Funded by the Erasmus+ Programme of the European Union

DIGI-GRENT Project

IO Number: 2

Output name: Digital and Responsible Entrepreneurship (DREP) Toolkit for Managing Quintuple Helix Cocreation in an Open Innovation Manner

Submission Date:	02/04/2019
Leading Partner:	ULO & SEERC

Document Revision History

Version	Date	Comment	Author(s)
1.0	02 April 2019	First Draft	Adrian Solomon, Bartek Kalinowski
1.1	15 May 2020	Updated Version	Adrian Solomon, Bartek Kalinowski

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Table of Contents

1 INTRODUCTION 3

2 OVERVIEW & CONTEXTUAL POSITIONING OF THE QUINTUPLE HELIX 4

2.1 OVERVIEW 4
2.2 GENERAL CONTEXT 4

3 OVERALL METHOD FOR QUINTUPLE HELIX CO-CREATION & OPEN INNOVATION 7

3.1 APPRAISAL 7
3.2 MAPPING 7
3.3 CONSULTATION 9
3.4 DESIGN 9
3.5 OBSERVATION 12

4 OPERATIONALIZING THE QUINTUPLE HELIX CO-CREATION 13

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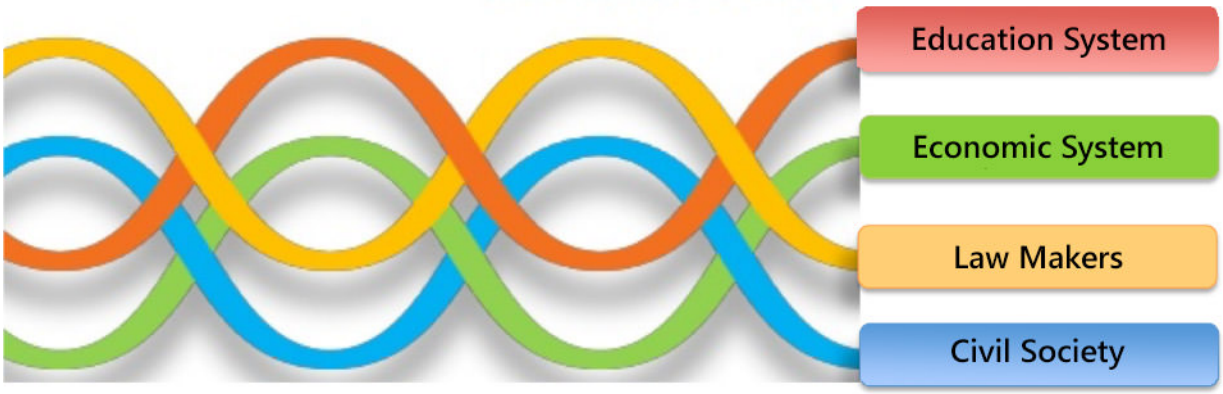
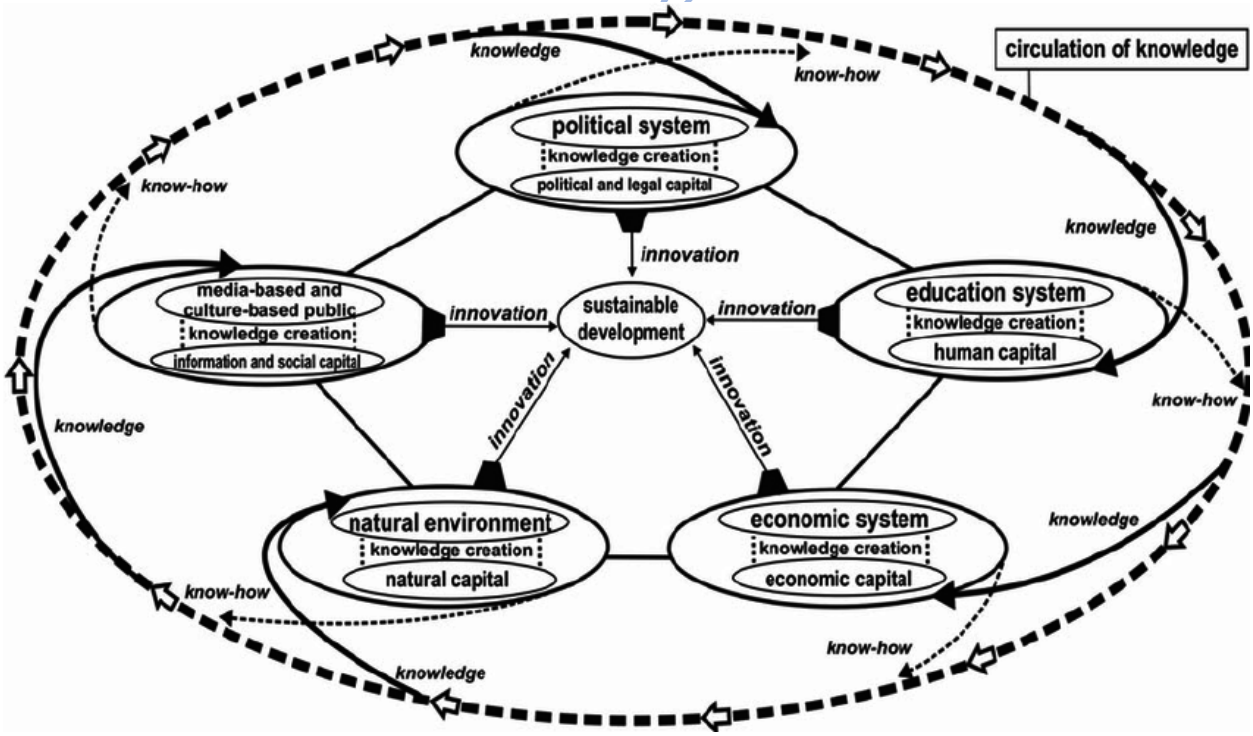
1 Introduction

