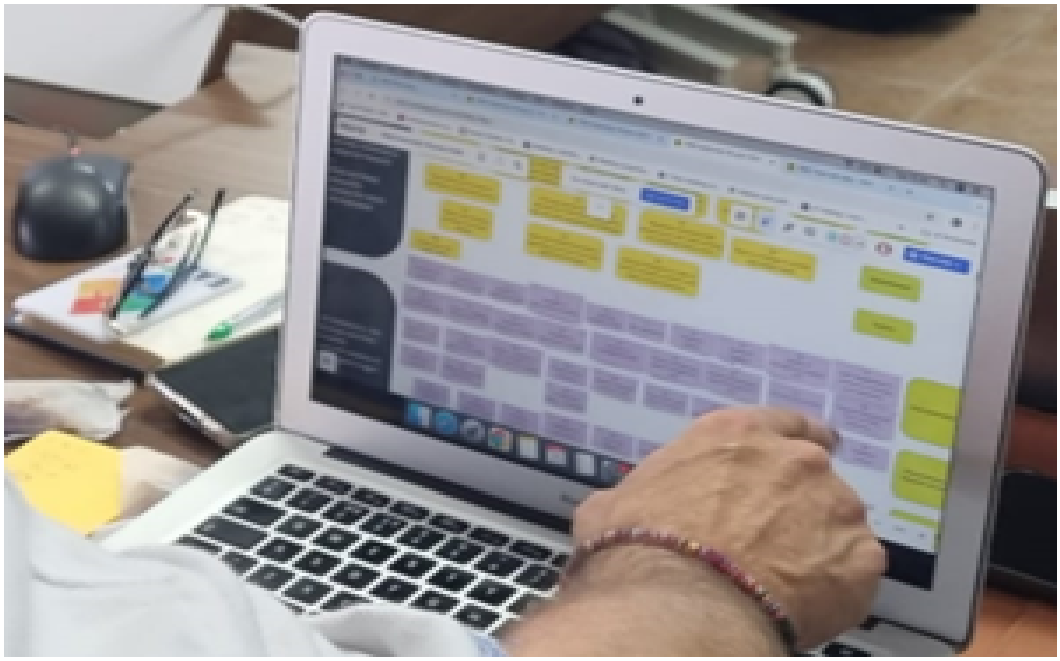
DECART: Designing higher Education Curricula for Agility, Resilience & Transformation

DECART WP2

Building process of a serious game for curriculum resilience

Deliverable R22

version 2.0, april 2025



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Preface

DECART (Designing higher Education Curricula for Agility, Resilience & Transformation) is a cooperation partnership in higher education funded by Erasmus+. The aim of the project is to propose methods and tools to guide STEM & Management educational leaders in innovative curriculum design and program transformations in an effort to be more prepared for unpredictable VUCA contexts (Waldeck *et al.,* 2019*)* (volatile, uncertain, complex and ambiguous) . The project facilitates the identification and sharing of innovative curricula among partners in the project as well as associated international participants, in essence to assess and improve interoperability and resilience of curricula. Over the course of 3 years (2022-2025), the project brings together 4 universities from Europe , 1 from Africa, and 1 from Asia.

This report shows the final results of objective 022 from the three objectives of work package WP2:

Objective 022 relates to the co-design of a serious game using a participatory process with DECART's members with a resulting deliverable (R22) showing the co-design process. The design of the serious game follows an action design research program (ADR) (Sein et al. (2011). ADR has both a design and action research focus. It is an approach and methodology which aims to carry out in parallel and in an intertwined manner the acquisition of scientific knowledge and concrete and transformative actions in the field through the design and use of an artifact such as a serious game. We use resilience theory to design the three steps which define three resilience abilities to be acquired by players during a serious game session: 1) building situational awareness i.e. the ability of players to identify crises and their consequences accurately, 2) the ability to identify keystones vulnerabilities and 3) the ability to design a plan of actions in order to improve the resilience of the curriculum. The serious game is designed in such a way that program leaders can deploy it in their own context to foster the resilience of their curricula.

Part 1 " the serious game development process" is a specification of the building process of the serious game. Part 2 " Feedback on SUCRE building process" presents the feedback on the process by the DECART partners. The objective was both to train the partners (train the trainees) and to have a process of continuous improvement of the development of the serious game called SUCRE.

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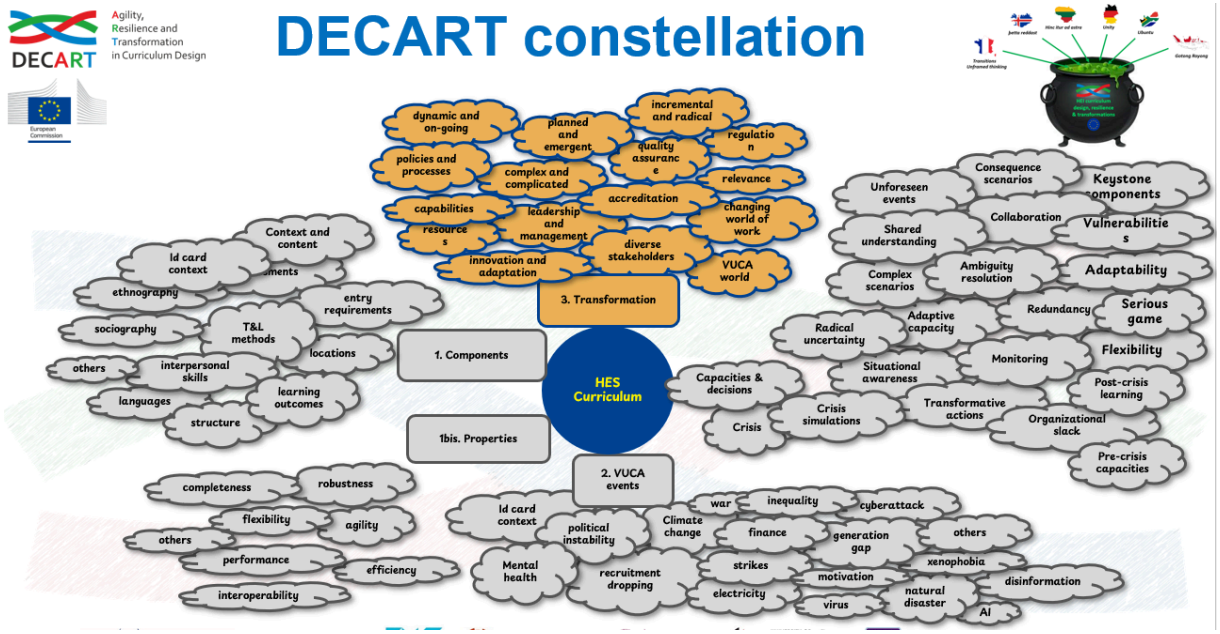

The DECART components - here focusing on Properties, VUCA, and Resilience.

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Partners in DECART

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The partners in the DECART projects are from six institutions. The Table lists the partners and the leaders from each institute.

Table. List of partners in the DECART project and the leaders from each institute.

Continent	Institute	Focus in DECART	Responsible person
Africa	**UKZN:** University of KwaZulu-Natal, Durban, South Africa	Management	Cecile Gerwel Proches
Asia	**ITD:** IT Del, Laguboti, Toba, Indonesia	Computer Science	Arlinta Barus
Europe	**IMTA:** MT Atlantique, Brest, France	Computer Science	Siegfried Rouvrais
	RU: Reykjavik University, Iceland	Engineering	Haraldur Audunsson
	VU: Vilnius University, Vilnius, Lithuania	Education	Valentina Dagiene
	RWTH: Aachen University, Aachen, Germany	Engineering	Clara Lemke

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- Title: Building process of a serious game for curriculum resilience
- Authors:
    - Roger Waldeck *et al.,* IMT Atlantique, Brest, France, leading author

Additional collaborators in the collaborators & acknowledgement section

- Formal link to the material: www.decartproject.eu

Dissemination model

Type	☒ Teaching material ☒ **Learning material** ☐ Training material ☐ Event ☒ **Report** ☐ Video ☐ Service/Product
Languages	English
Target groups	☒ **Teaching staff** ☒ Students ☒ Trainees ☒ Administrative staff ☐ Technical staff ☐ Librarians ☒ **Other: *University Management***
Dissemination level	☒ **Department / Faculty** ☒ **Institution**
Lead Organisation	WP2 coordinator: IMTA, Roger Waldeck
Participating Organisations	European partners: IMTA, RSB, RU, RWTH and VU African partner: UKZN ASEAN partner: ITD

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Introduction: design objectives

A considerable hurdle to fostering and continuously improving organisational resilience resides in the lack of attention given to organisational resilience education and training. This means that many organisations cannot determine which capabilities and capacities to invest in to achieve their predetermined organisational resilience goals. Academic definitions of organisational resilience converge toward a process that encapsulates a suite of dynamic capabilities that allow an organisation to rapidly adapt to internal or external shocks such that the prior or a more desirable operational state is attained (Desjardine et al., 2019; Duchek, 2020; Gardner Le Gars et al, 2023; Sheffi and Rice, 2005). However, in the real-world, organisations struggle to distinguish resilience capabilities from business continuity or risk governance related ones (Eliott et al., 2023). Moreover, knowing what resilience is in theory, does not equate to knowing how to become resilient in practice. Organisations and their members thus lack the pedagogical tools to learn and improve resilience. There is a paucity of practical tools to comprehensively operationalize organisational resilience in a way that organisations can readily deploy. In recognition of this significant practical issue, researchers have recently developed an organisational resilience serious game design algorithm (Gardner Le Gars & Waldeck 2022; Waldeck et al., 2023; Gardner Le Gars et Waldeck, 2025) that may help to design serious games enabling the learning and deployment of organisational resilience. The authors elucidate a resilience game design algorithm which integrates distinct facets of the resilience construct into a single framework. By identifying the different resilience dimensions, i.e. the temporal phases (preventive, proactive, recovery), the organisational topography (processes, ressources, roles in organisations) and contextual complexity (non cooperative or collaborative situation, decentralized decision making, dynamic complexity of transitions and crises), the algorithm serves to enrich or clarify the game intended resilience learning outcomes in the design of new serious games (SGs) depending on the different dimensions of the resilient constructs .

SGs are learning tools that facilitate engaging & realistic shared learning & training for game participants and may target any of the following goals (Abrami and Becu, 2021 ; Arnab *et al.* 2015 ; Ratan and Ritterfe, 2009; Mettler and Pinto, 2015 ; Schwengel et al., 2022):

1. Foster social (peer-driven) learning: shifts participants beyond individual mindsets and raises awareness of shared interests and mutually acceptable solutions (Bogdan and Cottar, 2022)
2. Facilitate active and experiential learning and knowledge transfer: achieve uniform literacy levels in an organisation of a particular topic while having fun
3. Shared understanding of complex issues: provide a safe space to explore contentious issues in simplified form

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4. Effective decision-making for complex problems such as achieving more resilient and sustainable socio-economic systems

The objective of 022 was to design a SG enabling the resolution of real world problems and the SG, called SUCRE (for Serious game for University Curriculum REsilience) developed in DECART meets the points 1., 2. 3. and 4 (see section “feedback on the serious game building process” and Waldeck et al. 2025c). It is devoted to creating a shared vision on the state of resilience of a curriculum with respect to different triggering events, that can be sudden, diffuse, long lasting, and design actions to increase the resilience state of the curriculum. Point 2 is an additional benefit as the participants will become aware of the resilience principles integrated in SUCRE during a game play (Waldeck et al. 2025c).

Serious games (SGs) are characterized by their intended learning outcomes, i.e. what kind of knowledge and skills the game is designed to convey. They are also described by their utility, meaning the extent to which the game impacts participants’ learning or contributes to solving real-world problems, and by their usability, which refers to how easily participants can engage with the game play and game elements. Usability is primordial for successful SGs (Klabbers, 2006). An overly simplified resilience SG, i.e. high usability, may impede pedagogical and practical goals, i.e. utility, meaning that participants fail to acquire knowledge that yields insights apt to serve organisational resilience. This trade-off between usability and utility is a common challenge in the design of SGs (Arnab *et al , 2015)*.

Therefore, the design of the serious game will have the following general design objectives:

- **Usability:** the accessibility to the game must be possible for a large spectrum of curriculum designers, teachers or executive staff. No particular knowledge about resilience concepts is necessary but some principles will be transmitted through the SG.
- **Utility:** the game must improve the players capacity to think about curriculum resilience within their own HEI context, i.e. be an effective decision tool for HEIs.
- **Scalability:** game scenarios and context (crises, impacts, curriculum id. describing the curriculum, solutions) will be provided in the standard version of the game but the game mechanisms ensure that players can create their own context by referring to their HEI curricula context as well as designing their own crises, impacts and solutions.

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The serious game development process

Action design research

The design of the serious game follows an action design research program (ADR) (Sein, 2011). ADR has both a design and action research focus. It is an approach and methodology which aims to carry out in parallel and in an intertwined manner the acquisition of scientific knowledge and concrete and transformative actions in the field through the design and use of an artifact such as a SG. The ADR program relies therefore on two parts: first a reflection on what in a SG relates to our model of reality (the design part), which may be informed either by theory or/and by the real system being modeled, and second, a use of the SG for transformation actions of the real system under scrutiny.
The SG SUCRE is scalable i.e. designed in such a way that curriculum leaders can adapt it to their own context and interests.

