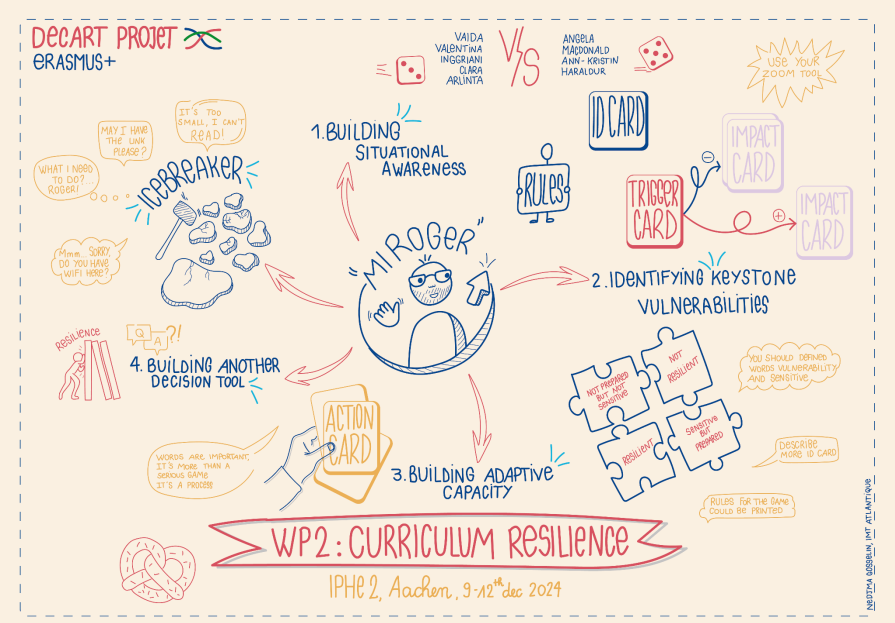
DECART: Designing Higher Education Curricula for Agility, Resilience & Transformation

DECART WP2: Curriculum Resilience

Deliverable R21

version 2.0, march 2025



The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.
www.decartproject.eu

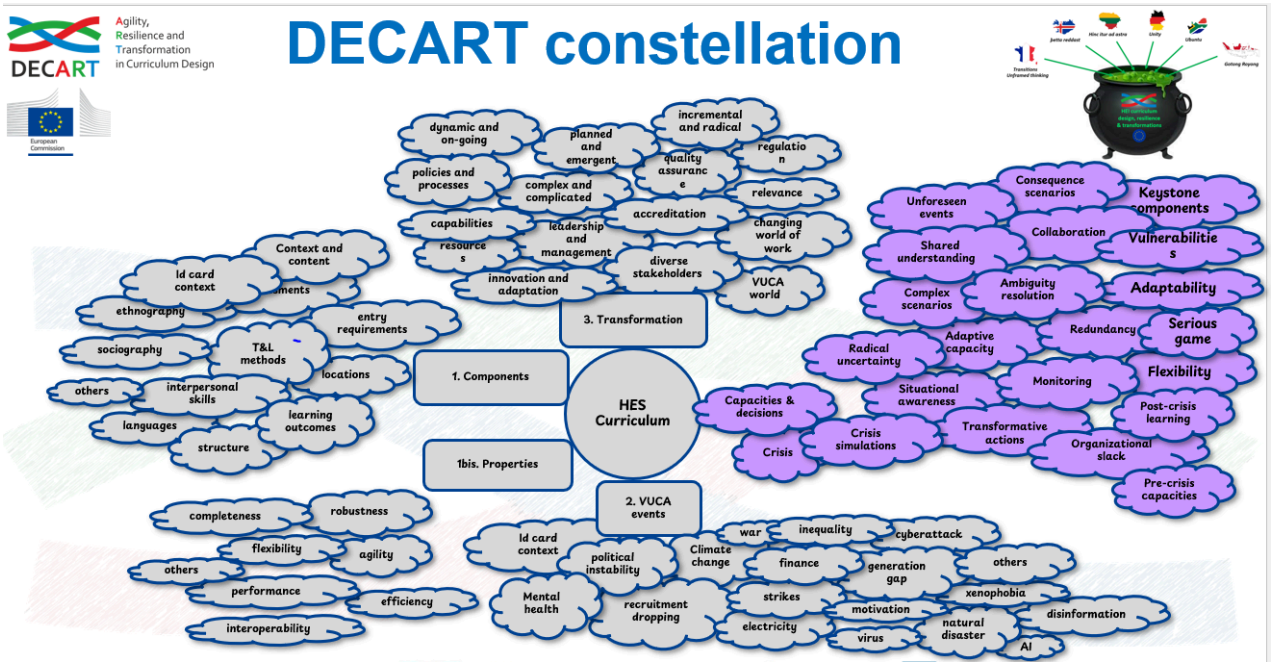
Preface

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 and 2 from South Africa and Asia.

This report presents the results of Objective O21: “to share insights on how program and curricula design impact specific dimensions of resilience“. It results in a “book of knowledge” (R21) about the drivers of resilient curriculum by combining i) a review of the literature focusing on higher education and curriculum resilience and ii) results from a questionnaire sent to DECART members and affiliates. This book of knowledge is organized as follows:

1. A short literature review on organizational resilience
2. A short literature review on resilience in Higher Education Institutions (HEIs) and HEIs curricula
3. Feedbacks from a questionnaire DECART survey sent out in april 2024 on curriculum resilience properties

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.



The DECART components - here focusing on Resilience.

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Partners in DECART

The DECART project is co-funded with support from the European Commission, a project under the Erasmus+ program (KA220-HED - cooperation partnerships in Higher Education, number 2022-1-FR01-KA220-HED-000087657). This document reflects only the views of the authors. The Commission is not responsible for any use that may be made of the information contained therein. This document and its annexes in their latest versions are available from the DECART website (www.decartproject.eu).

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
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

Copyrights

This report has been produced thanks to the co-funding scheme of the Erasmus+ European Programme, project number 2022-1-FR01-KA220-HED-000087657. To cite this material use:

- Title: Curriculum Resilience, the DECART project (Designing higher Education Curricula for Agility, Resilience & Transformation)
- Version 2.0, March 2025
- Authors:
    - Roger Waldeck, IMT Atlantique, Brest, France, leading author
    - Joanne Gardner Le Gars (non project member), Rennes, France
    - Ann-Kristin Winkens, RWTH , Germany
    - Haraldur Audunsson, Reykjavik University, Iceland
    - Siegfried Rouvrais, IMT Atlantique, Brest, France
    - Arlinta Barus, IT Del, IT Del, Laguboti, Toba, Indonesia
    - Valentina Dagiene, Vilnius University, Vilnius, Lithuania
    - Cecile Gerwel, University of KwaZulu-Natal, Durban, South Africa
    - et al.