This document provides an overview on the open innovation & co-creation framework for DREP curriculum development methodology, hereafter referred as quintuple helix co-creation & open innovation toolkit that sustain the whole vision of DIGI-GRENT in terms of ensuring a balanced view/insight of all the quintuple helix stakeholders in all the project deliverables with specific relation to the DREP curriculum.





(Carayannis, Barth & Campbell, 2012)

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2 Overview & Contextual Positioning of the Quintuple Helix

2.1 Overview

The roles of the quintuple helix co-creation & open innovation toolkit are:

- Ensure proper goal alignment, skill-gap assessment and mitigation in relation to the DREP curriculum.
- Ensure proper face-to-face quintuple helix collaboration and co-creation during the transnational training sessions.
- Ensure proper understanding the-each quintuple helix actor in order to know how to engage them in the curriculum development and to ensure their sustainable co-creation around DREP in an open-innovation manner.

2.2 General context

Quintuple helix co-creation & open innovation should be contextualised within the overall interpretation underlying the present situation of DREP curriculum development and expressed in the project structure.

- Science (i.e. DREP), as any other institution of modernity (political institutions, trade unions, institutional religions, etc.), is suffering from the **shift from modern to post-modern society**. Quite paradoxically, while science is becoming technically stronger (in terms of impacts and results), it is also becoming socially weaker.

- Some **critical issues** pertaining to science & DREP curriculum development are, for example:

  - decreasing authoritativeness and social recognition of scientific institutions and, to a certain extent, decreasing credibility of scientists
  - growing diffusion (as an effect of the emergence of the so-called "post-factual age") of societal views (of facts, events, processes) which are explicitly alternative or even opposite to those based on science, often propelled by anti-science attitudes and pseudo-scientific beliefs
  - ever-stronger connection between innovation, environmental and ethical and policy issues, triggering and feeding social tensions on controversial issues and "public battle" among experts
  - increasing sensitiveness of the public towards science-related risks
  - people's decreasing trust in scientific institutions leading to a growing demand for accountability and transparency
  - need for science & innovation institutions to increasingly demonstrate their social, environmental and economic usefulness to citizens as taxpayers.

- It is easy to see that these critical issues are similar to those affecting the other social institutions of modernity. See for example some of the phenomena affecting **policy:**
  - decreasing authoritativeness, social recognition and credibility of politicians and political parties
  - growing diffusion of anti-political and populist views, leading to a decreasing people's propensity to vote

