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Curriculum Components and Properties

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

DECART Workpackage 1: Curriculum Design

Report R11: Curriculum Components and Properties

version 1.0, April 2024



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 three years (2022-2025), the project brings together four universities from Europe and two from Africa and Asia.

This report, *Curriculum Components and Properties* (report R11) summarizes the work done in the first phase of the project, i.e. on curriculum design, and in particular on curriculum properties and styles. This was done by summarizing and comparing curricula from all partners, on the design process and peripheral constraints, and includes a preliminary study of transformation drivers at the curriculum level.

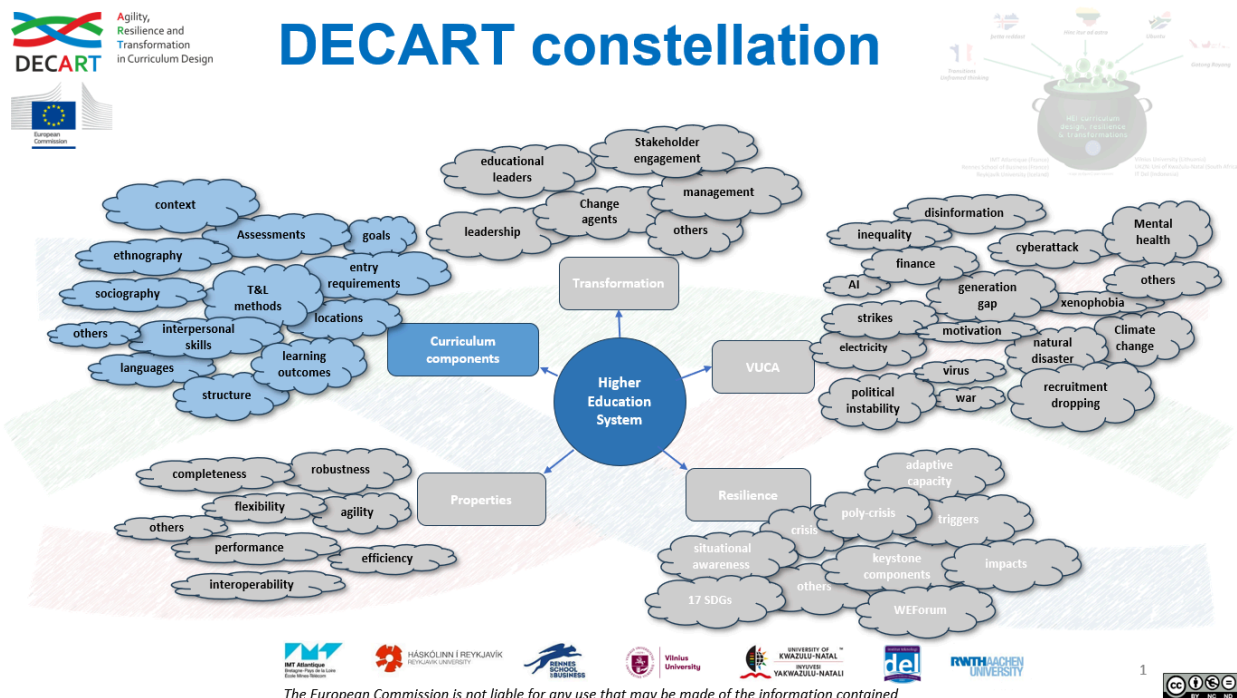


Figure. The DECART components - here focusing on Curriculum Components.



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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	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
	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





Agility,
Resilience and
Transformation
in Curriculum Design

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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 summarizes and compares curricula from all partners in the DECART project, on the design process and constraints. The analysis resulted in:

- establishing a cohesive and harmonized curriculum across all the partners, consisting of nine components,
- considering external factors and context influencing the curriculum, such as various stakeholders, accreditation bodies and national policies,
- identifying specific elements within partner curricula that are deemed valuable and noteworthy for inspiration and learning, and
- conducting an initial exploration of external influences that could directly impact or shape curricula..

The exploratory study of transformation drivers at curriculum level included:

- impact from the context of the external constraints and
- potential VUCA-like events.

These VUCA-like events are discussed in more detail in the follow up specific report on VUCA scenarios (R12: *VUCA Scenarios Impacting Higher Education*).

The report supports continuing work in the DECART project on curriculum design by defining the structure of practical curriculum and its properties. This includes observations from inspiring places, to advance the subject of the design study and shape future interventions and shared practices, and examples of curricula designs that may serve as a catalyst for mutual understanding, inspirations, and discussions of the curricula challenges by various stakeholders. Lessons learned and inspirations are listed from an experiential workshop for higher educators (staff training), methods used and evaluation, and examples. These included choices in curriculum actions or required transformations that can either amplify learning inequalities and bad qualities or facilitate more flexibility and resilience in adaptation to changes or unexpected crises.



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1. Introduction

The aim of the DECART 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. 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.

This report summarizes the work done in the first phase of the project, on curriculum design, and in particular on curriculum properties and styles.

Curricula may have different meanings and serve within different contexts depending on the country it is intended for. In this project partners are from six institutions and located in three continents. Therefore, the initial stage of this collaboration involved aligning and establishing a shared understanding of the term “curricula”, analyze the different curricula styles among the project participants and eventually outline the basic components that constitute a curriculum that may apply to all partners. This work eventually let us crystallize the principal features of curricula and the particulars in running programs that were deemed worthy to learn from and be inspired by.

In this initial phase we defined a harmonized curriculum, its nine components and context, which is crucial in our effort to analyse its sensitivity and resilience to the impact of VUCA-like events. Mapping these events and the analysis will be the next phase of the project, and will be discussed in the next report on *VUCA Scenarios Affecting Higher Educatio* (DECART-project, April 2024).

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;

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- 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.

Outcome of this report

The initial phase of WP1 focuses on O11, and also includes part of O12, and that work is covered in this report (R11). This report summarises and compares curricula from all partners, the design process and constraints, and includes a preliminary study of transformation drivers at curriculum level. Report supports:

- observations from inspiring places, to advance the subject of the design study and shape future interventions and shared practices;
- examples of curricula designs that may serve as a catalyst for mutual understanding, inspirations and discussions of the curricula challenges by various stakeholders;
- potential innovative methods and tools in the design process;
- informed curriculum choices and transformation decisions.

2. Curriculum Design

Methodology

The objective of this first phase of the DECART project was to collect information from its six partners on curriculum design, properties and styles, and as a group analyze all the contributions and in a coherent effort to obtain a holistic view on curriculum design and its properties.

The work proceeded in the following steps and they are presented in the diagram in Figure 2.1:

1. Discussing online on what may constitute a curriculum and an educational program, the overarching constraints (which may include national policies, stakeholders and accreditation bodies) and then on the general purpose and needed content of the curriculum for the purpose of operating an educational program.
2. Assembling examples of external constraints and curriculum of different partners. All six partners provided examples.
3. Analysing these contributions and extracting the fundamental components of the curricula and items to learn from and be inspired from.
4. Defining a harmonized curriculum and its components.
5. Extracting from exemplary curriculum aspects that were inspiring and indeed good to learn from. This was done for each component and resulted in one or more aspects for each component.

To have defined a harmonized curriculum with defined components is crucial in our effort to analyse its sensitivity, agility and resilience to VUCA-like events, which is the next phase of the project, and will be discussed in the next report, referred to as *VUCA Scenarios Affecting Higher Education*.

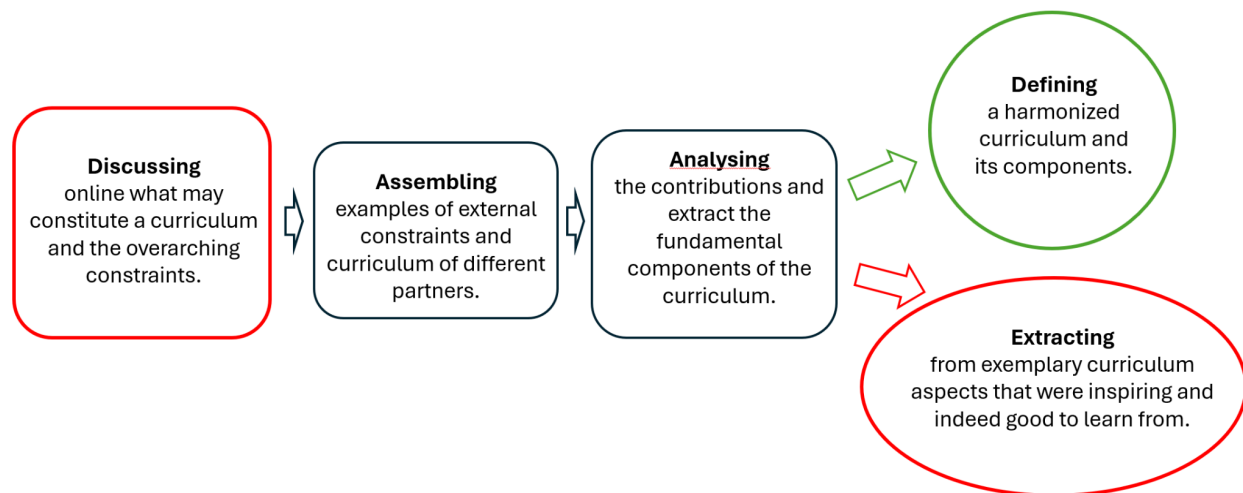


Figure 2.1. The workflow in the initial phase of the project – initial phase of Work package 1 (WP1).

The initial task of WP1 was to get a consensus on what is meant by “curriculum” (March 2023). There are several definitions around, some may be culturally dependent, and some may serve different purposes. Therefore, in an effort to get a real and practical description of curricula we wanted to assemble real cases from all the partners and hence try to decipher how the curriculum is actually designed and defined.

The work started out with an online discussion on what may constitute an educational program, the overarching constraints (which may include national policies, stakeholders and accreditation bodies) and then the general purpose and needed content of the curriculum for the purpose of running an educational program. As a demonstration, two of the diagrams used in the group to facilitate the discussion are shown in Figure 2.2a&b.