Additional collaborators and reviewers are listed at the end of this document, 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, RU, RWTH and VU African partner: UKZN ASEAN partner: ITD

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Table of Contents

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Introduction to objective O21

Education is the cornerstone of future prosperity (Yue & Zhao, 2020) and the education sector harbors the potential to catalyze sustainable innovation and growth (Aver, Fošner, & Alfirević, 2021; Yue & Zhao, 2020). Indeed, higher education has played a key role in globalization as students are increasingly able to benefit from universal, supranational learning environments and outcomes that favor the emergence of shared global cultural frames and identities (Schofer, Ramirez & Meyer, 2021). Although HEIs and in particular, renowned universities, demonstrate high levels of resilience, which has enabled them to adapt their culture, functions and structure over extended periods of time (Scott, 2006), the heterogenous HEI sector, is nested within an increasingly challenging and volatile economic context (Pekkola et al., 2021). Therefore, in today's Volatile, Uncertain, Complex, Ambiguous (VUCA) (Waldeck et al., 2019) world, preparing for the unknown is fundamental and HEIs must cultivate resilience to anticipate, cope and adapt with different types of adversity. The term resilience is traceable to the Latin word *resilire*, meaning to spring back, or rebound from adversity or after a setback. In contrast to traditional risk management, resilience is based on the idea that unforeseeable events need to be anticipated and prepared for by following a proactive and not only a reactive approach (Park et al 2013). This confers the capacity to rapidly adapt to disruptions and to ensure the continuity of essential functions and operations (Walker and Salt, 2012). It is also argued that a resilience perspective prepares organizations to exploit crises as vectors of transformative change. A crisis thus becomes an opportunity to shift to an improved post-crisis trajectory as opposed to a perturbation that must be endured and overcome (Lengnick-Hall, and Beck,2016). Higher Education Institution (HEI) resilience can be defined in the same way as the capacity to absorb, cope with and adapt to both intrinsic and extrinsic challenging circumstances and to rapidly reconfigure and restore services rendered to students, academic and industrial research partners (Karlsen and Pritchard, 2014). It is also crucial to envision resilience beyond a reconfiguration that merely restores, but also which innovates to conceive new and better services for educational stakeholders (Denyer, 2017). In common with the more general organizational resilience (OR) construct in business contexts, HEI resilience is thus contingent upon the development of capacities that confer the ability to bounce back or forward to a superior level from both intrinsic and extrinsic shocks (Karlsen and Pritchard, 2014).

When HEIs face crises such as cybertacks (Piovezan, 2025), personnel are called upon to rapidly develop and deploy innovative solutions to maintain the integrity of teaching services. As HEIs often possess highly diverse employee and student populations, transboundary type crisis events, which can provoke campus closures (Chow et al., 2020), are particularly challenging. Such crises are often unforeseen (Boin and Lodge, 2016), require rapid and radical changes to operations and thus demand the immediate mobilization of HEIs latent resilience capacities. Both organizational and human capacities must be prepared in advance

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

of the crisis. We specifically address what these organizational and human properties could be in the case of curricula of HEIs.

This book of knowledge is organized as follows:

4. A short literature review on organizational resilience
5. A short literature review on resilience in HEIs and HEIs curricula
6. Feedbacks from a questionnaire DECART survey sent out in april 2024 on curriculum resilience properties

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Insights on organizational Resilience

Disasters, crises and extreme events are increasingly prevalent (Hällgren, Rouleau, & De Rond, 2018), however, the characteristic complexity of the globally connected sociotechnical systems in which contemporary organisations operate, create new and unimaginable threats rendering foresight and prevention of disaster frequently inoperative (Boin, Comfort & Demchak, 2010). As extreme events and the crises they engender for organizations are becoming increasingly common, organisations need effective risk governance strategies. However, risk governance can fall short when an unanticipated and/or sudden disruptions happen, such as the Covid-19 pandemic or the 2011 nuclear power plant accident in Fukushima (Guarnieri and Travadel, 2018). Organizations must therefore become resilient to reinforce their capacity to cope with the unexpected. Resilience differs precisely with respect to risk management by the fact some events are unforeseeable and nevertheless an organization may prepare for it. Managing risk can lead to more resilient organisations but may not be sufficient in the face of unknown risks. Organisations must leverage past crisis experience to learn how to enhance their preparedness and thus better anticipate risks from future extreme events (Gephart et al., 2018). The process by which organisations learn from and develop capacities to prepare for and cope with crises, even unexpected ones, comprises organizational resilience (OR).

OR is a complex construct combining latent and manifest organizational capacities and employee capabilities (Somers, 2009). These capacities and capabilities can be latent until an intra or extra-organizational shock provokes a crisis which necessitates their rapid mobilization. Generally speaking, OR is described as a capacity to cope with unexpected disruptions such that an organisation may bounce back quickly and resume normal operational processes (DesJardine et al. 2019; Wildavsky, 1988). Some definitions add a prospective perspective referred to as bouncing forward. For instance, Macrae and Wiig (2019, page 122) describe resilience as "*the ability of an entity—individuals, communities, organizational units or larger systems—to return to some 'normal' condition or state of functioning after an event that disrupts its state; or to adapt to a new normal state, where system functioning is reorganised or enhanced in some way in response to the disruption*". The possibility that a shock may catalyze good change and innovation is thus referred to when organizational learning is sufficiently rapid that adaptations become a source of positive transformation. In both the bouncing back and bouncing forward interpretations, organizational resilience is conferred by the development of adaptive capacities and capabilities. Together, these allow an organisation (capacities) and its members (capabilities) to rapidly reconfigure information systems, organizational resources, functions and processes and human resources, when the operating context is perturbed by either extrinsic (contextual) or intrinsic (organizational specific) disruptions, to thereby ensure business continuity. To be able to do so, the ability of the organisation to prepare for future crises is also a preventive organizational capacity. Therefore, resilience rely both on prevention

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

and adaptive innovation potentially through the capacity to improve decision making and behavior from past experiences or forward thinking (Hollnagel , 2010 ; Denyer, 2017 , Gardner et al., 2023)

To become a resilient organisation, it is essential to adopt a comprehensive strategy which delineates the goals of resilience (*the what for*), identifies intra and extra-organizational sources of resilience (*the how*) and specifies when the first two elements should be mobilized (*the when*). Turning to 'the what'; certain authors suggest that the goal of resilience encompasses a capacity to sustain vital operations (Hollnagel, 2010) or to rapidly achieve pre-disturbance operations (Holling, 1973). More recently, a resilience goal, where organisations seek to capitalize on adversity to attain a new, enhanced modus operandi (Lengnick-Hall and Beck, 2005; Macrae and Wiig, 2019, p. 122, Denyer 2017, Chen et al. 2021), has emerged.

In terms of 'the h*ow*', individual employees are thought to be able to learn the capabilities necessary to practice resilience when they are "*supported by the organisation, to utilize resources to continually adapt and flourish at work, even when faced with challenging circumstances*" (Näswall et al., 2015). At the level of individuals then, resilience is indeed a capability that can be learned as opposed to an innate trait (Cyrulnik, 2013). At the level of the organisation, OR is associated with different capacities. A preparation phase enables to respond to regular and irregular disturbances when they appear. It requires building situational awareness, i.e. a capacity to monitor the organisation and its environment as well as to anticipate future events and state changes, i.e. threats and opportunities, that may affect the organisation's ability to function or to prosper (Hollnagel, 2010, McManus et al. 2008, Denyer 2017). Situational awareness of the organisation is enhanced by identifying critical changes and keystone vulnerabilities to focus on such as organizational tangible or intangible components and processes (Hollnagel, 2010, McManus et al. 2008). Adaptive capacity comprises an organisation's ability to continuously design and develop solutions to match or exceed the needs of their environment as changes in that environment emerge" (Lee et al , 2013).

Finally, turning to '*the when'*; the OR capabilities and capacities referred to above, must be developed in relation to three sequential phases (Ducheck, 2020): i) phase 1, which is pre-emptive, concerns anticipating and preparing for crisis events or shocks via pre-emptive actions, ii) phase 2 refers to the rapid reconfiguration of functions and processes when a shock occurs to ensure business continuity via proactive actions and iii) phase 3, which is post crisis, depicts a recovery phase in which the organisation learns from such events in order to become more proficient and better able to govern the risks to which it is exposed (Lengnick-Hall and Beck, 2009). The three phases are thought to operate as a virtuous OR cycle where learning during the recovery phase comprises an input to the pre-emptive stage (Vogus and Sutcliffe, 2007). When the OR construct is examined from these three perspectives (*the what, the how, the when*), it provides a comprehensive conceptual and multidimensional framework that has

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

the potential to generate insights and knowledge that will serve to improve risk governance processes.