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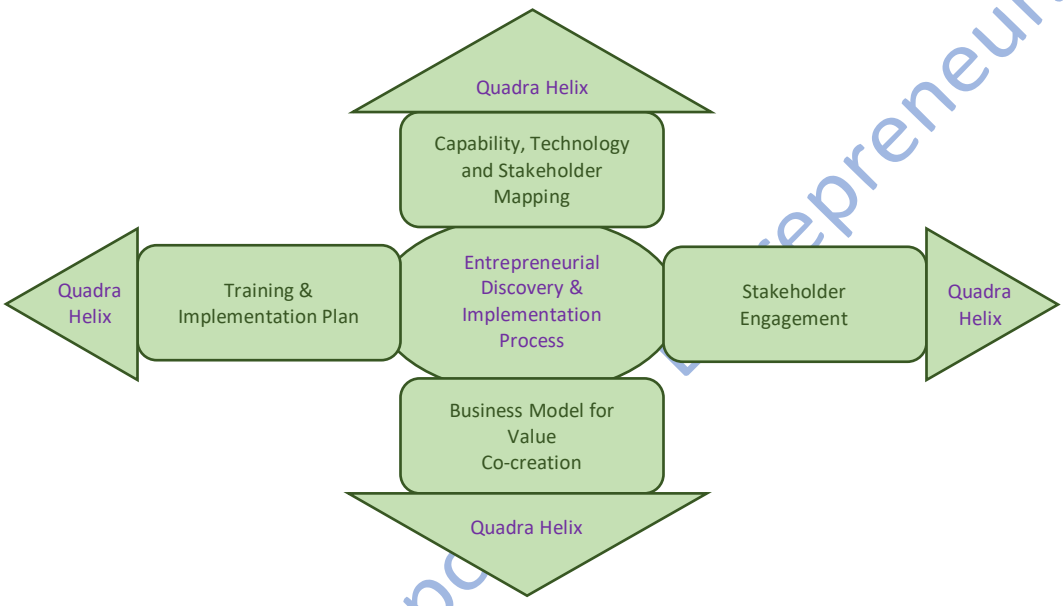
- ever-stronger connection between politics and ethical issues, especially regarding aspects like environmental sustainability, privacy, security, medical issues, or civil rights
- increasing sensitiveness of the public towards risks connected to politics (for example, corruption, connections between politics and industry, high costs of political institutions, etc.)
- people's decreasing trust in politicians and political institutions leading to a growing demand for accountability and transparency
- need for politicians and political institutions to increasingly demonstrate their capacity and usefulness to citizens as taxpayers
- need for a better accountability of the environment towards fulfilling the SDG goals
- all the above can be fulfilled through goal alignment, skill gap mitigation and co-creation



Therefore, there is a high need for a quintuple helix co-creation/communication in all aspects of nowadays society and especially in the prospect of DREP curricula development.

Therefore, in order for the European Union (EU) to be successful in implementing and expanding open innovation as one of the main driver of its socio-economic growth, higher education institutions (HEIs) must be able to produce independent, creative, entrepreneurial individuals, who understand inter- and multidisciplinary challenges of the socio-economic environment and as a result can contribute to open innovation in true convergence with technological growth & enterprise digitalization. EU's success in the global competition is heavily dependent on the ability of the economy to produce innovative enterprises with high growth potential that can give stimulus to the actors of the socio-economic environment. Creating a common framework and a unified entrepreneurial ecosystem across the EU requires a core engine of open innovation and co-creation among all the involved stakeholders in order for the inequality among the regions of the EU to be decreased. Achieving an empowered society that co-creates together with the market will provide a much proper context for growth, as society is the main driver of growth. Secondly, pierced by severe environmental concerns and eco-innovation, society pushes the actors (and vice-versa) for more innovative growth mechanisms that are more resource efficient and environmentally sustainable. Such shift not only that ensures long terms sustainability and societal development by

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improving living conditions, but it also drives the need for more innovation and knowledge exploitation towards finding unique solutions to growth in a digitally driven QUINTUPLE HELIX context (comprising of university, industry, policy, society, environment) where digital and responsible (socially & environmentally) entrepreneurship (DREP) should be the driver of sustainable development.

One way of achieving a working quintuple helix to foster DREP is through co-creation. Chesbrough (2013) argued that cocreation is the cornerstone of open innovation practices in today's society. For example, through co-creation, academia can gain useful input from the other stakeholders, that will eventually lead to more market oriented curriculum and better prepared graduates capable to implement responsible entrepreneurship (Chesbrough 2010; Chesbrough 2011). More recently, Carayiannis (2015) introduced the concept of targeted open innovation arguing that open innovation should be focused, strategic, and tailored to the current needs of the stakeholders, thus universities need to enhance their curricula accordingly. Hence, open innovation and co-creation between academia and stakeholders will highly increase academia's capacity of producing more market oriented curricula that will lead to graduates capable of being next generation leaders in responsible entrepreneurship.

