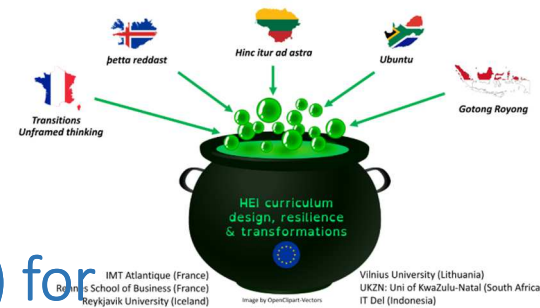


On the design process of Serious Games for resilient organizations

Roger Waldeck & Siegfried Rouvrais

Rochebrune , 22-26 January 2024

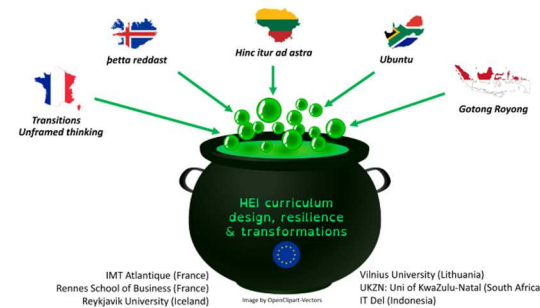
Objectives



Show the design process of creating a serious game (SG) for resilience management : a design-action research program

- **Action research:** how the game will be used for transformative action
- **Design research:** how the game will be designed
 - i.e. how incorporating resilience concepts into SG which will lead to **capacities for stakeholders towards resilience management**
- We will **not show the design of a crisis management game** (which may be another aspect of resilience = decision to recover DURING a crisis)
- But show the design for a **game allowing preemptive action research**

The application context



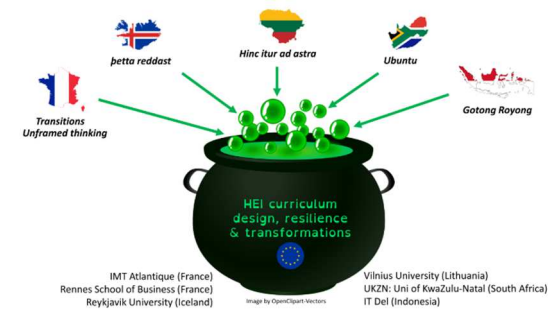
- designing a resilient curricula

www.decartproject.eu

- i.e. help **Higher Education Institution (HEI)** and program leaders to maintain their educational activities in faces of crises

WP2 : co-create a serious game (SG) prototype focusing on designing **resilient curricula** in HEI (on going)

1. Characterize resilient curricula
2. Design a SG: by designing activities enabling the co-construction of a game with project participants (7 intl. Institutions from 3 continents)

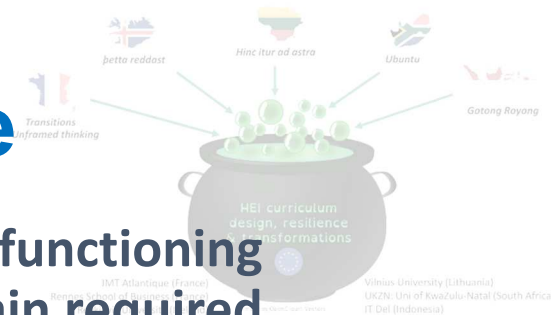


2. A rapid conceptual clarification on resilience and design process

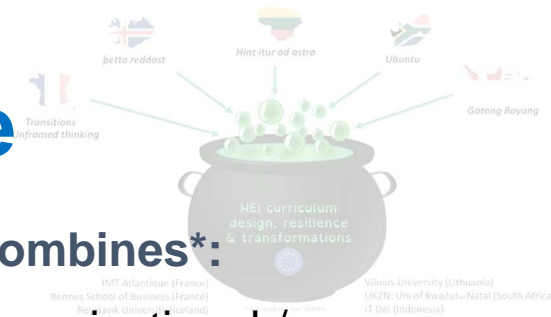
Rapid overview: about resilience

“The intrinsic ability of a system or an organization to adjust its functioning prior to, during, or following ...disturbances, so that it can sustain required operations under both expected and unexpected conditions”. (Hollnagel, 2010)

- Resilient to what ?
- Resilience of what ?
- Resilience how ?
- Resilience when?



Rapid overview: about resilience

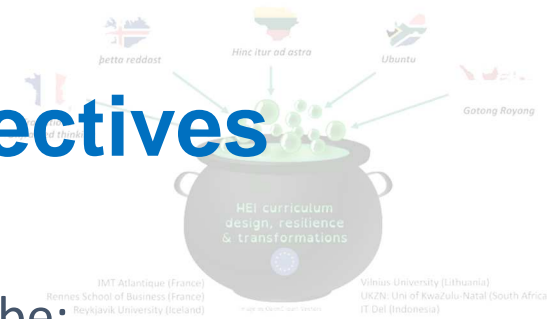


“Organizational resilience is thus a multi-faceted construct that combines*:

- 1. To what: resilience stimuli:** distinct **trigger events**: extra or intra-organizational / foreseen or unforeseen perturbations or opportunities ; diffuse or abrupt
- 2. When: Resilience phases:** a **three-phase**, cyclical process (pre-emptive/ proactive/ recovery (Duchek 2020)
- 3. How: Resilience sources:** organizational **capacities and employee capabilities**
- 4. Of what: Resilience context:** diverse **organizational systems**: a spectrum of more/less complex organizational configurations
- 5. Of what:** different organizational components : critical / essential components

*Source: Gardner Le Gars & Waldeck, 2022 – conference paper

Resilience: declined into SG objectives

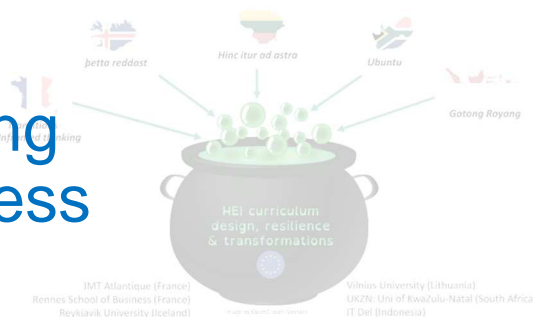


Improve the resiliency of organizations (HEI).

In a preventive (prior) phase (**when**), through the SG players must be:

1. **Capable of anticipation** / aware of threats or opportunities / hierarchization of threats/ capable of identifying cause and effect relations (**to what**)
 2. **Capable of identifying critical components (of what)** i.e. evaluate
 - Essential components / processes to their activities
 - Sensitivity to events of these components / processes
 - Preparedness of these components / processes (potentially with respect to a given threat)
- And the impact on organization as a whole
1. Capable of making plans and prospective vision (**How**): innovate and take decisions to **prevent bad things from happening or make good things happen**
- Have a shared vision of strength and weakness + plan of actions and roles

Resilience : operationalization of the SG building through an action design research (ADR) process combining



- **Design research**: the design of a SG by the use of **theory** on resilience
- **Action research** : the use of the SG for transformative action of the real system (Sein et al. , 2011)

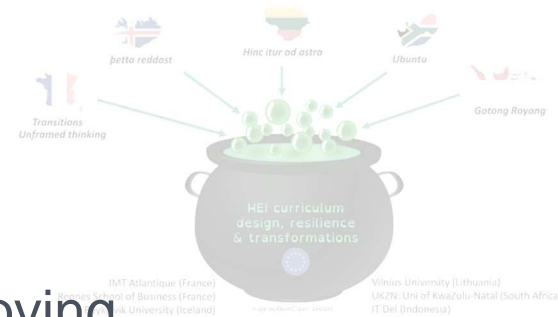
Theory ingrained design:

- **THEORY**: how does theory about resilience inform the design of the game: (Which) theory?
- **DESIGNER PART** : transform the theory in design activities : the design of content and game mechanisms.

