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VUCA Scenarios Impacting Higher Education

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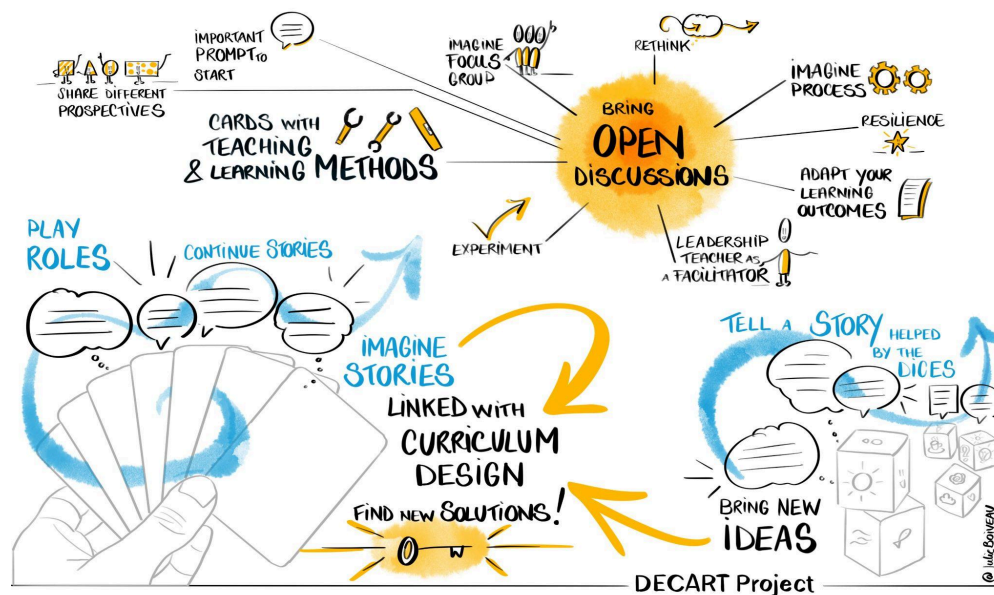
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DECART: Designing higher Education Curricula for Agility, Resilience & Transformation

DECART Workpackage 1: Curriculum Design

Report R12: VUCA Scenarios Impacting Higher Education

version 1.0, April 2024



DECART Project

Day 4 - 16/02/2024 - Curriculum analysis

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 (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, *VUCA Scenarios Impacting Higher Education* (report R12) summarizes the work done in the first phase of the project, i.e. on curriculum design, and in particular on the effect of VUCA scenarios on curriculum design. This was done through discussions among the partners and by a survey done in the latter part of 2023. The survey focussed on potential VUCA scenarios that faculty had experienced or foresaw, and the perceived sensitivity of different components of curricula to these events. Finally, the report summarizes the findings from the survey.

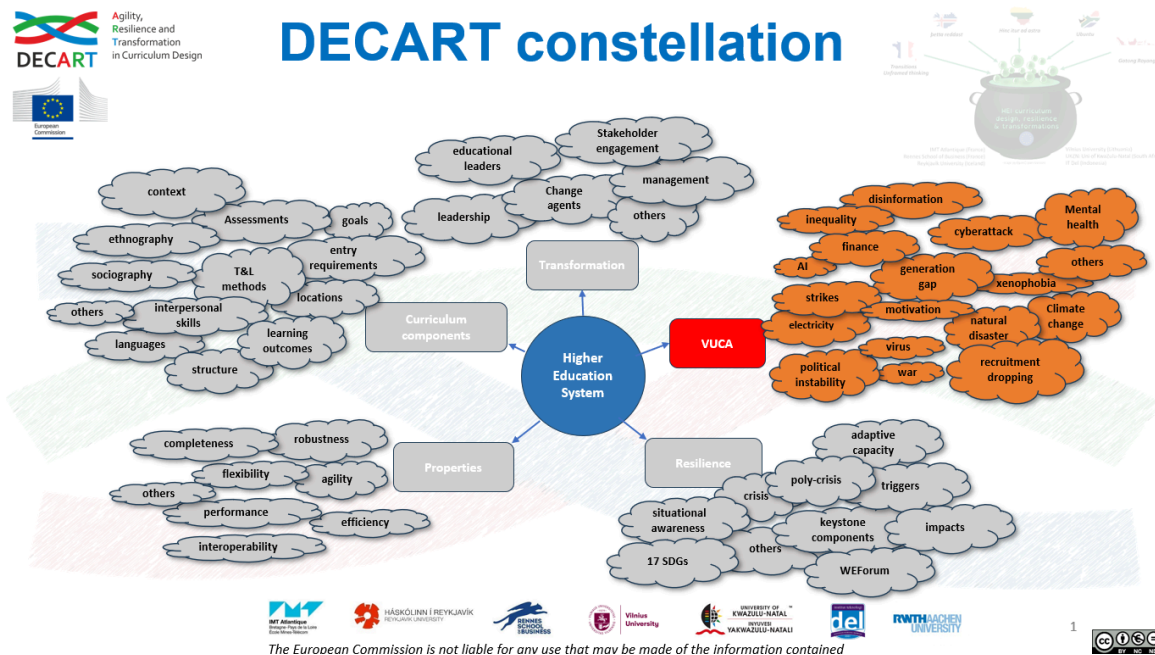


Figure. The DECART components - here focusing on VUCA that may impact higher education system.



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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
Asia	ITD: IT Del, Laguboti, Toba, Indonesia	Computer Science	Arinta 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
	RSB: Rennes School of Business, Rennes, France	Management	Joanne Gardner Le Gars
	RWTH: Aachen University, Aachen, Germany	Engineering	Clara Lemke



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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



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Dissemination model

Type	<input type="checkbox"/> Teaching material <input type="checkbox"/> Learning material <input type="checkbox"/> Training material <input type="checkbox"/> Event <input checked="" type="checkbox"/> Report <input type="checkbox"/> Video <input type="checkbox"/> Service/Product
Languages	English
Target groups	<input checked="" type="checkbox"/> Teaching staff <input type="checkbox"/> Students <input type="checkbox"/> Trainees <input type="checkbox"/> Administrative staff <input type="checkbox"/> Technical staff <input type="checkbox"/> Librarians <input checked="" type="checkbox"/> Other: <i>University Management</i>
Dissemination level	<input checked="" type="checkbox"/> Department / Faculty <input checked="" type="checkbox"/> Institution
Lead Organisation	WP1 coordinator: RU, Haraldur Audunsson
Participating Organizations	European partners: IMTA, RSB, RU, RWTH and VU African partner: UKZN ASEAN partner: ITD



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Summary

This report outlines the work done in the first work package of the DECART-project, which focused on curriculum design, with specific emphasis on curriculum properties and design principles. More specifically, the report is based on cooperative work and discussions among the partners in the project and on an online survey about potential VUCA scenarios that faculty had experienced or foresaw, and the perceived sensitivity of different components of curricula to these events. The report includes general discussion on how VUCA scenarios may affect higher education and curricula.