To this end, DIGI-GRENT responds to this need by aiming to develop an innovative, transnational framework that will improve the knowledge and skills of academic institutions to produce more marked/startup oriented DREP curricula, reducing the barriers in this field. The project consortium comprises key academics, investors, industry/employment associations, startup associations, and societal growth partners (and associated partners) from different sectors who will co-create the envisaged DREP curriculum and will pilot it through an open innovation and co-creation virtual learning environment (VLE). This outcome is directly pertinent to quintuple helix-academia cooperation for innovation and best practices with respect to DREP, and can also support policy reform in this area, leading to more prepared graduates ready for the startup market. DIGI-GRENT also follows up the recent plans of the EU to promote improved, efficient and clean operations by 2050 and is also relevant to the EU2020 targets for R&D, climate change, energy efficiency, entrepreneurship and social cohesion. This makes DIGI-GRENT directly relevant to the current objectives of the participating & affiliated uintuple helix organizations.

Additionally, DIGI-GRENT is highly aligned at a policy level with the goals of Strategic Partnerships for academia-market-society collaboration and the promotion of innovation and best practices, with the Headline Education Target and with the EU Higher Education Modernisation Agenda. Similarly, DIGI-GRENT is in line with the European cooperation in education and training (ET2020) strategy by fostering life-long-learning, improving the quality of education through stakeholder engagement, and promoting creative thinking towards DREP. The following reports and efforts are the base foundation of DIGI-GRENT: CEDEFOP's report on Environmental Skill Promotion (2016); OECD's report on Digital Entrepreneurship Skills for Young Entrepreneurs (2015); EU Commission's JRC Report on 2035 Sustainable Economy (2015); EU's EPALE platform report on Sustainable Business Skills (2017); EU Commissions New Skill Agenda for Europe (Employment and Social Performance) (2016); WEF Report on Graduate Skills for Enterprise (2016).

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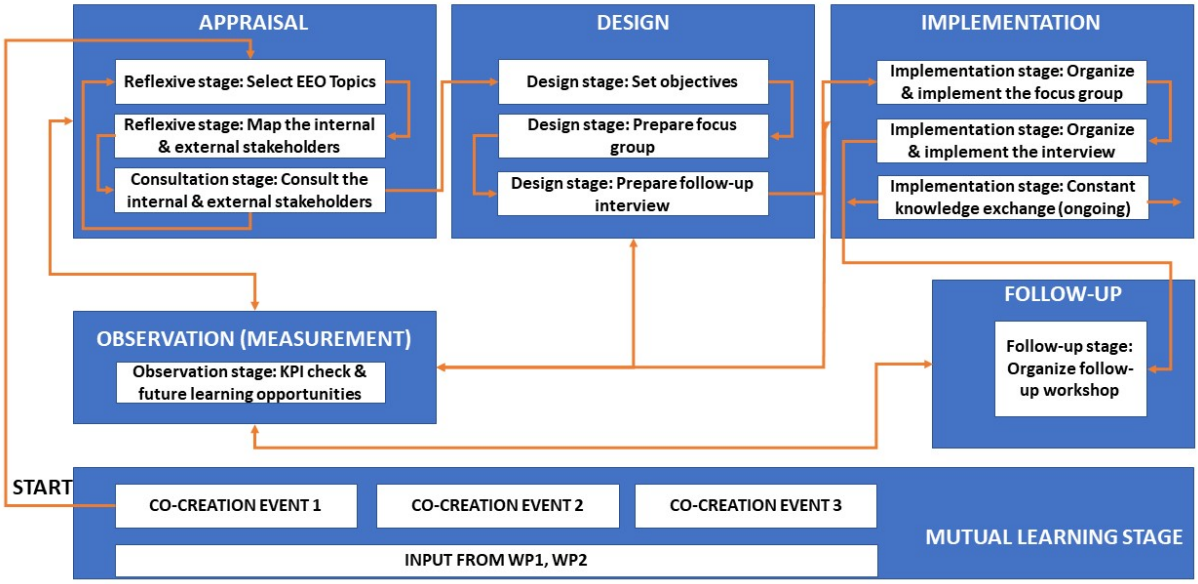
3 Overall method for quintuple helix co-creation & open innovation



3.1 Appraisal

The first main step in the implementation of the quintuple helix co-creation is the identification of the actual (ongoing/new) interests of the main initiating institution (in relation to DREP needs shown by IO1) and description of its main features as exemplified in the table below:

Organizer	<name of the institution>
Description	<few lines denoting the main needs in relation to DREP>
Stakeholders	<list which actors internal & external are involved>

3.2 Mapping

The next step is the stakeholder mapping process (identify internal + external stakeholders).