What part of the game is a-contextual (rely mostly on theory) ? What part of the game needs more context to instanciate the theory?

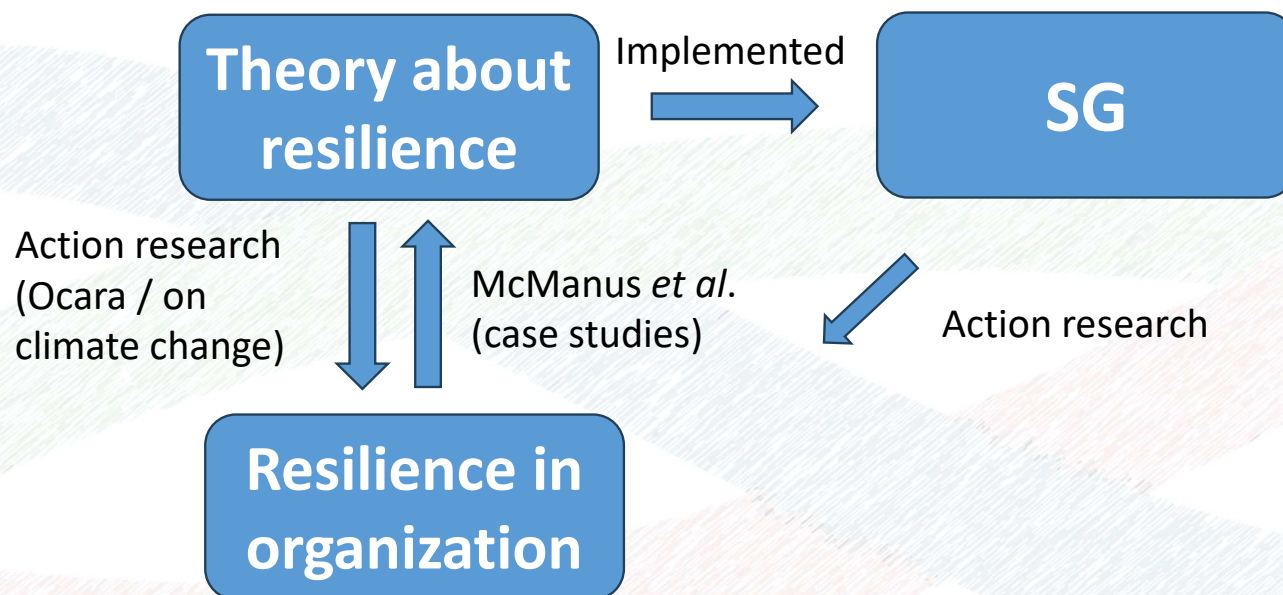
- Ex of a resilient HEI curriculum:
- **ACTION PART**: how will it be used and what can be learned from the SG by the players

THE THEORY used for building a SG

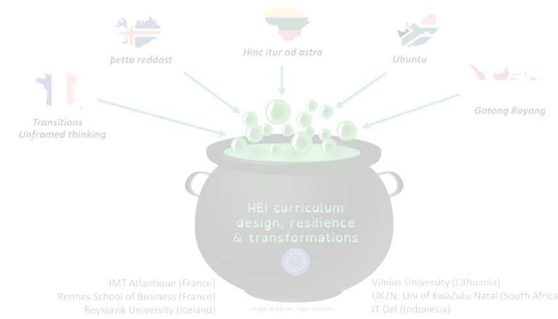


- McManus, Sonia et al. (2008). “Facilitated Process for Improving Organizational Resilience”. In: Natural Hazards Review 9.2, pp. 81–90.
- Méthode OCARA « Référentiel d’analyse de la résilience climatique des entreprises », Carbone4.
www.carbone4.com/files/Carbone_4_guide_methodologique_OCARA_05_22.pdf

Operationalization : an action design research (Sein et al. , 2011) process combining



Dissecting the THEORY



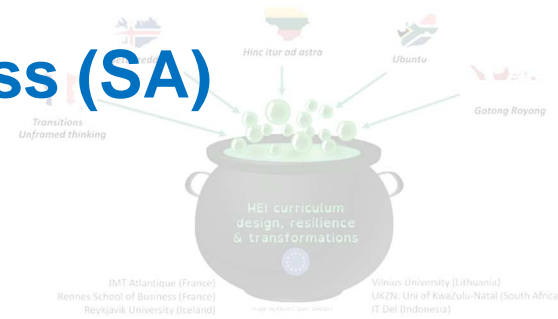
S. McManus₁; E. Seville₂; J. Vargo₃; and D. Brunsdon , 2008:
Resilience is a function of an organization's overall situation awareness, management of keystone vulnerabilities, and adaptive capacity in a complex, dynamic, and interconnected environment

Three pillars (capacities)

- Situation awareness,
- Management of keystone vulnerabilities,
- Adaptive capacity

THE THEORY : situational awareness (SA)

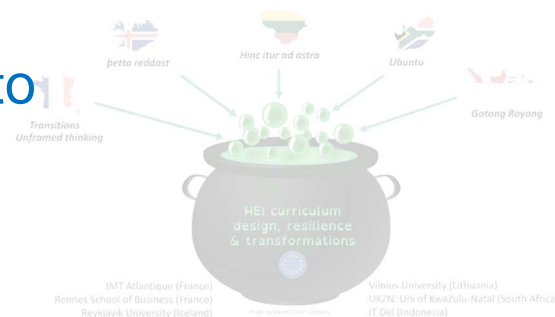
Situation awareness is defined as a measure of an organization's understanding and perception of its entire operating environment (McManus *et al*, 2008). This includes



the ability to look forward to opportunities as well as impacts of potential crises

- the ability to identify **crises and their consequences** accurately.
- Enhanced understanding of the trigger factors for crises
- an increased awareness of the **resources available (or necessary) both internally and externally**
- **An increased awareness of key processes / components**
- and a better understanding of minimum operating requirements : the **minimum viable product**
- **Create a shared vision of the environment**

The action / design part: What we want to achieve what must be designed?



- **Action part:** the SG must be capable to generate a process which enables players to build **Situational awareness (BSA)** at least :
 - become aware of different events which could affect the organization (HEI) and the impact of these events (on the educational program)
 - Identify the different components affected by the crisis
- **Design part:**
 - the expected and unexpected ; events , disturbances , opportunities , hazards that are sudden or gradual
 - Impacts of events
 - **Design consequence scenarios:** impacts of expected and unexpected : how do events **affect processes / components ? Conceptual map?**

THE THEORY : Identifying keystone vulnerabilities (IKV) (Mc Manus et al., 2008, OCARA, 2023)



Management of keystone vulnerabilities relates to those aspects of an organization, operational and managerial, that have the potential to have significant negative impacts in a crisis situation (*McManus et al, 2008*) .

Identifying keystone vulnerabilities:

- The first is the **speed** at which a component failure has a negative impact: rapid or insidious
- the second is the **number of component failures** required to have a significant negative impact on an organization discrete or cascading.

Tangible organizational components (buildings, critical supplies, computers, services...

less tangible components, for example, relationships between key groups internally and externally, communications structures...

Process : set of activities transforming inputs into outputs (OCARA, norm ISO 9000:2015 for quality management) : (e.g teaching a “macro” process : transforming knowledge into skills)

THE THEORY (Mc Manus et al., 2008, OCARA, 2023)



2. Identifying (Managing) keystone vulnerabilities (IKV) What are the Key processes / components of an organization:

- **high stake versus low stake** (how to define stakes , in % of turnover, nb of day the process can be out of service without critical damages for orga? Not meeting an accreditation for HEI)
- Vulnerable/resilient process / component? **The level of vulnerability** of the process depends both on the **level of sensitivity** to the event and **the degree of preparedness / adaptation** of the process .
- **Impact gravity** to a specific event: the impact on the process/component depends both on the importance of the process (high versus low stake) and the degree of vulnerability.

