagram



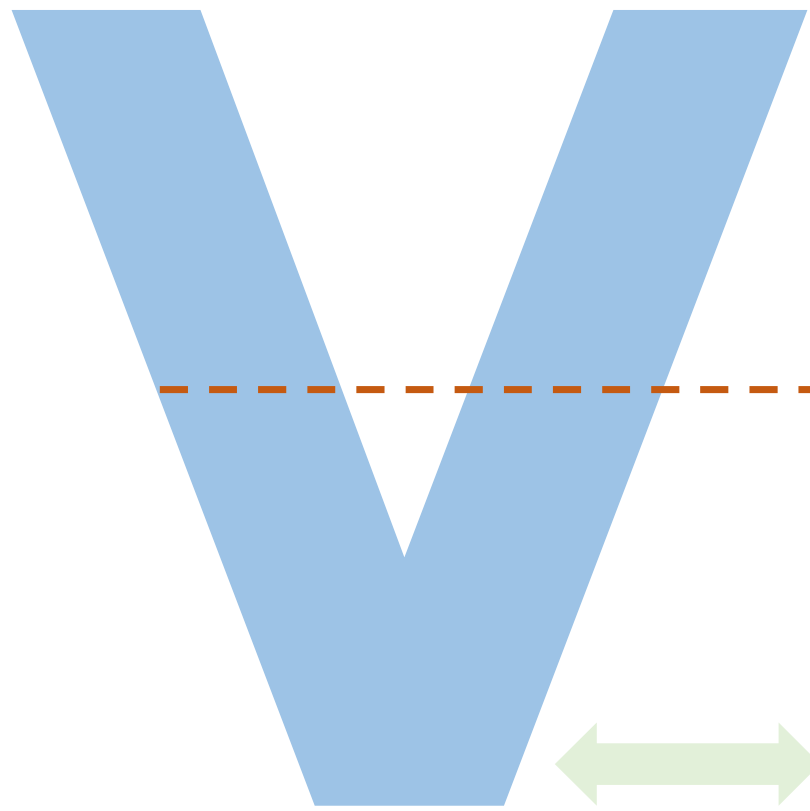
UcSoS Vee-diagram



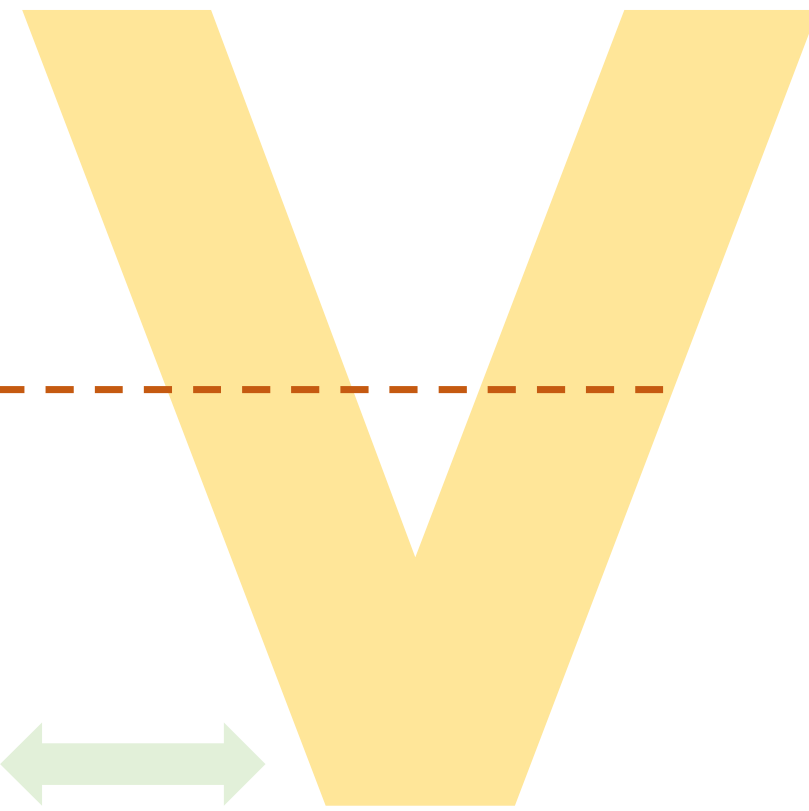
Vee-diagrams orchestration




TranSoS Vee-diagram




UcSoS Vee-diagram



SoS Architect



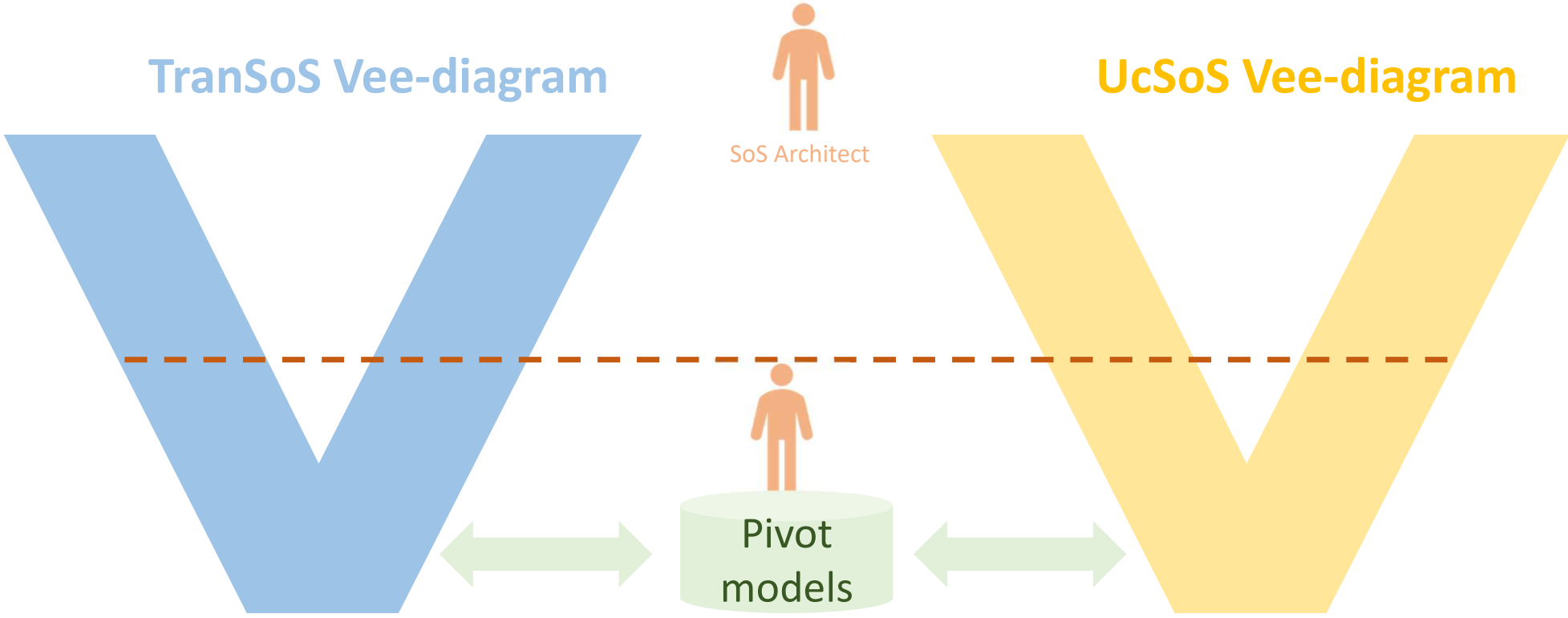
Operation

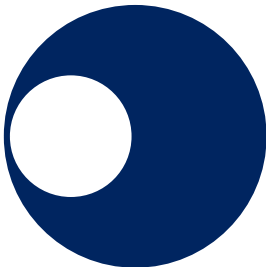


SoS specialist

Pivot models







Conclusion



What was the course purpose?

Clarifying our knowledge about conceptual design in SE, and more precisely, concept definition of operation (ConOps vs. OpsCon)

Defining a conceptual & practical framework hybridizing strategy & design, SE & design thinking included

What are the key ideas?

1. Always go back to the fundamentals of systems thinking to ensure conceptual coherence
2. Conceptualize the operation as an integrative key design entity with a conceptual occurrence (ConOps) & a realistic occurrence (OpsCon)
3. Hybridize strategy engineering, design thinking included (UX-driven design), & routine SE to implement a new concept definition process based on the Vee cycle
4. Create & use a System of Models
5. Consider the SoS as a capable reference solution combining social (TranSoS), services (UcSoS) & technical aspects, this last point not having been addressed
6. Do not forget that we are still in the upper layer of the Vee cycle: there is a lot of downstream design work to be done to elaborate the OpsCon

1. Ideally, this course should be aimed at strategy, marketing or UX specialists, not just engineers with SE as unique framework of reference