In the following, the process of creation of SUCRE is described by mixing both the design of the game elements and mechanisms and the objectives of interim steps where the designed elements were tested on the dimensions of usability and utility.
For ADR, we follow the two first steps in Sein, 2011:

- Stage 1: problem formulation with a theory-Ingrained SG. We rely principally on McManus et al. (2008) theory to inform the design process of a SG for building resilient curricula and on Gardner le Gars and Waldeck (2022; 2025) to specify the type of temporality and game intended learning outcomes we want to address for resilience. The serious game will focus on preventive anticipations and adaptation capacities. We rely on Mc Manus et al. (2008) resilience theory to design the three steps which should define three resilience abilities to be acquired by players during a serious game session: 1) building situational awareness i.e. the ability of players to identify crises and their consequences accurately, 2) the ability to identify keystones vulnerabilities of given HEI curricula and 3) the ability to design a plan of actions given what has been learned in steps 1) and 2) in order to improve the resilience of the HEI curricula, called building adaptive capacity. For defining a context, DECART participants will provide insights about the types of crises and curricula to consider. For building adaptive capacity, we rely on what has been learned from O21 (Waldeck et al. 2024 , Waldeck et al. 2025a, 2025b) on the drivers of a resilient curriculum.

- Stage 2: "Building, Intervention, and Evaluation (BEI): the problem framing and theoretical premises adopted in stage 1 provide a platform for generating the initial design of the SG

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blocks shaped by theory. Each block corresponding to a resilience objective must be tested according both to usability and utility.

Figure 1 shows the ADR process. Action research promotes a scientific research approach and methods that aims to combine the acquisition of scientific knowledge with concrete, transformative action in the field. This is shown in Figure 1 with an arrow 1 from theory to resilience in organisations and by resilience in organisations to theory with case studies used to define the properties of a resilient organisation. The ADR program has a circumvention strategy by first performing design research by building a SG with the use of theory (arrow 3) and second using the SG for doing transformative action research in the field (arrow 4). In addition the design of the serious game is enriched by contextual factors, such as the definition of crises and curricula, provided by DECART members (arrow 5) and insights gained on actions levers promoting curriculum resilience (arrow 6). The validation process defined in stage 2 was done in different sessions with DECART members and affiliates from November 2023 to January 2025 (arrow 7). The action research part will be set up with “train the trainees” session starting in March 2025 (arrow 8).

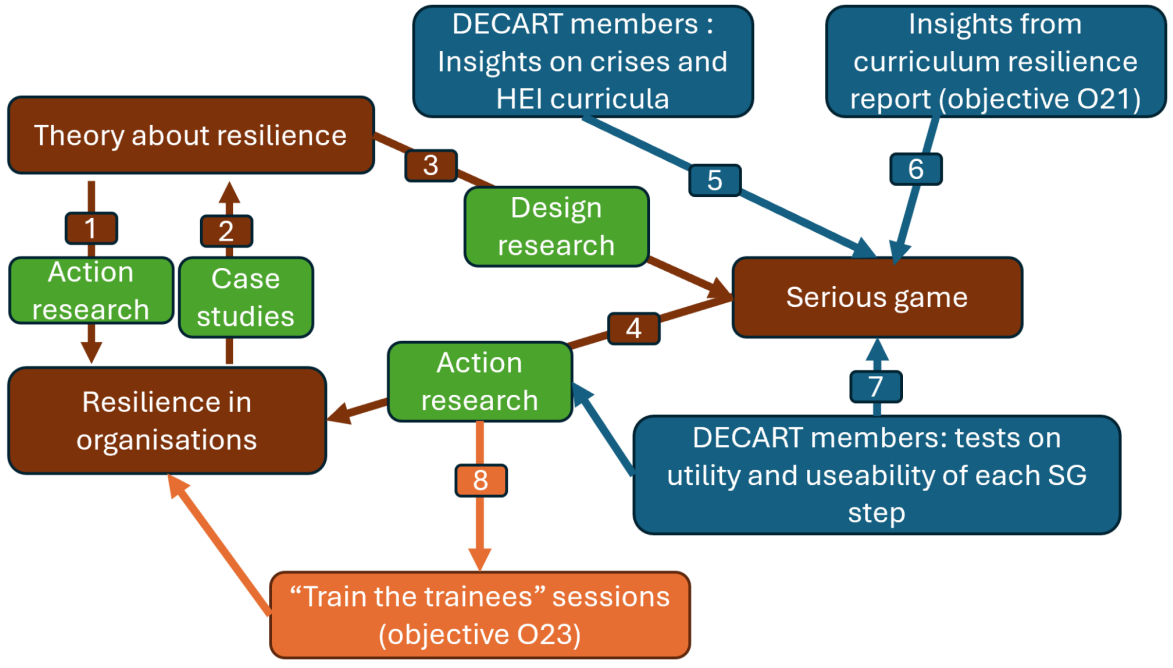

Figure 1 The Action Design Research process

A SG can transmit different resilience capacities depending on the resilience phase targeted by

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the SG (Gardner Le Gars and Waldeck 2022; Waldeck, et al. , 2023 , Gardner Le Gars and Waldeck, 2025). Typically a SG could target pre-crisis, in-crisis and post-crisis resilience capacities as shown in Figure 2. The preventive phase concerns anticipatory and preparatory actions upstream of a crisis or transition. The proactive phase arises during a crisis and requires a rapid reconfiguration of organisational functions and processes. The recovery phase focuses on learning from past disruptions to reinforce capacities and capabilities of the organisation to face future crises (Duchek, 2020; Hollnagel, 2010; Lengnick-Hall et al., 2011).

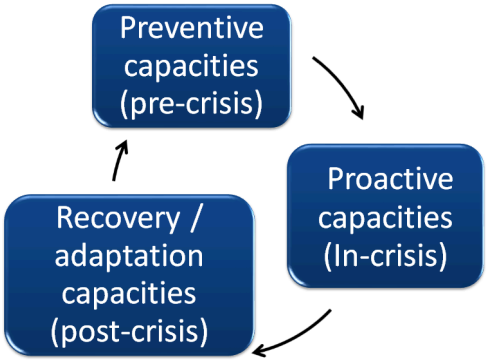

Figure 2 Types of capacities depending on the resilience phase (Gardner Le Gars & Waldeck, 2022, 2025, Waldeck et al., 2023).

In SUCRE, we focus on preventive capacities which will lead to transformative actions that can be applied in prevention of future crises (Figure 3). Each step is associated with different learning capacities and the whole SG defines a learning process associated with different instruments that can be instantiated for any real world curriculum context.

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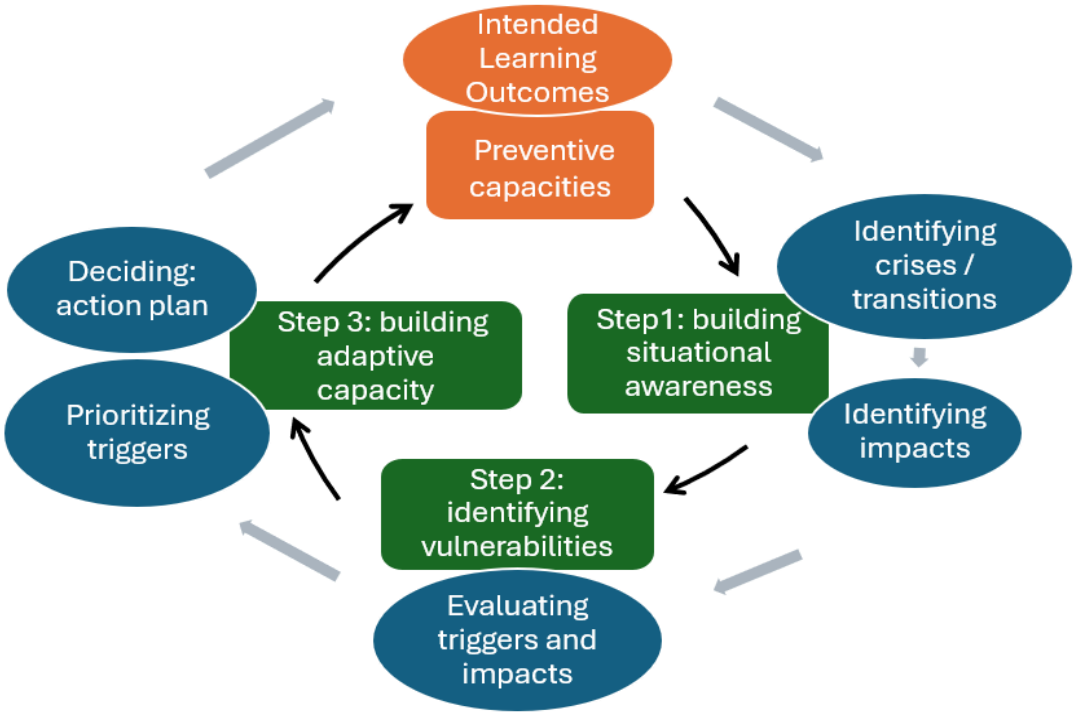

Figure 3 the implementation process of resilience capacities into SUCRE (inside loop in green) with associated learning outcomes (outside loop in blue)

More precisely, three properties for increasing the resilience of an organisation will be instantiated through three steps defining the stages to be played in SUCRE (Figure 3):

- Step 1: Building situational awareness (BSA) i.e. the ability to look forward to opportunities as well as impacts of potential trigger events which require the ability to identify crises or transitions and their consequences accurately. It requires an enhanced understanding of the trigger factors impacting a HEI, i.e. a crisis or transition scenario, and an increased awareness of the impacts of trigger events especially on the curricula through the building of a consequence scenario map linking the trigger event to different impacts. The intended learning outcomes of the serious game are to foster the capacity of players to foresee, analyze and respond to different future crises or transitions that may disrupt or impact higher education curricula. These VUCA (Volatile, uncertain, complex and ambiguous) events (Waldeck et al., 2016), called triggers in the following, generate multiple interpretations and evaluations from players, reflecting the complexity of real-world decision-making. Complexity arises from the interdependencies between a trigger and its consequences. Uncertainty stems from the challenge of determining whether the trigger's impact will be positive, negative or

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undetermined. Volatility is reflected in the rapid and unpredictable changes certain trigger events can provoke, which can create sudden disruptions in curriculum structures. Finally, ambiguity is reflected by the multiple possibilities, as well as the diverse interpretations players may have, on which consequences to consider.

- Step 2: Identifying keystones vulnerabilities (IKV) which requires pinpointing the key processes / components of an organisation which may be impacted by different trigger events. Keystones processes and components of an organisation may be defined by the following attributes. First, they are important for the organisation as their breakdown can heavily harm the functioning of the organisation (Lepousez et al., 2022). Second, they are sensitive to a given trigger event and their lack of preparedness may impede the functioning of the organisation (Lepousez et al., 2022). The consequence scenario map of step 1 may be used to identify which components and processes are affected by a given trigger event. In turn, depending on the curriculum context, a gravity impact for the HEI curriculum can be assessed for the given trigger event. At the end of step two, players must be able to evaluate the relative harm of different triggers played in step 1.

- Step 3: Adaptive capacity (AC) which requires to design an action plan based on the knowledge acquired during steps 1 and 2. Step 3 provides players with different action levers for increasing curriculum resilience. In this step , players prioritize triggers according to their impact on the curriculum and probability of occurrence. For the retained triggers, players define preemptive actions to foster resilience. The design of step 3 of SUCRE was performed thanks to the results of the DECART report R21 (Waldeck et al; 2025b).

SUCRE was first implemented on MIRO which is a collaborative platform enabling online game play by DECART members. A first printed version of SUCRE was provided in March 2025.

Workshops objective and schedules

Cooperative workshops were done for each of the three steps. Each workshop had the objective to develop the game components necessary to achieve the step objectives. In some workshops, tests were performed relative to the effectiveness of each step of achieving its objectives in terms of usability and utility. The workshop were set up according to the following schedules with the following objectives:

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- Project Meeting 3 (PM3): 28-30 November 2023, IMT Atlantique Rennes, France (2 days for WP2):
    - introduction to the general process of the SG design and presentation of the three steps to be designed.
    - DECART members started the development of the game components for step 1 “building situational awareness”. They had to imagine trigger events for HEIs, e.g. crises or transitions, by using World Economic Forum (WEF, 2023 report) crisis categories.
    - DECART members performed a first test on one game mechanism using “a consequence scenario analysis”. They were given a trigger and a list of impacts and had to build a consequence scenario map linking the trigger to different impacts.
- First online meeting, January 9, 2024. Objectives:
    - Continuing to define and rephrase trigger (event) cards with DECART members
    - Discussion on impact cards : rephrasing, labeling and adding new ones.
- 2nd online Meeting January 26, 2024: same objectives as first on-line meeting
- 3rd online meeting February 8, 2024: a test on a consequence scenario map. DECART members tested the usability of doing a consequence scenario map (Figure A2; A for Annex). An end session discussion showed that drawing a consequence scenario map may be difficult for some participants. An alternative game mechanism in the form of the table shown in Figure A1 was designed
- 1st presentation at a collaborative workshop with non DECART members (Waldeck & Rouvrais, 2024). First tests of step 1 and of a preliminary version of step 2.
- IPHE1 meeting: February 13-16, 2024, Brest , France : one day dedicated to WP2
    - Activity 1 : building situational awareness with a consequence scenarios analysis with respect to a Cyberattack: a test with DECART members and external partners
    - Activity 2 : identifying keystone vulnerabilities with the help of an id. curriculum card: a test of step 2
- 4th online meeting, April 17, 2024: test on step 1 “building situational awareness” and step 2 “identifying keystone vulnerabilities”
- 5th online meeting, May 15, 2024:
    - Objective: finish the design of curriculum identity cards (ID) which will serve to give a context to players useful for identifying vulnerabilities of a given HEI curriculum with respect to triggers.
- PM4 : June 25-27, 2024, IT Del Indonesia : two days workshop on the SG
    - Day 1 Presenting the methodology followed for the serious game and step 1 and 2 of the serious game . Playing step 1 “building situational awareness”
    - Day 2 : playing step 2 “identify keystone vulnerabilities”

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    - Collecting DECART members' feedback on steps 1 and 2 MIRO prototype .
- IPHE 2 December 9-12, 2024 , RWTH Aachen. A three day session on the three steps of the serious game SUCRE. Test and feedback on the whole SG.
- PM5 , January 28-30, 2025 UKZN, Durban: serious game Multiplier Event with play of the finalized prototype of the SG on MIRO

The design steps

STEP 1 : Building situation awareness: Resilient to what?