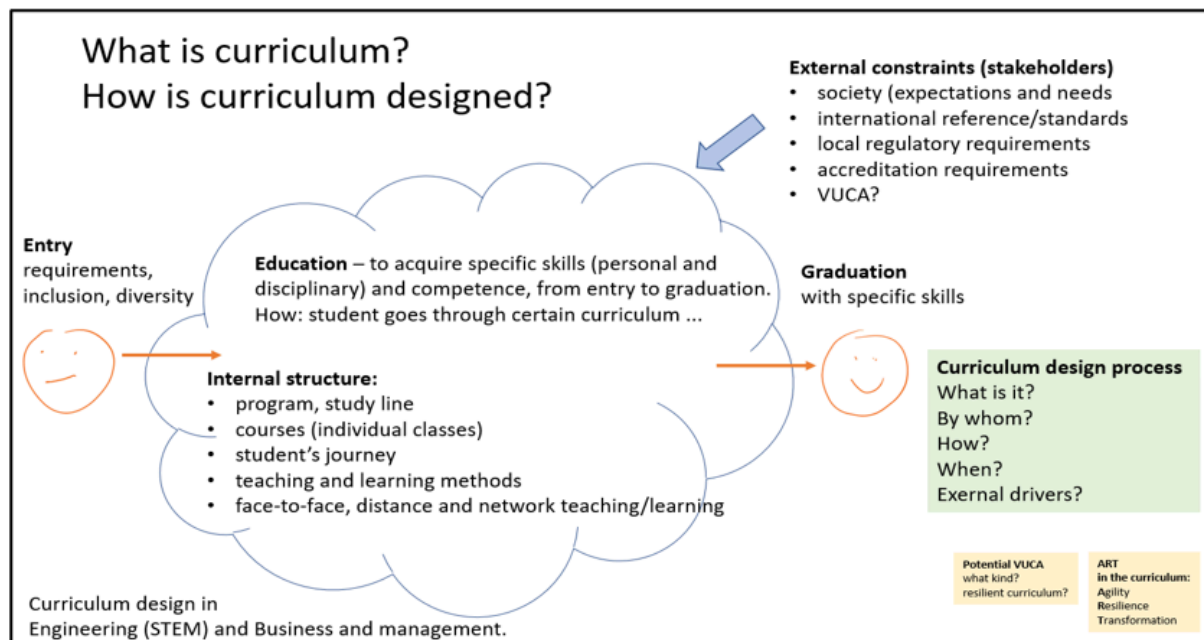


Figure 2.2a. Example 1 of a diagram used in the group to facilitate the discussion on the design and properties of curricula.

Figure 2.21 is intended to suggest some of the properties of a curriculum, the external constraints and to some degree the context. Furthermore. Figure 2.2b is intended to suggest some parts of a curriculum and indeed to remind the curriculum designer that an educational program should be juicy and flavorful for the student, and stimulate an enjoyable journey through the program.

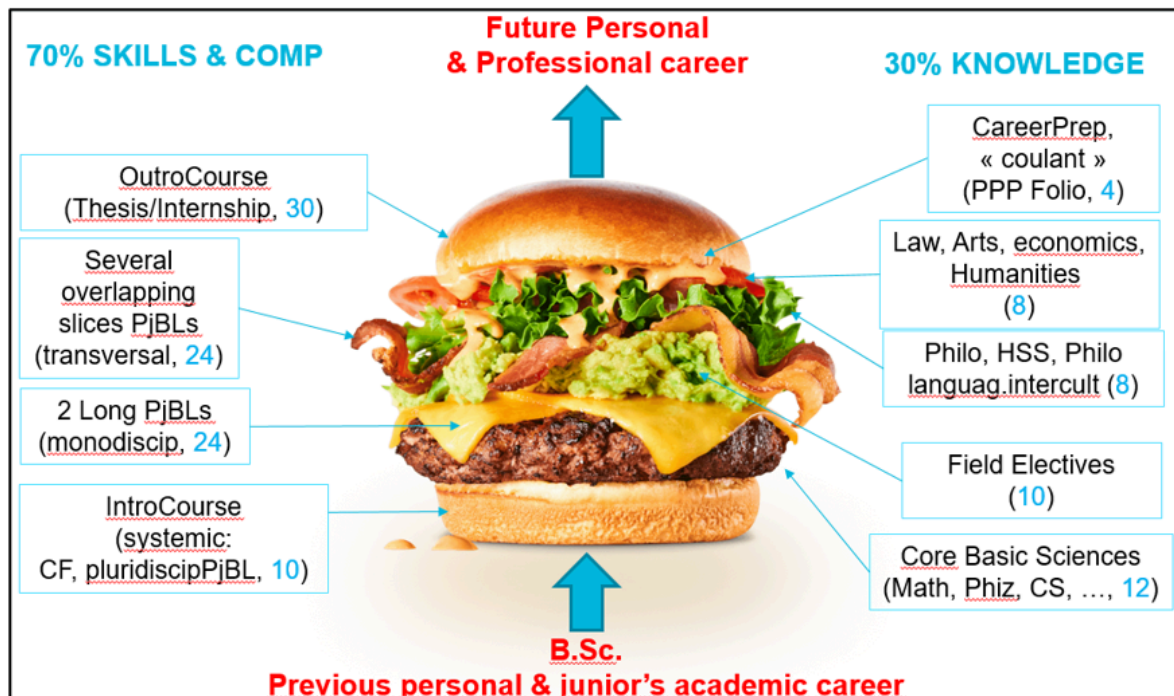


Figure 2.2b. Example 2 of a diagram used in the group to facilitate the discussion on the design and properties of curricula.

Following the open discussions on the intended purpose of curriculum, all partners sent in examples of curriculum from their own institutions. In addition, each partner presented a brief outline of the external constraints that formed or modulated the curriculum, kind of the context of the curriculum. As far as possible each partner was invited to add aspects that one might consider noteworthy or of interest for the other partners, something that may inspire others and to learn from, and provide seeds for our discussion on VUCA aspects of the program.

Table 2.1. Listing of curriculum examples provided by the partners.

University/partner	Initial Submission	Exemplar Submission
IMT Atlantique France (IMTA)	<ul style="list-style-type: none"> • Generalist Engineering Degree under student status program (2003-2017). • Specialized Engineering Degree under apprentice status program (2003- ongoing) • Engineering Degree under recognition of prior learning (2007). • Generalist Engineering degree under student status program (2018). • Generalist Engineering Degree under student status program (2024-ongoing). 	Generalist engineering degree under student status program
Institut Teknologi Del (IT Del) Indonesia (ITD)	Diploma-3 of Computer Technology	Engineering Management
Rennes School of Business France (RSB)	Master in General Management	Master in International Finance
Reykjavik University Iceland (RU)	Biomedical Engineering, BS and MS	Computer Science
University of KwaZulu-Natal South Africa (UKZN)	Master of Business Administration (MBA)	Master of Business Administration
Vilnius University Lithuania (VU)	Building energy systems engineering	Bachelor of Engineering Sciences in Energy of Vilnius Tech Engineering

Using these examples, including information on the external constraints when designing the curricula, we extracted the components that were deemed common to all the curriculum examples provided. This resulted in an analysis of the components. At the PM2 meeting in Reykjavik (June, 2023) there was a consensus on the nine components, which were further



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refined at the PM3 meeting in Rennes (November 2023) and then applied and used at the IPHE1 (Intensive program for Higher Education) in Brest, in February 2024.

Harmonized Template for Describing Curriculum

Based on all the initially contributed curricula from the partners in the project, the ensuing analysis and two project meetings, there was a consensus on nine components that constitute a holistic curriculum, as listed in Table 2.2. It is important to realise that these components were based on actual curricula and context. It was noteworthy, and to some degree expected, that the third component, on structure and content of the program, varied significantly among the partners, from simple sequence of courses to quite varied options such that it was not at all easy to list a typical journey for the students. In general, a graphical description often appeared to be the most informative representation of the program's structure. For clarification, these components are in addition to the external constraints and the context of the curriculum. Also of note, is that although the examples are from three continents and different fields of study, one was able to outline a single common structure of the curricula. These nine components constitute what we refer to as the harmonized curriculum of an educational program, i.e. Table 2.2 and Figure 2.3

Table 2.2 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>

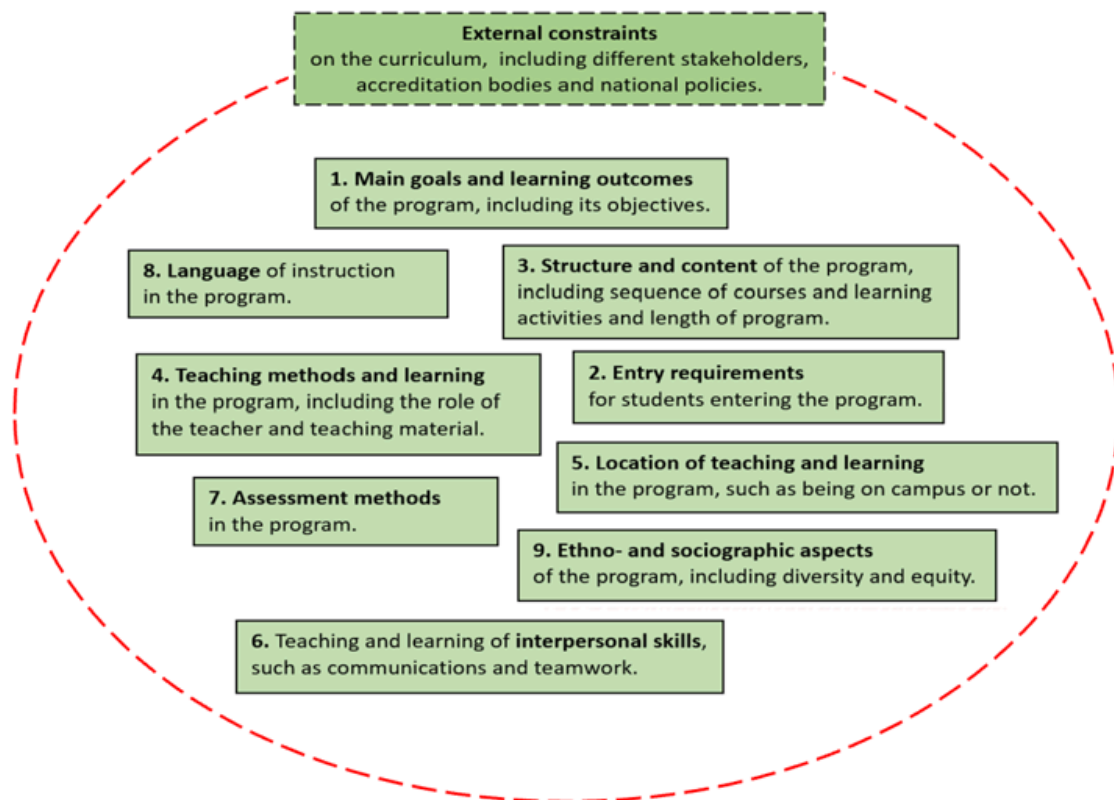


Figure 2.3. Harmonized curriculum and the overreaching external constraints, with components distributed to emphasise the nonlinear structure and interconnectivity.

Based on this harmonized curriculum a template was designed to facilitate the use of the structure, as shown in Figure 2.4. This template or canvas was used during the IPHE1 meeting in Brest in February. This canvas turned out to be a concise presentation of curriculum, and facilitated discussions of programs as well as a consistent presentation of educational programs from different universities (as done for example in the Nomadic Cruise workshop).