List the internal stakeholders	Internal stakeholders can be: • The research/teaching team (PDRAs, PhDCs, Academics, RAs, etc) • Teaching coordinator / Teaching office • Finance team • Any DREP-related office

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	• Startup support team • Digitalization team • Sustianability/Responsibility officers • Employability offices Provide a list with names, full titles/positions and contact of all the aforementioned stakeholders.
List the external stakeholders	External (quintuple helix) stakeholders can be: • Other external institutions interested in DREP • Local/regional/national policy bodies • Other field-compatible research centres, researchers and companies • Citizens and NGOs • DREP influencers, industries • Startups, incubators, methods • Business angel networks, investors • Regional funds authorities • Environmental organization & certification authorities • Digital hubs • Startup associations • Open innovation & citizen hub association How to identify the external stakeholders: • Undertaking a sectoral profile in the region/country to identify the key external players in this field • Undertaking a sectoral profile in other successful regions/countries from EU where the stakeholder-group is well-established in order to identify new relevant external stakeholders • Identification of the main regulatory framework that governs the DREP sector in order to reach the responsible institution (that monitors/control the regulation) • Analysis of the regional/national innovation & science communication policy framework in order to understand the actors involved • Analysis of similar research performed by fellow (or top performing) institutions in order to identify the names of the innovators in this field Provide a list with names, full titles/positions and contact of all the identified stakeholders.

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3.3 Consultation

After the stakeholders are mapped (identified), a consultation step will follow:

Survey/Interview	An informal survey (2 responses per stakeholder type) targeting both internal & external stakeholders will be implemented. The survey will contain the following items: • Description of the DREP challenge (needs) • Description of the purpose of the co-creation • Assessment of the know-how/implementation of DREP in the stakeholders' institution/work • Assessment of the stakeholder's institutional DREP governance settings • Assessment of the stakeholder's interest, motivation, perceived usefulness of DREP • Assessment of the relevance/usefulness of key related DREP practices emerged from IO1 • Qualitative input related to the quintuple helix implementation (how to bring the quintuple helix (related to the ongoing task of developing DREP training outputs) together more effectively • Assessment of the stakeholder's interest in participating in the co-creation events, follow-up interview and follow-up workshop related to the envisioned experiment

The quintuple helix co-creation event design step consists of the blueprint required to engage quintuple helix stakeholders co-creation DREP training outputs. In order to proceed to this stage, the stakeholder mapping and consultation must have been finalized to ensure that the entire stakeholder group and their views are properly considered in the experiment design process. As a guide for the design phase, the following table provides an overview:

3.4 Design

Organizer	<name>
Topic	<topic.. i.e. DREP area >
Objectives	Stipulate the DREP objectives of the co-creation (based on the identified needs) Examples: • Identify how to facilitate DREP startups to solve local needs ? • Assess what policy drivers would help DREP startups to scaleup ?

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	• What are the key trends in DREP and how do these affect society ?
Focus group	Organize a first focus group with internal + external stakeholders in order to discuss the objectives of the quintuple helix co-creation. This implies: • Set the date & time of the focus group (2.5h) • Send invitation to the identified stakeholders to participate in the focus group • Implement the focus group with the objectives that have been set. The goal of this focus group would be to open to the debate for the achievement/implementation of the previously set objectives. As a result, a clear set of actions will emerge. After this focus group, each stakeholder will be asked to "resume" their normal operation in their institutions and assess/identify how the objectives (through the emerged set of actions) can be implemented (in theory) and what changes/further actions would be required. Such changes can be operational, regulatory, etc. In any case, the idea is to minimize the effort for the stakeholders in order to ensure they participation.
Quintuple helix co-creation implementation approach	The multi-stakeholder management during the focus groups will be implemented following the forthcoming guideline(s): • Introductions & overview on the research, chosen DREP needs, objectives of the quintuple helix co-creation. • For each stakeholder: current awareness and interest related to the DREP needs[repeat for each need] • For the internal stakeholders: what do you require from industry, NGOs and policy in order to better develop DREP curricula into your ongoing teaching framework? • For the internal stakeholders: how can you better involve society in your teaching material design, implementation & follow-up stages and how would this impact on embedding the chosen DREP pillars in your curriculum ? • For industry & NGOs: what would make you engage more with universities (i.e. internal stakeholders) in order to