Fig. 1: Vulnerability / resilience of a process /component to a given event

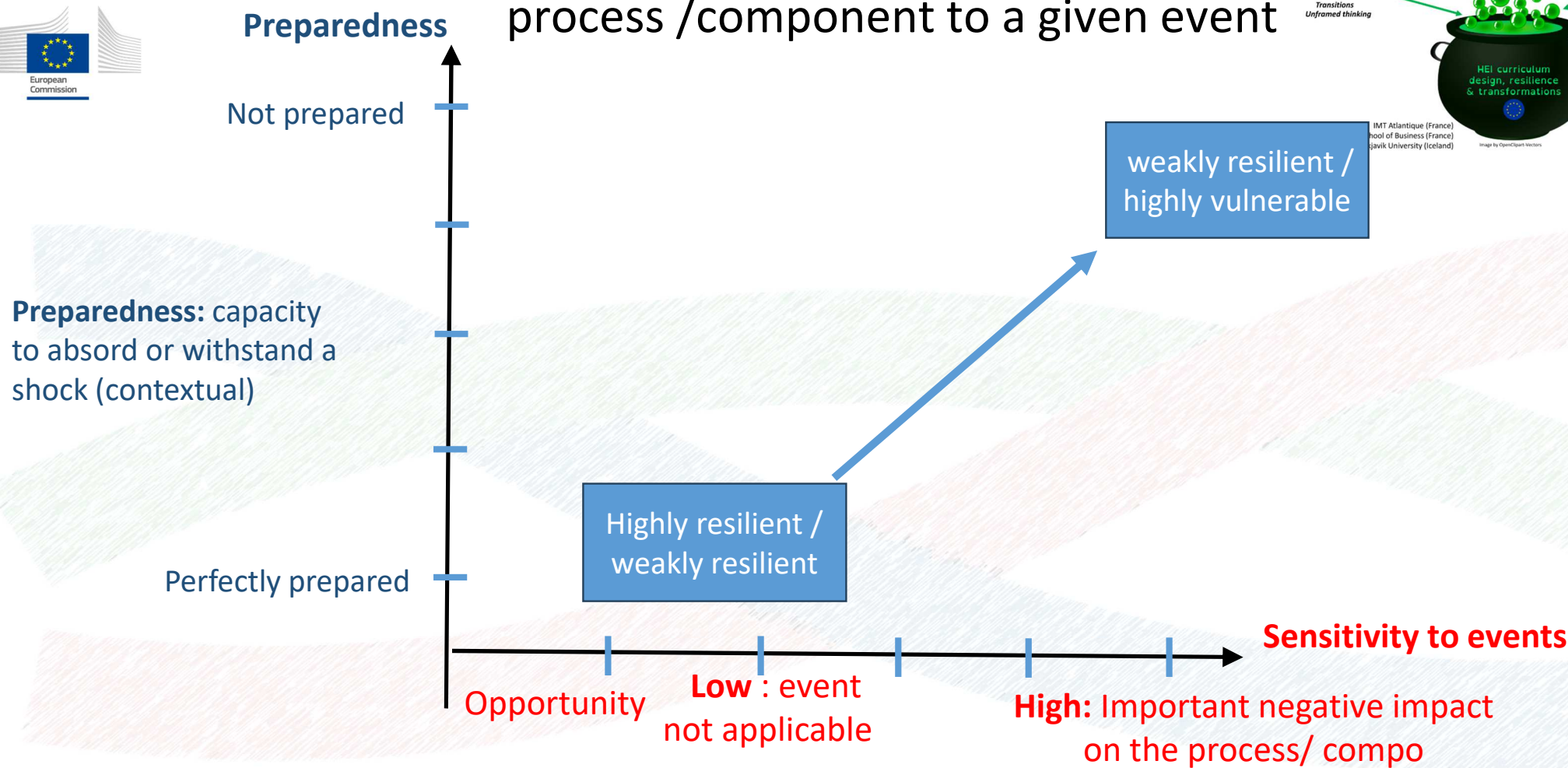
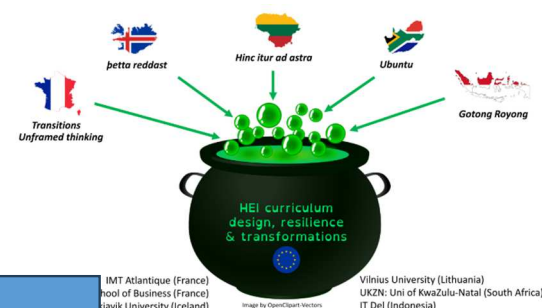


Fig. 1: Vulnerability / resilience of a process / component to a bunch of events

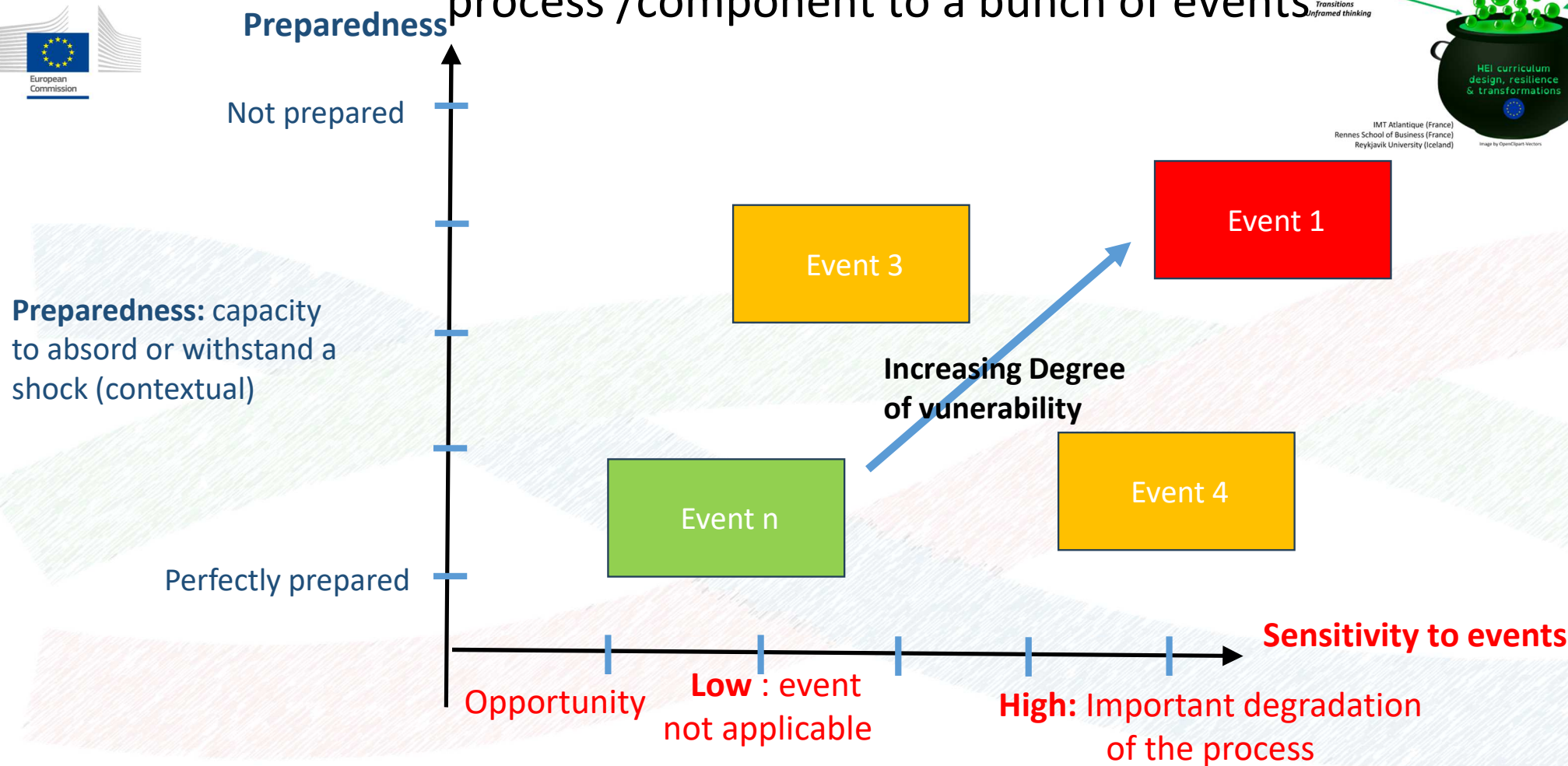
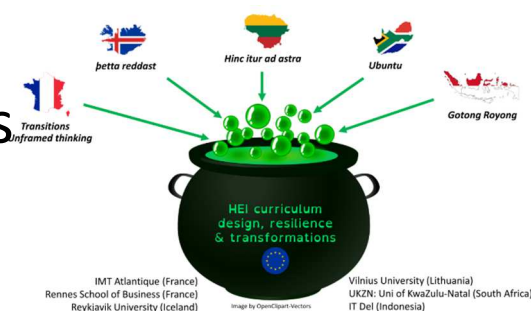