Objective

The objective of this step is to increase the awareness of players on the type of crises or transitions that may occur and their impacts on HEI curricula.

Process: definition of cards for step 1

Two main cards were designed:

- **Trigger event cards**: trigger event cards define the type of crises or transitions which may affect a HEI. To define trigger cards, we started with the four categories used by the World Economic Forum 2023 (WEF, 2023 report):
    - Environmental
    - Economic
    - Societal / geopolitical
    - Technological

Instruction given to DECART members : "start from WEF crises and find a more precise instantiation (what HEIs would call a crisis for themselves) for each WEF crisis "

Here are some **trigger cards** designed during the PM3 meeting and validated by participants:

- One of your major competitors is developing a new promising curricula
- Higher educational institutions will increasingly experience more competition from online providers, and open educational platform programs
- There is an increase of educational costs of public higher educational institutions relative to the private sector counterparts
- There is an increase of the perceived educational quality of public higher educational institutions relative to the private sector counterparts
- There is an increase of educational costs of private higher education institutions relative to the public sector counterparts

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- There is an increase of perceived educational quality of private higher educational institutions relative to the public sector counterparts
- Educational resources (textbooks , computers,...) and cost of living, including the rental market for students, will increase.
- There is a currency devaluation in main partner countries of your institution implying higher costs and difficulties to meet expenses for foreign students
- Repetitive extremely high temperatures will make working and studying indoors hard
- There will be an increase in pandemics and bacterial wars
- A foreign partner of your higher educational institution is affected by war and other geopolitical challenges
- There is an increase of hacker and cyber attacks

Sessions during which trigger cards were designed : PM3 (November 2023) and two online sessions in January 2024)

Process: definition of impact cards

With trigger event cards, players become aware of a range of crises which may impact HEI curricula. For a given trigger event card, different components of the HEI curriculum may be impacted. The objective of this step “building situational awareness” is precisely to assess the elements of the HEI curriculum which are at risk under the trigger.

- The **impact cards** were designed by using: i) different sources from the literature, mainly Berthoud *et al.* (2021) and Lattuca and Stark’s (2009) theoretical results on impacts of crises on curricula; ii) elements from the DECART WP1 on Curriculum canvas (table 1) were added. Below, some designed impacts cards:
  - Number of students
  - Number of national students
  - Number of international students
  - Number of apprenticeships
  - Students' attitudes towards study
  - Interpersonal skills
  - Students' competences upon completion of higher education studies
  - Physical and mental health of students
  - Students' social backgrounds
  - Study location
  - Students' geographical origin
  - Cost of education

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- Assessment methods
- Purpose of education

	Components of the harmonized curriculum
1	*Main goals and learning outcomes of the program*
2	*Entry requirements for students entering the program.*
3	*Structure and content of the program, including the sequence of courses, content and learning activities and length of program.*
4	*Teaching methods and learning in the program, including the role of the teacher and teaching material.*
5	*Location of teaching and learning in the program, including being on campus or not, or a hybrid combination.*
6	*Teaching and learning of interpersonal skills in the program, including communication and teamwork.*
7	*Assessment methods in the program.*
8	*Language of instruction in the program.*
9	*Ethno- and sociographic aspects of the program, including diversity and equity.*

Table 1 The nine components of the DECART harmonized curriculum from WP1
https://hub.imt-atlantique.fr/decart/wp-content/uploads/2024/05/WP1-R12-report-ALL.pdf

Process: definition of boards of step 1

DECART members tested the usability of doing a consequence scenario map starting from PM3 (november 2023). The 3rd online meeting 8 February 2024 revealed that drawing a map (Figures 5, 6 and A2) was a difficult exercise to perform for some players and an alternative game mechanism in the form of a table board was proposed (Figures 7 and A1).
We asked the participants of IPHE2 meeting at RWHT (December 2024) to choose between the two board options for step 1. We proposed three alternatives: i) using a table board (Figure A1) or ii) drawing a scenario map (Figures 6 and A2) or iii) both in combination

- Using only the board “Triggers and impacts”: 2
- Drawing directly a scenario map : 2
- Both in combination : 5

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We decided therefore to keep both boards as an option for players. The section “Feedback on SUCRE building process” shows additional feedback from DECART participants on steps 1, 2 and 3.

Summary of step 1

Table 2 summarizes the design process for step 1 “ building situational awareness” .

Theory used in step 1	**DECART members’’ design actions**	**Action part: use in SG play**	**Possible game mechanisms**	**Final design results**
Designing trigger events with the use of WEF Crisis categories (WEF, 2023 report)	The following instructions were given to DECART members during PM3 (nov 2023): “start from WEF crises and find a more precise instantiation (what HEIs would call a crisis for themselves) of each crisis. Fig. 4 shows an example: for a WEF crisis ‘Natural disasters and extreme weather events” participants came up, e.g., with “Earthquakes and eruptions , students are not able to use onsite facilities”. 3 sessions of design: PM3 and two online sessions in january 2024	Build situational awareness (fig. 3) with players building a Consequence scenario map (fig. 6) or filling in the “trigger and impacts board” (fig. 7)	Players choose a trigger event card from the desk of trigger cards OR players design their own trigger cards	39 trigger cards in 3 categories: "Competition and economy", “Environment” and Technology. 

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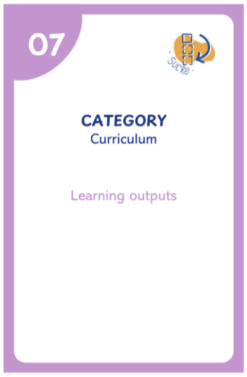
Designing impacts cards: use of literature results Berthoud *et al*. (2021), Lattuca and Stark (2009) use DECART Curriculum canvas from R11 report	Validation by DECART members of the different impact cards Test with DECART members of step 1 during 5 sessions from february 2024 to january 2025. Test with external partners during a workshop (Rochebrune 2024) in January 2024	Build situational awareness (fig. 3) with players building a Consequence scenario map (fig. 6) or filling in the "trigger and impacts board" (fig. 7)	Players choose different impact cards which are affected by the trigger. Empty cards for creating their own impact card. Players discuss how the chosen impacts are linked together and affect specific elements of the curriculum (either positively or negatively or neutral) (fig. 7) An advanced technique: draw a conceptual map linking event card to different chosen impact cards (fig. 6)	There are 44 impact cards with 4 categories: "Curriculum", "University conditions", "Staff" and "Students".  Boards are shown in Figures (A1 and A2)

Table 2 The design process for step 1 " building situational awareness"

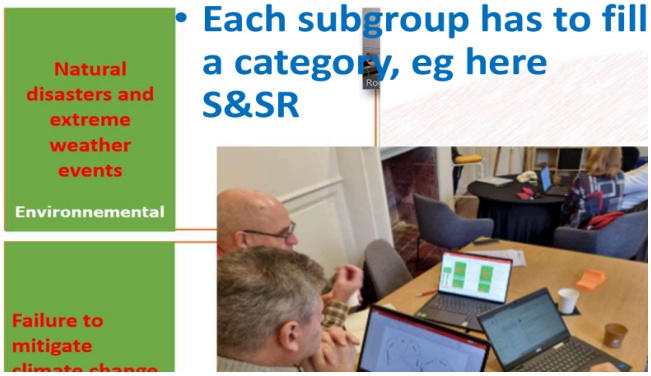


Figure 4 An example of a WEF category instantiated by participants into trigger events during PM3 meeting

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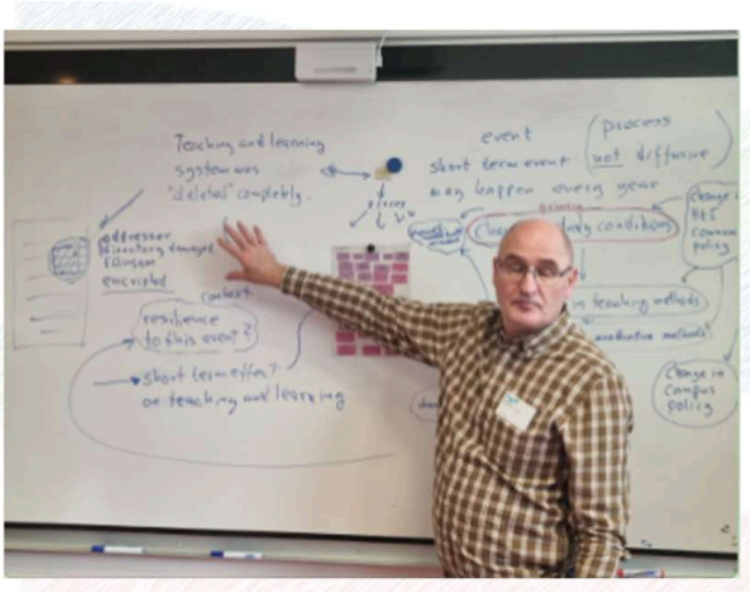

Figure 5 Presentation of a consequence scenario analysis during IPHE1 meeting , Brest 2024

Figures 6 and 7 show an example with MIRO of output which can be produced during the game play.

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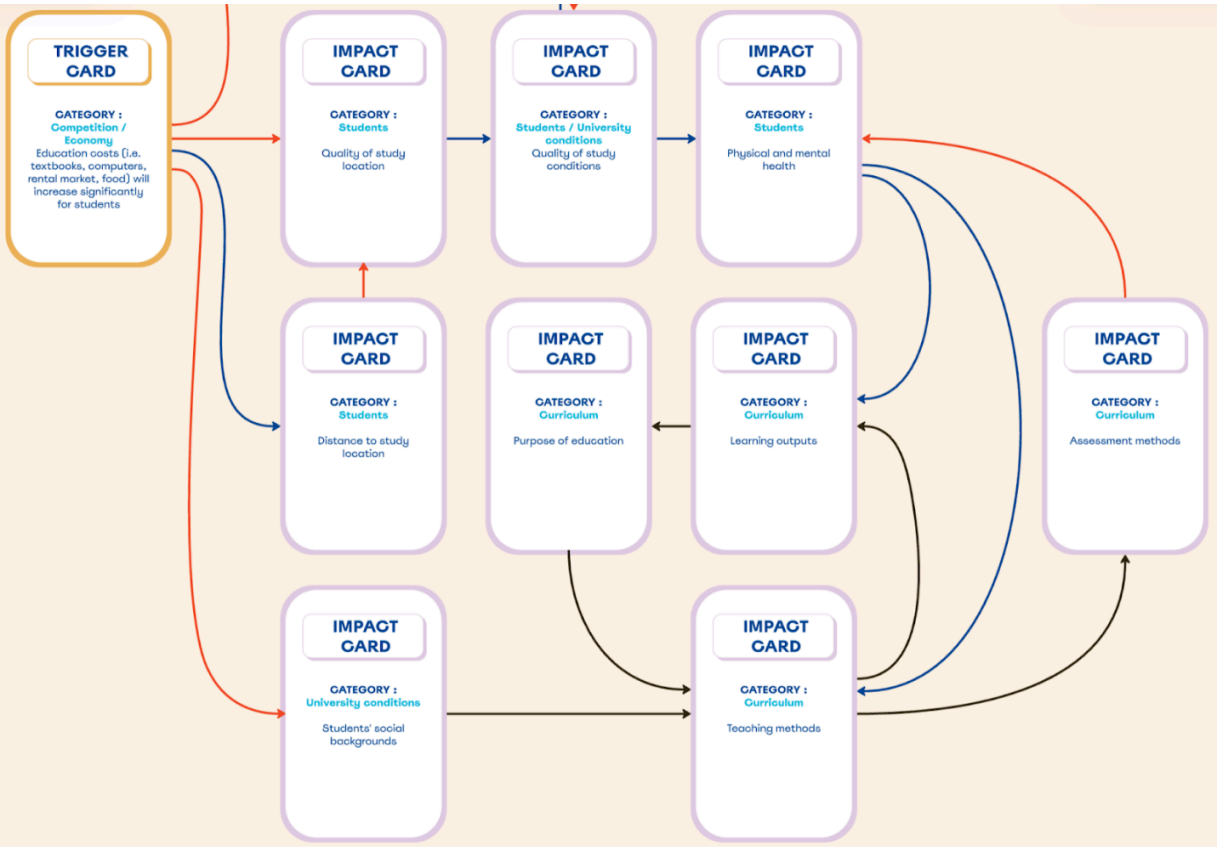

Figure 6 An example of a consequence scenario map showing the direct (impact cards) and cascading effects from one VUCA event (trigger card). The color of each arrow indicates if the effect is positive, negative or indeterminate.