Finally, the report summarizes the findings from the survey based on actual VUCA scenarios that faculty had already experienced, potential VUCA scenarios as perceived by faculty, listing of the components of a curricula that are perceived as being sensitive to the impact of VUCA scenarios and should therefore be scrutinized when developing resilient curricula, and finally preliminary study on external potential drivers that may affect directly or modulate curricula, which forms the basis for further work on characterizing VUCA events and scenarios that will affect higher education and hence be included when designing resilient curricula. According to the perception of the respondents to the survey, four out of the nine components that constitute a curriculum as defined in the DECART project, were considered most sensitive to the impact of VUCA scenarios, i.e.:

- teaching methods,
- location of teaching and learning,
- assessment methods and
- teaching of interpersonal skills.

When considering potential VUCA scenarios that may affect educational programs, • artificial intelligence (AI) was of most concern, followed by events like • disinformation online, • cyberattack, • disrupted online communication, and then • climate change and • natural disasters. It should be realized that the potential VUCA events and scenarios being considered may inherently be biased towards topical issues.

In addition there is one case presented on AI, how “ChatGPT fills the desire to know and kills the desire to learn” and how it is currently tackled by a faculty member at an South African university.

This report, *R12: VUCA Scenarios Impacting Higher Education*, is the second one outlining the work in Workpackage 1 (WP1) in the DECART project on Curriculum Design. The previous report, R11, is titled *R11: Curriculum Properties and Styles*, and the third one is *R13: Learning Material on Curriculum Design*.

1. Introduction

VUCA scenarios

The term VUCA is becoming well known to describe situations that are volatile, uncertain, complex and ambiguous. These four dimensions are often considered comprehensive in situations of this type, although the intensity of each may vary depending on the event. Because the world and society is changing at a faster pace than before, one expects VUCA to become more prevalent and important. There is plenty of literature on all kinds of VUCA scenarios, and on their occurrence and effect in different realms. To give example of VUCA events, just to name a few, may include:

Financial crisis
Surge of immigration
Unstable software systems

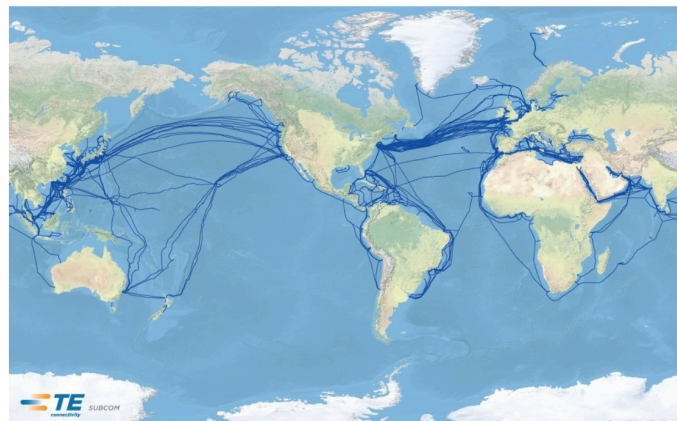
Natural disaster
Lack of electricity.

Figure 1.1 shows two examples. One is a natural disaster, an eruption in Iceland, something we have known of for hundreds of years, and the other example spotlights how dependent and vulnerable communities are to using the internet and the undersea cables for transmitting information. How these and similar events may affect higher education and curriculum is indeed one of the objectives of the DECART project.

Local and global



Íyjafjallajökull gaus árið 2010 og ríðskali flugi í langan tíma. mbl.is/20h
www.mbl.is/frettir/innlent/2020/04/14/tiu_ar_fra_thvi_gos_hofst_i_eyjafjallajokli/



manoa.hawaii.edu/kaunana/u-n-task-force-says-new-ocean-telecom-cables-should-be-green/

Figure 1.1 Examples of local and global events, i.e. a local eruption and international network of undersea communication cables. This figure was used in a presentation at PM2.

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The VUCA terms are defined more specifically in the DECART project as shown in Table 1.1.

What is the meaning of **VUCA**?

VUCA is an acronym that describes specific characteristics of situations that challenge organizations' coping capacities i.e. their resilience. In the DECART project, the VUCA terms are interpreted as follows:

Volatility	a situation liable to change rapidly.
Uncertainty	a state of limited knowledge where it is difficult to predict a future outcome.
Complexity	a state of having many parts/multiple variables, being difficult to understand or find the answer to.
Ambiguity	a situation open to more than one interpretation and inexactness, more than one possible meaning.

Table 1.1. Outline of VUCA as listed in Newsletter 1 of the DECART project.

What the 21st century may bring the world, let alone the educational systems worldwide, is to some extent uncertain, but our work is to try to look into the future and prepare the education systems as well as possible, in an effort to make it more resilient. Figure 1.2 is a visual representation of the situation.



Figure 1.2. Deciphering the 21st century (figure from Newsletter 1 of the DECART project).

Two examples of VUCA scenarios.

VUCA events can be either local or global, as depicted in Figure 1.1, but often it is not so easy to categorize them in such a simple manner, nor specify exactly their character and impact. Potential events are very diverse, and although an event may appear local with severe local impact, like the eruption in Figure 1,1, it may disrupt commercial flights globally for days and weeks. Which was actually the situation for the eruption in 2010 (<https://earthobservatory.nasa.gov/images/43684/eruption-of-eyjafjallajakull-volcano-iceland>). Another effect, disruption of undersea communication cables may have both local, national and continental effects. For example, undersea cables connect countries and continents, as depicted in Figure 1.1 and Figure 1.3, are becoming very important for communication and disruption of them can have significant effects, both across continents and within countries.