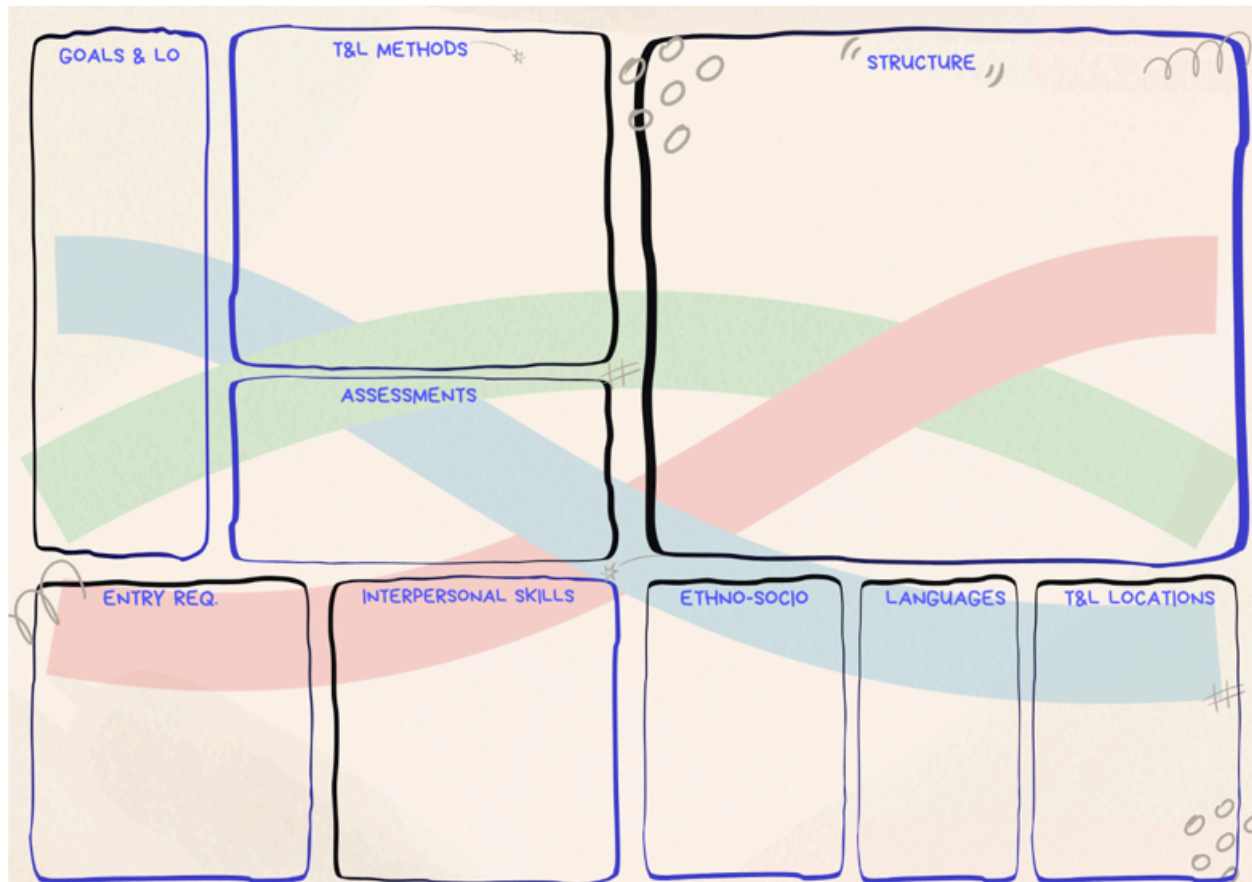


Figure 2.4. Canvas for designing curriculum based on the harmonized curriculum defined in the DECART project.

External Constraints and Context Forming the Curriculum

As a context for all the actual curricula submitted and analysed by the partners, was a kind of an umbrella or preamble for each curriculum. Again, this context was placed under the heading:

- External constraints on the curriculum, including different stakeholders, accreditation bodies and national policies.

Because this heading places the curriculum in context if it may be placed with the components of the curriculum. Examples of these external constraints are summarised in Table 2.3 and the actual descriptions are in Appendix A (A1 to A7).

Table 2.3. Examples of the external constraints on curricula as presented by the partners.

Partner/University	Program	Constraints
IMT Atlantique France	Generalist engineering degree under student status program	See Appendix A1
Institut Teknologi Del (IT Del) Indonesia	Engineering Management	See Appendix A2
Rennes School of Business France	Master in International Finance	See Appendix A3
Reykjavik University Iceland	Engineering	See Appendix A4
University of KwaZulu-Natal South Africa	Master of Business Administration	See Appendix A5
Vilnius University Lithuania	Bachelor of Engineering Sciences in Energy Engineering of Vilnius Tech	See Appendix A6
RWTH, Aachen Germany	General	See Appendix A7



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The last program in Table 2.3 is not in STEM nor in management, but is based on the expertise of that particular member and it adds valuable insight from other disciplines, as in this case from educational sciences and pedagogy.

Outline of all the constraints are in Appendix A to this report, but as an example the external constraints of the engineering program at Reykjavik University is given as an example.

The Icelandic case study: Accreditation Constraints and External Constraints on the Engineering Program at Reykjavik University, Iceland

1. All universities in Iceland have to be accredited by the Ministry of Education. Iceland has general law on universities and these include a section on quality assurance with respect to both teaching and research, as well as other general and internationally recognized criterias for universities (1, 2). The protocol for performing these quality assurance reviews is established by the Ministry of Education as the National Qualification Framework: „The National Qualification Framework for higher education in Iceland is a systematic description of the structure of qualifications and degrees at the higher education level and is specifically based on learning outcomes. All higher education institutions in Iceland, accredited by the Minister of Education, Science and Culture according to the Higher Education Act no. 63/2006, shall follow this framework.“ (3).

“The Icelandic Quality Enhancement Framework (QEF) provides an environment within which the Higher Education Institutions (HEIs) individually and collectively, secure the standards of all their degrees, and systematically enhance both the students’ experience and the management of their research efforts.” (4).

This quality assurance as outlined above is twofold, both internal review within the university and also regular external reviews.

1a) For the university as a whole there is an Institution-Wide Reviews (IWRs). A panel of experts in higher education take part in this extensive review and within the panel are international experts. This panel makes recommendations to the Ministry of Education.

1b) At the subject level each university has to do a Subject-Level Reviews (SLRs), for example in engineering, computer science, business management, and so on, and this is the responsibility of each institute. An external international expert, which is a member of the self-evaluation committee, finally evaluates the self-evaluation report and makes recommendations.

The above mentioned reviews are extensive, include reports, interviews and visits on site, and are every 5 years or so. Then there may be specific requirements or optional accreditations

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depending on the specific program involved. In the following, the focus is on engineering education in Iceland.

2. The Association of Chartered Engineers in Iceland places requirements on the curriculum in the Department of Engineering. The department graduates students with MSc in engineering, but to become a chartered engineer in Iceland one has to fulfil the requirements of the Association of Chartered Engineers in Iceland (5). The requirements focus on the curriculum of engineering and set minimum requirements on specific subjects, i.e.:

Category of subjects:	Minimum:	Guidelines for the categories:
Fundamental subjects in Engineering	50 ECTS	calculus, geometry, physics, statistics, chemistry, biophysics, etc
Engineering fundamental subjects	50 ECTS	programming, numerical analysis, economy, hydrology, database theory, etc
Engineering subjects	120 ECTS	design courses, concrete structures, hydropower, software testing, final thesis, etc
In addition, and generally from the above three groups	50-80 ECTS	
Total	270-300 ECTS	

In practice, after graduation each graduate in engineering applies to the Association of Chartered Engineers in Iceland to become chartered engineer, irrespective if the graduate is coming from a university in Iceland or from a university outside Iceland. Eventually it is the Ministry of Industry that issues the certification that one is a certified engineer. Based on these requirements the engineering program must be of a minimum of 270 ECTS, which in practice implies a graduation at the master level (MS).

In short, for the program in engineering to be accredited it must fulfil the general requirements by the Ministry of Education and then the specific requirements by the Association of Chartered Engineers in Iceland.

3. In addition to the above formal requirements, the engineering program:

3a) has to pursue the role of Reykjavik University “to create and disseminate knowledge to enhance the competitiveness and quality of life for individuals and society, guided by good ethics, sustainability and responsibility.”(6)

3b) follows general international norms in engineering (by far most of the faculty have done their



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doctoral work outside of Iceland).
3c) tries to follow the spirit of the CDIO initiative (7).

References:

- (1) Law on Universities (in Icelandic): <https://www.althingi.is/lagas/nuna/2006063.html>
- (2) Handbook: Criteria for Accreditation of Higher Education Institutions: <https://www.stjornarradid.is/library/04-Raduneytin/Haskola---idnadar--og-nyskopunarraduneytid/Criteria%20for%20Accreditation%20of%20Higher%20Education%20Institutions.pdf>
- (3) National Qualification Framework for higher education: <https://www.stjornartidindi.is/PdfVersions.aspx?recordId=8bfec154-2168-4de8-9170-4b19cf11d7c3>
- (4) Quality Enhancement Framework: <https://qef.is/quality-enhancement-framework/>
- (5) Requirements by the Association of Chartered Engineers in Iceland: https://www.vfi.is/media/um-vfi/Starfsheiti_verkfr_enska_birt_a_vef_jan_2016.pdf
- (6) Strategy and role of Reykjavik University: <https://en.ru.is/the-university/the-strategy-of-reykjavik-university/>
- (7) CDIO-initiative: www.cdio.org



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3. Curriculum structures

A central issue is in the design, maintenance, and transformation phases of these programmes. Confronted with diverse historical and current developments of teaching and learning modes, not all curriculums are identical, or even similar in their structures and styles, they most often differ.

A large variety of curriculum components exist in the literature, e.g. curricular spider [Akker 2003]. Three metamodels can describe various facets of a curriculum, they include the intended curriculum (learning outcomes), the taught curriculum (programme) and the validated curriculum (assessment). For the taught curriculum, a programme is for example composed of several courses, internships, or extra-curricular activities. The taught curriculum can be described by course components, which will constitute the curriculum architecture.

In the first semester of the DECART project, some activities aimed to promote dialogue and sharing between the academic spheres of the six partners, to allow cross-learning around the design of higher education curricula. The activity of presenting curriculum from different partners, hence programs in engineering, computer science, education and management, and from three different continents, promoted dialogue and sharing between the academic spheres, allow cross-learning around the design of higher education curricula. Curriculum can differ, following for example an analogy with the civil architecture domain, as in Figure 3.1



Figure 3.1. Analogy on curriculum framework from civil architecture domain, emphasising the different frames.