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Understanding curriculum resilience

Lessons from the literature

The Covid-19 crisis revealed that higher education institutions (HEIs) possess differing resilience profiles (Berthoud et al., 2021 , McKeown et al. 2021). Those who exhibited weaker performance, must now endeavor to learn from the crisis and reinforce their preparedness for future resilience demanding events (Habersaat et al 2020). If they fail to do so, they may experience severe financial sanctions such as loss of student fees and reputational damage (McKeown et al., 2021). Weaknesses in HEI systems also have the potential to propagate to the wider socio economic landscape. For instance, differences in resilience capacity engendered inequalities in terms of access to education particularly for students from less advantaged backgrounds (McKeown et al., 2021). Looking forward in today's increasingly VUCA contexts, achieving wide-spread HEI organizational resilience thus comprises an objective with wider ethical and democratic implications (Reimers and Schleicher, 2020). In addition, the success of industrial, entrepreneurial, corporate and government entities depends on the quality of the graduate pool of new recruits (Druker and Goldstein, 2007). It is thus essential to improve understanding of sources of organizational resilience in HEIs.

Curriculum resilience is part of the more general organizational resilience in HEI. Organizational resilience in the context of HEIs is understood as their capacity to adapt to the challenging circumstances and to rapidly reconfigure services rendered to students, academic and industrial research partners (Karlsen and Pritchard, 2014). In common with the organizational resilience construct which describes resilience in business contexts, HEI resilience studies thus evoke the capacity to absorb, cope with and recover from both intrinsic and extrinsic shocks (Pritchard and Karlsen 2013). The concept of resilient HEIs thus resonates with the mainstream organizational resilience literature transcribing pre-emptive, proactive and recovery phases (Duchek, 2020).
Beyond a culture incorporating a resilient mindset / resilience thinking, HEI's must develop specific resilience capabilities to anticipate, adapt to and learn from unexpected disruptions and shocks (Karlsen and Pritchard, 2014, Duchek , 2020) and maintain core functions (Walker and Salt, 2012) or even, implement transformative, positive changes (Lengnick-Hall, and Beck, 2016). However, understanding of how to foster such resilience capacities and capabilities in the higher education sector in practice, remains scarce (Shaya et al., 2023). The scholarship suggests that resilient HEIs comprise organizations that are loosely coupled meaning, they possess an appropriate balance between elements that are connected and independent, and that these elements co-exist within a dynamic and emergent structure (Young & Pinheiro, 2022). The need for organizational slack is also alluded to, and concerns the provision of redundant human and material resources, a form of productive waste that can be rapidly mobilized when

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

disruptions are detected (Young & Pinheiro, 2022). Redundant resources in HEIs may be generated via innovative initiatives such as shared teaching, multiple pathways and projects for producing research knowledge, the provision of learning topics that are explored in a diversity of disciplines (Young & Pinheiro, 2022). Agile technology services comprise an additional fundamental factor. During the recent Covid-19 crisis, the effective provision of and access to core teaching-related services via a diversity of collaborative learning platforms, synchronous (live) and asynchronous (recorded) educational technologies (EdTech), and flexible evaluation approaches, was shown to enhance HEI resilience (Chow et al., 2020). Flexibility in non-teaching student services is also of paramount importance (Martel, 2020). For instance, HEIs that were resilient during the Covid-19 pandemic initiated innovative programs to transform the modalities by which services such as student library, careers, counseling, individual tutoring and sports services were delivered (Crawford et al. 2020). Students themselves may also proactively contribute to HEI resilience as was seen during the pandemic, certain student bodies became partners with their institutions, change-agents, collaborating to contribute to the success of new operating models and to proactively support particularly isolated international students (Morgan, 2020). Students thus comprise a pool of latent and agile resources that if strategically deployed, may generate novel responses to emergent issues. For HEIs who face an increasingly challenging socio-economic climate (Altbach, Reisberg & Rumbley, 2019, p.4), students themselves may thus contribute to activating resilience by conferring the strategic agility needed to combine and reuse existing resources in new ways (Lengnick-Hall, and Beck, 2016). However, the capacity of students to partner in the wider resilience performance of their institution is also influenced by students' individual resilience capacity (van Kessel et al., 2021; Woolf et al., 2019). This individual-level resilience is the outcome of several factors such as self-esteem and family relationships (Robbins, Kaye & Catling, 2018), the inclusion of resilience-building programs such as seminars, course modules or self-regulated learning within curricula (Goodchild, Heath & Richardson, 2023; Imhof et al., 2024; Stallman, 2011) and appropriate extra-curricular activities (Price, 2023). Cultivating student resilience in practice requires tailored approaches adapted to the stage in a student's learning journey, the type of institution and corresponding proportion of international and home students (Woolf et al., 2019). Furthermore, studies emphasize the importance of an institutional culture and curricula that support an incremental acquisition of resilience knowledge, skills and practice (van Kessel et al., 2021).

The role of curricula design in resilience activation was evidenced during the Covid-19 pandemic and revealed how faculty, administrative personnel and students were able to collectively conceive and employ innovative and adaptive learning strategies (Chow et al., 2020) and novel curriculum designs (Berthoud et al., 2020). A diversity of properties of resilient curricula has been examined in the literature (Berthoud et al., 2020; Quintana et al., 2021), Chow et al., 2020, Rasli et al. , 2022). A first property, flexibility, in the sense of adaptability of a given means or resource, is the outcome of multiple antecedents. At the program level, flexibility

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

may be improved by structural simplification of content and assessment methods and tighter coupling between program-level intended learning outcomes and course assessments (Berthoud et al., 2020). This streamlined program design ensures greater flexibility for students to switch between programs (Chow et al., 2020; Rasli et al. , 2022). Flexibility is also enhanced when the types of pedagogy and teaching delivery methods are complexified and diversified via the inclusion of new tools and technologies that facilitate rapid adaptations in a changing environment (Berthoud et al., 2020; Chow et al., 2020, Rasli et al. , 2022). Second, redundancy, understood as having at disposition different means for a given objective, is another facet of curriculum resilience. It provides the organization with a form of robustness and a capacity to adjust and react to different shocks. In the case of a curriculum, redundancy is the outcome of a design that integrates different means for motivating students (Quintana et al., 2021), multiple assessment methods and omnichannel, technology-enabled approaches to both teaching and learning (Berthoud et al., 2020; Rasli et al., 2022; Chow et al., 2020). Redundancy of teaching resources is also primordial and may be provided through connectivity and extra-organizational relationships such as international collaborations for joint degree programs (Rasli et al. , 2022).

Third, the potential of curricula to reinforce HEI resilience requires a broader resilience culture in which inter and intra-organizational collaborations, connectivity and networking are proactively and continuously developed and nurtured. This resilience perspective facilitates resource sharing and also enhances the capacity of students and employees [3] to cope with the crisis by enlarging their relational support network (Rasli et al. , 2022, Chow et al., 2020). Intra-organizational collaboration is also a source of curriculum resilience. For instance when academics from different departments co-develop and structure the curriculum, readability and accessibility for students is improved (Berthoud et al., 2020). Furthermore, this enhanced coordination generates opportunities for shared teaching which fosters redundancy (Berthoud et al., 2020). More generally networked interorganizational relationships also confer a form of community resilience and are an important driver of organizational resilience in companies (Ishak and Williams , 2018). Table 1 summarizes these insights inferred from the literature regarding how curricula contribute to HEI resilience.