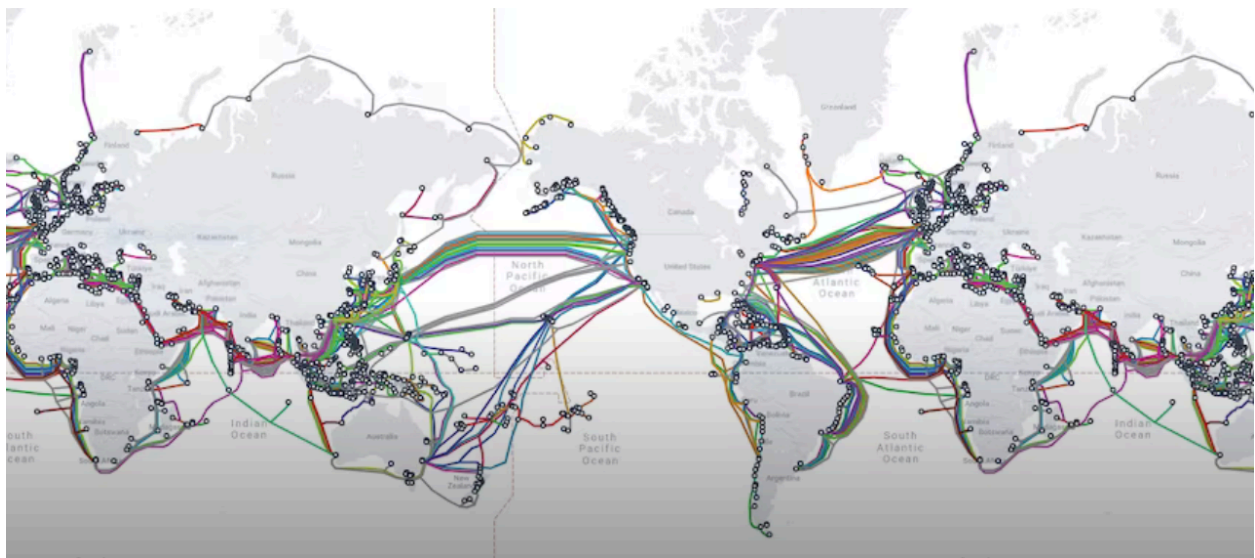


Figure 1.3. Undersea communication cables across the globe, showing both densely populated areas and smaller more isolated locations that may depend heavily on this form of communication. Image from

<https://www.abc.net.au/listen/programs/latenightlive/geopolitics-of-undersea-cables-joe-brock-lane-burdette/102899874> .

The breaking of an undersea communication cable on the west coast of Africa affected email, work teams and bank service, to mention a few. And it follows that it affects higher education as it depends so much on communications and data transfer. The heading of this news item tells a big story: “Multiple undersea cable failures between South Africa and Europe are currently

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impacting South Africa's network providers, including Vodacom.”
(<https://techcentral.co.za/internet-south-africa-subsea-cable-breaks/241390/>).

As an example of the vulnerability of today's society and higher education is the heading in the news media shown in Figure 1.4.



Figure 1.4. Heading on the web TechCentral
(<https://techcentral.co.za/internet-south-africa-subsea-cable-breaks/241390/>).

Although the internet is designed in such a way it is robust to some extent to failing connections, these disruptions can severely limit the operation and communications in smaller communities. For example, oceanic islands like Iceland are very vulnerable, which depend on just a few undersea cables to connect to the larger world. Smaller communities along the Arctic Circle are even more sensitive to disruptions to these cables, as indicated in Figure 1.3. Communities all around the globe are more and more dependent on electronic communications, including these undersea cables, hence are more vulnerable to disruptions - which may at times be considered a VUCA scenario.

Measures of VUCA

For a particular VUCA scenario these four dimensions V, U, C and A, may have different intensity, and one way to describe that is shown in Figure 1.5. In addition, as the reaction to these events is people and personal communication, often the fifth dimension is added, the interpersonal one.

	Inter-personal	Volatility	Uncertainty	Complexity	Ambiguity
strong		X			
medium	X				
weak			X	X	X

Perturbation rubric adapted from Siegfried et al, 2018.

Figure 1.5. Rubric to evaluate and describe different intensities of the four dimensions of VUCA for a particular scenario, along with the interpersonal dimension.

Another aspect of VUCA scenarios and their impact is time, as some events may occur quickly with sudden impact, but others may take longer and have more prolonged effects that may thus take longer to affect the system. This is of particular concern for education, as the time frame is sometimes from one class hour to several years. Although the basic dimensions of VUCA are only four, the diverse actual effects on higher education and curricula are diverse, ranging from sometimes direct, sudden, and great effect, to indirect, long term and of little effect. Hence, one may add characteristics to potential events affecting education that include the effect of time and if the event has direct effect or not, as shown in Table 1.1.

Table 1.1. On potential rubric to evaluate or characterize the impact an VUCA event can have on an educational system and curriculum.

VUCA impact	<i>time</i>	<i>effect</i>
	immediate	direct
	prolonged	indirect

Effect of VUCA on curricula and operation of educational systems

Although a particular VUCA event may be very well characterized, its effect on higher education and curricula can be quite complex and ambiguous, and the relevance may be very site specific. One should be aware that VUCA scenarios can cause adverse effects, but also invite positive consequences, something to learn from and by inspired form, and can thus improve how one designs curricula and operates an educational system. Furthermore, even a single VUCA scenario may bring about both effects.

The harmonized DECART curriculum, Table 1.2, appears to be a reasonable framework to test the sensitivity and resiliency of an educational program to unexpected and disruptive events, akin to the four dimensions of VUCA. In this work we want to test the sensitivity of different educational programs to the impact of VUCA events, using the curriculum of the programs. The results will then guide the revision and the design of programs that are more resilient to such events and scenarios. This approach was indeed the basis for our survey on potential VUCA scenarios that may affect higher education, and in particular curricula.

Table 1.2. The nine components of the DECART harmonized curriculum.

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

Example - Transforming curriculum

One outcome of WP1 in DECART is a practical template of curriculum in higher education and the context it operates within. We want to test it's sensitivity to external VUCA events and disruptions, and the results may form a basis for continuing work on transforming curriculum.

Opertti (2023) in the report *Curriculum in Transformation Mode* uses the structure by Jonnaert (2021) and, among other sections, there is one on "The curriculum in a context of disruption".

The characteristics listed in the report are on a much longer timescale than the ones normally referred to as VUCA scenarios. Even so these characteristics may add some dimensions to VUCA-discussions and are listed here (Opertti, 2023, page 14):

- *The emergence of technology that blurs—while it simultaneously reshapes—the borders between the physical, digital, and biological dimensions.*
- *The lengthening of the human lifespan and the redefinition of cycles of life, education, and work.*
- *The growing impact of technology in shaping our perceptions of the world, changing our behaviour, and influencing our identities as human beings.*
- *The profound changes in the relationships between humans and nature, as well as between humans and machine learning.*
- *The tensions and synergies between coexistence, complementarity, and competition with machine learning.*

References for this section:

Opertti (2023): *Curriculum in Transformation Mode*,
<https://www.ibe.unesco.org/en/publication/curriculum-transformation-mode>

Jonnaert (2021): *Towards indigenous curricula*, In-Progress Reflection No. 41,
<https://unesdoc.unesco.org/ark:/48223/pf0000375339>

Literature on VUCA situations is abundant, as well as on how today's VUCA world may affect students' journey through their education. As is evident from the discussion above, analysing how VUCA scenarios do affect educational systems is complex and can be ambiguous, but such research is slowly emerging, and the DECART project is indeed one important contribution in such analysis.