Diagrams may be used to describe a curriculum and share its structure between programme leaders, accreditation bodies, faculty, students or so, we can choose diagrams. These diagrams may be constructed to be appropriate with the curriculum specification goals, as for the comparability.



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Curriculum adequacy is primordial, a shared common language for describing the structures is a cornerstone for shared analysis. Giving some formality in specifying the architecture of a professional development programme permits sharing a static view of the curriculum structure and a dynamic view of how the curriculum implementation works for a student from the first semester until the student graduates. A curriculum architecture description includes all the course components that can be flowed by learners from their entry as freshmen to graduated students. Usually, depending on the size chosen for component descriptions, a curriculum can be constituted with 10-40 components, e.g. when being of course granularity. The more optionality there is, the more components are integrated in an architecture. Components can be organised in clusters, e.g. semesters, even if the student population, e.g. freshmen with sophomores, can be mixed with electives. Some components may be linked together, in the form of pre- and post-requisites. It enables the verification of properties on curriculum models, e.g. to check constraints on student pathways and ensure their correctness.

Globally, curriculum design and implementation are confronted with diverse historical and current developments, such as new pedagogical teaching models integrating student-centred learning, students more involved in their professional development/learning, with greater, varied choices in the learning paths. Current developments of 21st century education (Gosper & Ifenthaler, 2014), with transformative, cultural, and contextual engagements are intense and complex. Even if developments in educational frameworks in higher education have witnessed changes in some patterns and constraints, as with the Bologna process in Europe with the LMD semester structure and ECTS or the ASEAN higher education framework for South-East Asia accreditation scheme, educational leaders are given considerable latitude in terms of programme contents, teaching methods, assessment procedures, targeted skills, course type and volume, or scheduling. The variety of curriculum components is further observed in the field of STEM professional development programmes, where curricula are very diverse in their styles. The quality assurance organisations and accreditation bodies focusing on college and university programmes in STEM disciplines share the formal requirements, which have been readjusted to the recurrent and new needs of industry and society, as student diversity and their needs of flexibility.

Curriculum styles

A style, as existing in building architecture and mapped in software engineering, defines constraints on the form and structure of a set of architectures. More specifically, it contains the vocabulary used to define components and connectors. A style may include certain topological constraints to determine which compositions are permitted, as well as semantic constraints to ensure the coherence of a composition. The use of styles has several benefits: it facilitates reuse, it helps to understand the organisation of the system if conventional structures are used, it allows specialised analyses.

As a curriculum architecture can be exhaustive in its number of components, nevertheless it can show some abstract characteristics. A curriculum style defines a family of architectures. Styles enable curriculum architects to choose a standard solution adapted to their needs. Several styles can be identified and are often part of a national culture, sometimes reinforced or constrained by accreditation references and orientations, which can be regional or national. As example, some curriculums inherit from:

- a pipe style, where learners have a single workflow among course components till graduation;
- a spiral style, where each semester, students go deeper in a course domain (e.g. Computer Science 1 (CS1), CS2, CS3 courses), in a repetitive and complex over the course of education;
- a liberal arts style, with many electives covering a range of disciplines;
- a discipline-centred style, monodisciplinary within a particular field of study, in-depth study;
- a multi or interdisciplinary style, that integrates content and methods from multiple academic disciplines. It seeks to bridge the gaps between disciplines, encouraging students to explore connections and gain a holistic understanding. Interconnected global challenges such as climate change, economic inequality, and technological innovation demand an interdisciplinary approach to education [Audunsson et al. 2024];
- project-based style, to engage in extended, real-world projects, to apply and integrate knowledge and skills from various subject areas;
- integrated style, as recommended by the CDIO community for engineering education . In that spirit, the complexity of the modern world requires a curriculum that transcends disciplinary boundaries;
- apprenticeship style, with a mix of in-class and professional environment courses/sessions all along the teaching & learning path, incl. work integrated periods; etc.

Styles can be combined.

Joint Curriculums

Sharing curriculum architectures and their components among institutions is a medium for discussing and comparability, as investigated in the DECART project. Deeper cooperation between higher educational institutions to align their curriculum structures and programme outcomes could engender more joint curriculum design and development, and thus favor greater international and interdisciplinary mobility. As a good and large-scale example, in Europe, the 50 European Universities clusters created recently and comprising 430 Universities overall, are experimenting and testing new models of deeper cooperation, in which the linkage, coherence and adequacy of two or more curriculum is primordial. Initial analysis shows that curriculum transformations will be needed. The EU Commission is preparing to examine options and necessary steps towards a joint European degree and considering the award of a European Degree label. ‘Building bridges for effective European HE cooperation’ to facilitate deeper transnational cooperation is now an imperative for curriculum adequacy and resilience. Finally, we should point out that complex joint curriculums and programme-to-programme often require the ability to combine several styles.

		
<p>https://eulist.university</p>	<p>https://eua.eu/</p>	<p>https://arqus-alliance.eu/</p>

Figure 3.2. DECART partner implication in European Universities.

Universities have a key role for future generations. Multilateral European cooperation is a real lever for transformation to be stronger, more creative and more competitive together. The interoperability of training programs is a way to strengthen the actions of European strategies for the future of Europe and create bridges for effective cooperation in the field of higher education.

DECART sheds lights to recommendations to help overcome obstacles, particularly in European university alliances. The DECART project is a pilot and additional tools to guide the interoperability of programs of excellence but also inclusive to facilitate the strengthening of skills and the integration of students into the labor markets. DECART has sought to facilitate the pooling of assets and resources for Universities wishing to go further in their cooperation.

4. Curriculum Properties

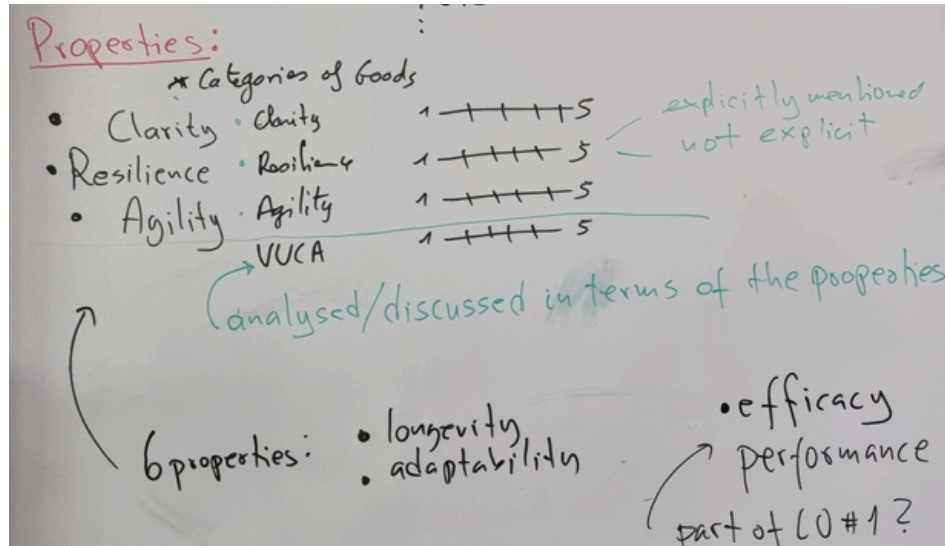


Figure 4.1. Curriculum property reflections from DECART project meeting in Iceland.

Curriculum agility

Curriculum agility is important when relevant professional disciplines are developing rapidly, as in engineering (Brink et al., 2021). Brink et al. developed a shared vision on curriculum agility, where an agile curriculum is responsive and adaptable to changes in society and business, as well as student characteristics and needs, by having the capacity to change structures, learning outcomes, and learning activities in a timely manner. They introduced nine principles of curriculum agility, which defines or refines the concept of curriculum agility. Agility is perhaps now more than ever an unavoidable property of curricula to meet the transformational challenges of educational programmes in a more continuous manner, due to the various crises impacting the HE sector. In 2022, within the CDIO community, the development of self-assessment rubrics for the agility identified principles is underway for three clusters: Curriculum Vision & Strategy, Curriculum Quality & Provision, and Curriculum Design & Research principles. These rubrics are to support programme leaders in assessing the agility of their curricula to support the change processes in a common maturity scale.



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Brink, S.C., Carlsson, C.J., Enelund, M., Georgsson, F., Keller, E., Lyng, R., and McCartan, C. (2021). Curriculum Agility: Responsive Organization, Dynamic Content, and Flexible Education. In IEEE Frontiers in Education Conference (FIE).

Performance or robustness of curriculum?

In the French context, Olivier Hamant (Director of Research at INRAE) explains that, according to his definition and approach, performance is about achieving objectives with maximum efficiency, while robustness maintains operation in the most stable way possible, despite environmental fluctuations (or turbulence) and limited resources. He argues that the unbridled pursuit of performance can be counterproductive, as it often leads to rebound effects and has high environmental costs.

Hamant's concepts are best understood in the context of life and the environment. However, it is undoubtedly possible to make links with the educational system immersed in a natural, economic and social environment. Hamant points out that performance is often favoured because of its simplicity and the fact that it gives great satisfaction on the maximised criterion(s), but it can neglect long-term problems and create new dependencies by degrading other criteria that are not favoured. Robustness, on the other hand, requires an approach that is undoubtedly more complex, perhaps more holistic, but better suited to a world in constant change. He suggests evaluating solutions according to their robustness in the face of fluctuations, rather than focusing on performance.

Ultimately, Hamant believes that in a VUCA world (cf. DECART R12 report), it is preferable to sacrifice performance in favour of solutions that are less efficient but more durable, since they have foreseen a maximum number of environmental configurations to which they can adapt if necessary. Hamant also argues that in an uncertain world (we can extend this to VUCA without distorting his words), it is preferable to adopt an adaptable rather than an adaptive approach (being adaptable Vs knowing/being able to adapt). In practical terms, this means that instead of concentrating your energy on preparing ONE backup solution when the situation arises (transforming to respond to ONE change = adapting), it's better to modify your structure by distributing your efforts so as to be able to respond to any unforeseen transformation (having an adaptive approach = knowing how to adapt).

For him, the real challenge lies in the choice of solutions, favouring those that are robust rather than simply high-performance. If we were to quote just one sentence from Hamant on this issue, it would be "When you're adaptable, you multiply the options without knowing which one will be the right one." Finally, in the context of a turbulent world (i.e. VUCA), Hamant argues for a transition to robustness, which favours diversity, cooperation and creativity, while reducing our impact on the environment.