Fig 2: Impact gravity to a given event

Importance of the process for the functioning of the organization

High stake

Low stake

Minor impact

Major impact

Low

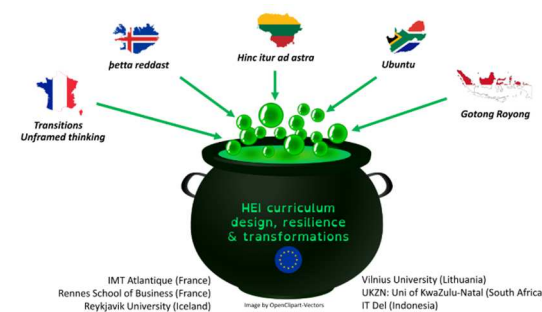
High

High

low

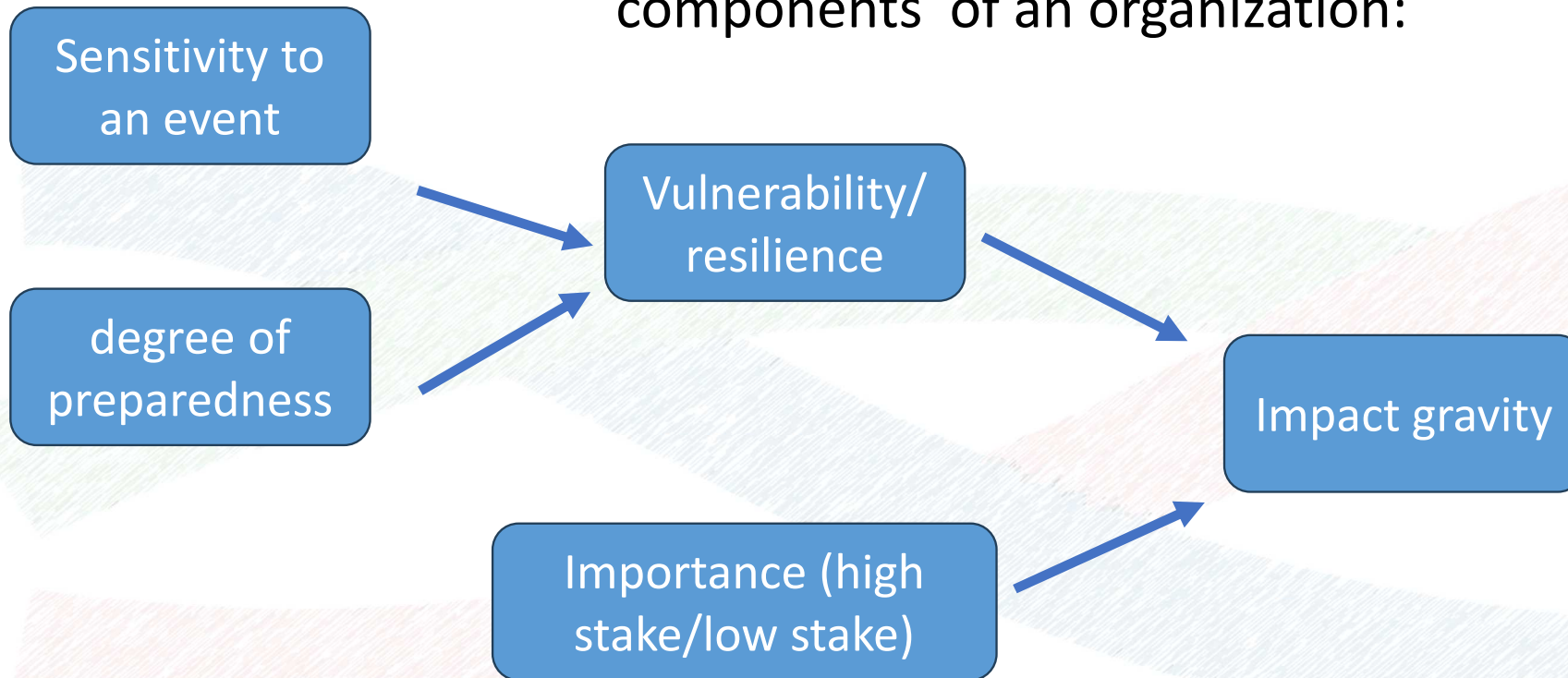
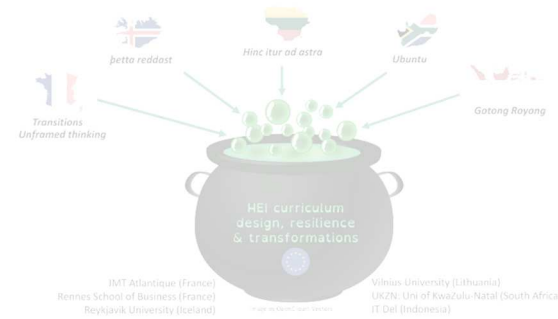
degree of vulnerability

degree of resilience (fig1)

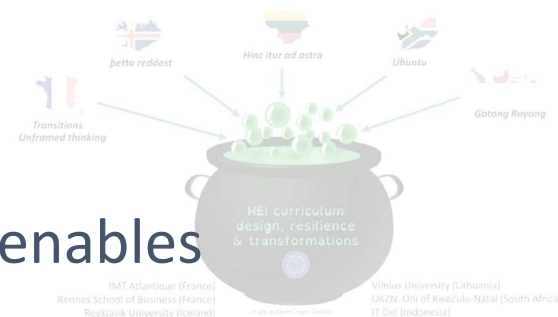


Dissecting tHE THEORY (OCARA, 2023)

IKV identifying Key processes / components of an organization:



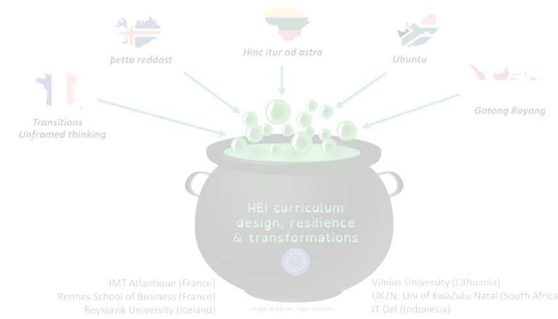
The action/design part: What we want to achieve / what must be designed?