2. The mesh of models between strategy engineering, design thinking and route SE is not yet seamless
3. Be aware that operation is an ill-defined object of dissensus, misunderstandings & idle debates: the terms Conops and Opscon remain unclear and esoteric
4. The modeling of the scenario with the sequence diagram is not yet complete
5. The hybridization of visual management tools for supporting teamwork (collaboration) with single-user SE models has just begun



Acronymes

act, activity diagram
 BMA, Business & Mission Analysis
 BMC, Business Model Canvas
 BPMN, Business Process Modeling Notification
 CAPAROD, Capacity Roadmap
 CD, Concept Definition
 ConOps, Concept of operations
 DT, Design Thinking
 EM, Empathy Map
 Es, External Systems
 INCOSE, International Committee of Systems Engineering
 ISO, International Organization of Standardisation
 J.I.T., Just-in-Time
 MBSE, Model-based Systems Engineering
 Opscon, Operations concept
 PESTLE, Political, Economic, Social, Technological, Legal, Environmental
 PL, Other Player
 SD, System Definition
 SE, Systems Engineering
 SEBok, Systems engineering Body of Knowledge
 seq, sequence diagram
 Sol, System of Interest
 SoM, System of Models
 SoS, System of Systems
 SDTP, Stanford Design Thinking Process
 SWOT, Strengths, Weaknesses, Opportunities, Threats
 SY, Subsystem
 SysML, Systems Modeling Language
 TranSoS, Transactional System of Systems
 Uc, Use Case
 UcSoS, User-centered System of Systems
 UJM, User Journey Map
 UML, Unified Modeling Language
 US, User
 UX, User's eXperience



Thank you!