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Curriculum Dimensions[1]	Resilience Properties
Teaching & learning	**Redundancy:** Different means for motivating students, multiple means of knowledge representation, expression and actions. (Quintana et al, 2021), interchangeable teaching resources, intra-organizational connectivity and extra-organizational relationships (Rasli et al., 2021) **Flexible and creative pedagogy:** leverage technologies to incorporate new and multi-functional educational tools with context adaptable teaching and learning methods (Berthoud et al., 2021, Chow et al., 2020, Rasli et al., 2021) Assessment methods: at program level ensure different types of assessment. Appropriate balance between formative and summative assessment, theoretical and practical and **constructive alignment** (Berthoud et al., 2021) **Diversity in teaching methods channels** both on-line and in classroom possible; E-learning (EdTech) infrastructure and agile technology services; Virtual mobility of students (Berthoud et al., 2021, Rasli et al. 2021, Chow et al., 2020)
Curriculum structure	**Extensible:** A minimum viable product *at the course level* and additional units of instruction capable of anticipating a shift in instruction mode and adaptable to multiple contexts (Quintana *et al,* 2021). At *the program level,* extensibility via an appropriate diversity of options in programs (Rasli et al. 2021) **A simplified and standardized curriculum** structure is a consistent structure that confers i) An appropriate planning of formative and summative assessment, ii) ease of readability by students of different academic expectations over a large range of course units (e.g. Engineering Mathematics, Engineering Science, Mechanical Engineering, ...), iii) effective coordination of the many units provided by academics from different departments and consistent/coherent, transversal skills teaching i.e. not reliant on piecemeal implementation across multiple units. (Berthoud et al., 2021).
Curriculum context	**Organizational slack:** readily available and rapidly mobilizable, redundant human and material resources (Young & Pinheiro, 2022, p.183) **Agility:** combine, re-use and redeploy existing resources in new ways to deal with emergent issues and meet new needs (Lengnick-Hall & Beck, 2016) e.g. students may be considered as a source of organizational slack that once deployed can confer agility **Flexibility**: including exit-entry of students and student switching in programs (Rasli et al., 2021).

[1] The curriculum dimensions of the thematic analysis from the DECART questionnaire (see next section table 6) have been taken for table 1

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Quality Culture	**Collaboration and Connectivity**: relationships with international partners, joint degree program and joint teaching. On-line components of curriculum, virtual laboratory (Rasli et al. 2021), sharing and exchange of educational information and resources, MOOC platforms to facilitate sharing of educational resources (Chow et al., 2020) **Networking:** engage students in interdisciplinary teams with a mission to address global challenges (Berthoud et al., 2021) which would favor virtual mobility and international online collaboration (Rasli et al. 2021). Ensure alternatives for fundamental non-teaching student services (Crawford et al., 2020; Martel, 2020). Resilience culture: nurture the progressive and organization-wide acquisition of resilience knowledge, skills and practice (van Kessel et al., 2021) and develop student individual resilience training such as seminars, courses, self-regulated learning of resilience enhancing tools adapted to the student's stage in the learning journey (Goodchild, Heath & Richardson, 2023; Imhof et al., 2024; Price, 2023; Stallman, 2011), support extra-organizational collaborations and relationships to foster community resilience (Ishak & Williams, 2017)

Table 1. Summary from the literature of the key properties of curricula resilience

DECART survey 2024 on curriculum resilience properties

Questionnaire and main statistics

A questionnaire was sent to the DECART members and associates by the end of march 2024 to collect their feedback on what a resilient curriculum could be. The questionnaire consisted of 23 questions, some on a scale from 1 to 5 and a few open questions and is shown in the annex.

A total number of 35 respondents with a repartition per country given in column 1 of table 2 answered the questionnaire. Concerning the types of HEI, STEM (Science, Technology, Engineering and Math) institutions represented 2/3 of the institutions (column 2) and among the respondents half of them (18) had a good practice of curriculum design (leaders or participated more than once). 20 respondents had some expertise with resilience concepts. 12 respondents had both participated to curriculum design and had a good expertise in resilience (table 3)

Country	**HEI Institutions**	**Curricula design expertise**	**Resilience expertise**
France: 6	HSS 2	never participated: 1	No or vague knowledge: 4
Germany: 3	Management 9	Participated as external observer: 4	Knowledge from social conversation: 11

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Iceland :2	STEM 23	Participated once as an active member: 12	Knowledge from science or through professional activities: 10
Indonesia: 15	STEM-Man-HSS 1	Participated more than once as an active member 13	Knowledge and some practice with the concept: 8
Lithuania: 5		Participated as a leader 5	Expert 2
South Africa: 4			

Table 2. Summary statistics (read the table by column)

	1 No or vague knowledge	**2 Common wisdom**	**3 Scientific or professional knowledge**	**4 Knowledge and practice**	**5 Expert**
1 **Never participated**	0	0	0	0	1
2 Only observer	0	1	1	1	1
3 Active member =1	1	5	4	2	0
4 Active member >1	3	4	3	3	0
5 Leader	0	1	2	2	0

Table 3. repartition of expertise : curriculum (column) versus resilience (row)

The questions and associated variables and scales are shown in table 4 (complete questionnaire is in annex).

Questions	**Variable name**	**Scales**
1. How would you rate your expertise of program curriculum design like building a new master program or amending a first year bachelor program?	Exp_Curri	Quantitative 1:5

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Questions	Variable name	Scales
2. How would you rate your expertise with resilience concepts or theory ?	Exp_Resi	Quantitative 1:5
3. Please state at least one or more properties of a curriculum that makes it resilient. To answer this question, you may wish to refer to a curriculum that you are aware of.	Prop_Res	Textual
4. Please state at least one or more properties of a curriculum that makes it NOT resilient.	Prop_NoRes	Textual
5. Redundancy in learning methods : different means for students to engage with a given the topic such as visual, auditory, written, kinesthetic, MOOCs, storytelling, games, project-based learning, etc.	Red_LearnM	Quantitative 1:5
6. Redundancy in the assessment methods for a given topic: different ways for teachers to evaluate a given skill or knowledge e.g. Multiple Choice Questions, homework, distance orals, reports, etc.	Red_AssesM	Quantitative 1:5
7. Redundancy of channels or media for transmitting a given course content e.g. Zoom, discord, Microsoft Teams, kahoot, etc.	Red_Media	Quantitative 1:5
8. Redundancy of teaching methods : different ways for the instructor to interact with students to achieve a given learning objective e.g. lecturing, inquiry-based learning, game-based learning, group project learning, inverse classes ...	Red_TeachM	Quantitative 1:5
9. Different scientific fields in addressing a given topic	Red_SciFields	Quantitative 1:5
10. Can you think of any other redundancy factor that could be essential or very useful to the resilience of a curriculum ?	Red_Other	Textual
11. Please rate the usefulness of standardizing and simplifying the curriculum structure for curriculum resilience ?	Cur_Struct	Quantitative 1:5
12. By which properties would you define a resilient curriculum structure	Cur_Struct_Prop	Textual
13. Generative artificial intelligence (AI) is an AI technology enabling to continuously and automatically improve its performance from data (Unesco, 2023) , e.g. chatGPT. How would you rate the degree of risk represented by generative AI for curricula resilience?	AI_Risk	Quantitative (0= no risk , 1 = small risk , 2 = high risk)
14. How would you rate the opportunity represented by generative	AI_Opp	Quantitative (0=

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Questions	Variable name	Scales
AI for curricula resilience? ? (A technology can both be a risk and an opportunity)		no impact/ neutral , 1 = small opportunity , 2 =big opportunity)
15. How would you rate the degree of risk represented by digital technologies NOT based on AI for curricula resilience (e.g. technologies that support the digitalisation of the learning experience or facilitate online teaching like moodle, on-line learning technologies, woodclap, ...)?	Digit_Risk	Quantitative (0= no risk , 1 = small risk , 2 = high risk)
16. How would you rate the opportunity represented by digital technologies NOT based on AI for curricula resilience?	Digit_Opp	(0= no impact/ neutral , 1 = small opportunity , 2 =big opportunity)
17. Please rate the usefulness of flexibility for a resilient curriculum	Flex	Quantitative 1:5
18. In particular, please rate the usefulness for a resilient curriculum of flexible course formats (e.g. a course that can easily be instantiated into different teaching modes such as face-to-face, online, hybrid) ?	Flex_Course	Quantitative 1:5
19. Please indicate what a flexible curriculum could be or mean for you OR state any other contributor of flexibility you can think of for curriculum resilience ?	Flex_Other	Textual
20. Please rate the usefulness of continuous adaptation for a curriculum resilience ?	Cont_Adap	Quantitative 1:5
21. Adjusting educational methods and content based on economic intelligence (links with industries, market probing, social network analysis, news and social medias...) :	Eco_Intelli	Quantitative 1:5
22. Adjusting educational methods and content based on technological innovations:	Tech_Inno	Quantitative 1:5
23. Before submitting this questionnaire is there any remark about the design of a resilient curricula that you would like to share , e.g. on action levers or properties not already stated in the above questions?	Miscan	Textual