- The SG must be capable to generate a process which enables stakeholders **BY PLAYING**:

- Awareness : Become aware of the hazard types (risks or opportunities) , probability of occurrence , sudden or gradual and their impact (consequence scenarios)
- Design part: Identifying keystones vulnerabilities (IKV):**
 - Vulnerabilities : which components or processes are a high stake for the HEI curriculum?
 - Which process / components are sensitive to the event
 - Preparadness** of the keystone processes / components to risky events : **contextual**

THE THEORY



Resilience theory (Mc Manus et al 2008)

1. Situational awareness (BSA):
2. Identifying keystones vulnerabilities (IKV)

Both BSA and IKV gives an indication of the actual level of resilience of the organization ?

3. Adaptive capacity (AC) : the culture of the organizations and their ability to remain flexible and adaptable is a critical feature of their overall resilience

- What are the margins for improving the organization resilience?
- Depends on BSA and IKV
- What actions need to be taken and depending on the type of crises?

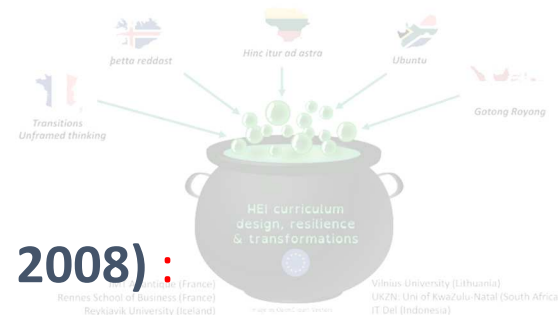
The action/ design part: What we want to achieve what must be designed?



- The SG must be capable to generate a process which enables stakeholders BY PLAYING:

1. BSA: Become aware of the hazards (risks or opportunities) and consequence scenarios for the organization .
2. IKV: Identifying keystones vulnerabilities or opportunities:
3. **Adaptive capacity (AC) : design activities?**
 - Design action levers ?
 - Or debriefing session: let participant imagine their proper action levers **for the current context they are embedded given** what has been learned in BSA and IKV

Design part: recap



Three resilience learning contents to implement (Mc Manus et al 2008) :

1. Building situational awareness (BSA) elements:

- What hazards / opportunities? **Probability of occurrence , sudden or gradual**
- What impact: how do they **affect processes / components of a HEI curricula?**

2. Identifying keystone vulnerabilities (IKV) / weaknesses :

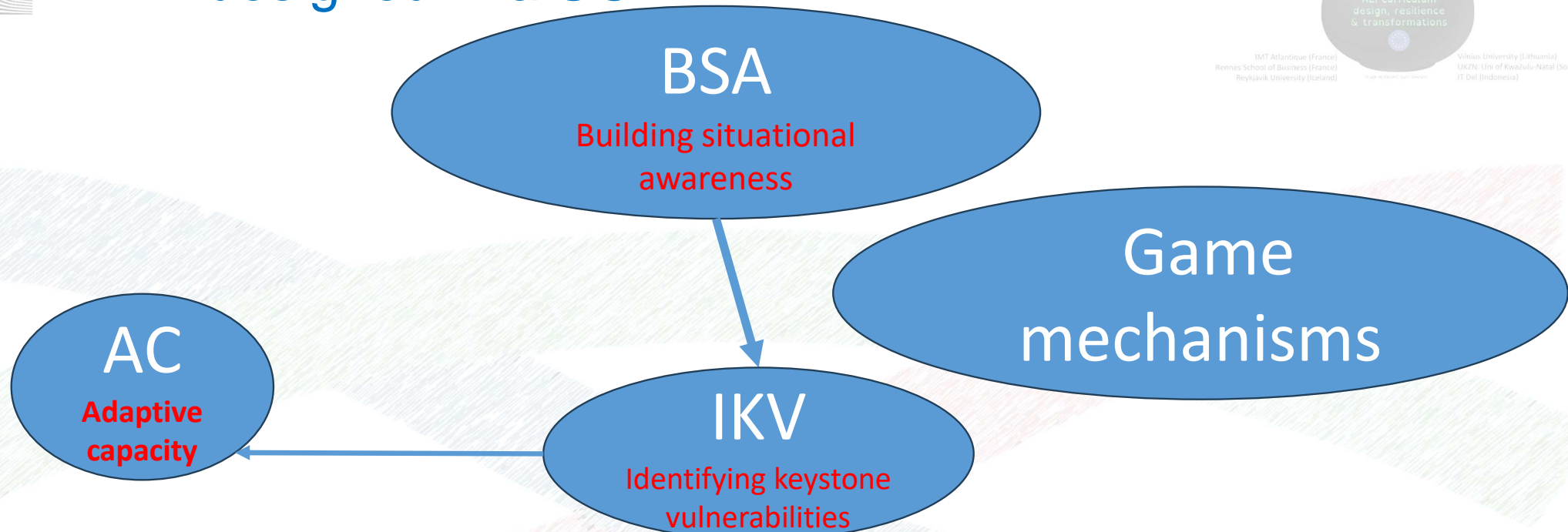
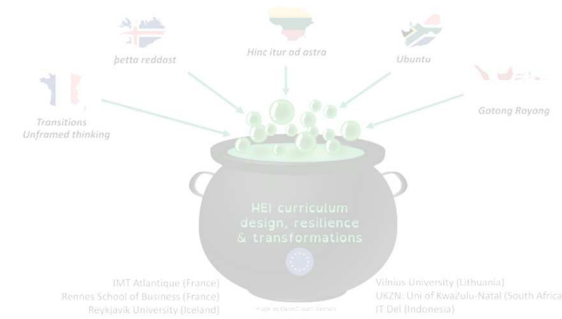
- Which components ? Vulnerable to what ? Impact on organization?

3. Building adaptive capacities : designing for a plan of actions given what has been learned in BSA and IKV

4. **The game mechanism:** how do we gamify the different contents to achieve (some of) the learning goals fixed in the action part

- **The exemple of consequence scenarios**
- **IKV**

The Design part: or what must be designed in a SG?

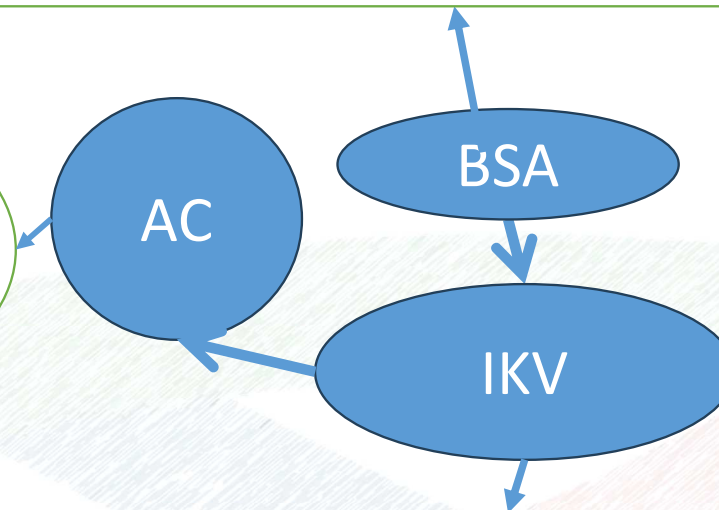


- ✓ Designing crises /opportunities .
- ✓ Designing impacts of crises.