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The following books will undoubtedly be of great interest to readers:

- *Antidote au culte de la performance. La robustesse du vivant*, par Olivier Hamant, [collection Tracts, Gallimard](#)
- *La Troisième Voie du vivant*, par Olivier Hamant, [édition Odile Jacob](#)

Table 4.1. Comparison of efficient or robust approaches to human achievement (inspired by Hamant)

Key points	Aim	Strong points	Form of social structure associated with achievement	Sustainability of the approach	Resource usage	Examples
Performance Approach	Adaptation	Maximum efficiency Optimization Resistance in the face of identified adversity	Competition	Long-term fragility	Major Maximized if necessary	Construction of giant wind turbines Intensive livestock
Robust Approach	Adaptability	Stability in the face of fluctuations Creativity	Sharing of actions, goals and resource Cooperation	Long-term durability	Moderate Reasoned	Cooperative planting of micro forests developing alone Holacracy Shared gardens

A mapping of performance and robustness has been done in the context of higher education curricula: what are the characteristics of a robust curriculum? This analysis is presented in Table 4.3, at a programme level perspective. From this first analysis, a categorization was made in the face of each DECART canvas curriculum components, as summarized in Table 4.2 and Table 4.3 for each property prism with some good practices.

Table 4.2. Performance vs. Robustness in Curriculums

Specificities Approach	Diversity	Educational environment	Training courses	Pedagogy	Management
Performance approach	Diversity dictated: - quotas - goals - obligations	- pressure on staff, teachers, students - loss of well-being in favor of efficiency	- standardization of programs and courses	- standardization or poverty of educational systems - insufficient preparation of students for VUCA situations	- excessive focus on KPI/ ranking - sclerotic hierarchy and little open to change - favorable to competition between institutions
Robust Approach	Diversity encouraged: - Occasional - Opportunistic - Relevant - Thoughtful	-social impact taken into account	-wide variety of programs	- diversity of teaching approaches -open pedagogy -taking into account VUCA environments in student training	-Management open to creativity, innovation, ready to question itself -Management favorable to sincere collaboration between institutions

Table 4.3.a. DECART curriculum components and criteria through performance and robustness prisms (by G. Jacovetti).

DECART curriculum components / Approach	Admission Requirements	Learning Outputs	Teaching methods	Evaluation methods	Structure
Performance Approach	Strict and rigid admission requirements (diplomas, competition rankings, minimum levels)	Development of competencies for predetermined professions or situations	Classic teaching methods (courses, practical work, tutorial, project)	Assessment methods based on table assignments, reports or MCQs. - Sanction for plagiarism without training in responsibility and ethics.	Rigid program structure
Robust Approach	Flexible admissions requirements to accommodate a diversity of learners	<ul style="list-style-type: none"> - Preparation for a constantly changing environment, - Diversity of teaching and learning methods, - Long-term acquisition of essential skills 	<ul style="list-style-type: none"> - Diversity of teaching and learning methods, including technology-enhanced approaches, - Self-directed projects, - Flipped classrooms - Participatory and collaborative approaches 	<ul style="list-style-type: none"> - Varied and original evaluation methods aligned with learning objectives, - Use of criteria grids, - Peer evaluation, - Self evaluation 	Flexible and adaptable program structure to meet fluctuating needs

Table 4.3.b. DECART curriculum components and criteria through performance and robustness prisms (by G. Jacovetti).

Key points	On campus or not	Interpersonal skills	Ethno/sociography	Education language
Performance Approach	<ul style="list-style-type: none"> - Learning formatted to be mainly played on site. - Effective routine in the organization of courses (timetable prepared in advance and rigid, room reservation procedures, etc.) 	Poorly developed interpersonal skills	Homogeneous student and teacher demographics	<ul style="list-style-type: none"> - Predominance of one language of instruction. - Teachers and staff not very comfortable with other languages
Robust Approach	Hybrid or online options to accommodate varied learning preferences, or, better yet, co-modality	Emphasis on developing interpersonal and intercultural skills alongside academic skills	Emphasis on diversity and inclusiveness within the student and faculty body	<ul style="list-style-type: none"> - Multilingual approach to welcome a diversity of learners and to open up to other cultures. - Teachers and staff who are multilingual or from varied origins

Uneasy terminology issues

Curriculum terminology is not unified. There are different ways of discussing the curriculum. The scope of the curriculum field is broad, with textbooks on the subject covering a wide range of topics and perspectives, with lack of unified terminology for concepts around curriculum perspectives: curriculum frameworks, qualification frameworks, accreditation frameworks and standards, curriculum components, program, courses / modules / units of a curriculum, syllabus, etc. Figure 4.2 presents the perspective from an Indonesian perspective, where curriculum is considered the main engine to run a study program.

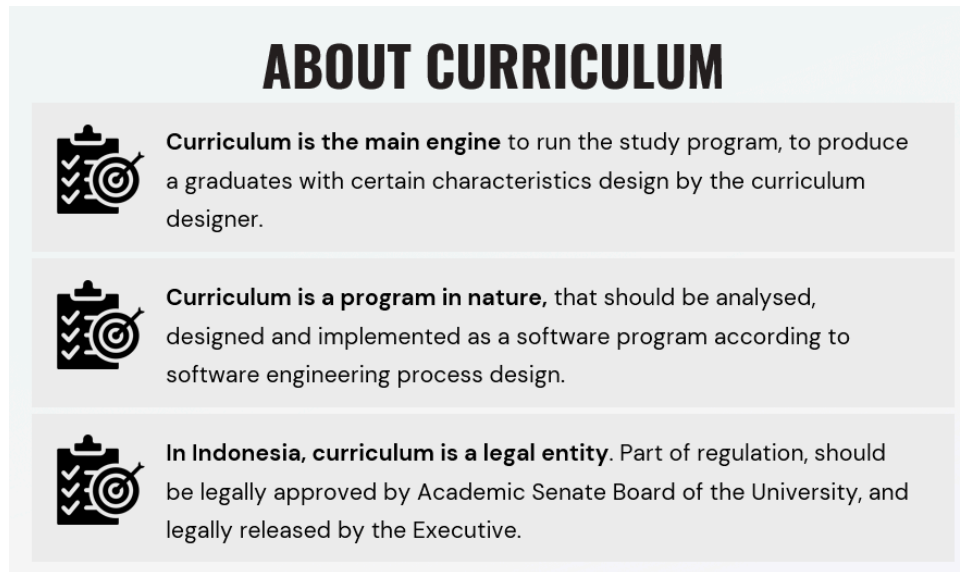


Figure 4.2. The Indonesian perspective, where curriculum is considered the main engine to run a study program.

Several discussions took place among the DECART international members and an informal conceptual map, presented in Figure 4.3, where the curriculum component is at the heart, and linked to the 9 DECART components, was shared and gained a flexible consensus during meetings. National definitions, based on national policy documents, were often discussed in their terminology.

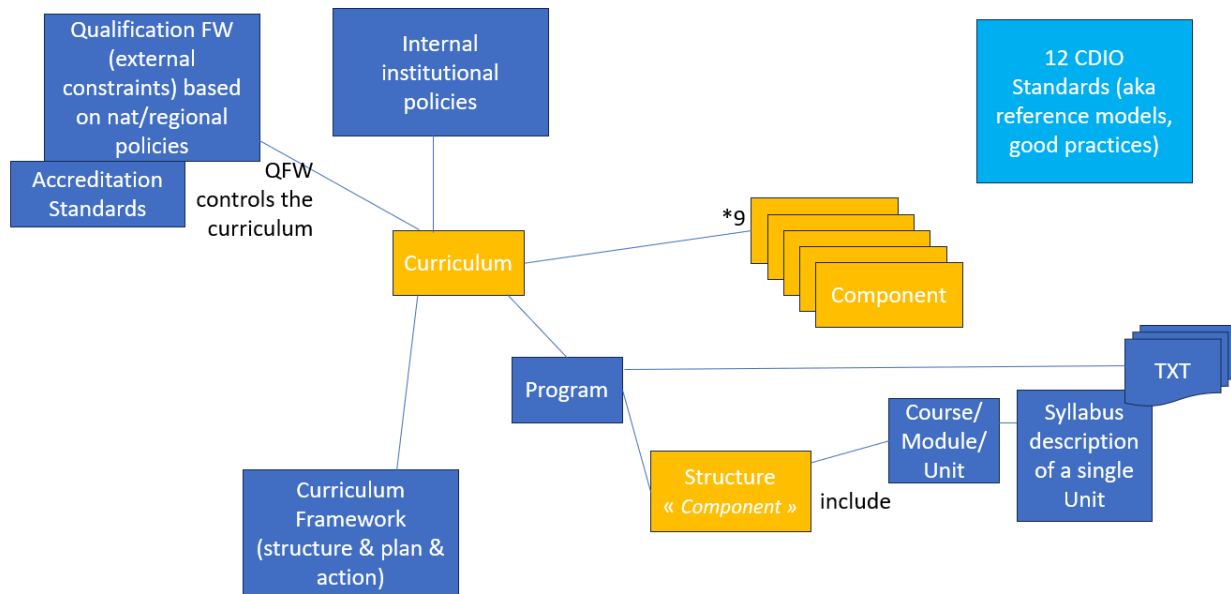


Figure 4.3. Conceptual map of curriculum as used in the discussions.

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A curriculum can adhere to a framework and/or a set of standards (as with the CDIO approach), where here also concepts differ, i.e. Figure 4.4.

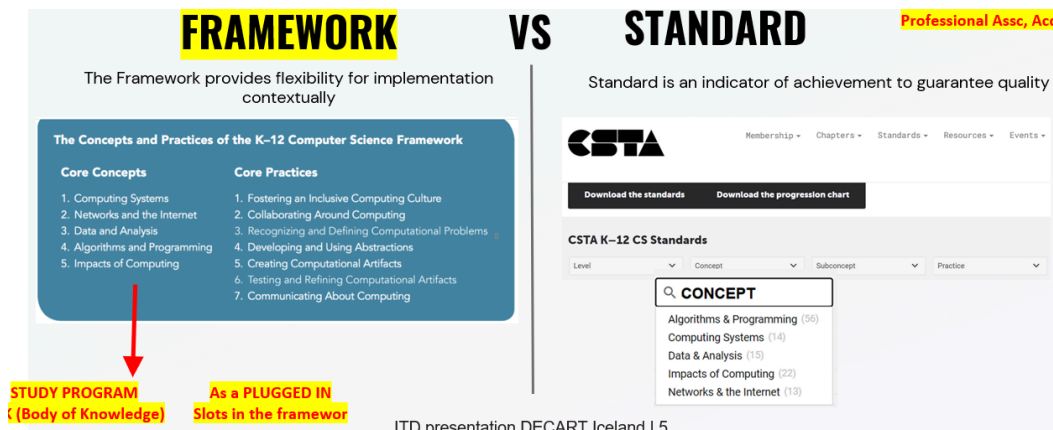


Figure 4.4. Curriculum as a framework or as a standard.