Table 4. All quantitative variables if not stated otherwise are on a scale 1:5 with 1= impedes resilience , 2 = neutral, 3 = a bit useful, 4 = very useful, 5 = essential

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Lessons learned from the questionnaire: quantitative analysis

variable	min	max	median	mean	question nb
Digit_Risk	0	2	1	0,80	15
AI_Risk	0	2	1	1,29	13
Digit_Opp	0	2	1	1,46	16
AI_Opp	1	2	1	1,49	14
Red_Media	1	5	4	3,51	7
Red_SciFields	1	5	4	3,71	9
Red_AssesM	1	5	4	3,74	6
Cur_Struct	1	5	4	3,77	11
Eco_Intelli	2	5	4	4,03	21
Flex_Course	2	5	4	4,14	18
Red_LearnM	3	5	4	4,14	5
Tech_Inno	3	5	4	4,29	22
Flex	3	5	5	4,40	17
Red_TeachM	4	5	4	4,43	8
Cont_Adap	4	5	5	4,51	20

Table 5. Main statistics on quantitative variables

Table 5 shows the principal results for the drivers of resilience.
Redundancy in transmission channels (Red_Media) had the lowest mean (3.51 between 3 = a bit useful, 4 = very useful for curricula resilience) but with the median significantly different from the neutral/no effect score of 2. All factors were therefore significant drivers of resilience.
Three groups with increasing significance for curricula resilience can be proposed (Waldeck et al. 2024)

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

- Group 1: **Red_Media (**redundancy of channels or media)**, Red_SciFields** (different scientific fields for a given topic)**, Red_assesM** (different ways for teachers to evaluate a given skill) **and Curr_Struc** (adjusting educational methods and standardizing and simplifying the curriculum structure).
- Group 2: **Eco_Intelli (**continuous adaptation of content based on economic intelligence**),** **Flex_course** (flexible course formats)**,** **Red_LearnM** (redundancy in learning methods as different means for students to engage with a given the topic (visual, auditory, written, kinesthetic, MOOCs,...)) **and** **Tech_Inno** (continuous adaptation of content methods and content based on technological innovations).
- Group 3: **Flex** (flexibility i.e. a means, resource or approach that can be adapted to alternative uses / ends or objectives)**, Red_TeachM** (redundancy of teaching methods e.g. lecturing, inquiry-based learning, game-based learning, group project learning, inverse classes) **and Cont_Adapt** (continuous adaptation i.e. cultivating a mindset of continuous learning, where teachers adjust continually educational methods, content and strategies based on external changes (industry, innovation, laws, etc.))

Lessons learned from the questionnaire: thematic analysis

In addition we conducted a thematic analysis of the textual responses provided by the survey participants. Each dimension comprises distinct properties that contribute to resilience, as summarized in Table 6. Across all themes, flexibility and redundancy emerged as recurring aspects central to resilience. Flexibility operates on multiple levels, from curriculum adaptability to varied teaching and learning methods that can accommodate shifts in context. Redundancy, both technical and human, mitigates dependency risks, ensuring resources and teaching personnel are readily adaptable (Waldeck et al. 2024 for additional clarification on results and analysis process).

Dimension	**Properties**

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Teaching and learning	**Flexibility and Adaptability** Adaptable modes of teaching and learning strategies - e.g. collaborative/service/project- and problem-based learning Adaptable modes of teaching and learning formats - e.g. switch from onsite to online teaching - MOOCs **Redundancy** Redundancy in terms of interchanging profiles of teachers - Diverse expertise and backgrounds of teachers Use of diverse IT infrastructure for teaching and learning, no dependence on individual systems.
Curriculum Structure	**Transparency** - Structure itself is clearly defined (clear building blocks, clear interrelation between building blocks) - Learning objectives are formulated detailed and concrete - Comprehensive overview of structure, resources, assessments, teaching and learning strategies, etc. - Readability for students is guaranteed **Flexibility** - Many elective courses, no dependency on single courses, minimize mandatory courses - Courses are offered flexibly at different times during the program - Foster modularity: Multiple and different learning paths to achieve the learning objectives - Courses can be flexible exchanged and adapted - simplification of procedures for program renewal

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Curriculum Context	**Adaptability** - Context for a curriculum is determined by real-world challenges - Flexible response to changing context by using problem- and project-based learning (change the problem, not the content) - Focus on students' competency development (not on the content) - Integration of real-world experiences and hands-on experience **Stability** - Core and scientific knowledge of fundamentals that endures - Constructive alignment is ensured, i.e., content aligns to learning objectives
Quality Culture	**Collaboration** - Involvement of all relevant stakeholders (e.g. students, teachers, industry…) - Integration of diverse and different perspectives and backgrounds - Develop a mindset for adaptation **Monitoring** - Continuous evaluation of the curriculum by different perspectives and people

Table 6. Properties of Resilient Curricula inferred from qualitative survey results

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Key recommendations for curriculum resilience

Key lessons learned

Teaching and Learning

Teaching and learning within a resilient curriculum are characterized by flexibility, adaptability, and diversity in both content delivery and instructional formats.

The curriculum is equipped to respond to various external demands and challenges, such as transitioning from in-person to online instruction, integrating MOOCs, or employing flexible assessment methods and independent systems enhances resilience by reducing reliance on any single platform. Additionally, diversity in the expertise and backgrounds of instructors, facilitates adaptability through the interchangeability of teaching profiles, providing different means for motivating students and interchangeable teaching resources.

Curriculum Structure

A resilient curriculum structure is both transparently defined and adaptable. Key components, such as learning objectives, resources, and assessment methods, are explicitly detailed, ensuring students and faculty have a clear framework. Flexibility within the structure allows for elective courses and an appropriate diversity of options at the program level, switching of students between programs, minimal dependency on mandatory courses, and modular design options that provide multiple pathways to achieve learning outcomes. Modules are adaptable, allowing for rapid, resource-efficient reconfiguration in response to changing needs. The curriculum structure is consistent allowing ease in readability by students and possesses an appropriate planning of formative and summative assessment

Curriculum Context

The curriculum context aligns with real-world VUCA challenges and problems. By using problem- and project-based learning, the curriculum can pivot its focus based on the competencies required by changing external conditions, rather than the specific content taught. While adaptability is emphasized, a stable foundation of core, scientifically validated knowledge

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

supports continuity and reliability within the curriculum, ensuring that fundamental concepts remain relevant despite contextual shifts.
The curriculum context is also characterized by readily available and rapidly mobilizable, redundant human and material resources or resources that can be adapted in new ways to deal with emergent issues and meet new needs.

Quality Culture

A resilient curriculum depends on active collaboration and continuous monitoring across all stakeholders, including students, educators, and industry or international partners. This collaborative quality culture is sustained by the diversity of perspectives and shared responsibility, fostering an adaptive mindset and a commitment to continuous improvement, or by sharing and exchange of educational information and resources. Regular evaluations incorporating multiple viewpoints allow for iterative enhancements that strengthen the curriculum's ability to respond to changing conditions.
In reflecting on resilient curriculum design, one crucial insight is the need to cultivate a culture of innovation and continuous improvement within educational institutions. Beyond specific properties and interventions, establishing an environment that promotes experimentation, adaptability, and collaboration among educators, students, and stakeholders is essential for fostering resilience.
Finally a resilience culture nurtures the progressive and organization-wide acquisition of resilience knowledge, skills and practice, both at staff and student levels, which should extend to and support extra-organizational collaborations and relationships to foster community resilience.