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	properly facilitate the development of DREP curricula? What perceived benefits do you foresee and what are the blockers? How is the policy framework supporting such engagement? • For policy makers: How should the co-creation between the internal stakeholders, society and industry evolve in order to properly contribute to the national/regional policies on supporting DREP curricula? What are your main mechanisms to control and monitor the developments of DREP curricula implementation (and how do you measure the impact (graduate know-how) at a local/regional/national level)? • For industry & policy: Would you be willing to provide funding for boosting the embedment of the DREP curricula in other universities? • For society/NGOs: How would you expect to be involved and contribute in the design, implementation and follow-up stages of this ongoing DREP curriculum development? How will your contribution impact on embedding the DREP curriculum in universities? • Consensus: Direct the discussions towards achieving (if possible) a consensus among the stakeholders and set the following next steps that each stakeholder will have to consider.
Follow-up interview/ questionnaire	Organize a follow-up interview/questionnaire with (the same) internal + external stakeholders in order to discuss the follow-up on the actions set in the first focus group. The objective would be to understand to what extent the previously set actions can be implemented and if (perhaps) any other blockers are emerging while also updating on the research progress. This would enable the internal stakeholders to incorporate progress-feedback in their process of assessing the implementation of the DREP curriculum. Guidelines: The targets upon which the progress should be reported are:

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	○ Internal stakeholders (as well as external researchers/ universities): Identify how to involve the quintuple helix stakeholders for better boosting this co-creation for DREP curriculum development. A practical approach could be adopted by the internal stakeholders by piloting the most relevant DREP needs that have been debated during the co-creation meeting. ○ Policy makers: identify what policy changes are required (and if they are feasible) to better support the quintuple helix co-creation around DREP. ○ Industry & NGOs: identify potential cooperation opportunities with the internal stakeholders and what would be the framework/expected outcomes (win-win) in terms of enhancing the development of marker-oriented DREP curricula. ○ Society & NGOs: identify the current/ongoing needs (based on the overall context discussed in the focus group & related to the chosen DREP needs) and propose ways for the internal stakeholders to account them in the research stages. Each stakeholder will be contacted by phone for a brief interview (30 minutes) in order to follow-up for each of the set targets.

3.5 Observation

The quintuple helix co-creation will be implemented based on the previously developed design. Throughout the implementation, inter-co-creation knowledge-exchanges (within DIGI-GRENT) as will take place. During the implementation of the quintuple helix co-creation, the teams will promote an idea exchange among them so as to building a common view of the open innovation & knowledge-flows and to learn from each-other.

The ultimate role of observation is not to act as a corrective measure but to identify learning opportunities that will be discussed in the follow-up quintuple helix co-creation events. The observation will take place at the following stages:

- Initial stage (after the quintuple helix co-creation design is finalized)
- Mid-stage (after the follow-up interviews)
- Final stage (after the DREP curricula is fully developed)

The observation will be based on the following co-creation KPIs:

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Quantitative:

- Representation of each internal & quintuple helix actor
- Interest in DREP of each internal & quintuple helix actor [at the beginning & end of the co-creation]
- Awareness of DREP of each internal & quintuple helix actor [at the beginning & end of co-creation]
- Perceived usefulness of DREP of each internal & quintuple helix actor [at the beginning & end of the co-creation]
- Number of DREP best practices, curricula, case studies evaluated and highly rated by the stakeholders
- Number of internal stakeholders involved in the co-creation
- Number of quintuple helix consensus solutions (common agreed plans/steps) for supporting the collaboration around DREP

Qualitative:

- Policy change recommendations
- Organizational change recommendations
- Industry proposals for collaboration with academia
- Society-driven proposals for collaboration with academia
- Observation of result/best practice multiplication in the quintuple helix ecosystem
- Number of DREP startups emerged/scaled-up from this exercise

4 Operationalizing the quintuple helix co-creation

The quintuple helix co-creation approach described in this document has been used in all of DIGI-GRENT's outputs, however the best example (show-case) of how this is taken into practice is shown by each training event (C1, C2, C3) organizing according to the Training Scheme Methodology document. Each training is basically a quintuple helix co-creation I which actors from each relevant quintuple helix sector gather in various setting (i.e. workshops, trainings, dissemination & co-creation sessions) in order to co-produce the targeted objectives. In the case of C1, C2, C3, the objectives would be to: pilot & subject to open innovation & co-creation the DREP training material & VLE in a quintuple helix context, identify further trainings needs and raise awareness on DREP. In order to organize these sessions, each training event organizer has utilized the quintuple helix co-creation guidelines for engaging the stakeholders and then they have operationalized the co-creation by relying on the training methodology.

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