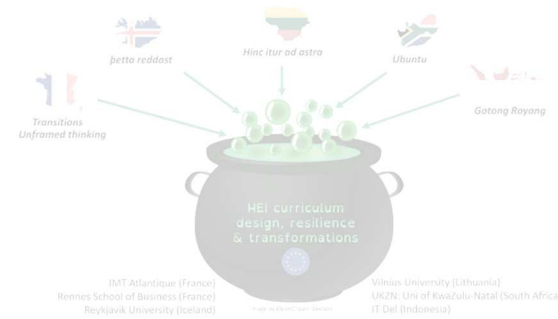
I. Designing cause-effect relations (consequence scenarios)

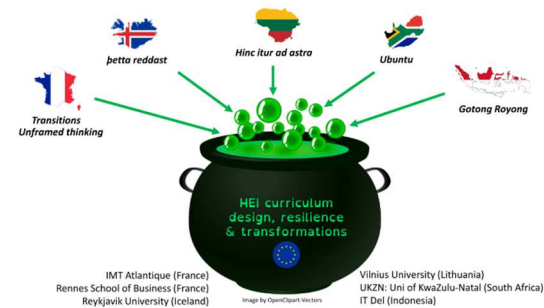
Action levers (3)

Action levers for
each type of crisis
which may appear



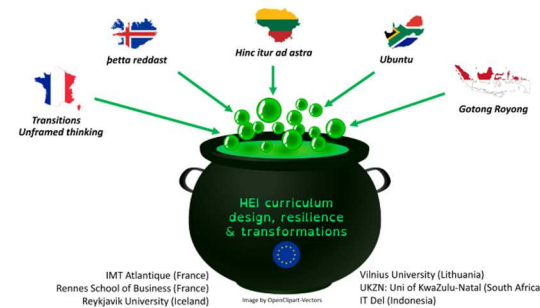
1. Assessing high stake versus low stake processes components
2. Assessing sensitivity: If crisis Y → effect Z on process (low – high , opportunity)
3. Assessing preparedness: If crisis Z → component/process (not prepared - prepared)
4. 2) and 3) → assessing vulnerability or resilience of the organization
5. 4) and 1) : impact gravity for the organization
6. 5) and 1 (BSA) impact on the organization



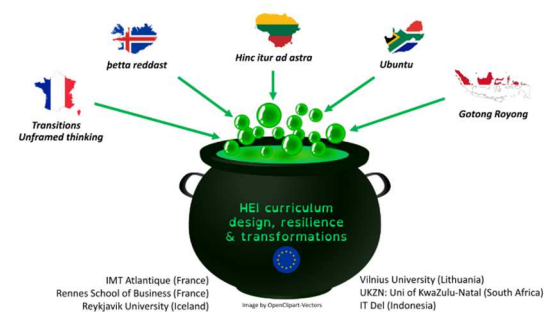


Creating a Serious Game on resilient curricula – The design part

Design part : Three activities



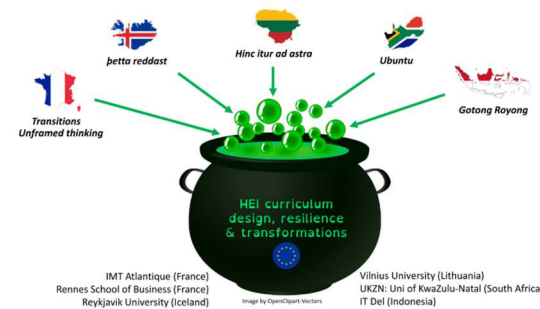
1. Building situation awareness : testing consequence scenario
2. IKV : using context for identifying keystone components in HEI using consequence scenarios analysis
3. Discussion
 - Of the improvement which could be made
 - Discussion : use of the methodology for other contexts



Design Part

Building situational awareness

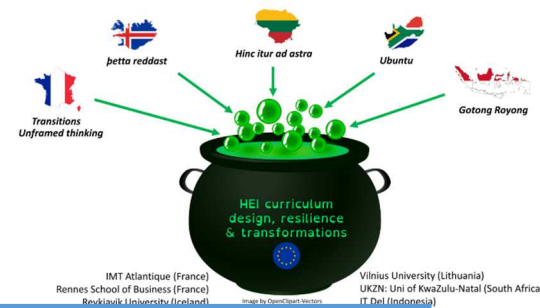
The design part on resilient curricula



“Building Situational awareness” contents

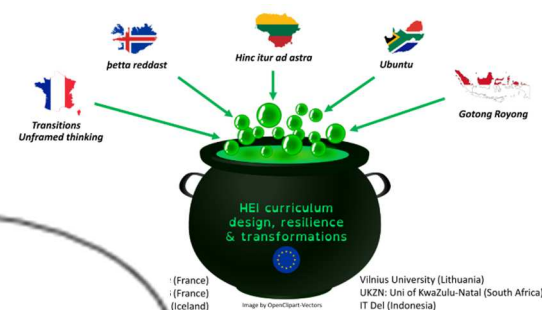
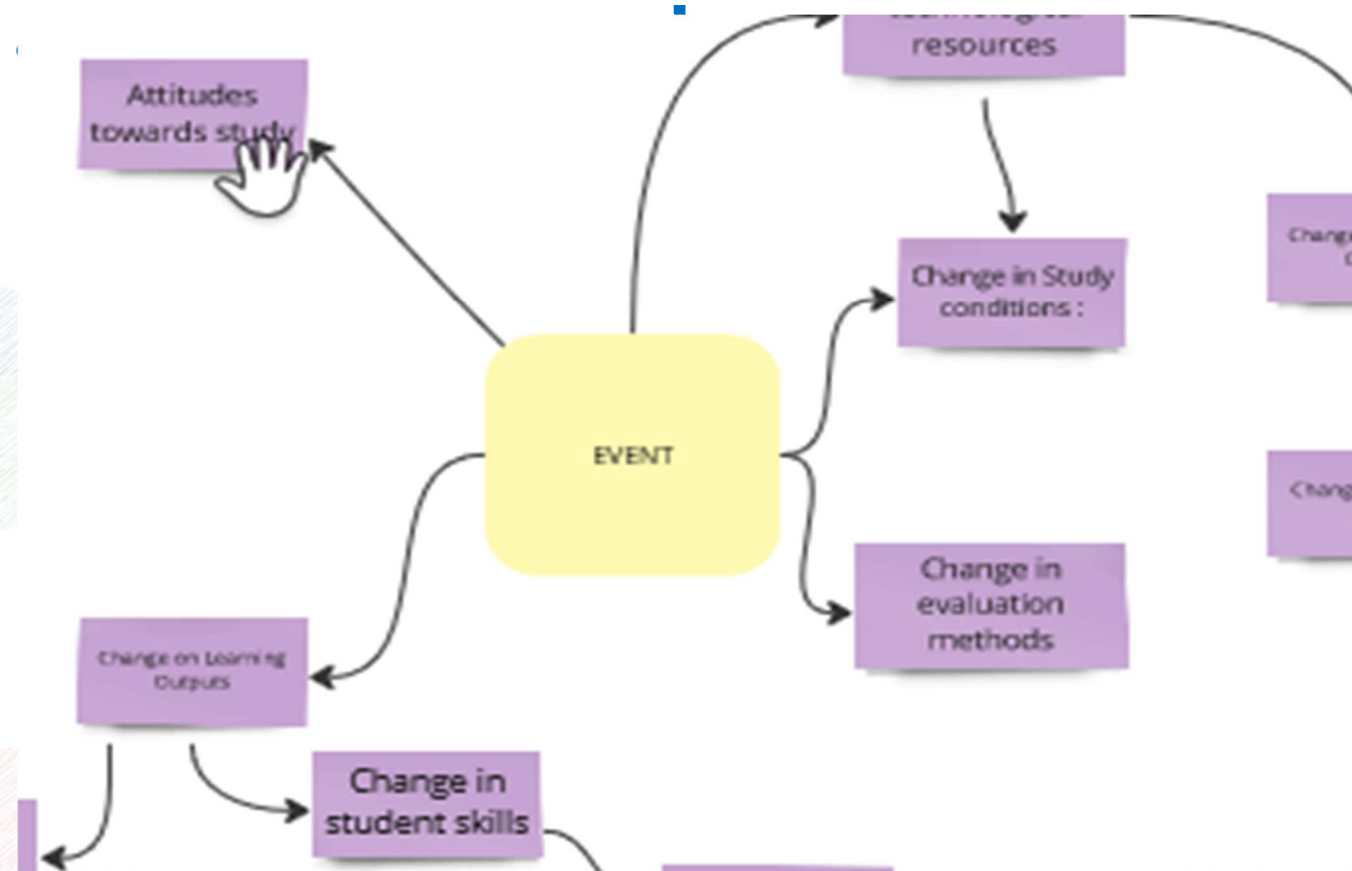
- ✓ -creating HEI **related** events
- ✓ Creating **impacts** (or symptoms of events) on the organization
- We will test the links between events/hazards and impact HEI curricula: consequence scenarios and characterized it by VUCA