Perspectives: building a ready-to-use decision tool for HEI

The results obtained both from the questionnaire and the literature will be used in a follow up stage to build a decision tool.

The decision tool will comprise a survey and a diagnostic tool designed to help program leaders to evaluate specific indicators of curriculum resilience and in so doing, reach informed choices regarding how to reinforce resilience and reduce their institution's vulnerability to crises by effecting intelligent and traceable changes to curricula.

The conception of the decisional tool involves the following steps:
First, we design a survey tool developing for each dimension of the curriculum, i.e. “teaching and learning” , “curriculum structure” , "curriculum context” and “quality culture”, specific assertions on a 5-point Likert scale (“1 = strongly disagree” to “5 = strongly agree”) targeted to specific stakeholders (program leaders , teachers and students). The questions will be

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

designed to probe the attitudes and feelings of targeted HEI stakeholders regarding specific properties of resilient curricula.

For example, for the category “teaching and learning”, one such assertion will be:
“Teaching methods are diversified in my course, including options like inquiry-based learning, collaborative learning, game-based learning, etc”. ”
Relevant stakeholders for this assertion will be teachers which will give their degree of agreement with the assertion on a Likert scale (“1 = strongly disagree” to “5 = strongly agree”). The resilience property which is tested by the assertion is the capacity of the curriculum to have adaptable delivery modes (flexibility).

50 assertions have been built thanks to the BoK developed in the DECART project.

We will employ the Delphi method to evaluate the pertinence of and reach decisions regarding which assertions to retain in the resilience curricula diagnostic tool. We initiated the Delphi survey using contacts in the DECART project in December 2024. Specifically we will ask the respondents to rate the relevance of each assertion for curriculum resilience i.e. to answer the following question

"**probing one of these stakeholders with that assertion on a likert scale (from strongly disagree to strongly agree), does it inform the "university" on the level of curriculum resilience?**" Your answers are on a scale from 1 to 5 with 1= Not relevant at all for resilience, 2= Slightly relevant, 3= Moderately relevant , 4 = Highly relevant, 5= Essential for resilience

A second round of the DELPHI method has been initiated in march 2025 for assertions which were found to be problematic in the first round i.e. not reaching consensus rate of more than 70% of participants found the assertion relevant (agree or strongly agreed) and no more than 15% of participants found the assertion irrelevant (strongly disagree or disagree).

The results should help us to select the assertion to retain for a ready-to-use survey that different HEI may use to test the resilience of one of their curricula.

A second element of the decision tool is a diagnostic tool in the form of an algorithm which will result in a synoptic view of the curriculum resilience across different dimensions: a first dimension relates to the curriculum responding to the question “resilience of what”. A second dimension concerns the resilience perception of stakeholders (resilience by whom). A third dimension defines the properties of resilience i.e. how is resilience achieved. Properties of resilience are : redundancy , flexibility , monitoring , collaboration and networking.

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

References

Project and Partners Bibliographical References

Gardner Le Gars J, Simonin J, Waldeck R, Puentes J (2023) A dual perspective of organizational resilience (OR) and information technology systems resilience (ITSR): an analysis of interdependencies and tensions. ARPHA Conference Abstracts 6: e107704. https://doi.org/10.3897/aca.6.e107704

Waldeck, R., Gardner le Gars, R., Audunsson, H., Barus, A., Liem, I. , Kanyangale, M., Gerwel Proches, C., Rouvrais, S., Winkens, A-K. (2024) HIGHER EDUCATION RESILIENT CURRICULA: LESSONS FROM A EUROPEAN PROJECT, ICERI2024 Proceedings, pp. 3592-3600.

S. Rouvrais, A-K. Winkens, C. Leicht-Scholten, H. Audunsson, and C. Gerwel-Proche (2023). VUCA and Resilience in Engineering Education: Lessons Learned. In Proceedings of the 19th International CDIO Conference, hosted by NTNU, Trondheim, Norway, June 26-29.

General Bibliographical References

Aver, B., Fošner, A., & Alfirević, N. (2021). Higher Education Challenges: Developing Skills to Address Contemporary Economic and Sustainability Issues. Sustainability

Berthoud, L., Lancastle, S. A. and Gilbertson, M. A. “Designing a resilient curriculum for a joint engineering first year,” SEFI European Engineering Education Conference, Sep. 2021.

Boin, A. , Comfort, L. K., and Demchak, C. C. “The rise of resilience,” in *Designing Resilience*, A. Boin, L. K. Comfort, and C. C. Demchak, Eds., in Preparing for Extreme Events. , University of Pittsburgh Press, 2010, pp. 1–12. doi: 10.2307/j.ctt5hjq0c.5.

Boin, A. and Lodge, M. “Designing resilient institutions for transboundary crisis management: a time for public administration,” *Public Administration*, vol. 94, no. 2, pp. 289–298, Jun. 2016, doi: 10.1111/padm.12264.

Chen, R., Xie, Y., and Liu, Y. “Defining, Conceptualizing, and Measuring Organizational Resilience: A Multiple Case Study,” *Sustainability*, vol. 13, no. 5, 2021, doi: 10.3390/su13052517.

Chow, R. S., Lam, C. M., and King, I. “Crisis Resilience Pedagogy (CRP) for Teaching and Learning,” in *2020 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)*, Dec. 2020, pp. 384–391. doi: 10.1109/TALE48869.2020.9368496.

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M. , Burton, R., Magni, P., and Lam, S. 2020. COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching* Vol 3,1, 2020.

Lengnick-Hall, C. A., and Beck, T. E. "Resilience capacity and strategic agility: Prerequisites for thriving in a dynamic environment," in *Resilience Engineering Perspectives*, Erik Hollnagel, Christopher P. Nemeth., vol. 2, 2009.

Cyrulnik, B. "La résilience : un processus multicausal," *Revue française des affaires sociales*, no. 1–2, pp. 15–19, 2013, doi: 10.3917/rfas.125.0015.

Dass, S., Barnieu, J., Cummings, P. and Cid, V. "A Cognitive Task Analysis for an Emergency Management Serious Game," *Interserv Ind Train Simul Educ Conf*, vol. 2016, p. 16244, 2016.

Denyer, D., "Organizational Resilience: A summary of academic evidence, business insights and new thinking.," BSI and Cranfield School of Management, 2017. [Online]. Available: https://www.cranfield.ac.uk/som/case-studies/organizational-resilience-a-summary-of-academic-evidence-business-insights-and-new-thinking

DesJardine, M. , Bansal, P., and Yang, Y. "Bouncing Back: Building Resilience Through Social and Environmental Practices in the Context of the 2008 Global Financial Crisis," *Journal of Management*, vol. 45, no. 4, pp. 1434–1460, Apr. 2019, doi: 10.1177/0149206317708854.

Duchek, S. Organizational resilience: a capability-based conceptualization. Bus Res 13, 215–246 (2020). https://doi.org/10.1007/s40685-019-0085-7

Gephart, R. P. "The Textual Approach: Risk and Blame in Disaster Sensemaking," *The Academy of Management Journal*, vol. 36, no. 6, pp. 1465–1514, 1993, doi: 10.2307/256819.

Goodchild, T., Heath, G., & Richardson, A. (2023). Delivering Resilience: Embedding a Resilience Building Module into First-Year Curriculum. Student Success.

Guarnieri, F. and Travadel, S. *Un récit de Fukushima: le directeur parle*. Paris: PUF, 2018.

Habersaat KB, Betsch C, Danchin M, Sunstein CR, Böhm R, Falk A, Brewer NT, Omer SB, Scherzer M, Sah S, Fischer EF, Scheel AE, Fancourt D, Kitayama S, Dubé E, Leask J, Dutta M, MacDonald NE, Temkina A, Lieberoth A, Jackson M, Lewandowsky S, Seale H, Fietje N, Schmid P, Gelfand M, Korn L, Eitze S, Felgendreff L, Sprengholz P, Salvi C, Butler R, "Ten considerations for effectively managing the COVID-19 transition," *Nat Hum Behav*, vol. 4, no. 7, pp. 677–687, Jun. 2020, doi: 10.1038/s41562-020-0906-x.