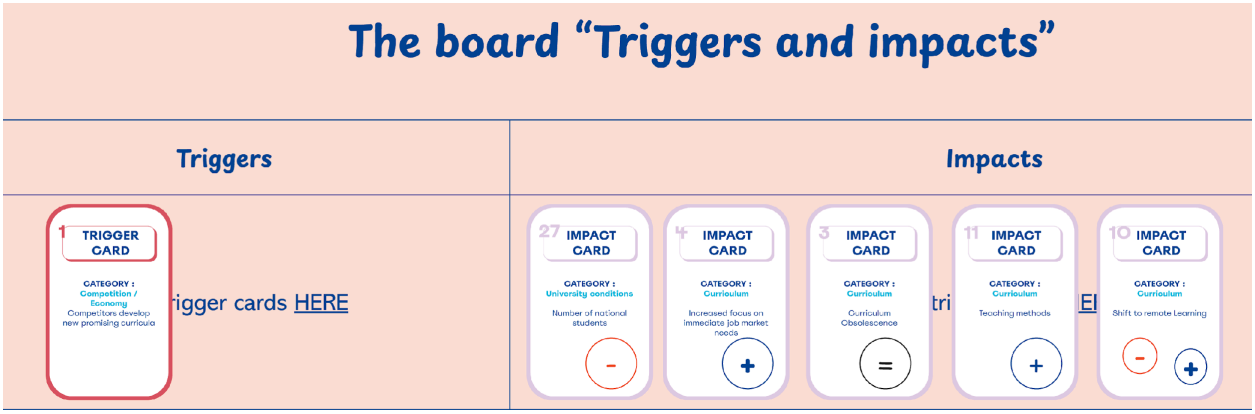

Figure 7 A snapshot of the use of board "Triggers and impacts"

Figure 7 is an example played by participants during PM5 (UKZN, January 2025) of using the simplified game mechanism with the board "Triggers and impacts", i.e. not drawing a

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consequence scenario map (Figure 6); the signs indicates if the global effect of the trigger on the impact is positive, negative or indeterminate (possibly neutral i.e. neither negative nor positive).

STEP 2 : resilience of what

Objective

For step 2, “Identifying keystones vulnerabilities”: the design challenge is to provide players with **a HEI context** representing both a curriculum and HEI that could exist in reality. The objective of these **context cards**, called **curriculum id. cards**, is that players may be able to identify their vulnerabilities (sensitivity) and degree of preparedness to a given trigger.
More specifically, **curriculum id. cards** will serve to assess

- which components or processes are at high stake for the HEI curriculum (independently of triggers)
- Which processes / components are sensitive to a trigger given the scenario analysis developed in step 1.
- Which components or processes are not well prepared for the given crisis

Process: definition of an id. canvas and Id curriculum cards

DECART members were provided with a curriculum id. canvas showing different dimensions of a curriculum context and HEI context of the curriculum. The canvas was designed along the structure given in Figure 8 and the complete canvas is shown in Figures A3 and A4. The curriculum id. canvas has two objectives: i) during the research design process DECART members used it to create identity cards for SUCRE representing a typical curriculum from their own HEI. DECART members provided their curriculum id. cards from July 2024 to November 2024. Three others curriculum id. cards were generated by ChatGPT thanks to the curriculum id. canvas frame. Figure 9 shows a curriculum id. card called “An engineering degree in industry and digital technologies” created by the IMT Atlantique team ; ii) during the action research phase, players of SUCRE can use the curriculum id. canvas to design their own curriculum.

The curriculum id. card purpose during a game play is to identify strengths and vulnerabilities of a HEI curriculum. The curriculum id. card is not a precise or a complete description of a HEI curriculum. The id. curriculum cards were nevertheless designed such as to have an appropriate tradeoff between accuracy, i.e. having the minimal number of elements necessary for performing the objectives of step 2, and length of the description.

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Process: definition of step 2 “the resilience board”

Design research: to identify the vulnerability of a HEI curriculum to different triggers (played in step 1) three questions must be answered (Figure 10):

- What are the key processes / components for the HEI curriculum. These are identified thanks to the curriculum id. card.
- How many components are affected by the trigger? This is deduced from step 1. How important are these components for the HEI? This is deduced thanks to the curriculum id. card
- Is the HEI prepared to face the trigger ? This is deduced thanks to the curriculum id. card.

Sensitivity (to the trigger) is defined by the number and importance of affected components. Sensitivity and preparedness are the two dimensions defining the resilience board (Figures A5 and 11) of step 2 (Lepousez et al. 2022)

Action research in step 2: during a game play for a given trigger, a team

1. identifies the type of components (students, staff, balance sheet, elements of curriculum,…) affected by the trigger event (with the help of step1 results**).**
2. identifies the ones which are important for the university given the Curriculum id. card
3. Evaluates the sensitivity of the curriculum to a given trigger measured by the number of components affected by the crisis and their importance for the university
4. Thanks to the Curriculum id. card, makes an approximate statement about the degree of preparedness of the university to a given trigger
5. evaluate the resilience of the university to the trigger by placing the trigger card on the "Resilience board " (Figure 11). We define “Low resilience” to be equivalent to “vulnerable to the trigger”. Low resilience is when the curriculum is sensitive to the trigger and the HEI is not prepared to face the trigger.

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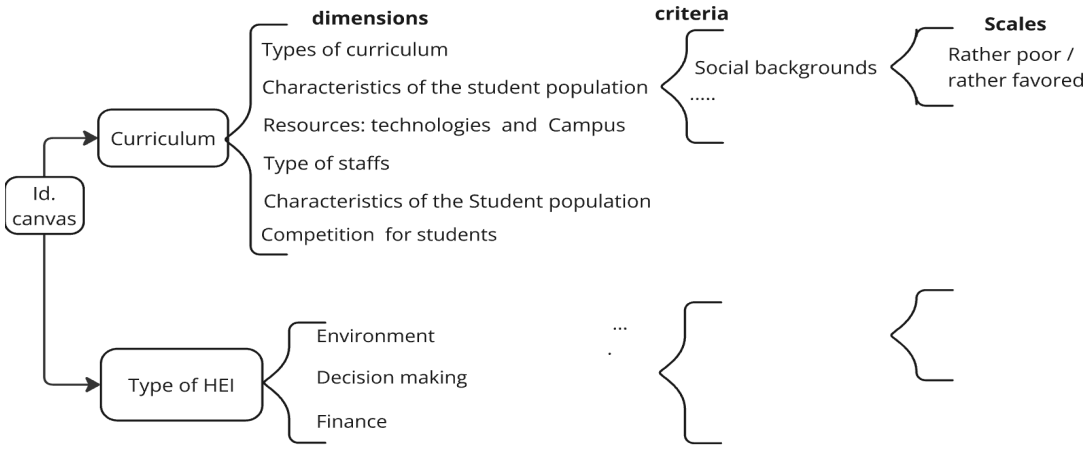
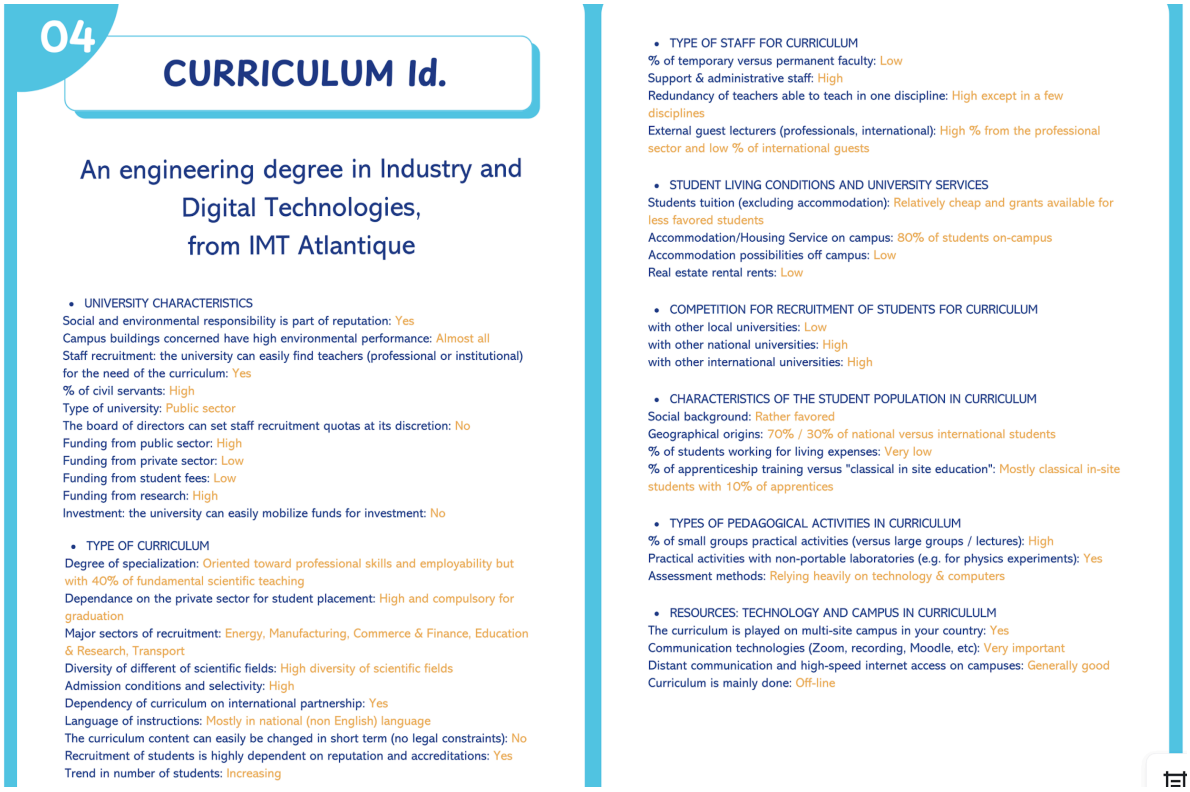


Figure 8 The structure of the canvas



04

CURRICULUM Id.

An engineering degree in Industry and Digital Technologies, from IMT Atlantique

- UNIVERSITY CHARACTERISTICS

Social and environmental responsibility is part of reputation: Yes
Campus buildings concerned have high environmental performance: Almost all
Staff recruitment: the university can easily find teachers (professional or institutional) for the need of the curriculum: Yes
% of civil servants: High
Type of university: Public sector
The board of directors can set staff recruitment quotas at its discretion: No
Funding from public sector: High
Funding from private sector: Low
Funding from student fees: Low
Funding from research: High
Investment: the university can easily mobilize funds for investment: No

- TYPE OF CURRICULUM

Degree of specialization: Oriented toward professional skills and employability but with 40% of fundamental scientific teaching
Dependance on the private sector for student placement: High and compulsory for graduation
Major sectors of recruitment: Energy, Manufacturing, Commerce & Finance, Education & Research, Transport
Diversity of different of scientific fields: High diversity of scientific fields
Admission conditions and selectivity: High
Dependency of curriculum on international partnership: Yes
Language of instructions: Mostly in national (non English) language
The curriculum content can easily be changed in short term (no legal constraints): No
Recruitment of students is highly dependent on reputation and accreditations: Yes
Trend in number of students: Increasing

- TYPE OF STAFF FOR CURRICULUM

% of temporary versus permanent faculty: Low
Support & administrative staff: High
Redundancy of teachers able to teach in one discipline: High except in a few disciplines
External guest lecturers (professionals, international): High % from the professional sector and low % of international guests

- STUDENT LIVING CONDITIONS AND UNIVERSITY SERVICES

Students tuition (excluding accommodation): Relatively cheap and grants available for less favored students
Accommodation/Housing Service on campus: 80% of students on-campus
Accommodation possibilities off campus: Low
Real estate rental rents: Low

- COMPETITION FOR RECRUITMENT OF STUDENTS FOR CURRICULUM

with other local universities: Low
with other national universities: High
with other international universities: High

- CHARACTERISTICS OF THE STUDENT POPULATION IN CURRICULUM

Social background: Rather favored
Geographical origins: 70% / 30% of national versus international students
% of students working for living expenses: Very low
% of apprenticeship training versus "classical in site education": Mostly classical in-site students with 10% of apprentices

- TYPES OF PEDAGOGICAL ACTIVITIES IN CURRICULUM

% of small groups practical activities (versus large groups / lectures): High
Practical activities with non-portable laboratories (e.g. for physics experiments): Yes
Assessment methods: Relying heavily on technology & computers

- RESOURCES: TECHNOLOGY AND CAMPUS IN CURRICULULM

The curriculum is played on multi-site campus in your country: Yes
Communication technologies (Zoom, recording, Moodle, etc): Very important
Distant communication and high-speed internet access on campuses: Generally good
Curriculum is mainly done: Off-line