A major obstacle to the comparability and analysis of curricula in higher education is the size of the programme's detailed descriptions of the components, as a variety of courses and their constituents. All these descriptions are most often described verbatim in long course' syllabuses (i.e. module handbooks, in text format). At a more abstract level, due to a large diversity of curricula, questions raised concern the purpose for the structure of programmes, i.e. its architecture. Not all curricula are identical, their characteristics and content differ, including their architectures, design patterns and styles. The general structure of a curriculum (a DECART canvas document), i.e. its architecture, becomes a central issue in the design of e.g. BSc. and MSc. STEM educational programmes.

5. Analysing and comparing curricula

There are several definitions and templates on what constitutes a curriculum. We in DECART decided to work from the grassroots, and develop a template based on actual curricula submitted from each partner institution, six in total (this was done in June 2023). The initial framework was very open (in part stimulated by the juicy hamburger) because we wanted as much as possible to work with the actual curriculum as practised at each institution. This extracted template was based on all relevant aspects of the submitted ones, like a common denominator for all curricula. The initial analysis revealed 9 components (initially there were

10, but one of them was more of a property), and these components are shown in Figure 5.1. The value of this curriculum is that it is based on our own actual curricula from all partners.

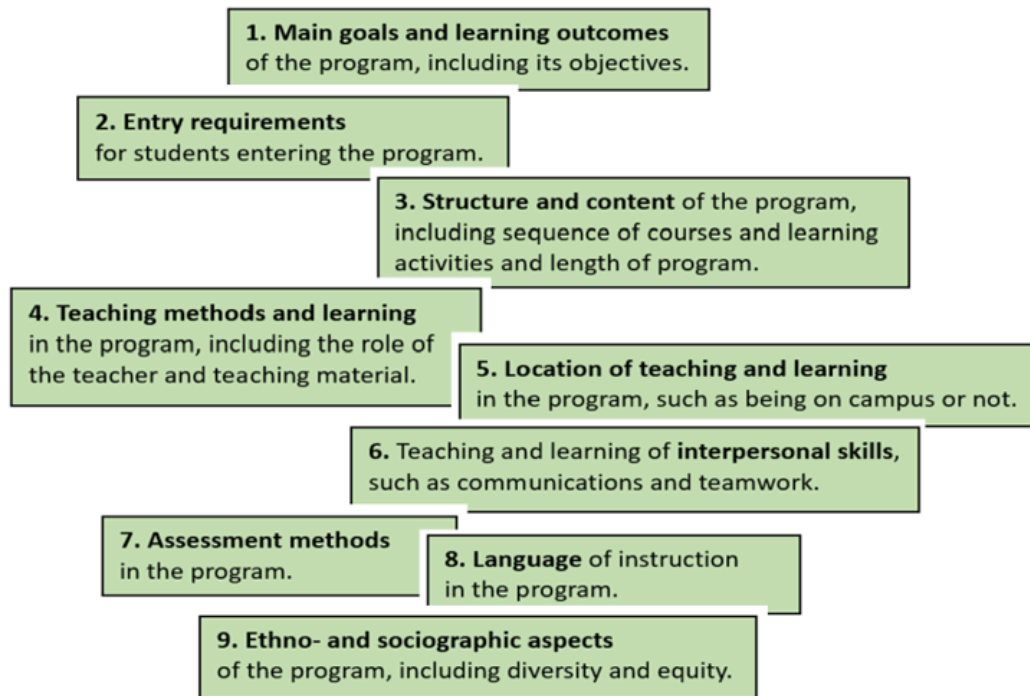


Figure 5.1. The 9 components of the DECART Curriculum template along with brief descriptions.

External Constraints and Accreditations

All the partners in DECART outlined or listed the external constraints and accreditation bodies that kind of set the frame or context for the curriculum. The external constraints place the curricula in context, which include one or more of the following, local, national and international, and may include different stakeholders and reference to different accreditation bodies. These constraints are represented by the top box “External Constraints” of the DECART Curriculum in Figure 5.2. In Annex I of this report can be found elements of accreditation references in the context of project partners.

Comparing curriculums

It is valuable to compare the DECART Curriculum template to some previous and published curricula. Of quite many curricula templates and definitions around, we have chosen three

curriculums to compare with: 1) by Akker (2004), *Curriculum Perspectives: an Introduction*, which is quite often referred to, 2) by Jonnaert et al. (2021), *Towards indigenous curricula*, which is sometimes used as a model when the aim is to transform the curriculum, and 3) by the CDIO initiative, *The CDIO Standards 3.0*, which is oriented towards engineering programs. The references to these templates are in the bibliography section of this report.

Figure 5.2 shows the harmonized template by DECART and the one by Akker (2004), placed side by side to make comparison easier.



Figure 5.2. Comparing the templates by Akker (2004) and by DECART (this report).

It is apparent from Figure 5.2 that the main structure of the two curriculums are similar and many components are the same, but not all. Also, emphasis of different components of curriculum may vary, in part based on for example:

- a) the educational level, elementary or higher education,
- b) the intended use of the presented template or architecture,



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- c) if the template is pre or post covid, hence may reflect different teaching and learning modalities,
- d) the effect of more accessibility to AI or digital resources,
- e) different norms at different places.

There are many different views on what curriculum is, its notation and how it should look like. Furthermore, there is vast literature available on curriculum theory, and to complicate the field further, and at the same time make the discussions more fruitful, are international aspects. To help us in discussing curriculum it is important to have basic concepts and perspectives in common. One researcher that appears to be well recognised in this field is Jan van den Akker at University of Twente in The Netherlands and he has been quite involved in curriculum related research. Akker summarizes his views in *Curriculum Perspectives: an Introduction*, which is an introductory chapter in the book *Curriculum landscapes and Trends*, p. 1-10 (2004). Figure 5.3 lists all four templates or outlines of curriculum, side by side to compare, including the one from Akker (2004).

Compare the DECART template to the one by Akker

The structure of curriculum as presented by Akker (2004) is basically classic, but may need some update as it refers more to the situation before the covid-impact on higher education. On the other hand, the DECART curriculum is more flexible with regard to the ever increasing hybrid mode of teaching and learning, and secondly it is more explicit on aspects that are becoming the more accepted international norm like language of instruction and ethno- and sociographical aspects, including inclusivity and of equity, and address explicitly the entry requirements to programs. These more up to date components are included in the DECART harmonized version which therefore appears to be more up to date and adaptable.

The CDIO standards

The CDIO initiative 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. The “curriculum” as presented by the CDIO initiative is not really a curriculum, but lists 12 items that should be included or addressed in the curriculum, hence the name “The 12 standards of CDIO”. These 12 standards form the rubric to measure the extent a specific engineering program has adapted the CDIO-spirit in its program.

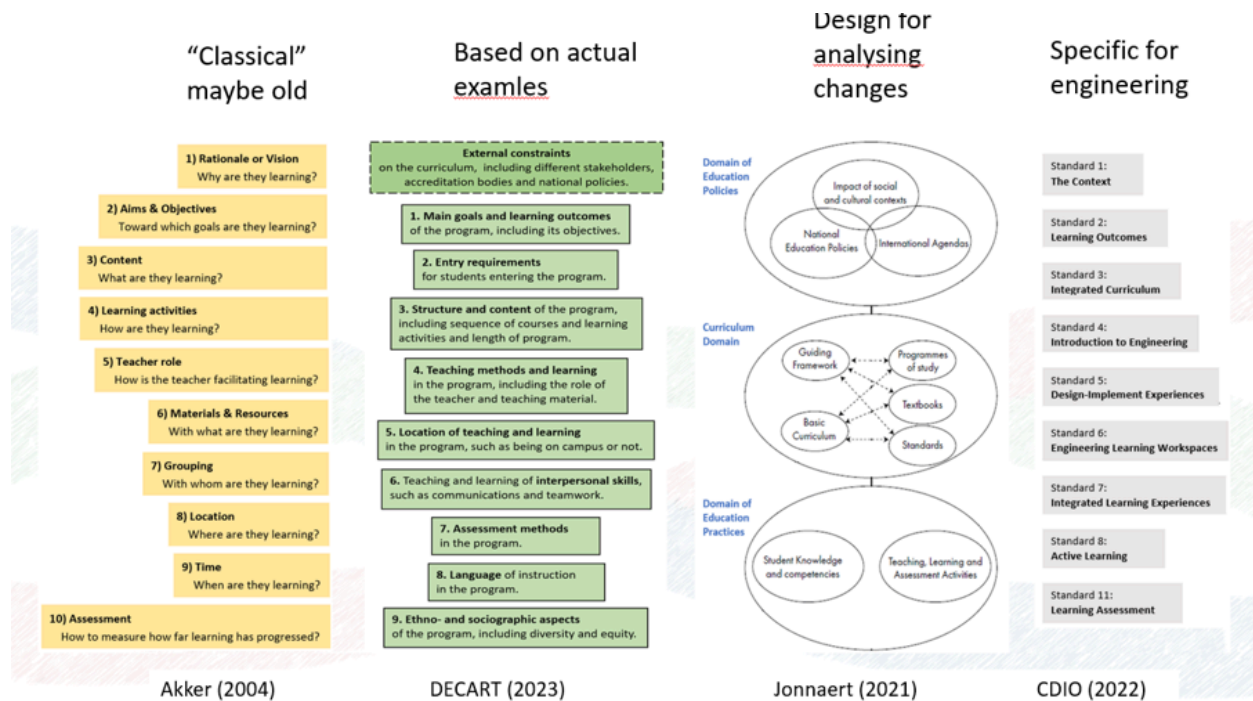


Figure 5.3. Comparing the four “templates” of the curriculum.

VUCA and the DECART curriculum

The harmonized DECART curriculum appears to be a good framework to test the sensitivity and resiliency of an educational program to unexpected and disruptive events. Such events are often characterised by the VUCA dimensions, i.e. to what extent the situation may be volatile, uncertain, complex and ambiguous. Results of our DECART survey on VUCA-like scenarios and the sensitivity of different curriculum components will be presented in the following report R12: *VUCA Scenarios Impacting Higher Education*.

6. Curriculum lifecycle

A curriculum is not static. Curriculum update is necessary due to the latest technology and industry updates for example in engineering education, but still needs to meet the National framework and standard. Minor updates can be made periodically for each new academic year, but major updates can be made more long term, like between accreditation cycles (e.g. every 5 years), i.e. Figure 6.1.