Hällgren M. , Rouleau L., and de Rond M. , "A Matter of Life or Death: How Extreme Context Research Matters for Management and Organization Studies," *ANNALS*, vol. 12, no. 1, pp. 111–153, Jan. 2018, doi: 10.5465/annals.2016.0017.

Holling C. S. , "Resilience and Stability of Ecological Systems," *Annu. Rev. Ecol. Syst.*, vol. 4, no. 1, pp. 1–23, Nov. 1973, doi: 10.1146/annurev.es.04.110173.000245.

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Hollnagel E. , “How Resilient Is Your Organisation? An Introduction to the Resilience Analysis Grid (RAG),” in *Sustainable Transformation: Building a Resilient Organization*, Toronto, Canada, May 2010. [Online]. Available: https://minesparis-psl.hal.science/hal-00613986

Imhof, M., Worthington, D., Burger, J., & Bellhäuser, H. (2024). Resilience and self-regulated learning as predictors of student competence gain in times of the COVID 19 pandemic – evidence from a binational sample. Frontiers in Education

Ishak, A. W., and Williams, E. A. “A dynamic model of organizational resilience: adaptive and anchored approaches,” *CCIJ*, vol. 23, no. 2, pp. 180–196, Apr. 2018, doi: 10.1108/CCIJ-04-2017-0037.

Karlsen J. E. and Pritchard, R. Eds., *Resilient Universities*. Peter Lang UK, 2014. doi: 10.3726/978-3-0353-0537-1.

Lee, A. V. ,Vargo, J. and Seville, E. “Developing a Tool to Measure and Compare Organizations’ Resilience,” *Nat. Hazards Rev.*, vol. 14, no. 1, pp. 29–41, Feb. 2013, doi: 10.1061/(ASCE)NH.1527-6996.0000075.

Lengnick-Hall, C. A. and Beck, T. E. “Adaptive Fit Versus Robust Transformation: How Organizations Respond to Environmental Change,” *Journal of Management*, vol. 31, no. 5, pp. 738–757, Oct. 2005, doi: 10.1177/0149206305279367.

Lengnick-Hall, C. A., Beck, T. E. and Lengnick-Hall, M. L. “Developing a capacity for organizational resilience through strategic human resource management,” *Human Resource Management Review*, vol. 21, no. 3, pp. 243–255, Sep. 2011, doi: 10.1016/j.hrmr.2010.07.001.

Lengnick-Hall, C.A. and Beck, T.E. Resilience capacity and strategic agility: Prerequisites for thriving in a dynamic environment. In Resilience Engineering Perspectives, Vol. 2, pp. 61-92, CRC Press, 2016

Macrae, C. and Wiig, S. “Resilience: From Practice to Theory and Back Again,” in *Exploring Resilience*, S. Wiig and B. Fahlbruch, Eds., in SpringerBriefs in Applied Sciences and Technology. , Cham: Springer International Publishing, 2019, pp. 121–128. doi: 10.1007/978-3-030-03189-3_15.

McKeown, J. S., Bista, K. and Chan, R. Y. “COVID-19 and Higher Education: Challenges and Successes during the Global Pandemic,” *SSN*, pp. 1–7, Sep. 2021.

McManus, S., Seville, E., Brunsdon, D., and Vargo, J. “Resilience Management: A Framework for Assessing and Improving the Resilience of Organisations,” Jan. 2007. [Online]. Available: https://ir.canterbury.ac.nz/bitstreams/e2469bee-f5fd-4bbb-86dd-98eac72da469/download

McManus, S., Seville, E., Vargo, J. and Brunsdon, D. “Facilitated Process for Improving Organizational Resilience,” *Nat. Hazards Rev.*, vol. 9, no. 2, pp. 81–90, May 2008, doi: 10.1061/(ASCE)1527-6988(2008)9:2(81).

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Martel, M. “COVID-19 effects on US higher education campuses. From Emergency Response to Planning for Future Student Mobility,” 2020. [Online]. Available: https://www.iie.org/publications/covid-19-effects-on-us-higher-education-campuses-report-2/

Morgan, H., 2020. Best practices for implementing remote learning during a pandemic. The clearing house: A journal of educational strategies, issues and ideas, 93(3), pp.135-141.

Naswall, K., Kuntz, J. and Malinen, S. “Employee Resilience Scale (EmpRes) Measurement Properties,” Aug. 2015.

Park, T. P. Seager, P. S. Rao, M. Convertino, & I. Linkov, Integrating risk and resilience approaches to catastrophe management in engineering systems. Risk Analysis, 33(3), 356–367, 2013. https://doi.org/10.1111/j.1539-6924.2012.01885.x

Pekkola, E., Pinheiro, R., Geschwind, L., Siekkinen, T., Carvalho, T., & Pulkkinen, K. (2020). Nested hybridity and value definition in public higher education: A conceptual view. In Hybrid governance, organisations and society (pp. 59-80). Routledge.

Piovezan, S. Cyberattaque à Saclay : "Dans la période actuelle, il faut sécuriser nos données, notamment scientifiques" (C. Galap). AEF Rubrique: Formation Dépêche n°726755 2025 03 06

Quintana, R. M., Fortman J., & DeVaney, J, “Advancing an approach for resilient design for learning by designing for extensibility, flexibility, and redundancy.,” in Resilient pedagogy: Practical teaching strategies to overcome distance, disruption, and distraction, Thurston, T. N., Lundstrom, K., González, C., Utah State University., 2021, pp. 77–92.

Rasli, A., Tee, M., Lai, Y. L., Tiu, Z. C. and Soon E. H., “Post-COVID-19 strategies for higher education institutions in dealing with unknown and uncertainties,” Front. Educ., vol. 7, p. 992063, Oct. 2022, doi: 10.3389/feduc.2022.992063.

Reimers, F. and Schleicher, A., “Schooling disrupted, schooling rethought: how the Covid-19 pandemic is changing education,” OECD, 2021.

Robbins, A., Kaye, E.M., & Catling, J.C. (2018). Predictors of student resilience in higher education. Psychology Teaching Review.

Schofer, E., Ramirez, F. O., & Meyer, J. W. (2021). The Societal Consequences of Higher Education. Sociology of Education, 94(1), 1-19. https://doi.org/10.1177/0038040720942912

Scott, J. (2006). The mission of the university: Medieval to postmodern transformations. The Journal of Higher Education, 77 (1), 1–39.

Shaya, N., Abukhait, R., Madani, R., & Khattak, M. N. (2023). Organizational resilience of higher education institutions: An empirical study during Covid-19 pandemic. Higher education policy, 36(3), 529-555.

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Somers, S. “Measuring Resilience Potential: An Adaptive Strategy for Organizational Crisis Planning,” *Contingencies & Crisis Mgmt*, vol. 17, no. 1, pp. 12–23, Mar. 2009, doi: 10.1111/j.1468-5973.2009.00558.x.

Vogus, T. J. and Sutcliffe, K. M. “Organizational resilience: Towards a theory and research agenda,” in *2007 IEEE International Conference on Systems, Man and Cybernetics*, Oct. 2007, pp. 3418–3422. doi: 10.1109/ICSMC.2007.4414160.

Waldeck, R., Gaultier Le Bris, S. and Rouvrais, S. (2019). Interdisciplinarity and VUCA. In Methods and Interdisciplinarity, R. Waldeck (Ed.). https://doi.org/10.1002/9781119681519.ch5

Walker, B. and Salt, D. Resilience thinking: sustaining ecosystems and people in a changing world. Island press, 2012.

Wildavsky, A. B. *Searching for safety*. in Studies in social philosophy & policy, no. no. 10. New Brunswick, USA: Transaction Books, 1988

Woolf, S., Zemits, B.I., Janssen, A., & Knight, S. (2019). Supporting resilience in first year of university: Curriculum, consideration and cooperation. Journal of Academic Language and Learning, 13.