ADR: Building Situational awareness (BSA)

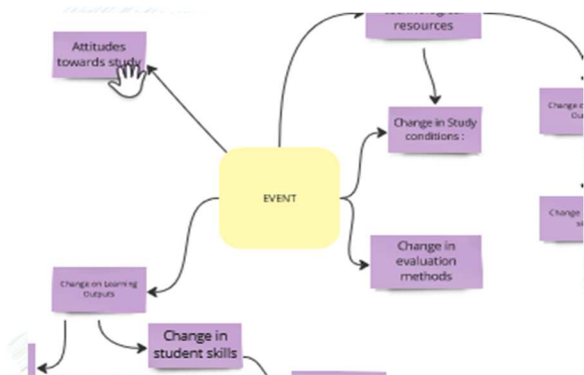
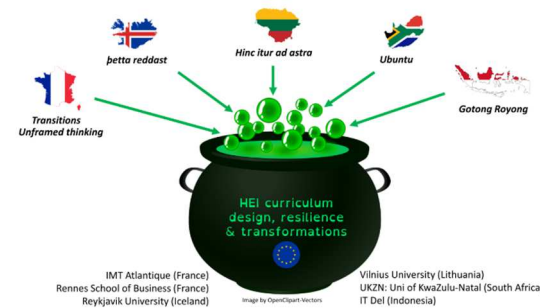


Theory (BSA)	Design	Action part :use in SG	Possible game mechanisms
WEF Crisis categories : economic , societal, techno , envt, geop.	1) HEI Event Cards: <i>"techno : AI is not able to distinguish real data and facts from fakes"</i> .	Consequence scenarios	Cards : pick an HEI event card from the desk of events card
Impacts of crisis on HEI (Berthoud et al. , Lattuca and Stark's (2009) , DECART Curricula)	2) IMPACTS Cards: <i>"Change in evaluation methods" OR "Change in Study conditions"</i>	Use in consequence scenarios	Given the HEI event: choose potential impacts
	A map	A conceptual map on consequence scenario of a given crisis & discuss VUCA properties	Draw a conceptual map linking an HEI event card to different chosen impact cards

ADR: Building Situational awareness (BSA)



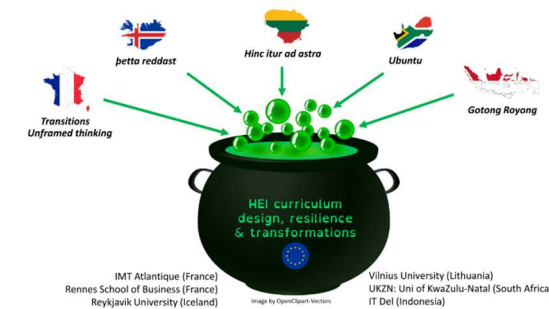
Consequence scenarios : VUCA?



VUCA: Volatile, Uncertain, Complex, Ambiguous environments :

- an acronym used by managers to qualify their environment and adapt their policies
- Can we use it to qualify the type of impacts an event has in the consequence scenario analysis?
- What would be the use (policy?)

ADR: VUCA qualification



Volatility Change 23, Unpredictable 8, Dynamic 6, Unstable 6
 (Taskan & Junca-Silva 2022, a systematic review on 26 papers)

Volatility The magnitude of variation over time of a given random variable .
 (Waldeck , 2020) Ubiquitous phenomena in complex systems and is linked to the non
 linearity present the combination of positive and negative feedback
 produce patterns of stability and instability.

ADR: VUCA qualification



Uncertainty Unpredictable (13), Lack of information (10), Unknown (6)
(Taskan & Junca-Silva 2022)

- Uncertainty** (Waldeck, 2020)
- **Radical uncertainty** is a very limited ability to describe the states (unknown – unknown) or future outcomes that may occur. Not all outcomes known
 - **"simple" Uncertainty**: known states/outcomes but unknown probabilities. (known – unknown)
 - **Risk**: know probabilities and states.
 - **Model uncertainty**: uncertainty on the underlying independent variables induces uncertainty on some model outcomes (econometric modeling, bifurcation theory and tipping points effects , butterfly effect” ,...)
 - **Strategic uncertainty** : uncertainty about behavior of others
 - **Idiosyncratic uncertainty**: about own preferences

ADR: VUCA qualification



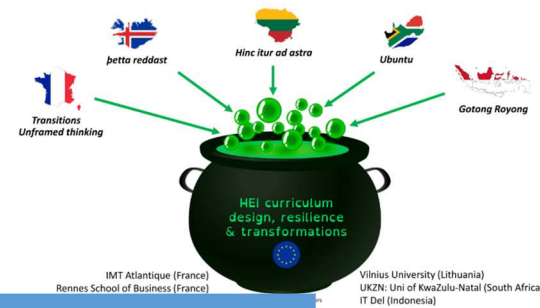
Complexity

Quantity of factors to analyse (14), Relations between factors (13),
Confounding (7) , Chaos and confusion 6 (Taskan & Junca-Silva, 2022)

Types of situations	Complicated systems - ≠ Complexity (Waldeck, 2020)	
Characteristics	Reductionism	Irreducible.
	<p>Aggregation, averages</p> <p>Central limit theorem, Gaussian distributions</p> <p>Ergodicity</p> <p>Outcomes are predictable from past trends or from expertise (knowledgeable systems).</p> <p>Predictability from causes to effects</p> <p>Bayesian updating or frequentist approach</p>	<p>Composition effects</p> <p>Power law distributions, clustered volatility</p> <p>non ergodic systems; phase transition; hysteresis.</p> <p>Probe or experiment for prediction, retrospective coherence. Prospective futures.</p> <p>Causes and effects may be intertwined.</p> <p>Predictability by phase stability over long periods and unpredictability by tipping point effects or chaos</p>
Decision making	<p>Rather centralized, structured or hierarchical groups.</p> <p>scheduled Decisions ;</p> <p>Cooperative games although conflicts of interest may exist.</p> <p>Group decision via aggregation or predefined social choice rules</p>	<p>Rather decentralized, diffuse real authority and power</p> <p>Adaptive decision making and resilience management.</p> <p>Rather decentralized and non cooperative games, although coordination of actions may be</p> <p>Group decision through probing learning and experimentation.</p>

(Waldeck, 2020)

ADR: VUCA qualification



Ambiguity

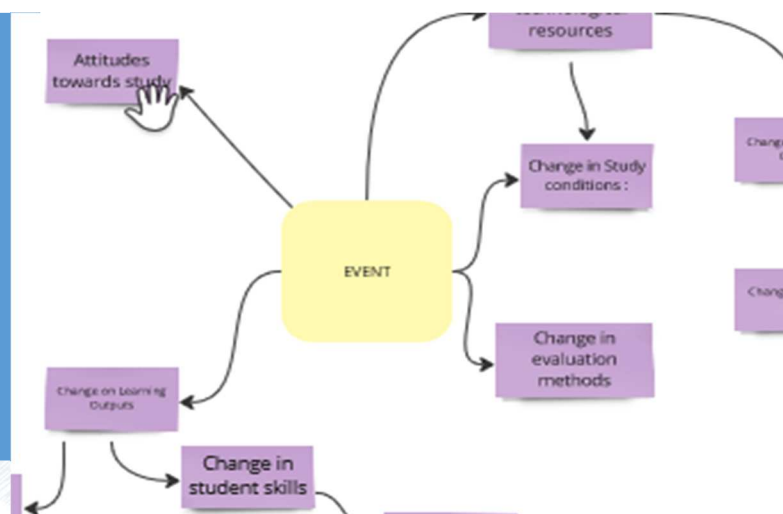
- Inability to understand/interpret (11), Lack of clarity (10) , Multiple interpretations (8) Uncertainty (7) , Confounding (5) (Taskan & Junca-Silva 2022)