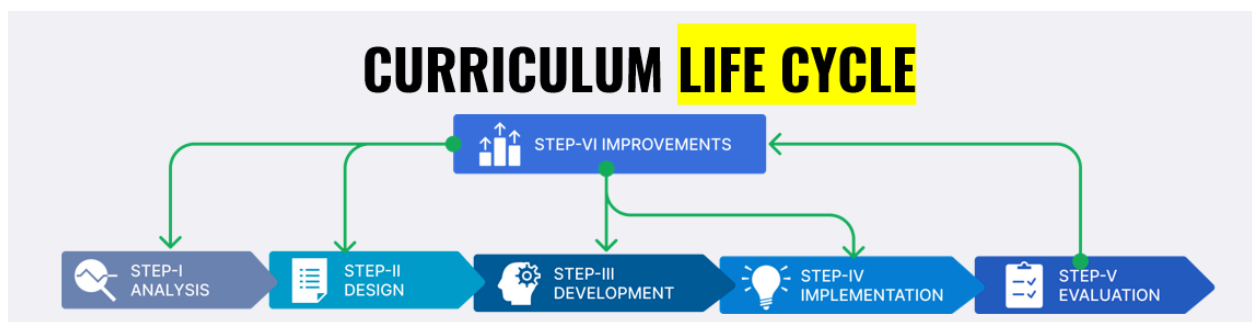


Figure 6.1. The six steps of the curriculum life cycle.

To develop a new curriculum, both top-down and bottom-up process can be used by programme leaders, i.e. Figure 6.2.

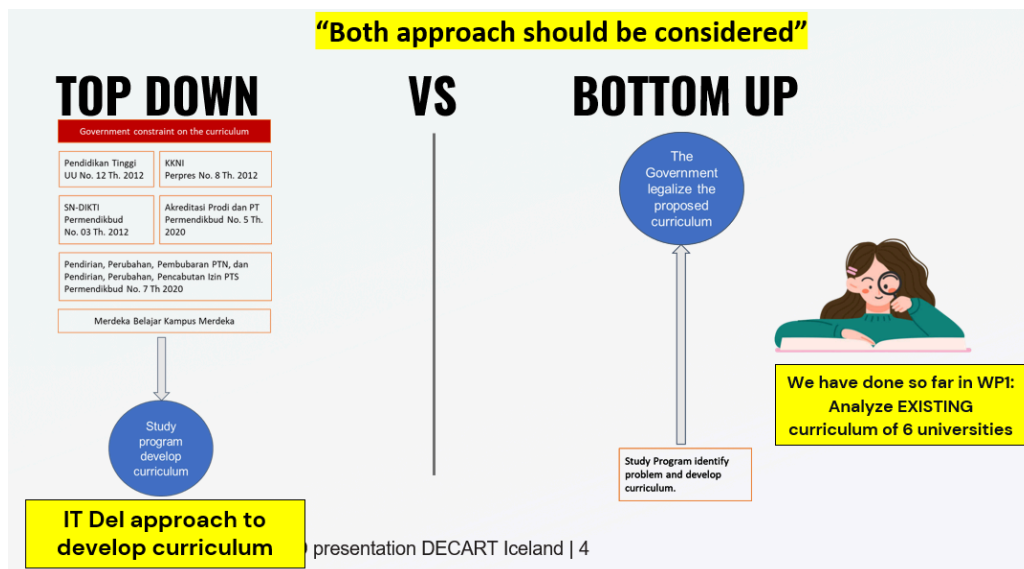


Figure 6.2. Top down and bottom up approaches in developing new curriculum.

A broad consensus during clarification discussion was that goals and learning outcomes are the essence to start designing and specifying a curriculum, as is apparent in the DECART curriculum canvas. An example of 21st Century Skills is given in Figure 6.3.

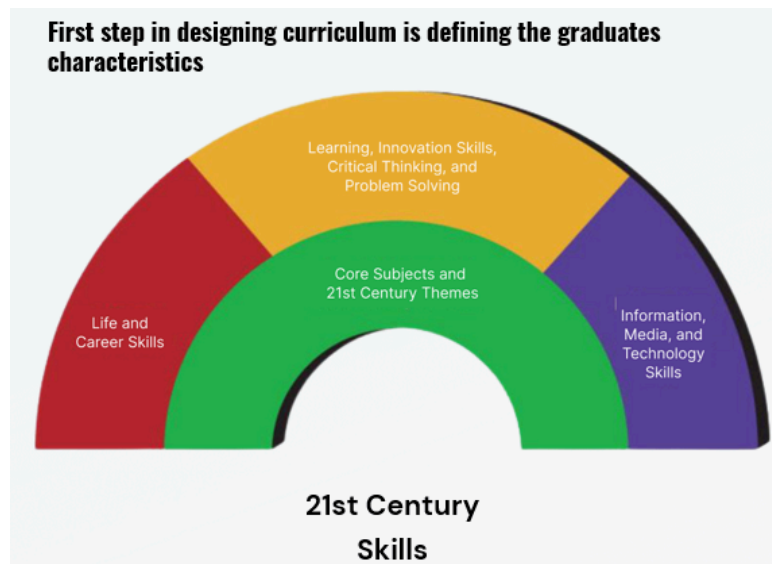


Figure 6.3. An example of 21st Century Skills.

The terminology behind learning outcomes is also not clear, depending on the country's professional or knowledge orientations, the differences between *competencies*, *skills* and *knowledge*. Sometimes *dispositions* as in the CC2020 guidelines which state that dispositions are "not only important to industry but are also clearly needed for long-term professional success, and even for personal growth and development of character and citizenship". However, "the competencies do not explicitly address dispositions" and that "it may be necessary for future curricular documents to indicate explicitly the scope and breadth of dispositions in computing".

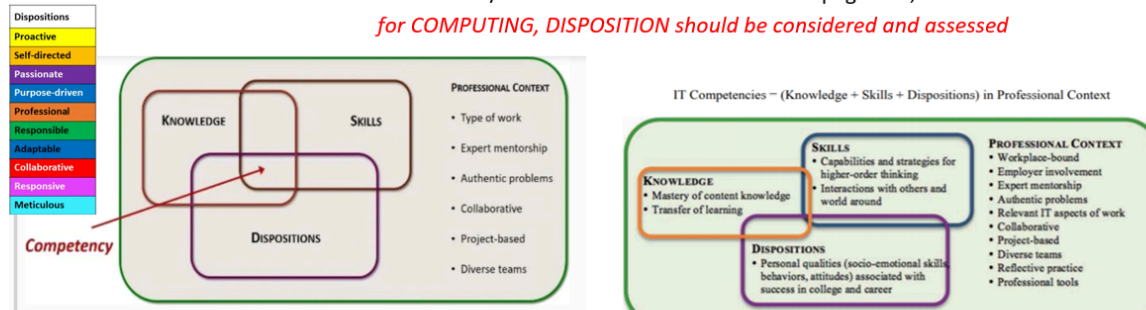
Computing Area Guideline

<https://ieeexplore.ieee.org/abstract/document/8363484>

The CC2020 project — computing curricula guidelines for the 2020s

DOI: 10.1109/EDUCON.2018.8363484 - John Impagliazzo, Arnold Neville Pears

for COMPUTING, DISPOSITION should be considered and assessed



<https://link.springer.com/article/10.1007/s10639-020-10127-1#Fig3>

The CC2020 project and its subsequent products consider all aspects of computing education. The task force is responsive to regional practice, language considerations, cultural differences, and **different ways of learning**. The report will promote global awareness since it recognizes that its content reflects a part of a **worldwide community** of computing educators and professionals. The task force will accommodate global differences in vocabulary and interpretations that pervade the professional environments of teachers and researchers. Lack of cultural knowledge can hinder understanding the meaning of terms, thereby inhibiting communication among colleagues and professionals.

Figure 6.4. Example outlining the revision process for computing curricula, the CC2020 project (from Impagliazzo et al., 2018, <https://ieeexplore.ieee.org/abstract/document/8363484>).

Curriculum change

Curriculum change is the focus in the latter part of the DECART project, and that activity aims to identify the premises of events that can lead to crisis management in institutions. How such events may and will affect the running of educational programs can be explored through the concept of curriculum, with the aim of designing the curriculum such that it will be resilient to these events. The harmonized curriculum as presented earlier in this report will therefore be fundamental in such analysis. The approach by Jonnaert and coworkers is one such potential approach, with the curriculum at its center, and is outlined in Figure 6.5.

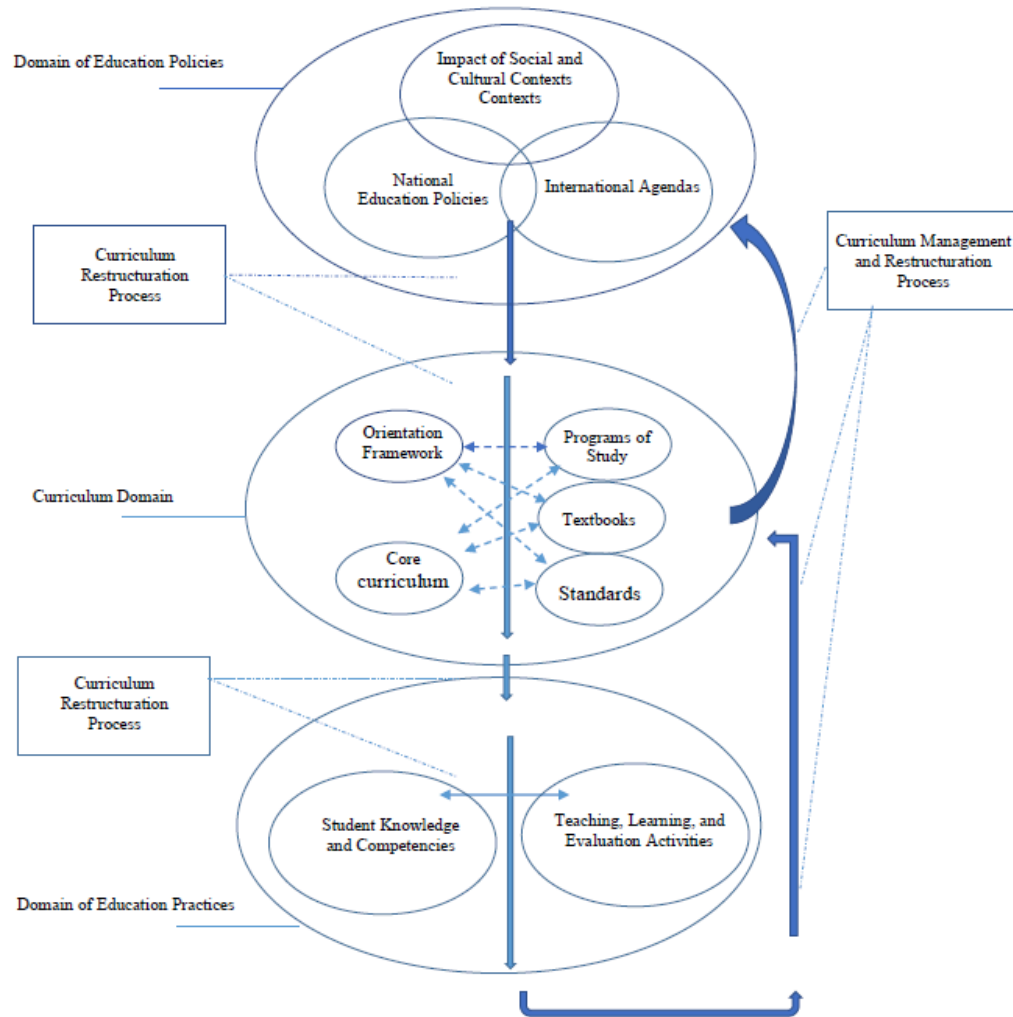


Figure 1: Holistic curriculum and the process of curriculum restructuring, adapted from Depover and Jonnaert (2014: 188).