Example - Transforming curriculum in Indonesia

Educational systems may react differently to external events and the systematics of reaction is country dependent and may also depend on the hierarchy of the education system. Although this issue will be worked on more later in the DECART project, on transformation in WP3, it is worth mentioning it briefly here. In Indonesia for example, if an external event, be it a VUCA event or change in delivery, affects an educational program it triggers an event in the curriculum, for example change the learning delivery. The study program should then coordinate with its upper organization, which is the practice in Indonesia where one can not easily change the current running curriculum. A study program is driven by the authority of the faculty, which is

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driven by the Vice Rector of academic affairs, which is under the rector. The rector is directly under the minister of education. The same applies to both public and private universities in Indonesia. This structure may vary among countries and cultures, but the reality of different hierarchies of educational systems should be considered when evaluating the mechanism of transformation of curriculum.

Objective of the first work package

The objective of this first work package (WP1) is to share experience among the participants, and select external HEI leaders, ascertain the experience and hence obtain a holistic perspective into the diverse practices in curriculum design. WP1 has three sub objectives:

1. **O11: to share innovative curricula:**
 - to learn from and be inspired by partners and other institutions having original curriculum structure, backgrounds or way of doing, including student centered learning, SDG, entrepreneurship or work integrated learning, research orientation, decolonisation, freedom of learning, scaled multisite, native reconciliation, original managerial cultural heritage, inclusion, diversity;
2. **O12: to identify external drivers for curricula transformation and VUCA scenarios:**
 - review accreditation needs of external quality assurance systems in STEM and Management curricula, constraints, flexibilities;
 - return the experience (RetEx) from Covid crisis and agility principles;
 - imagine and reflect on potential VUCA scenarios and timeframe of agility.
3. **O13: to obtain an holistic perspective into the diverse practices/modes of designing curricula, need for agility and general architectures of curricula:**
 - provide and share a new view of meaning on curriculum structures
 - identify and categorize internal drivers of partner' curricula transformations, first indicators of resilience
 - design curriculum workshops, to highlight why and how collaboration is needed to open mindsets and encourage innovation. On an international scale, collaboration of all stakeholders in design can be done effectively even with online tools. Online collaborative tools are excellent for producing a "collective" design, the design can be iteratively improved and facilitate collaboration from different parts of the world.



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Outcome of this report

This report, R12: *VUCA Scenarios Impacting Higher Education*, covers the work done according to one of the sub objectives in O12, to imagine and reflect on potential VUCA scenarios and timeframe of agility.

The other two reports, R11: *Curriculum Components and Properties* and R13: *Learning Material on Curriculum Design*, cover the rest of the objectives presented above.

Continued work and more in depth will be presented in the second and third work packages of DECART (WP2 and WP3).

It is clear that potential VUCA scenarios are abundant, but it is not at all obvious which effects may affect curricula and higher education, let alone outlining the specific effects. Therefore, as part of work package 1 (WP1) we implemented a survey among all the participants in the project and faculty at the respective institutions. The process and the main results are presented in the paper "*Factors that may impact curriculum design in higher education in a VUCA world*" which is reproduced in **Appendix A** to this report.

The work presented here is based on the third objective of O12. The main results are this report itemizing lessons learned and inspirations from all partners, listing of potential and realistic VUCA scenarios and initial test of sensitivity of curriculum to VUCA scenarios, via:

- collaborative workshop activities to analyze curricula structures facing given constraints and VUCA scenarios,
- general discussions and clarification of challenges and tensions exacerbated e.g. by the 2020 pandemic in higher education, and how institutions adapted and learned from this experience.
- online survey on VUCA scenarios and sensitivity of components of curricula to VUCA scenarios
- general factors to consider when designing curriculum that facilitates more flexibility and resilience in adaptation to changes or unexpected crisis;
- VUCA cards to test curriculum outline against VUCA scenarios, hence the properties of agility and resilience (this game is described in R13: *Throwing VUCA cards at curriculum canvas*).



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2. Potential VUCA scenarios and timeframe of agility - the survey

The purpose and design of the survey

This report (R12) focuses on what kind of VUCA scenarios may affect curriculum design within the context of the VUCA world. The results form the basis for the ensuing work in the DECART project on how VUCA scenarios may impact curriculum and eventually how one may design curriculum and operate educational programs in such a way that they are more resilient in a VUCA world. The results of the work are based on discussions online, in workshops and on a survey among faculty at the participating institutions in the DECART project and on collaboration among the partners in the project. The process and the main results are presented in the paper "*Factors that may impact curriculum design in higher education in a VUCA world*" which is reproduced in **Appendix A** to this report.

To achieve the aim of this research, i.e. to better understand which components of curricula are sensitive to potential VUCA scenarios, we developed an online survey. The components of this harmonized curriculum model, and which are used as the basis in the main survey, are listed in Table 1.2. (this is the same as in the previous report R11, but is included here for easy reference).

In June 2023, a preliminary version of the survey was developed and conducted. It focused only on potential VUCA scenarios and became an inherent part of the main survey. In October and November of 2023 the main survey was conducted. It was sent to several faculty members at six different institutions of higher education that are involved with the DECART project. At each institution, one person was responsible for sending the survey to faculty members that were either directly involved in curriculum design or responsible for running educational programs. The survey was implemented using docs.google.com service. Figure 2.1 shows the introductory section of the survey and Table 2.1 shows the four parts of the survey.

DeCART questionnaire on VUCA sensitivity of curriculums and education

B I U ↻ ✕

In this survey we are interested in unexpected and impactful events that you foresee may occur and affect the curriculum of the program that you are mostly concerned about or involved with at your institution.

Here we use "unexpected and impactful event" as a more general description rather than the technical and more analytical term VUCA, which stands for volatile, uncertain, complex and ambiguous. Examples of these events may include unexpected lack of local electricity, strikes, AI (artificial intelligence), sudden changes due to global warming, and so on.

Figure 2.1. Introductory section of the online survey, done by using docs.google.com service.

Table 2.1. The four parts of the survey.

<i>Part of survey</i>	<i>Questions</i>
Part 1	3 questions: background questions on involvement or experience with STEM, management or other education, on expertise in curriculum design, and the country where one is based.
Part 2	9 questions: directly on the different components of the harmonized curriculum model
Part 3	6 questions: on specific potential VUCA scenarios.
Part 4	Open comments: space for respondents to make open remarks on potential VUCA events and scenarios that may impact the program, as well as on the survey in general.

As the term VUCA may not be understood in the same way by all, it is not a common term, in the survey we instead used the phrase "*unexpected and forceful event*". The scale used for the

responses were based on the five-point Likert scale, with “Totally disagree” and “Totally agree” at the ends of the scale.

A total of 37 responded to the survey, and at least 4 from each of the partner institutions, and of these only two out of the 37 indicated that they had little or no expertise. Table 2.2 shows the results from part 1 of the survey.

Table 2.2. Number of respondents, field of education and countries.