Figure 9 The curriculum id. card from IMT Atlantique

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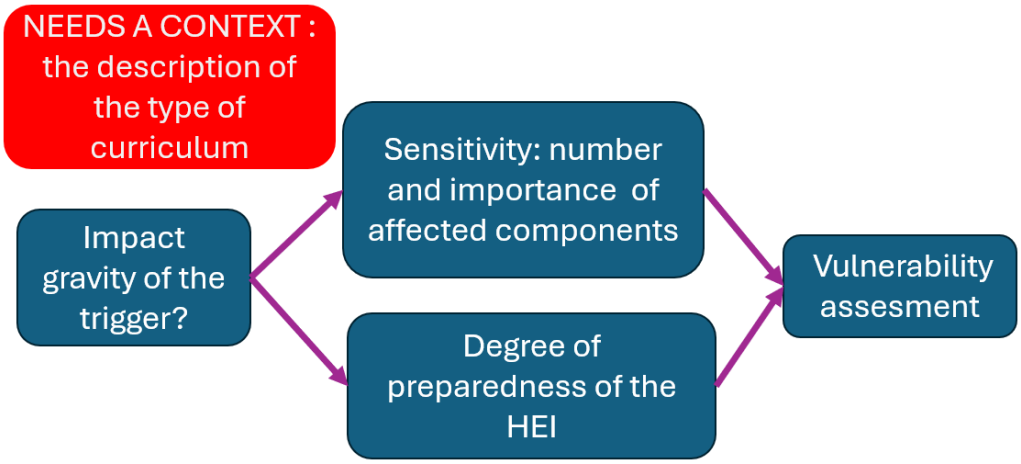

Figure 10 The process for assessing resilience

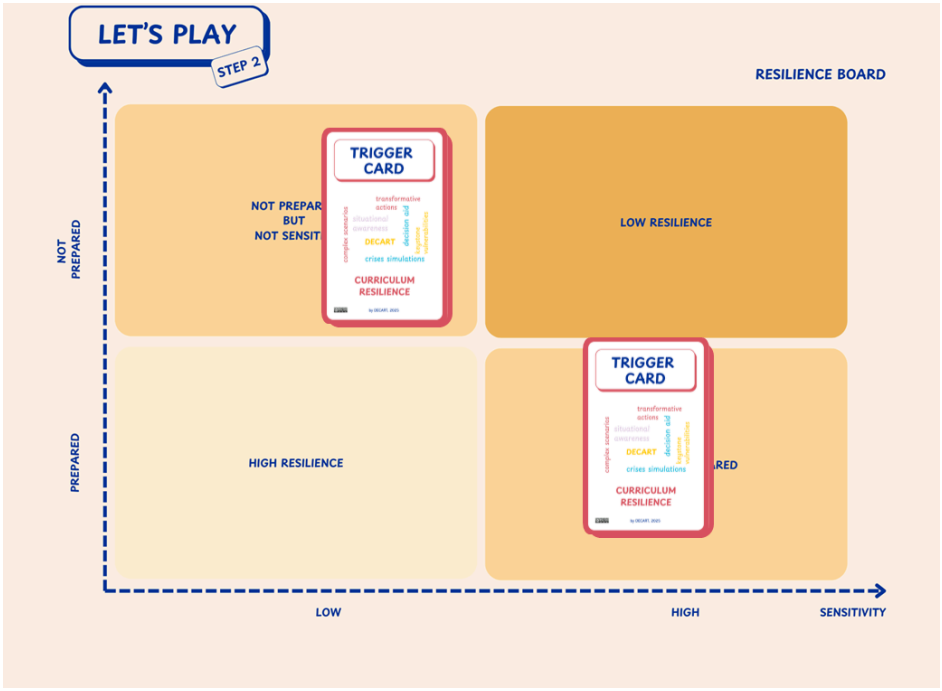

Figure 11 : an example of the use of step 2

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Summary of step 2

Theory used in step 2	**DECART members' design actions**	**Action part: use in SG play**	**Possible game mechanisms**	**Final design results**
The structure of Figure 8 and building of Id canvas was inspired by the CTI report (2024). Additional descriptive items were inserted for the needs of the game play	They designed a curriculum of their own HEI with use of the curriculum id. canvas (figs. A3 & A4)	Each curriculum id. card represents a context enabling players to identify keystones vulnerabilities. The curriculum id. canvas serves to create from scratch a new curriculum describing the players' HEI context. It will be used in a decision aid context	**Basic scenario** - different teams play with the same curriculum id card, each team representing therefore the same curriculum. In this situation, all teams will cooperate together to increase the resilience of the curriculum - different teams choose a different curriculum id. card. In this case teams need not to be connected together and each tries to deal with its own curriculum and triggers. A debrief session may serve to share experience of what has been learned **Advanced scenario** : thanks to the curriculum id. canvas, each team creates its own curriculum id. card representing a curriculum the team is interested in.	Figures 9 , A3 and A4

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Lepousez et al., 2022		A resilience board for measuring the resilience of the curriculum to the trigger thanks to the curriculum id. card: two dimensions - Sensitivity measured by the number of affected components and their importance for the university - the degree of preparedness of the university to a given trigger	Evaluate the resilience of the university to the trigger by placing the trigger card on the "Resilience board (see Report R23, Waldeck *et al*. 2025c)	Figure 11

Table 3 The design process for step 2 " Identifying keystone vulnerabilities"

STEP 3 : Building adaptive capacity: resilience how?

Objective

For step 3 "building adaptive capacity", the design challenge is to give players tools so that they can i) prioritize the triggers to focus on, depending on what has been learned in steps 1 and 2 , and ii) define an action plan, i.e. building adaptive capacity, for being more resilient in the case of occurrence of one of the trigger events.

Process: prioritizing the triggers

The "vulnerability board" (Figures A5 and 12) serves to prioritize the trigger to focus on. The board relies on the "resilience board" of step 2. The 4 panels of the "resilience board" are projected on the vertical axis with three levels : low resilience (top right panel of the "resilience board"), sensitive or not prepared (top left and bottom right panels of the "resilience board") and high resilience (bottom left panel). The horizontal axis represents the frequency of occurrence of the event according to three levels : " not probable, happens every 50 years", "likely, happens every 10 years" and "highly probable, happens within 5 years". Note that for the two last items of the scale we are in the domain of risk management which in principle should be mastered by any organisation. But resilience is also the capacity to face unforeseen events (Boin and Lodge, 2016, Waldeck et al., 2025b) often events that happen on a longer time scale like the covid crisis.

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Use of the "vulnerability board" (Figure 12): players place their triggers cards played in steps 1 and 2 on the board. Triggers placed on the boxes "low resilience" should be given priority and among those, the ones with high probability of appearance on top priority.

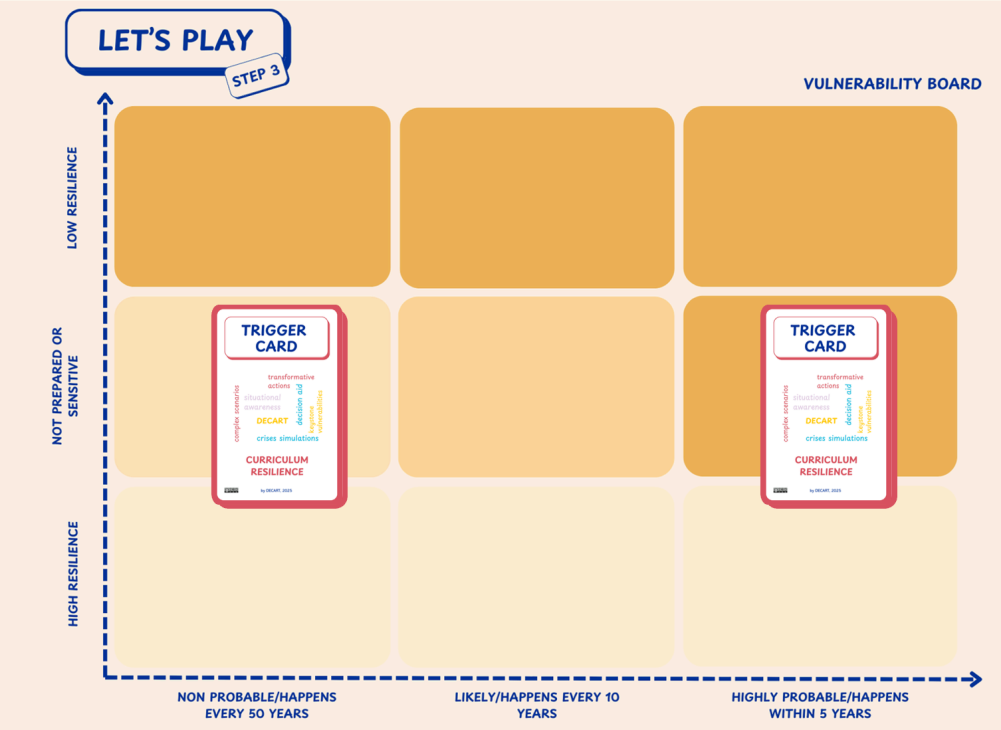

Figure 12 Placing triggers on the vulnerability board

Process: definition of action cards

Design phase: several drivers of curriculum resilience are stated in report R21 (Waldeck et al, 2025b). The report is a "book of knowledge" about the drivers of a resilient curriculum combining results from i) a lit. review focusing on higher education curriculum resilience and ii) from a questionnaire sent to DECART members and affiliates. The drivers of curriculum resilience are instantiated as action (cards) shown in table 4.

Action phase and use during the game play: action cards are used to resolve a particular problem created by a trigger played in step 1. For example, the action card "Redundancy in teaching methods" would be a card that could be used to increase the type of teaching methods used in a specific curriculum. Increasing the type of teaching methods could for example be useful in a breakdown where traditional teaching would be out of reach.

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Curriculum dimension	Action
Teaching and learning	Redundancy in teaching methods
	Redundancy in learning methods
	Adaptable modes of teaching
	Adaptable modes of learning
	Adjusting educational methods based on technological innovations
	Adjusting educational methods based on economic intelligence and on external changes (market probing, surveys,...)
	Redundancy in media or transmission channels
	Adaptable delivery modes
	Redundancy of assessment methods
	Adaptable assessment methods
	Well- balanced assessment methods
	Redundancy in scientific fields addressing a given topic
	Teaching of core and scientific knowledge and of fundamentals that endures
	Focus on students' competency development
Curriculum structure	Readability (by students) of the different expectations and objectives
	Comprehensive overview of curriculum structure (building blocks and interrelation between building blocks)
	Comprehensive overview of curriculum resources
	Comprehensive overview of curriculum teaching and learning strategies
	Comprehensive overview of curriculum assessments
	Constructive alignment is ensured, i.e., curriculum content aligns to learning objectives
	Flexibility : many elective courses, offered at different times during the program
	Flexibility : courses can be exchanged and adapted
	Modularity: multiple and different learning paths to achieve the learning objectives

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Curriculum dimension	Action
Curriculum Context	Adjusting educational content based on economic intelligence and on external changes (market probing, surveys,...)
	Adjusting educational content based on technological innovations
	Integration of real-world experiences and hands-on experience
	Adaptability: curriculum is determined by real-world challenges
Quality culture	Environment that promotes experimentation and collaboration among different stakeholders
	Monitoring: continuous evaluation of the curriculum by different perspectives and stakeholders
	Collaboration: involvement of all relevant stakeholders (e.g. students, teachers, industry,…)
	Integration of diverse and different perspectives and backgrounds
	Teachers cultivating a mindset of continuous learning and adaptation to external changes
	Diverse expertise and backgrounds of teachers
	Redundancy in terms of interchangeable teachers
	Agility: combine, re-use and redeploy existing resources in new ways to deal with emergent issues and meet new needs
	organisational slack: readily available and rapidly mobilizable, redundant material resources
	organisational slack: readily available and rapidly mobilizable, redundant human resources
	Human resources: identify the level and disponibility of a specific resource (human or material)
	Material resources: identify the level and disponibility of a specific resource
	Situational awareness of interdependencies: identifying roles and responsibilities
	Breaking silo mentality: foster collaboration
	Students' individual resilience training

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Curriculum dimension	Action
	Staff's individual resilience training
	create your own action card

Table 4 Action cards (from Waldeck et al., 2025b)

Process: definition of the solution board

The solution board is composed of the following columns shown in Figure 13:

- Identified problems from step 1 and 2 that should be coped with. Typically a trigger card should be placed on this column but to have a better description, players can complete it with impact cards that have been identified in step 1.
- Proposed solutions : players choose or create action cards in order to resolve the identified problem.
- "Advanced scenario" i.e. for a decision aid objective: identify stakeholders: i) concerned by the deployment of the solution ; ii) impacted by the solution.
- "Advanced scenario": identify the expected impacts of the solutions on the curriculum and HEI
- "Advanced scenario": discuss the "ease in feasibility": expected up to resolution, costs, constraints