Young, M., & Pinheiro, R. (2022). The post-entrepreneurial university: The case for resilience in higher education. Towards resilient organizations and societies: A cross-sectoral and multi-disciplinary perspective, 173-193.

Yue, Z., Zhao, K. (2020). Understanding the Effectiveness of Higher Education System: Evidences from Market Outcomes of Early University Graduates in Seven European Countries. Sustainability. 10.3390/SU12187761

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Annex: DECART Questionnaire on Curricula and resilience.

DECART is an Erasmus+ European project on "Designing higher Education Curricula for Agility, Resilience & Transformation". The objective of the questionnaire is to probe participants on different topics related to curriculum resilience.

The questionnaire consists of **23 questions,** some on a scale from 1 to 5 and a few open but non compulsory questions. The questionnaire should take **about 20-25 mns**. **Please try to answer open questions** as much as possible in order to build a "book of knowledge" on what a resilient curriculum could be. Thank you very much for your contribution.

1. How would you rate your expertise of program curriculum design like building a new master program or amending a first year bachelor program?

- Non expert : never participated
- Participated as an external observer
- Participated once as an active member
- Participated more than once as an active member
- Participated as a leader

One definition of resilience is "The ability to i) anticipate and prepare for, ii) adapt to and capitalize on, and iii) recover from, actual or potential adverse events."

2. How would you rate your expertise with resilience concepts or theory ? *

- No or vague knowledge
- Knowledge from social conversation
- Knowledge from science or through professional activities
- Knowledge and some practice with the concept
- Expert

3. Please state at least one or more properties of a curriculum that makes it resilient. To answer this question, you may wish to refer to a curriculum that you are aware of.
4. Please state at least one or more properties of a curriculum that makes it NOT resilient.

The following sections probe the relation of some concepts to resilient curricula.

Redundancy
Redundancy is defined as having at disposition **different means or ways** to achieve **a given objective**.

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

If not indicated otherwise, all questions have a scale from 1 to 5, where 1 *means impedes resilience,* ***2 = neutral/no impact for resilience****, 3 = a bit useful for resilience, 4 = very useful for resilience and 5 = essential (without it no resilience)*. Please remember that 2 is the neutral/no impact reference point.

Please rate the usefulness of the following redundancy factors for curriculum resilience :

5. Redundancy in learning methods : different means for students to engage with a given the topic such as visual, auditory, written, kinesthetic, MOOCs, storytelling, games, project-based learning, etc.

*1 "impedes resilience" … 5 "essential"

6. Redundancy in the assessment methods for a given topic: different ways for teachers to evaluate a given skill or knowledge e.g. Multiple Choice Questions, homework, distance orals, reports, etc. (reminder: 1= *impedes resilience* , *2 = neutral, 3 = a bit useful, 4 = very useful, 5 = essential)*

*1 "impedes resilience" … 5 "essential"

7. Redundancy of channels or media for transmitting a given course content e.g. Zoom, discord, Microsoft Teams, kahoot, etc.

*1 "impedes resilience" … 5 "essential"

8. Redundancy of teaching methods : different ways for the instructor to interact with students to achieve a given learning objective e.g. lecturing, inquiry-based learning, game-based learning, group project learning, inverse classes ...

*1 "impedes resilience" … 5 "essential"

9. Different scientific fields in adressing a given topic

*1 "impedes resilience" … 5 "essential"

10. Can you think of any other redundancy factor that could be essential or very useful to the resilience of a curriculum ?

Simplified and standardized curriculum structure

A simplified and standardized curriculum structure is a consistent structure allowing i) a better planning of formative and summative assessment, ii) a better readability by students of many different academic expectations over a large range of course units (a unit is for example Engineering Mathematics, Engineering Science, Mechanical Engineering, ...), iii) a better coordination of the many units provided by academics in several departments (Berthoud et al., 2021)

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

11. *Please rate the usefulness of* standardizing and simplifying the curriculum structure for curriculum resilience

*1 "impedes resilience" … 5 "essential"

12. By which properties would you define a resilient curriculum structure

Digitalization

13. Generative artificial intelligence (AI) is an AI technology enabling to continuously and automatically improve its performance from data (Unesco, 2023) , e.g. chatGPT. How would you rate the degree of risk represented by generative AI for curricula resilience? (0= no risk , 1 = small risk , 2 = high risk)

14. How would you rate the opportunity represented by generative AI for curricula resilience? (0= no impact/ neutral , 1 = small opportunity , 2 =big opportunity) (A technology can both be a risk and an opportunity) ?

15. How would you rate the degree of risk represented by digital technologies NOT based on AI for curricula resilience (e.g. technologies that support the digitalisation of the learning experience or facilitate online teaching like moodle, on-line learning technologies, woodclap, ...)? (0= no risk , 1 = small risk , 2 = high risk)

16. How would you rate the opportunity represented by digital technologies NOT based on AI for curricula resilience? (0= no impact/ neutral , 1 = small opportunity , 2 =big opportunity)

Flexibility

Flexibility means having a means, resource or approach that can be adapted to alternative uses / ends or objectives. (e.g a course or assessment that can be done both off- and on-line)

17. Please rate the usefulness of flexibility for a resilient curriculum (1= impedes resilience, *2 = neutral, 3 = a bit useful, 4 = very useful, 5 = essential)*

*1 "impedes resilience" … 5 "essential"

18. In particular, please rate the usefulness for a resilient curriculum of flexible course formats (e.g. a course that can easily be instanciated into different teaching modes such as face-to-face, online, hybrid) ?

*1 "impedes resilience" … 5 "essential"

19. Please indicate what a flexible curriculum could be or mean for you OR state any other contributor of flexibility you can think of for curriculum resilience ?

Continuous Adaptation

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Teachers' continuous adaptation implies cultivating a mindset of continuous learning, where teachers adjust continually educational methods, content and strategies **based on external changes** (industry, innovation, laws, etc.).

20. *Please* rate the usefulness of continuous adaptation for a curriculum resilience ? (*1= impedes resilience, 2 = neutral, 3 = a bit useful, 4 = very useful,, 5 = essential)*? *

*1 "impedes resilience" … 5 "essential"

Please rate the usefulness of the following strategies of continuous adaptation for curriculum resilience .

21. Adjusting educational methods and content based on economic intelligence (links with industries, market probing, social network analysis, news and social medias...) :

*1 "impedes resilience" … 5 "essential"

22. Adjusting educational methods and content based on technological innovations:

*1 "impedes resilience" … 5 "essential"

23. Before submitting this questionnaire is there any remark about the design of a resilient curricula that you would like to share , e.g. on action levers or properties not already stated in the above questions?

The DECART project has been funded with support from the European Commission. This document reflects only the views of the authors.Habersaa
The Commission is not responsible for any use that may be made of the information contained therein.

Acknowledgments & contributors

The authors of this report are particularly grateful to the students, faculty, university managers, academic leaders, teaching and learning professionals, and educational researchers who gave their time for fruitful discussion in the partner institutions, during conferences or workshops, during DECART onsite and virtual meetings activities or training, or even aside other project meetings. DECART Industry partners and Associations are warmly thanked for their advice.

A special thanks to Anna Gomes-Guerra and Bérenger Hautier, two former students of IMT Atlantique who helped through a student research project from September to December 2023 to the conception of the DECART questionnaire found in the annex of this BoK.

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, 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 process,

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 Jacovett, Siegfried Rouvrais, and Roger Waldeck from IMT Atlantique,

- Chantal Puren and Coraline Lozac'h for the project administrative purposes
  - Also with Joanne Gardner Le Gars 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.

www.decartproject.eu

The European Commission support for the production of this report does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Main project contact:
Dr. Siegfried Rouvrais
IMT Atlantique
Graduate School of Engineering
Technopôle Brest-Iroise, CS 83818
Brest, France