	Involved with STEM education	Involved with Management education	Other	Total
France	4	5	0	9
Germany	4	0	0	4
Iceland	8	0	0	8
Indonesia	2	1	1	4
Lithuania	4	1	1	6
South Africa	0	6	0	6
Total:	22	13	2	37

Respondents to the survey had an opportunity to make open remarks on potential VUCA scenarios that may impact the program, as well as on the survey in general, i.e. part 4 in Table 2.1. These remarks, done at the conclusion of the survey, are all listed in Appendix B.

Results from the survey

According to the perception of the respondents in the survey (see paper in Appendix A), four of the nine components of the curriculum may be considered sensitive to VUCA scenarios. These four are:

- teaching methods,
- location of teaching and learning,
- assessment methods and
- teaching of interpersonal skills.

The first three refer to how one actually conducts the teaching and facilitates the learning, and these components may very well include the ambivalence towards AI. The inclusion of the component “teaching of interpersonal skills” may reflect the increasing need for such skills in the workplace, as well as during the learning process and perhaps it underlines an ongoing endeavor in higher education.



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One relevant case is the CDIO initiative that refers to a revised vision of engineering programs, an international initiative that started almost twenty years ago and which quite many engineering departments worldwide have adapted. The CDIO abbreviation refers to Conceive, Design, Implement and Operate, the four main themes of the initiative. To measure the adaption of the CDIO themes in an educational program, 12 standards are used and they form the basis of the relevant rubrics, and although CDIO focuses primarily on engineering education (www.cdio.org), interpersonal skills are mentioned in 6 out of the 12 standards of the CDIO initiative.

Of the potential VUCA scenarios that may affect educational programs, the following were ranked the most important or of most concern:

- AI, in an ambivalent manner,
- disinformation online,
- cyberattack,
- disrupted online communication,
- climate change, and
- natural disasters.

The VUCA events and scenarios which were identified, will support further work in the DECART project and will be refined through cooperative workshops with faculty and other stakeholders. Such events will allow for the development of good to best practices regarding curriculum resilience and adaptation.

3. On Artificial Intelligence (AI)

It is very evident from the survey, that the respondents' perception is that AI is the main concern for the future when considering the operation of educational systems and in particular teaching and learning.

Experience from South Africa - ChatGPT fills the desire to know and kills the desire to learn

Discussion with an academic at a South African University. "I feel the stress as an academic. We use Turnitin. All students have to run all assignments and Masters and Doctoral research through Turnitin. Now Turnitin offers us the option to see potential use of AI. Problem is that we all agree that we need clear and consistent institutional policies and processes to ensure that we respond appropriately, but it seems easier said than done. For now, I have added in a nice



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long paragraph in my assignments about plagiarism and use of AI, and how we can check with Turnitin.”

“Academics have to set up the Turnitin accounts, then share details with their students. Students can see the similarity index and have a chance to revise until the deadline. We do not allow more than 10%. We as academics can then log in and check the submissions. Students must then upload all submissions to Turnitin - it must be students who upload so that they can be in charge. It is also important that students are trained / oriented regarding using Turnitin, as well as good academic writing, plagiarism and referencing.“We speak to them about it in class and also show them how the Turnitin reports look and what we will see. So we make it very clear to them that we will look at the similarity index and the AI %. Also emphasize that they must upload timeously and not wait for the 11th hour.

4. Conclusion

This report is on the work done in WP1 focussing on how VUCA scenarios may impact higher education. First, it is argued that there are numerous events with the VUCA characteristics that can affect the operation of educational systems, secondly their number and effect may be increasing in today's world, and thirdly the effects are quite often ambiguous, let alone they can be either mild, disastrous or even stimulate positive revisions. A survey was conducted among faculty in six different countries, a total of 37 respondents. The aim of the survey was twofold, to ascertain the sensitivity of different components of a curriculum to the impact of VUCA scenarios and then list potential and the most relevant VUCA scenarios. Considering the perceptions that emerged from the survey, the factors that need to be further examined, especially when designing curriculum, is the way in which teaching is actually conducted and learning facilitated, and specifically how AI may impact the curriculum. Due to the few respondents, given the nature of the study, one should be careful in generalizing the results, which essentially represents exploratory indications and perceptions of the respondents at the time that the study was conducted. The results contribute to the foundation in the next work packages in the DECART project.

The work and data presented here is the basis of the paper “*Factors that may impact curriculum design in higher education in a VUCA world*”, Proceedings of the 20th International CDIO Conference, hosted by Ecole Supérieure Privée d’Ingénierie et de Technologies (ESPRIT) Tunis, Tunisia, June 10 – June 13, 2024



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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 November 2022. All DECART partners share values and ideologies around the project objectives. This DECART report, as project WP1 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	WP1 Coordinator: RU
Participating Organisations	European partners: IMTA, RSB, RU, RWTH and VU African partner: UKZN ASEAN partner: ITD

The 'leader' for the collaborative writing of this report was Haraldur Audunsson, Reykjavik University. 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 alphabetical order of country:

- 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
 - Joanne Gardner Legars and Elodie Huré from Rennes School of Business
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Agility,
Resilience and
Transformation
in Curriculum Design

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Appendix A

Copy of the paper “*Factors that may impact curriculum design in higher education in a VUCA world*”.

This paper outlines the survey, its design, implementation and results. The paper will appear in *Proceedings of the 20th International CDIO Conference, hosted by Ecole Supérieure Privée d’Ingénierie et de Technologies (ESPRIT) Tunis, Tunisia, June 10 – June 13, 2024.*



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FACTORS THAT MAY IMPACT CURRICULUM DESIGN IN HIGHER EDUCATION IN A VUCA WORLD

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ABSTRACT

Higher Educational Institutions (HEIs) have been characterized by volatility, uncertainty, complexity, and ambiguity (VUCA), with the Covid-19 pandemic being a recent example, which significantly affected higher education worldwide. The aim of this research was to better understand which components of curricula are sensitive to potential VUCA-like events, and which VUCA events one may foresee that may impact study programs and teaching. A survey was developed to gather data, and thirty-seven faculty members with experience in curriculum design from six countries participated in the survey which was carried out in 2023. To start with, we outlined the different components of a curriculum which then formed the basis for evaluating their perceived sensitivity to VUCA-like events. Based on the survey we then analyzed and summarized the factors that may potentially impact the curriculum. The components of a curriculum that are most sensitive to VUCA-like events are the ones directly related to the actual teaching and learning processes. In addition, the study findings indicated that when considering potential VUCA-like events, Artificial Intelligence (AI) was expected most likely to significantly affect educational programs, followed by events such as disinformation online, cyberattacks, disrupted online communication, as well as climate change and natural disasters. The increasing VUCA characteristics of the world are expected to affect the curriculum in general and in particular the actual teaching and learning. Therefore, HEI leaders and curriculum designers need to ensure that the HEI system is responsive to the VUCA-like events and that the system becomes resilient.