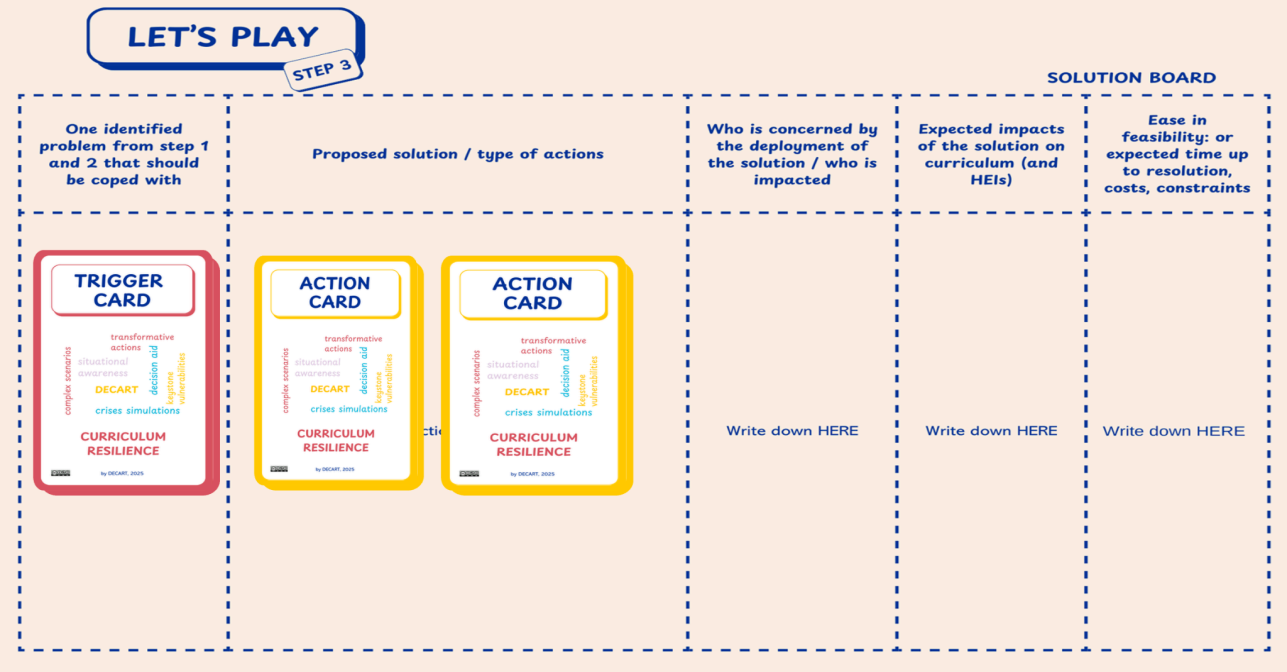

Figure 13 The solution board

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Summary of step 3

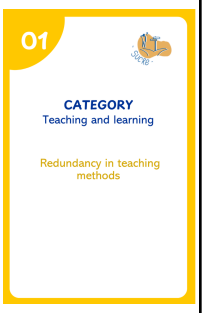
Theory used in step 3	DECART members' design actions	Action part: use of SG play	Possible game mechanisms	Final design results
		Vulnerability board: used to order triggers	Players place the triggers played in step 1 and 2 on the board. A discussion on the triggers to retain for the solution phase is based on the level of resilience and occurrence urgency	Figure 12
Curriculum resilience drivers (Waldeck et al. 2025b)		Action cards serve to "build adaptive capacity" i.e. develop solutions to identified problems from steps 1 and 2		
		The "solution board" defines: - The problem to be resolved, - type of solution , - who is involved, - expected impact of the solution - feasibility of the solution	Players place problematic triggers and action cards on the board.	Figure 13

Table 5 The design process for step 1 " building adaptive capacity"

Feedback on SUCRE building process

During the whole design process DECART members provided many feedbacks at different levels:

- Insights on the game elements and game mechanisms

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- Insights on the design
- Evaluation of the different steps of SUCRE

Two main evaluations of the game were performed and are presented in this report:

- One evaluation was done during PM4 meeting at IT Del in june 2024 after the completion of step 2
- The second one was at completion of the whole game and was done during IPHE2 meeting at RWHT in december 2024
- The complete game was also played during PM5 at UKZN in January 2025, both with DECART and external members with informal feedback .

Feedback from the PM4 meeting IT Del

PM4 meeting took place in June 2024 at IT Del in Indonesia. Two days were dedicated to the play of step 1 and 2 (step 3 was not in its final shape).
The game was played on MIRO with 4 groups on site and 1 group online (Figure 17) and the 18 players had on MIRO different explanation panels .
One panel was called “resilience principles and cards”. The panel was meant to give players a description on how the different resilience concepts were linked to the different elements of the game (cards and boards). An example of the two first resilience principles given to players is shown in Figure 14.

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Figure 14 Resilience principles and cards from the MIRO board in june 2024 and used for PM4 meeting at IT Del

A second panel is called “Let’s play game play and rules”. The objective of the panel “Let’s play game play and rules” (Figure 15) was to help players to go through the game play at their own pace; ideally the panel was meant to be a set of instructions making a game master useless.

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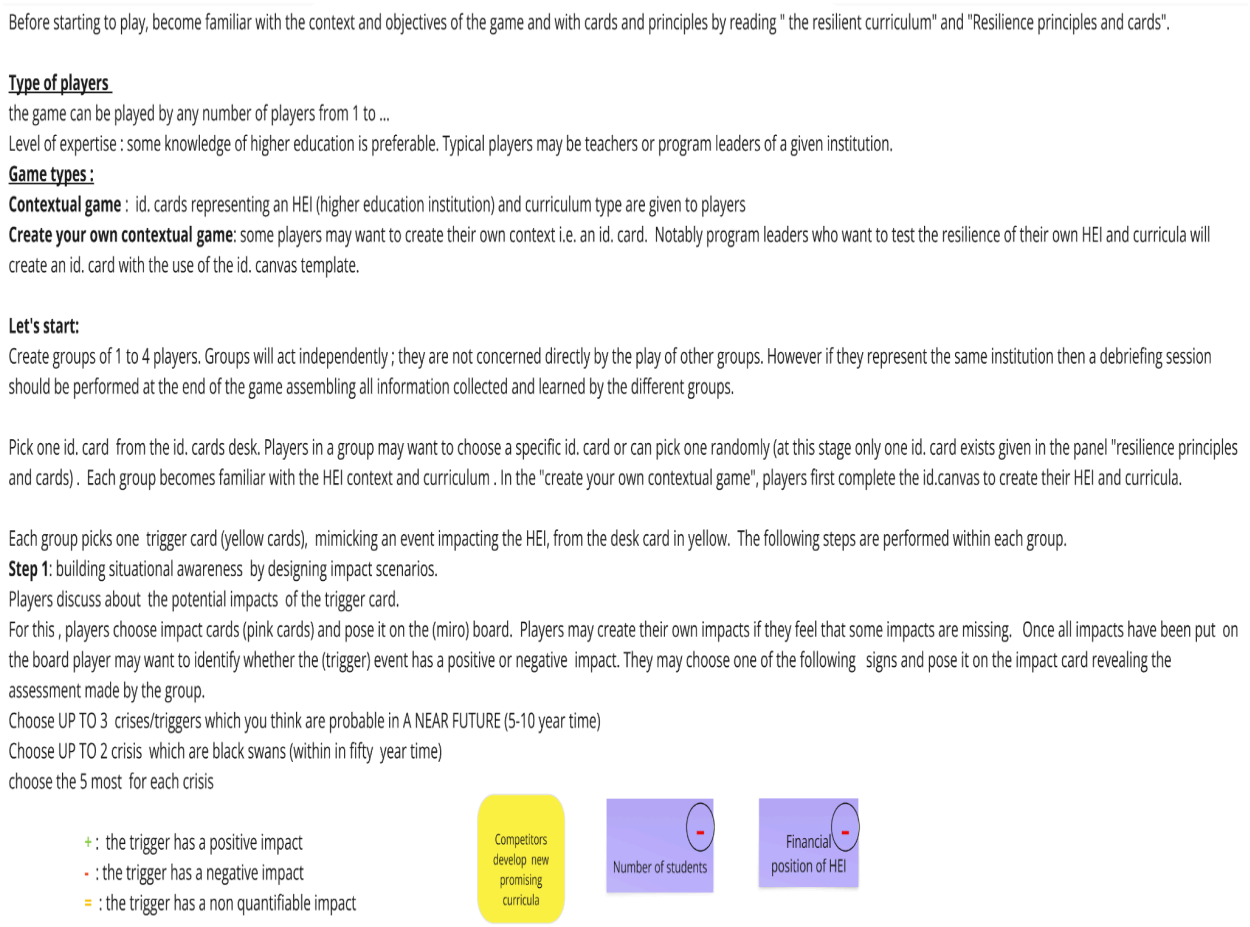

Figure 15 Extract of the panel (from MIRO june 2024) " Let's play game play and rules"

The two day session ended with a discussion and survey gathering the players' feedback on different elements of the game.

The following questions were asked in the survey on a likert scale (strongly disagree, disagree Neither agree nor disagree , agree , strongly agree):

- your feeling is that: The game is appropriately designed to improve the resilience of HEIs and their curricula
- your feeling is that: Step 1 about consequence scenarios helps players to model and understand a VUCA situation
- your feeling is that: Step 2 helps players to identify their vulnerabilities
- your feeling is that: Steps 2 and 3[1] helps players to prioritize the trigger events to focus on

[1] Step 3 was in an embryonary form in June 2024, notably action cards were not defined and step 3 was mainly meant to be a debrief session at that time where players had to design their own action plan

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- your feeling is that: all together, the game has the potential to help players to think about and create transformative actions that will improve the resilience capacity of their curriculum and HEI
- your feeling is that: After having read "principles and cards" I better understand the resilience concepts and their use in the serious game
- your feeling is that: After having read the frame "Let' play " specifying the rules of the game, players could play the game without a game master

Some open questions were asked to the 18 participants who have played step 1 and 2 of SUCRE during the two day session
How did you find the panel "principles and cards"
Your suggestion, if any, of improvements for the panel "principles and cards"
How did you find the panel "let's play"
Your suggestion, if any, of improvements for the panel "let's play"
After having played the game, your suggestion, if any, of improvements of the id. Canvas.

Figure 16 shows the quantitative feedback from the PM4 session. Overall only the assertion that " players could play the game without a game master" lacked a strong agreement.

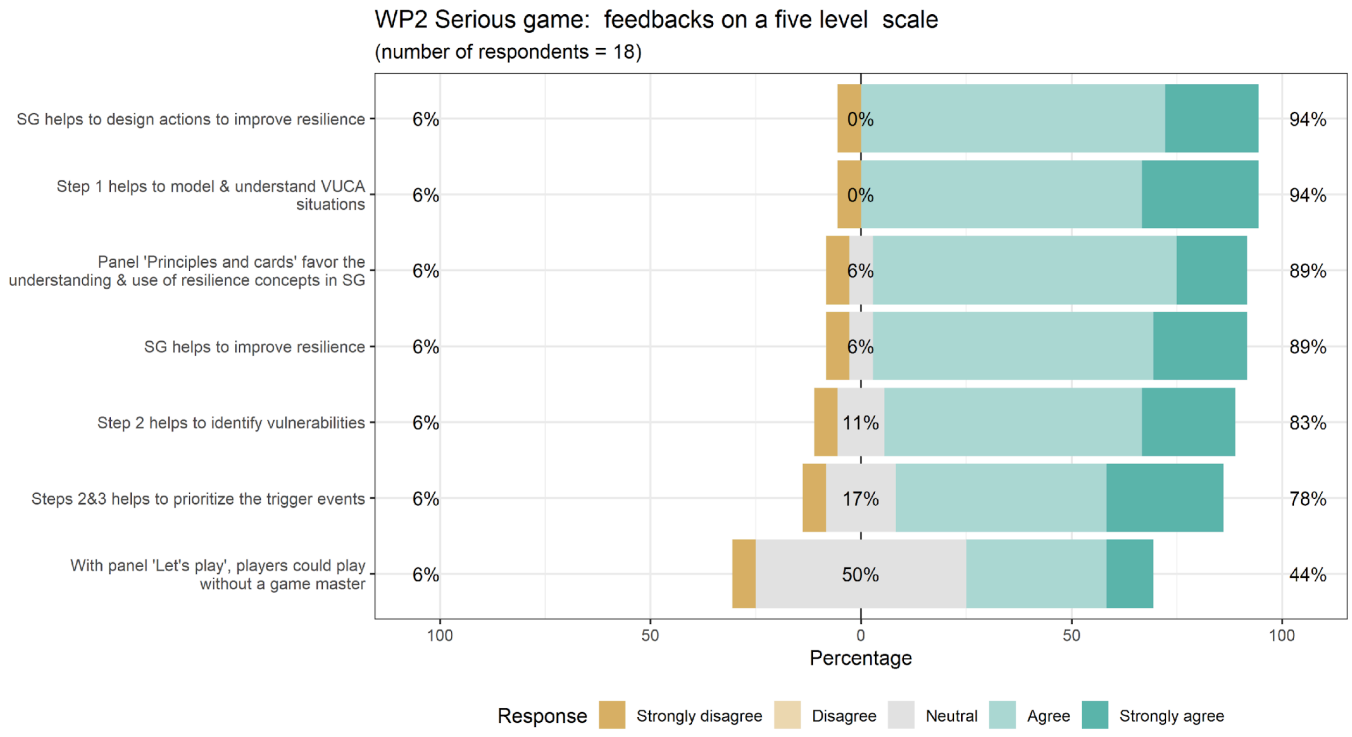

Figure 16 Quantitative feedback from PM4

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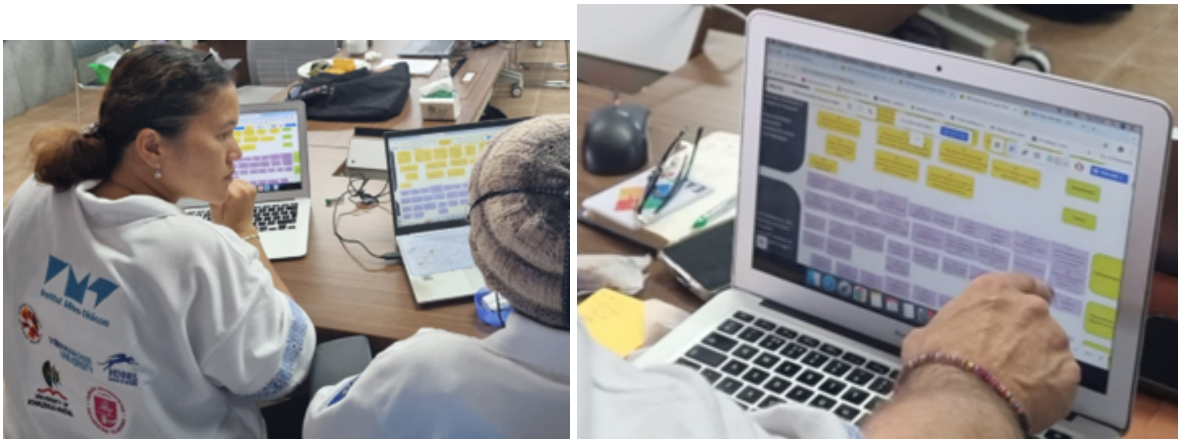