Figure 6.5. One possible approach on restructuring educational programs with the curriculum at its center. Figure from Jonnaert (2021).

Drivers for curriculum change

The primary drivers for curriculum change are the external constraints, sometimes man induced (for example national politics and changes in accreditation bodies) and sometimes by nature (for example natural disasters and global warming). These drivers can be sudden or more diffuse,

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and either predictable or not. Secondary drivers are the ones that can directly affect how the curriculum is executed and the programs are actually run (changes in student population, revised financial support, housing and facilities available, communications and electronic media).

The next report in the project, R12, *VUCA Scenarios Impacting Higher Education* (DECART-project, April 2024), focuses on potential events that may affect curriculum. Furthermore, in the DECART project, work packages 2 and 3 focus more on VUCA scenarios that may induce changes in educational systems and how to design them more resilient.

Potential references on curriculum change include Rouvrais et al. (2020) on "Preparing 5.0 engineering students for an unpredictable post-COVID world" and Gaultier le Bris et al. (2019) on "Learning Methodologies for VUCA Situations".

Curriculum to learn from and be inspired from

Having constructed the harmonized curriculum all partners contributed exemplary curriculum from their institution, following our new harmonized template.

- These particular examples of curricula designs may serve as a catalyst for mutual understanding, inspirations and discussions of the curricula challenges by the various stakeholders, including:
- Potential innovative methods and tools in the design process;
- Informed curriculum choices and transformation decisions.

These selected curricula were analyzed by all partners and individual components in each curriculum were marked as if it contained "something to learn from" if that was the case and why it was considered valuable. The results were summarized as shown in Figure 6.6, showing the number of positive votes for each. The items that got votes above 10 were scrutinized further, for all to learn from and be inspired.

The study underlined the importance of this kind of analysis and concluded with recommendations for a wide array of stakeholders, including educators, curriculum leaders, quality assurance and accreditation bodies, students, and industry players. Specific results have the potential to drive curriculum transformation, agility, and resilience and accentuates the potential impact on curriculum and course development, engineering projects, student preparation, and engage

Initial analysis: “Good example to capitalize? yes/no”

Simple summary, only counted 'yes' = green boxes in the main table to the question:

This table is only indicative
 - It is qualitative, not quantitative
 - Template prone to different understanding

	(1) Goal or Learning Outcomes	(2) Entry requirements	(3) Structure	(4) T&L methods	(5) On Campus or not	(6) Interpersonal Skills	(7) Flexibility	(8) Assessment methods	(9) Language of instruction	(10) Ethno/sociographic
IMTA curriculum	10	8	15	10	12	13	12	11	8	12
ITD curriculum	10	7	8	8	8	10	13	7	8	1
RSB curriculum	5	9	14	2	3	5	2	0	1	1
RU curriculum	15	13	13	14	14	11	15	9	8	9
UKZN curriculum	11	9	9	10	9	10	7	7	6	11
VU curriculum	6	8	8	12	10	0	6	7	6	0
	score of 10 or higher (max is 17).									

Figure 6.6. Table summarizing the analysis of all exemplar curricula and highlighting the ones that were generally considered as “good example to capitalize”.

In summary, best practices in curriculum design for engineering education are multifaceted, encompassing industry relevance, active learning, interdisciplinary approaches, and a focus on soft skills development. A curriculum that adeptly integrates these elements not only equips students with technical knowledge but also cultivates the adaptability and versatility necessary for a successful engineering career. As technology advances and societal needs evolve, engineering education must remain at the vanguard of innovation to produce graduates capable of tackling future challenges. It's crucial for leaders in higher education to regularly reassess their curriculum and engage in curriculum transformation to ensure ongoing quality improvement. The shared curricula underwent critical examination based on key features related to curriculum components. The analysis includes reflection and feedback from project partners. These findings hold significance for engineering educators in various contexts, offering insights to drive curriculum transformation, agility, and resilience amidst increasingly Volatile, Uncertain, Complex, and Ambiguous (VUCA) environments, which continue to influence engineering education and higher education as a whole.

7. Meetings, workshops and outreach

Meetings and workshops

Table 7.1 lists the formal online and onsite meetings already in this first phase of the project, on Curriculum Design.

Table 7.1 Program Meetings and workshops.

Type of meeting	Working dates	Site	Active participants
PM1	21 – 22 November 2022	On line (Zoom)	<p>On-line (14 persons):</p> <ul style="list-style-type: none"> • VU: Valentina Dagienė and Vladimiras Dolgopolas, • RU: Haraldur Audunsson, Anna Sigridur Isling, • UKZN: Cecile Gerwel, • RSB: Joanne Gardner-Legars and Elodie Huré, • ITD: Arlinta Barus, Tahan Sihombing, Eka Stephani Sinambela, Inggriani Liem and Sari Muthia Silalahi, • IMTA: Siegfried Rouvrais and Roger Waldeck.
PM2	21 - 22 June 2023	Reykjavik , Iceland	<p>On-site (12 persons):</p> <ul style="list-style-type: none"> • RU: Haraldur Audunsson and Asrun Matthiasdottir, • UKZN: Cecile Gerwel, • VU: Egle Jasute and Valentina Dagienė, • IMTA: Siegfried Rouvrais, Gilles Jacovetti, Nathalie Chelin and Roger Waldeck, • RSB: Joanne Gardner-Legars and Elodie Hure, • ITD: Tahan Sihombing. <p>On-line (6 persons):</p> <ul style="list-style-type: none"> • UKZN: Angela James and MacDonald Kanyangale, • ITD: Arlinta Christy Barus and Inggriani Liem, • IMTA: Chantal Puren and Coraline Lozach.

PM3	28 – 30 November 2023	Rennes, France	<p>On-site (11 persons):</p> <ul style="list-style-type: none"> • VU: Valentina Dagiene, • ITD: Tahan Sihombing, • UKZN: MacDonald Kanyangale, • RU: Asrun Matthiasdottir and Haraldur Audunsson, • RWTH: Clara Lemke, • IMTA: Gilles Jacovetti, Nathalie Chelin, Roger Waldeck and Siegfried Rouvrais, • Learning Salad: Marine Mas <p>On-line (4 persons):</p> <ul style="list-style-type: none"> • UKZN: Cecile Gerwel and Angela James, • ITD: Arlinta Christy Barus and Inggriani Liem.
IPHE1	13-16 February 2024	Brest, France	<p>On-site (12+4 persons):</p> <ul style="list-style-type: none"> • VU: Valentina Dagiene and Asta Meškauskiene, • ITD: Arlinta Christy Barus, Eka Stephani Sinambela and Sari Muthia Silalahi, • UKZN: Angela James, • IMTA: Siegfried Rouvrais, Nathalie Chelin, Roger Waldeck and Gilles Jacovetti, • RU: Haraldur Audunsson and Asrun Matthiasdottir, • Cameraman: Anthony Diaz, • ENSTA Bretagne: Brad Tabas, • BBS: Yann Quemener, • Scriber / graphical designer: Julie Boiveau.



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Outreach

Newsletters during the initial phases of the project are listed in Table 7.2.

Table 7.2. Content of Newsletters 1 and 2.

	Content
Newsletter 1 April 2023	<ul style="list-style-type: none">● Project partners' map● About DECART● Project objectives● What is the meaning of VUCA?● DECART project program● Overview of the project work packages● Anticipated results● Spotlight on the coordinating partner: IMT Atlantique● Spotlight on the first onsite meeting host: Reykjavik University● Summary view of the DECART project partners● Status update and ongoing project activities
Newsletter 2 April 2023	<ul style="list-style-type: none">● Reminder about DECART project● RWTH as a new member● Spotlight on the German accreditation system● Second project meeting in Reykjavik, Iceland● Curriculum canvas● Curriculum resilience● Erasmus Days 2023● Third project meeting in Rennes, France● Publications

Direct Project References

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

Dispositions as an Important Component in Computing Curriculum in IT Del, A. Barus, I. Liem, T. Sihombing, A. Sinaga, E. Sinambela and S. Silalahi. In 2023 IEEE International Conference on Data and Software Engineering (ICoDSE). DOI:10.1109/ICoDSE59534.2023.10291337



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Factors that may impact curriculum design in higher education in a VUCA world. H. Audunsson, A. Matthiasdottir, A. Barus, S. Rouvrais, R. Waldeck, and C. G. Proches. To appear in Proceedings of the 20th International [CDIO](#) Conference, hosted by ESPRIT, Tinis, Tunisia, June 10-13-, 2024.

References addressing curriculum design and content

CDIO (2023): *CDIO Standards 3.0*,

<http://cdio.org/content/cdio-standards-30>

Akker (2004): *Curriculum Perspectives: an Introduction*,

https://link.springer.com/chapter/10.1007/978-94-017-1205-7_1

Akker (2007): *Curriculum Design Research*,

http://cls.ea.gr/sites/default/files/Curriculum_design_research_Van_der_Akker.pdf

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>

Bruce Kloot (2015). "[Curriculum reform as a driver for change in higher education: the case of South Africa](#)". *Journal of Education* (60), pp. 123-144.



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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
- In Germany:
 - Carmen Leicht-Scholten, Clara Lemke, and Ann-Kristin Winkens from RWTH Aachen University,

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- In Iceland:
 - Haraldur Audunsson and Asrun Mathhiasdottir from Reykjavik University
- In Indonesia:
 - Arlinta Barus, Inggriani Liem, Sari Silalahi, Eka Stephani Sinambela, and Tahan Sihombing from IT Del,
- In Lithuania:
 - Valentina Diagene, Vladimiras Dolgopolas, Egle Jasute and Asta Meškauskienė from Vilnius University,
- In South Africa:
 - Angela James, MacDonald Kanyangale, and Cecile Gerwel Proches from University of KwaZulu-Natal.



Agility,
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Appendix

External constraints by the partners

The detailed descriptions of all the external constraints are in a separate file, i.e. Appendix to report R11.

Listing of contributions in the Appendix:

Partner/University	Program
IMT Atlantique France	Generalist engineering degree under student status program
Institut Teknologi Del (IT Del) Indonesia	Engineering Management
Rennes School of Business France	Master in International Finance
Reykjavik University Iceland	Engineering
University of KwaZulu-Natal South Africa	Master of Business Administration
Vilnius University Lithuania	Bachelor of Engineering Sciences in Energy Engineering of Vilnius Tech
RWTH, Aachen Germany	General