KEYWORDS

Curriculum design, curriculum sensitivity, VUCA events, CDIO Standards: 1-12.



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INTRODUCTION

Most countries provide educational guidance on what to teach and the educational process at each school level; this guidance is referred to as the curriculum or curriculum standards. The curriculum is important to identify the focus of the content, describing the degree of learning appropriate for the preparation of students for the future, and to ensure the introduction of the content in relation to the goal of the education. The complexity of the modern world requires a curriculum that transcends disciplinary boundaries, and which is resilient (Ciolacu et al., 2023; Ramsaroop, 2023). Interconnected global challenges such as climate change, economic inequality, and technological innovation demand an interdisciplinary approach to education. Curriculum designers must emphasize the integration of diverse perspectives, fostering a holistic understanding of complex issues and preparing students to engage with multifaceted problems (Ciolacu et al., 2023).

In the ever-evolving landscape of higher education, educators and curriculum designers find themselves grappling with the challenges posed by the volatile, uncertain, complex and ambiguous (VUCA) nature of today's world (Pannipa et al., 2023; Rouvrais et al., 2023), which has been characterized by pandemics, wars, and erratic weather (Rockley, 2022), and an uncertain future which may bring about further surprises. Multiple disruptions in Higher Educational Institutions (HEIs) over the years have resulted in curriculum leaders having to consider the relevance and impact of the programs that are offered. The Covid-19 pandemic was particularly disruptive for higher education as a whole (Ramsaroop, 2023), and resulted in many HEIs being pushed rapidly into much-needed technological advancement (Ciolacu et al., 2023). HEIs have to be proactive and agile to be able to respond to the multiple disruptions in the external and internal environments.

In engineering education, the principles of VUCA offer a strategic lens through which to comprehend and address the multifaceted landscape that engineers must navigate (Kamp, 2023). Furthermore, program leaders have to design and operationalize their curricula in a context of unknown changes (Ciolacu et al., 2023). Designing a curriculum involves defining and describing its components and structure (van den Akker, 2004). When ascertaining the factors that may impact the curriculum, in particular from potential VUCA-like scenarios, one way to do so is to look at the effect they may have on these components.

The authors of the paper are part of a project called DECART and are from the fields of STEM and management education. The project is an international cooperation partnership, including France, Germany, Iceland, Indonesia, Lithuania, and South Africa. The primary goal is to allow partner's organizations to develop new practices and methods as well as sharing and confronting ideas in curriculum design, with a focus on Designing higher Education Curricula for Agility, Resilience and Transformation. Here in this paper, we focus on one aspect of the project by examining curriculum design within the context of a VUCA world.

In this paper, we present results from a survey that was carried out to better understand which components of curricula are sensitive to potential VUCA-like events, and also VUCA events one may foresee that could impact study programs and teaching in higher education. The respondents who completed the survey are mostly from STEM and management education.

LITERATURE REVIEW

Policy documents from OECD and UNESCO emphasize the need to support today's students to develop skills and attitudes to survive and succeed in a VUCA world (Hadar et al., 2020). Looking through the VUCA lens provides an opportunity to understand the dynamic forces at play in the contemporary educational environment (Ramsaroop, 2023; Niemczyk, 2023). As industries undergo rapid technological advancements, globalization reshapes collaboration, and societal needs evolve. It becomes imperative for higher education curriculum designers to adopt an adaptive, forward-thinking approach.

In the abbreviation VUCA, volatility refers to the frequent, rapid, and unpredictable changes that characterize today's world (Bennett & Lemoine, 2014). It is critical to understand the opportunities and threats which are present in the situation, and to embrace agility to deal with the volatility. Uncertainty acknowledges the lack of predictability and the prevalence of unknowns, and essentially relates to the lack of adequate information (Bennett & Lemoine, 2014). Complexity recognizes the intricate interconnections that shape educational contexts, with a complex situation being defined by many interconnected parts (Bennett & Lemoine, 2014). Ambiguity acknowledges the haziness of situations where cause-and-effect relationships are unclear, and where there is little precedent to enable predictions to be made (Bennett & Lemoine, 2014). In the realm of curriculum design, embracing VUCA is not merely a response to these VUCA challenges, but an opportunity to foster resilience, innovation, and lifelong learning skills among students.

Prideaux (2003) argues that "The curriculum represents the expression of educational ideas in practice. The word curriculum has its roots in the Latin word for track or race course. From there it came to mean course of study or syllabus. Today the definition is much wider and includes all the planned learning experiences of a school or educational institution". Curriculum furthermore refers to the formal requirements for the degree or syllabus, and is usually composed of contents and topics relating to lectures, reading lists, and content knowledge (Annala & Mäkinen, 2011). The more holistic definition of the higher education curriculum provided refers to "an intentional and dynamic process, which reveals the values and principles in relation to learning, knowledge and disciplines, and cultural and political purposes of HE" (Annala & Mäkinen, 2011, p. 4).

RESEARCH METHODOLOGY

To achieve the aim of this research, as stated in the Introduction section, we developed an online survey. As is evident from the above review of the literature, a curriculum may have varied meanings and different structures, so we started out by analyzing the structure of actual curricula used in STEM and management education for the purpose of this research. Firstly, the curriculum is designed within the overarching external constraints, which may include national policies, stakeholders, and accreditation bodies. Secondly, curriculum is often presented as a set of components (e.g. van den Akker, 2004; Jonnaert et al., 2021).

In this research, we used actual examples of curricula presented by all six partners in the DECART project and based on an analysis of them, we developed a harmonized curriculum model consisting of nine components. This model is in general agreement with conventional curriculum models (e.g. van den Akker, 2004), with some components being basically the same, but there are additional components which include stating explicitly entry requirements (#2), on interpersonal skills (#6), language (#8) and ethno- and sociographic aspects (#9). As



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the model is based on actual curriculum, it may reflect more the current situation concerning programs in higher education. The components of this harmonized curriculum model, and which are used as the basis in the main survey, are:

1. Main goals and learning outcomes of the program, including its objectives.
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.

A survey was conducted; a preliminary version of the survey which was developed initially focused only on VUCA events and then it was later finalized and constitutes the main survey. The preliminary survey was conducted in June of 2023 with a small subset of the respondents that participated in the main survey which was conducted in October and November of 2023. The main survey was sent to several faculty members at six different institutions of higher education, all of which are involved in the DECART project. At each institution, one person was responsible for sending the survey to faculty members that were either directly involved in curriculum design or responsible for running educational programs. These members received a link to the survey which was conducted online.