Figure 17 Two players discussion during a MIRO session at IT Del

The five groups had also a debriefing session where they had to discuss and make a presentation on the following items:

- Elements of the principles and game play that could be improved
- Elements of the principles and game play that work fine
- Improvement suggestions

We present a summary of the main findings (both by questionnaire and group feedbacks):

- **How did you find the panel "principles and cards"**
  - It was clear/useful/important/good … (*no negative comments*[2]) .
  - From Miro / from instructions
- **Your suggestion, if any, of improvements for the panel "principles and cards"**
  - needs time / some items that can be clarified. Add more principles cards/ Briefly describe the steps of the game again in a few sentences, what has to be done first, what has to be done second / Put the title above the cards so then the game player can notice easily the group of event triggering cards and impact cards
  - Improve visualization (for MIRO)

- **How did you find the panel "let's play"**
  - Clear / informative /good/easy to navigate / helped us do the game although more explanation might be needed from the game leader.
  - a little bit shorter
  - A little confusing, we jumped the HEI card (curriculum Id card) and went straight to trigger and impact cards

[2] In italic , observations from the authors of the report (not from the participants to the survey)

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- **Your suggestion, if any, of improvements for the panel "let's play"**
  - Similar to previous suggestion, the instruction could be clearer if put in different app (or made more distinctive from playing board)
  - Design and visualization (MIRO)
  - The HEI ID (curriculum Id card) could be given a more descriptive label (e.g. HEI characteristics), and visual flow diagram of sequence would help
  - Some of the statement in the id.cards (curriculum ID card) do not support the impacts that are chosen by the players
  - It is good to be accompanied by example, not only for step-1 but also for step-2, step-3, and step-4 (now step 3)

Feedback from the IPHE 2 meeting, RWTH

Following PM4 meeting IT Del feedback, many improvements were made. We recruited from September 2024 on to April 2025, an apprentice doing her studies as a graphic designer. The MIRO version of SUCRE was improved and a material version of the game was designed. We first played the complete MIRO version of the game at RWTH Germany in December 2024. The evaluations of the complete game are presented in Figures 18, 19, 20 below.

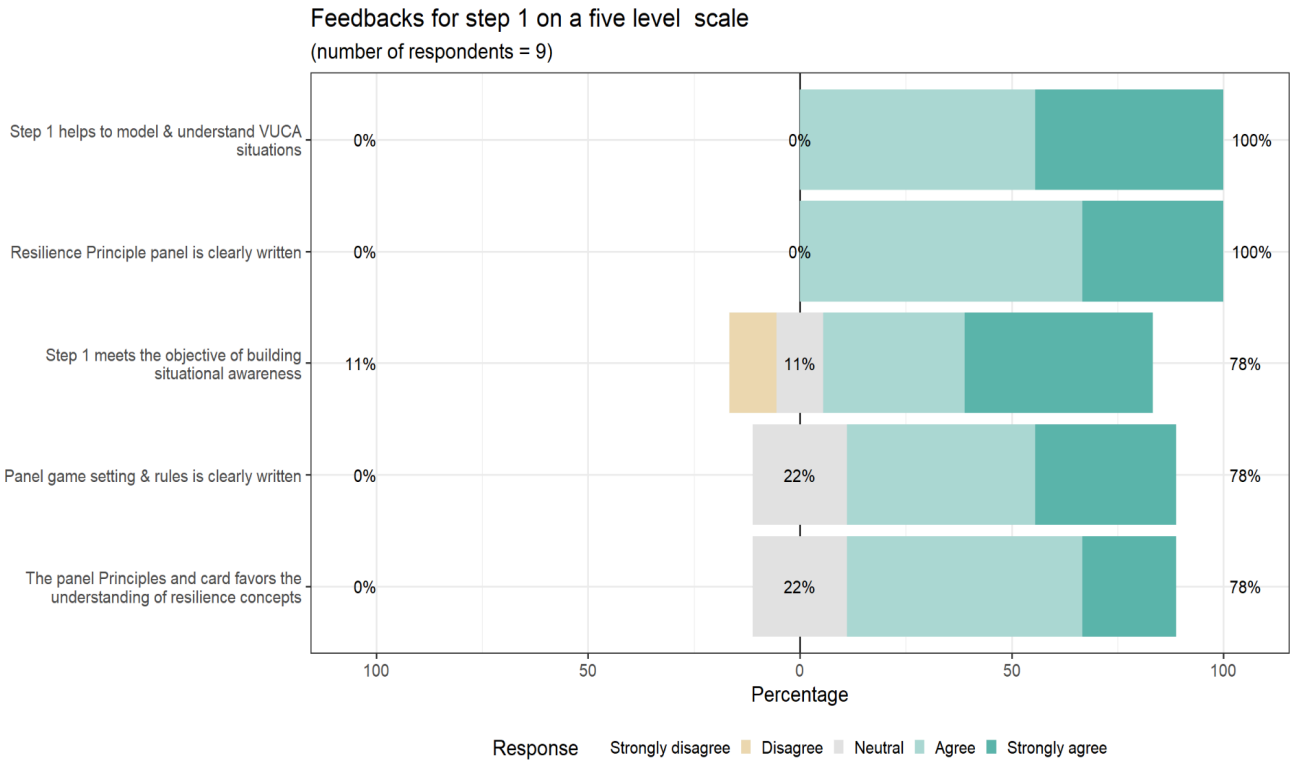

Figure 18 Feedback step 1, RWTH Aachen December 2024

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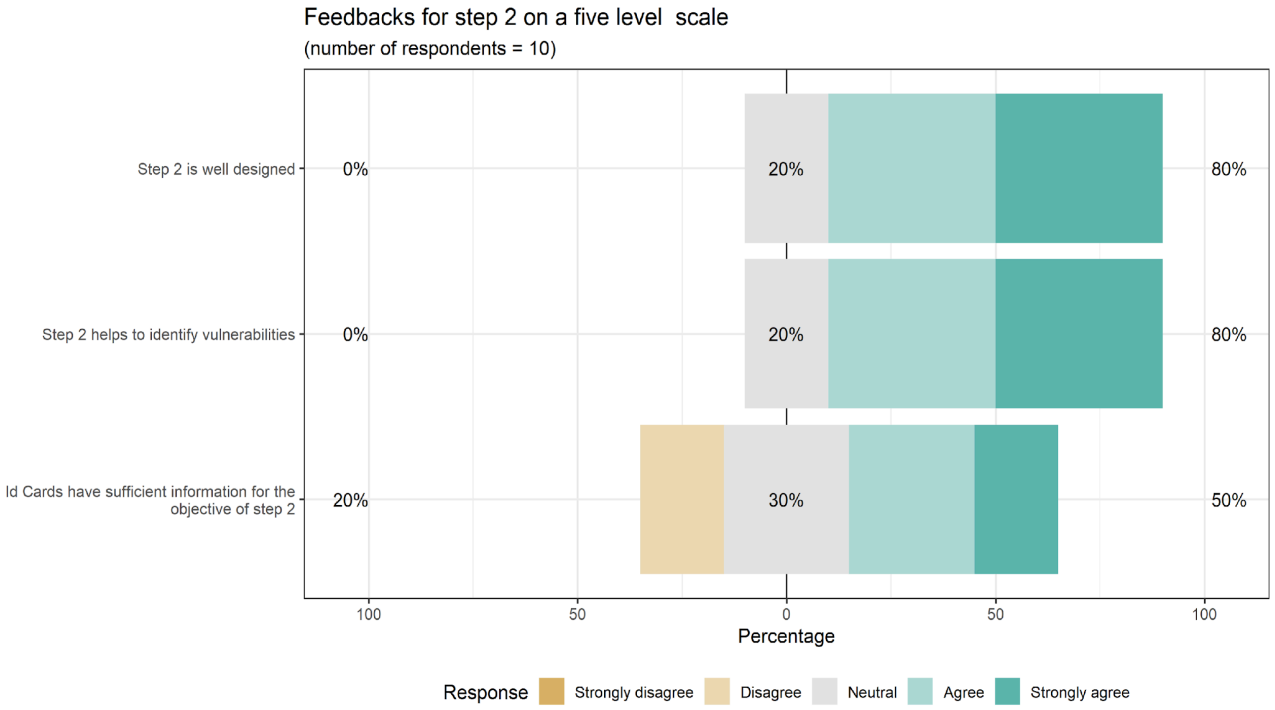

Figure 19 Feedback step 2, RWTH Aachen December 2024

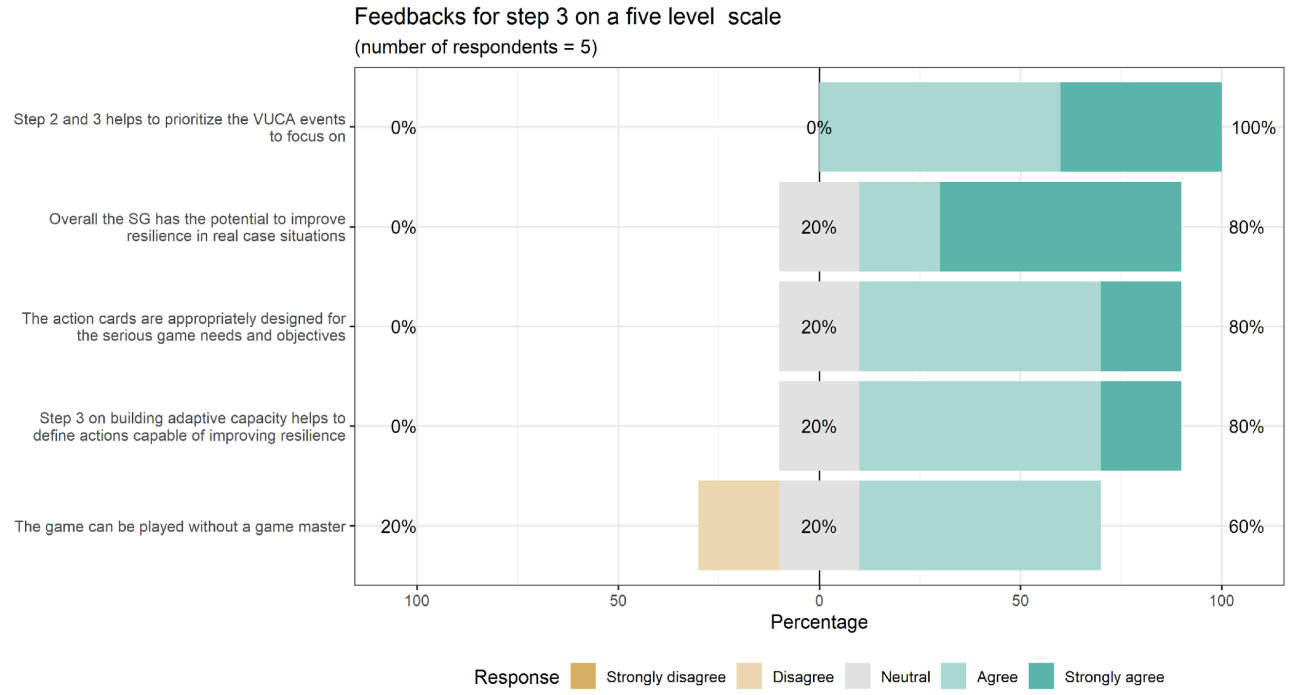

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Figure 20 Feedback step 3, RWTH Aachen December 2024

Conclusion

SUCRE is not only a serious game but also an operational decision tool as it reveals a process for instantiating resilience into a real context. The complete serious game prototype and train the trainees sessions to facilitate continued use of the serious game materials is shown in report R23. It will consist of a presentation of the different elements of the serious game, resulting detailed game play elements (including storylines, administrative procedures, actions, timelines,...) principles, and the use of a video explaining rules and principles of the game. The game will be made available through both the use of a MIRO interface and a board game.