Ambiguity (Waldeck, 2020)

- Lack of understanding of cause-effect relationships possibly due to multiple possible theories of cause -effect relations
- Multiple interpretations, and interpersonal variability, of a given information
- Lack of a procedure for decision making when conflicting criteria.
- No clear (group) decision making process or collective rules specifications

ADR BSA: consequence scenarios VUCA qualification

Volatility Magnitude of variation over time of a given random variable . (positive and negative feedback loops) . Periods of Instability followed by stability

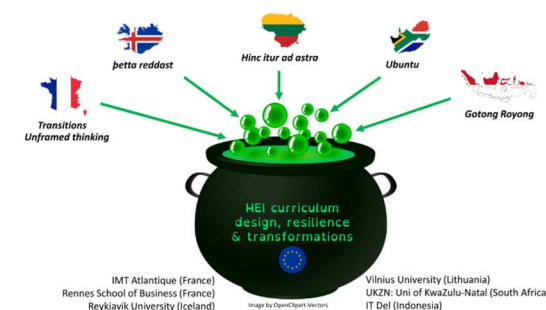


Complexity many components, non linear interactions and feedback loops

Ambiguity Lack of understanding of cause-effect relationships, no clear model specification
Multiple possible interpretations, and/or interpersonal variability in interpretation

Uncertainty Lack of predictability. Impacts of events difficult to "quantify"

- Model
- Strategic
- Idiosyncratic
- Radical
- simple
- risk

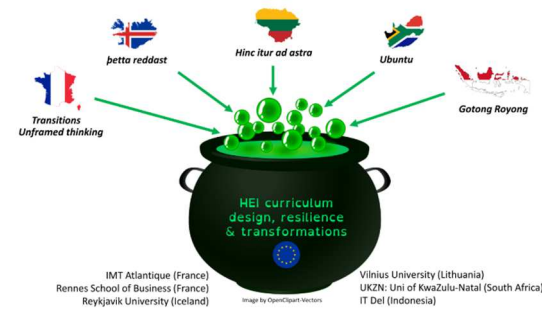


VUCA grid , Waldeck (2020)



	V	U	C	A
Low	No parameter fluctuation or small range regular fluctuation	Knowledge of possible outcomes and associated probabilities. Information easily accessible	Complicated: many components and relations but reducible systems; Prediction from past possible or from expertise / engineering systems	The problem structure (cause-effect relations, goals,...) is well understood AND mostly shared among DMs ; only minor points of disagreements
Medium	Larger but regular and predictable fluctuation	Knowledge of possible outcomes but no probas	Complex (non linearity in cause and effects, feedbacks but closed systems (cooperation & self organization)	Multiple concurrent interpretations of the problem structures among DMs
High	Unpredictable and abrupt changes (volatility clustering)	Radical: unknown future outcomes Information difficult to be found / no precedence	Complex open systems (adaptative and decentralized)	No clear problem structure (goals , causes & effects)

Well designed ? Usefull for decision making in a SG or why and how would it be useful?

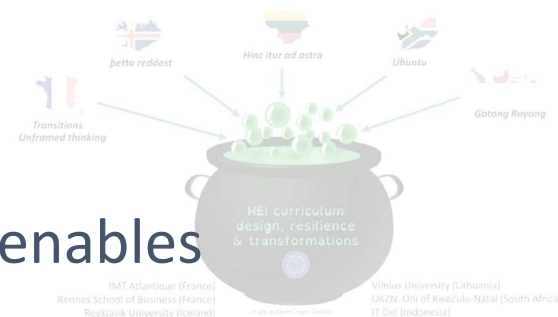


Activity 1

Testing consequence scenarios with VUCA considerations:
managing a curricula in HEI

https://miro.com/app/board/uXjVN5x8i-0=/?share_link_id=846899246237

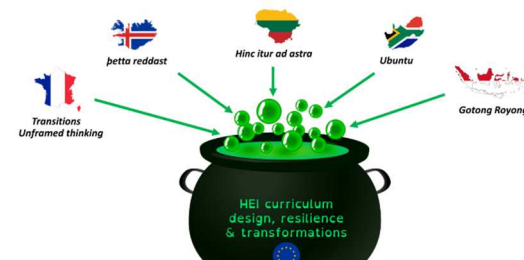
The action/design part: What we want to achieve what must be designed?



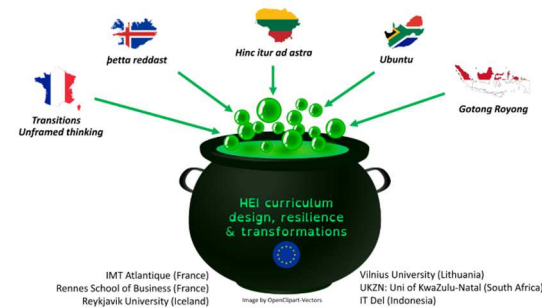
- The SG must be capable to generate a process which enables stakeholders **BY PLAYING**:

1. Identifying keystones vulnerabilities (IKV): think / discuss about

- vulnerabilities : which components or processes are a high stake for the HEI curriculum?
- which process / components are sensitive to the event
- Preparedness** of the keystone processes / components to risky events



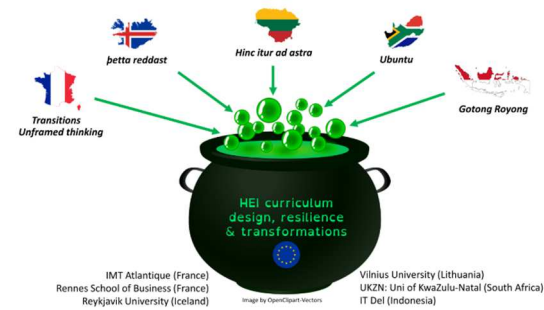
Theory (IKV)	Design: Cards	Action part :use in SG	Possible game mechanisms
	<p>Create context: describe different organizations (Orga):</p> <ul style="list-style-type: none"> - market driven/ versus public driven Orga - technology intensive versus labor intensive Orga - Highly connected versus Orga 	<p>Each card will represent a player or group of players (representing a type of HEI).</p> <p>A context will enable players to identify the key / critical components</p>	<p>Cards :</p> <ul style="list-style-type: none"> -1) initialization: pick a context card -2) Each round of play : pick an event card and draw the consequence scenarios map. 3) Identify the critical components within the consequence scenario map (BSA). 4) Identify the impact for the HEI



Activity 2

Given the context given by two cards : Try to identify , vulnerabilities by using consequence scenarios? Suggestion of what is missing?

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Activity 3

Discussion on the use of the methodology to other context ?

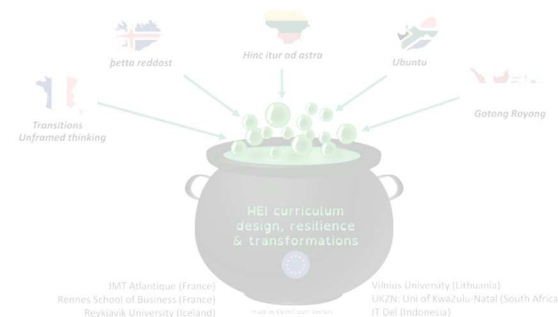
Thank You!

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