In the survey, the faculty were asked to consider which components of the harmonized curriculum model might be affected by some VUCA-like events, and also which potential VUCA scenarios they foresee might happen in the future and affect current educational programs. The purpose was to evaluate the sensitivity of different components of the curriculum to unexpected VUCA-like scenarios. The survey was composed of four parts. The first part presented three background questions, i.e. on involvement or experience with STEM, management or other education, on expertise in curriculum design, and the country where one is based. This was followed by nine questions directly related to the different components of the curriculum model as outlined above. The third part presented six general questions on specific potential VUCA-like scenarios. The fourth part was to allow respondents to make open remarks on potential VUCA-like scenarios that may impact the program, as well as on the survey in general. As VUCA is not a common term and perhaps not understood in the same way by all, in the survey we used the phrase "unexpected and forceful event". The scale used for the responses were based on the five-point Likert scale, with "Totally disagree" and "Totally agree" at the ends of the scale.

When asked to rate their expertise of program curriculum design, 35 out of 37 respondents indicated expertise, and only two out of the 37 indicated that they had little or no expertise. Table 1 shows the total number of respondents.

Table 1. Number of respondents, field of education and countries.

	Involved with STEM education	Involved with Management education	Other	Total
France	4	5	0	9
Germany	4	0	0	4
Iceland	8	0	0	8
Indonesia	2	1	1	4
Lithuania	4	1	1	6
South Africa	0	6	0	6
Total:	22	13	2	37

There are several ways to analyze the data based on the responses on the Likert-scale, including statistical methods or simple fractions. Here we want to focus on the number of respondents that agree with the given statement compared to the respondents that disagree. Therefore, to distinguish these positive agreements, we used the number of responses in categories “Strongly agree” and the one next to it (“Agree”) and compared it to the number of responses in “Strongly disagree” and the category next to it (“Disagree”) by using a simple ratio of the two. This bias ratio is labeled R in Tables 2 and 3. In the analysis of the data, we consider a response convincingly positive if the bias ratio R is two or higher and the mode is on the positive side, i.e. either “Agree” or “Strongly agree”.

RESULTS AND DISCUSSION

Sensitivity of components of the curriculum

In the survey, nine statements were focused on the sensitivity of each of the different curriculum components to VUCA-like scenarios. The components were the ones of the adapted curriculum model as presented in the Introduction section. All the statements had the same structure, i.e. “I am concerned that the *main learning outcomes* of the program, including its goal and objectives, will change significantly in the near future due to unexpected and impactful events”, and so on. The words in italics in exemplary statements above were replaced by the ones listed in Table 2. Counts of the responses are presented in Table 2.

Table 2. Sensitivity of different curriculum components. Entries represent the number of responses for each category.

<i>Component</i>	Likert scale category					R
	Strongly disagree				Strongly agree	
1. main learning outcomes	4	7	11	10	5	1,4
2. entry requirements	5	8	11	8	5	1,0
3. structure of the program	3	8	8	11	6	1,5
4. teaching methods	3	5	7	15	7	2,8

5. location of teaching and learning	1	9	7	16	4	2,0
6. teaching of interpersonal skills	2	7	7	13	7	2,2
7. assessment methods	3	6	8	13	7	2,2
8. language of instruction	10	9	7	8	3	0,6
9. ethno- and sociographic aspects	2	13	8	10	4	0,9

Four components have both distinctly higher R than the rest of the statements and modes on the agree-side, satisfying our criteria of being convincing. Therefore, there are four components of the curriculum that the respondents were concerned about that may change and may therefore be more sensitive to unexpected and impactful events. These four components are Teaching methods ($R=2,8$), Location of teaching and learning ($R=2,0$), Teaching of interpersonal skills ($R=2,2$) and Assessment methods ($R=2,2$).

The sensitivity of Teaching of interpersonal skills (#6) may be due to shifts in the world of work, coping with studies, and perhaps this is a skill that has not received enough attention over the years. One may argue that the other three (#4, 5 and 7) of these components are considered more sensitive because of the impact of the Covid-19 pandemic, like online teaching and learning, more options in teaching methods and assessments, and the uncertain effects that AI may have on higher education. These changes will certainly affect faculty, as they have no option but to adapt, but they may not know how exactly to do so.

Potential VUCA events

The statements on six specific potential VUCA events in the main survey were based on the most frequently mentioned events in the preliminary survey. In the main survey, all six statements had the same structure, i.e. "I am concerned that *AI (Artificial Intelligence)* will significantly affect the program.", and similar for the other five events (the words in italic were replaced in each statement by the ones in Table 3). The results are shown in Table 3.

Table 3. Number of responses regarding suggested VUCA like events.

Event	Likert scale category					R
	Strongly disagree				Strongly agree	
AI (Artificial Intelligence)	6	7	3	13	8	1,6
global warming	4	11	7	11	4	1,0
international conflict	7	5	8	13	3	1,3
local unrest or conflict	8	9	11	7	2	0,5
local access to electricity	12	11	3	8	3	0,5
too few students	6	8	12	6	5	0,8

Of the suggested events, only AI stands out as a major area of concern, when considering both the mode of responses and the bias ratio R . Local access to electricity appeared to be of least concern (on the other hand load-shedding is rather common in South Africa). The bimodal

response for Global warming is intriguing and indicates that concern for it may be site dependent, and the same applies for local access to electricity. Although we use the term event, some of them may be prolonged over some time and still have the VUCA characteristics.

AI may be so prevalent in the survey because it is so topical today in daily discussions, but it is also clear that AI poses both a threat as well as creates opportunities for higher education, both in terms of teaching and learning, and in the assessment of students. How HEIs deal with AI and take advantage of it, is outside the scope of the survey and this research.

Qualitative results on not foreseen and potential VUCA events

In both the preliminary and the main survey, some questions were directly related to potential VUCA events. In the preliminary survey, we asked about VUCA events in three different timeframes, i.e. events that one was not able to foresee, and then events that one may anticipate in the next three and in the next 50 years. As the events indicated for these two latter timeframes were similar and the results from the main survey were comparable, the listings from both were combined. In the main survey we asked: *“Outline the events or items that you are concerned about that may affect the program or your teaching due to an unexpected and drastic event. Up to five (5) items can be mentioned”*. This was implemented by filling in the underlined space: *“I am concerned that _____ will significantly affect the program or my teaching.”* These potential events are summarized in Table 4, and are often rephrased for the sake of brevity.

Table 4. VUCA events that have already occurred and potential VUCA events in the future.

VUCA events that you have encountered or have already taken place, that you were not able to foresee:	Potential VUCA events <u>in the near future</u> that may significantly affect the program or my teaching (the first items are in order of how often they were mentioned):
<ul style="list-style-type: none"> • Covid-19 • software crash • no electricity • no classroom • sudden online teaching • student strikes • cancellation of classes due to low student enrolment • availability of faculty for specific courses. 	<ul style="list-style-type: none"> • AI • disinformation online • cyberattack, disrupted online communication • climate change and sustainability megatrends • natural disasters • political instability and war • student recruitment dropping • not well enough prepared students • generation gap and different approaches • cultural mixing and adaption, including xenophobia • increasing inequality • mental health • financial cost of program • slow response of HEI to external change • not enough qualified teachers • motivation of teachers • governmental funding • governmental requirements.