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Annex: Additional game material

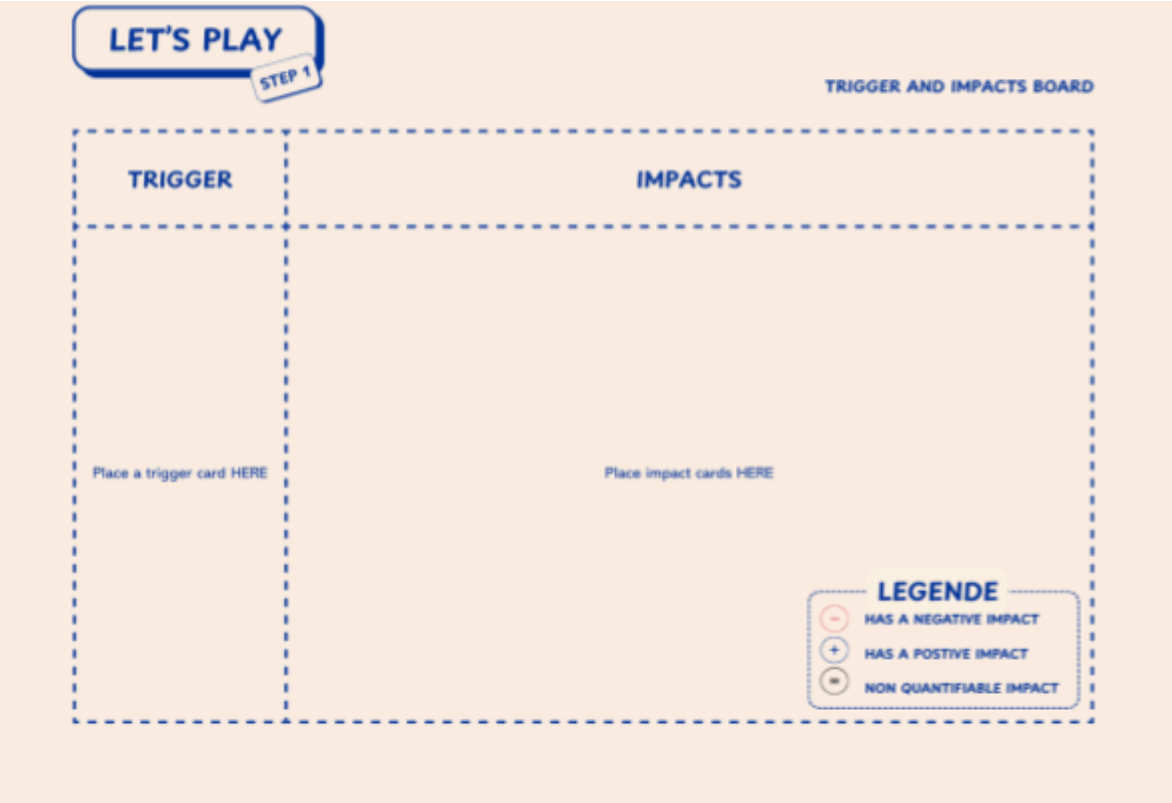

Figure A1 The board "Trigger and impacts" of step 1

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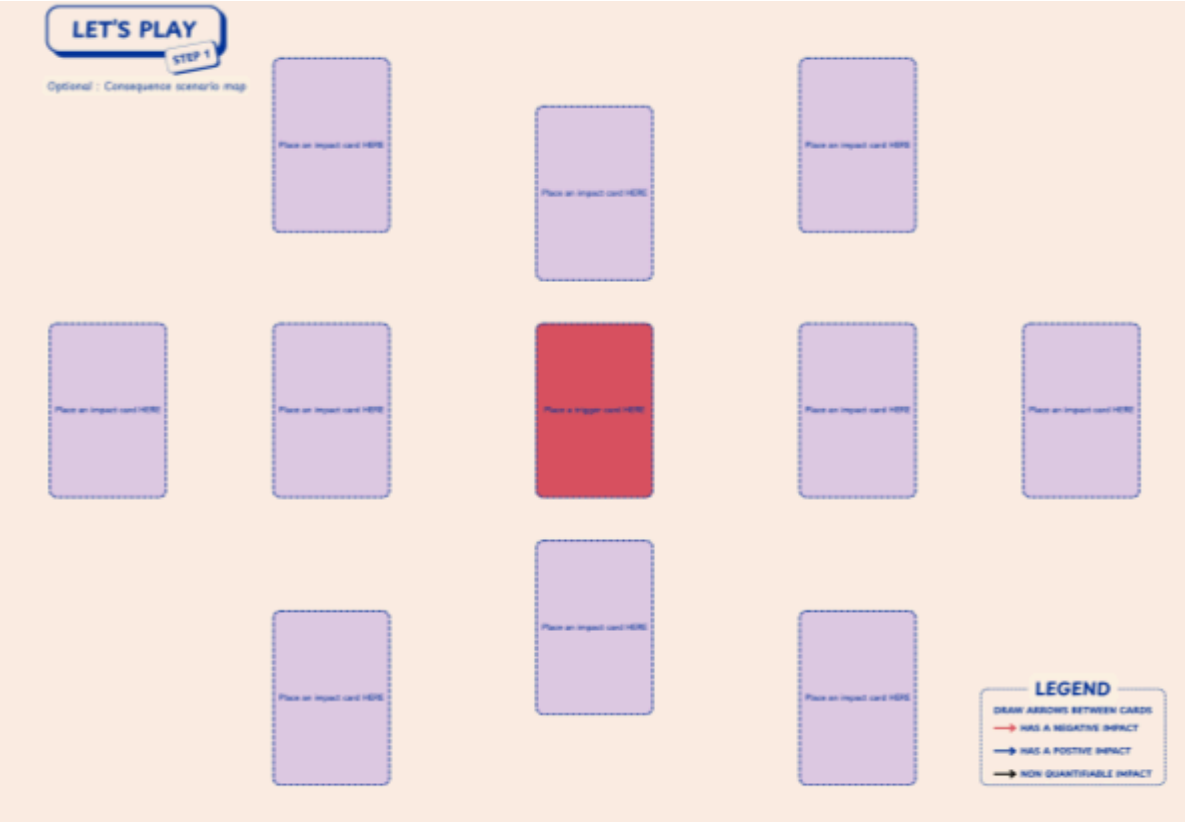

Figure A2 An alternative board for step 1: a consequence scenario map

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Figure A3 The recto of the id. Canvas card

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Figure A4 The verso of the id. Canvas card

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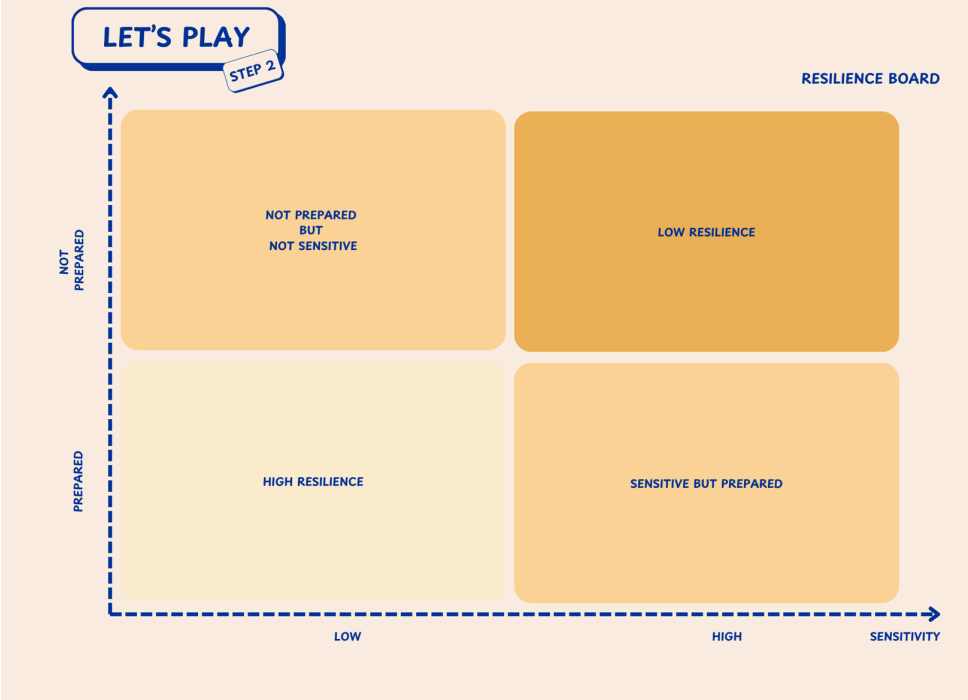

Figure A5 The "resilience board" of step 2

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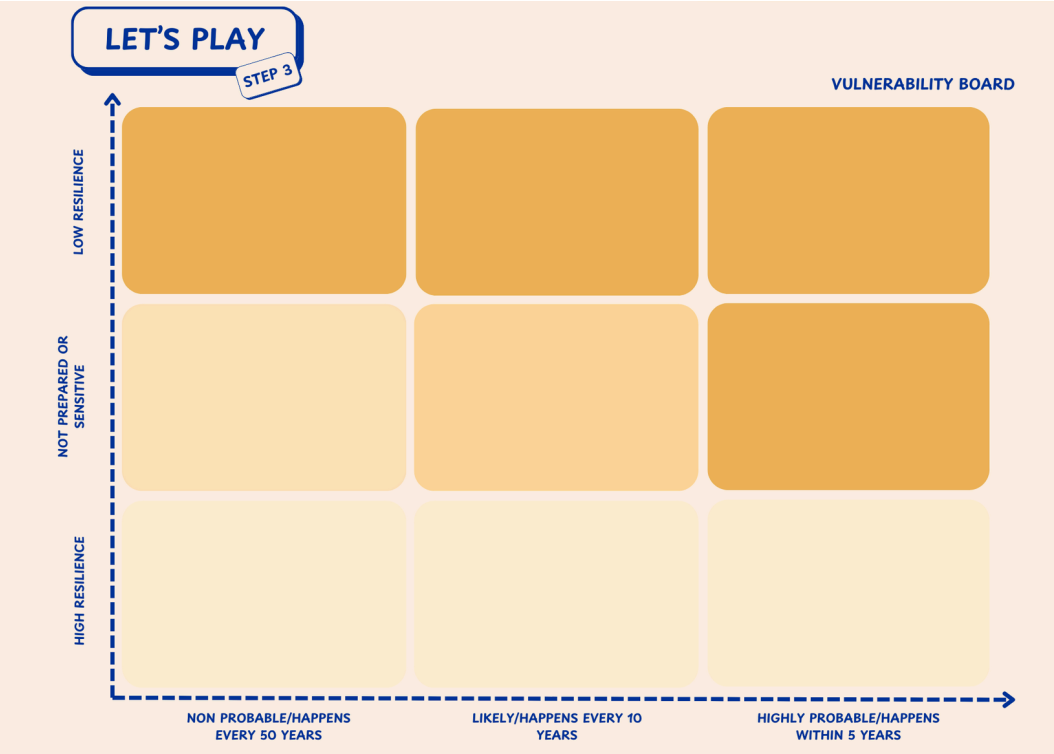

Figure A6 The "vulnerability board" used to prioritize the trigger events

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Acknowledgments & contributors

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The contribution in this report has benefited from previous work of one of the authors with Joanne Gardner le Gars, to whom he extends his warmest thanks

Contributors

DECART project is an inter-institutional collaboration which includes a process in which parties (individuals or institutions) work together to achieve project goals. DECART knowledge is shared through regular open discussion during plenary project' and ZOOM meetings from April 2023. All DECART partners share values and ideologies around the project objectives. This DECART report, as project WP2 deliverable, is a joint authorship: several authors have participated and whose contributions cannot be separated one from the other. The property of this document content is the one of all the corresponding authors.

Lead Organisation	WP2 Coordinator: IMTA
Participating Organisations	European partners: IMTA, RSB, RU, RWTH, and VU African partner: UKZN ASEAN partner: ITD

More precisely, there is generally a 'leader' of the collaboration for this report:

- At IMT Atlantique, Roger Waldeck was responsible of this report writing,

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A collaborative project can not exist without the active implication on several stakeholders in the partnership. Several members actively collaborated for this first DECART report, formally as subsection producers or during informal discussion during project meetings or join staff training events. They include in country alphabetical order:

- In France:
  - Nathalie Chelin, Gilles Jacovetti, Siegfried Rouvrais, and Roger Waldeck from IMT Atlantique,
    - Chantal Puren and Coraline Lozac'h for the project administrative purposes
  - Joanne Gardner Legars from Rennes School of Business
- In Germany:
  - Carmen Leicht, Clara Lemke, and Ann-Kristin Winkens from RWTH
- In Iceland:
  - Haraldur Audunsson and Asrun Mathhiasdottir from Reykjavik University
- In Indonesia:
  - Arlinta Barus, Inggriani Liem, Sari Silalahi, Eka Stephani Sinambela, and Tahan Somkid from IT Del
- In Lithuania:
  - Valentina Diagene, Vladimiras Dolgopolovas, Egle Jasute and Asta Meškauskienė from Vilnius University,
- In South Africa:
  - Angela James, MacDonald Kanyangale, and Cecile Gerwel Proches from University of KwaZulu-Natal.

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