It is evident that even though a particular VUCA event may be suggested (second column in Table 4), its potential effect on specific curriculum components and on operating an educational program, may not always be stated nor is its effect clear. This may reflect the fact

that the effects on educational programs are ambiguous and that several different VUCA-like events and scenarios may have similar or the same effect on operating an educational program (e.g. Berthoud et al., 2021).

End-of-survey comments

At the end of the survey, space was provided for optional comments from the respondents. They were able to be classified into two groups. One was on the exact meaning of “I am concerned about ...” as used in the statements on the curriculum components. The other group of comments reflected the different understanding of what constitutes a VUCA-like event among the persons responding to the survey. This was reflected in quotes such as:

“I do not really understand the “I am concerned about” language.”

“... I am not concerned about most of the events in question, indeed, I am looking forward to disruptive events leading to change of, e.g. assessment methods or the usage of AI in teaching.”

“... I think mainly my health and motivation may affect the program and my teaching.”

“VUCA factors are not just push or pull factors like fire, flood, or even war.... simply listing the factors that will affect the curriculum is not within the scope of VUCA.”

“... very good survey, push thinking and rethinking”

CONCLUSION

The aim of the study was to determine which components of a curricula are sensitive to potential VUCA-like events, and which VUCA events faculty may foresee that could impact programs and teaching in the near future. As curricula may have different structures, meaning and purpose at different educational institutions, we adapted a particular curriculum model based on actual examples from six different institutions as outlined in the Introduction section. This model has nine components, which formed the basis for evaluating the different components with respect to different VUCA-like events. Thirty-seven faculty members from six countries related to the DECART project responded to the survey, most of whom had at least some expertise in curriculum design.

Results from the survey showed that four of the nine components of the curriculum may be considered sensitive to VUCA-like events according to the perception of the respondents, i.e. teaching methods, location of teaching and learning, assessment methods and teaching of interpersonal skills. The first three are in essence how one actually conducts the teaching and facilitates the learning, and may to some degree reflect the impact that Covid-19 had on higher education and the ambivalent anticipation of AI and its effect on education. The focus on interpersonal skills may reflect the increasing need for such skills in the workplace, as well as during the learning process and perhaps it is an ongoing endeavor in higher education. Interpersonal skills are mentioned in 6 out of the 12 standards of CDIO (www.cdio.org), so the relevance is not new to the CDIO community. Therefore, one may expect that these four components are indeed on the list of topics currently under review at many HEIs or may be added to such a list. When considering potential VUCA-like events that may affect educational programs, AI was of most concern, in an ambivalent manner, followed by events like disinformation online, cyberattack, disrupted online communication, and then climate change and natural disasters. It is important to realize that VUCA-like events may indeed significantly affect curricula, and may also lead to positive developments and changes. In addition, the potential VUCA events being considered may inherently be biased towards topical issues.



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Considering the perceptions that emerged from the survey, the factors that need to further examined, especially when designing curriculum, is the way in which teaching is actually conducted and learning facilitated, and specifically how AI may impact the curriculum. Due to the few respondents, given the nature of the study, one should be careful in generalizing the results, which essentially represents exploratory indications and perceptions of the respondents at the time that the study was conducted.

The VUCA events and scenarios which were identified, are presently being further explored in the DECART project and refined through cooperative workshops with faculty and other stakeholders. Such events will allow for the development of good to best practices regarding curriculum resilience and adaptation.

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Appendix B

Comments at the conclusion of the survey.

The results of the survey are presented, analysed and discussed in the paper in Appendix A. All comments to the final statement "Please feel free to add any concerns, clarification or comments regarding the survey." are listed below, 16 in total. Only five of these are listed in the enclosed paper in Appendix A provided there as examples. Following are all the comments unedited:

Possibility to add more than five items in the end. Sometimes hard to predict what may happend in the future.

Thanks. Interesting questionnaire

None

Programme accreditations. Presently our postgraduate management contact (in person) programmes are being delivered remotely (online). Special permission was granted for 2023. But what about 2024, 25 and 26 and forward? If forced to return to contact it may affect many matters discussed above like enrolment numbers, demographics of the class, assessment methods and so forth. Contact also increses transport and leave costs for both students and contract staff. And additional safety considerations and travel challenges like congestiin and risks of both public and private transport on our roads. Staff and Students studying remotely are not sufficiently building relationships and networking. Hence losing out on some of the benefits of such postgraduate management classes.

-

Work environment

No specification on higher education (strategic vision). We have the impression that it is teaching in general. However, competition is greater in higher education. Furthermore, in general, the "level is falling in math/physics", would the curriculum make it possible to bring students to a homogeneous level before they enter the course? (online courses, accelerated courses, summer school)

I do not really understand the "I am concerned about" language. Does it mean that I believe that it is statistically probable that these things will happen, or that I am actively worried? Colloquially, one says, I am concerned regarding things that may be irrational or statistically improbable, and one can lack concern for things that are highly probable. Or is the actual question something along the lines of: "When building a curriculum, I TAKE INTO ACCOUNT these factors?"



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Several of the different items of the questionnaire already had impacts on the program lately

It will be interesting to view the results.

*I think that the statement "I am concerned" above is not entirely appropriate. I **believe**/**think** that external factors will influence curricula, but that doesn't automatically imply that I am concerned.*

I found the survey formulations strange: I am not concerned about most of the events in question, indeed, I am looking forward to disruptive events leading to change of, e.g. assessment methods or the usage of AI in teaching. Universities are at the pinnacle of innovation, except for when it comes to teaching. Here, I frequently experience a fast inertia and - maybe - a need for crisis to induce transformation. On a similar note, I am not concerned that our entry requirements change. This is the way of things. But I am concerned that the level of competence, heterogeneity and/or mindset of applicants change, and that we are unable to adapt to that.

Why do you say "I am concerned"? For some of the aspects mentioned, it would be good if they changed

very good survey, push thinking and rethinking

I see the problem with this survey is that it treats curriculum as simply a non-overlapping set of teaching methods, content, pedagogy, etc. I guess, all of these elements should be closely interrelated. For example, a change in entry requirements will affect the curriculum as a whole, or, for example, assessment methods cannot be changed independently of all other elements of the curriculum. On the other hand, if the study is designed to identify the most potentially expected item (trigger), it is unclear how it might affect the program as a whole (if it does). For example, local access to electricity (if electricity is unavailable or expensive) will affect all of life and the education system (as part of it), but not directly the program (even if the program is canceled because of it).

The ranking and accounting Logic will change education. Poor people will suffer



Agility,
Resilience and
Transformation
in Curriculum Design

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