Directed Project

D1.2. Capacity Development Strategy for DIRECTED

Training of Trainers – Implementing transdisciplinary knowledge co-production processes in Real World Labs

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Report overview

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Executive summary

The Risk-Tandem Framework addresses several challenges, related to disaster risk reduction (DRR), climate change adaptation (CCA) and systemic risk management. This strategy outlines its operationalization through Training of Trainers for the hosts within each Real-World Lab (RWL), delivered online and in-person training sessions, planning workshops and complementary activities.

The main ambition is to empower Trainers to apply DIRECTED's principles in their Real World Lab's through co-exploration and co-production of risk governance strategies with local stakeholders. This enables locally tailored implementation of DIRECTED based on priorities as identified by stakeholders themselves, reflecting the unique needs of stakeholders in the Capital Region of Copenhagen, Emilia-Romagna, The Danube, and the Rhine-Erft Regions. Rather than a blueprint fit for all RWLs, this document provides a collection of theories, tools and methods that can be iteratively leveraged depending on emerging needs and adapted to diverse risk governance contexts.

This strategy delves into the theoretical and contextual challenges of multi-hazard risk governance, including the issues of navigating complexity in the European context, as well as integrating different DRR, CCA and other knowledge, data or disciplines towards holistic risk reduction.

This establishes the rationale for the Risk Tandem Framework (further developed under Deliverable 3.1.) and associated capacity development. Chapter 3 outlines the practical, iterative and context-driven approach to capacity development, including proposed modules for the first year), and lays the foundation for further development of learning materials, ensuring alignment with DIRECTED's overarching objectives and multi-hazard risk governance ambitions. The strategy ends in a brief description of the proposed Monitoring, Evaluation and Learning (MEL) plan, to be co-developed with RWL hosts (Trainers) and stakeholders for a comprehensive evaluation of DIRECTED's impact.

Contents

Table of Figures

Index of Tables

List of Abbreviations

ACRONYM	DEFINITION
CCA	CLIMATE CHANGE ADAPTATION
DMP	DATA MANAGEMENT PLAN
DRM	DISASTER RISK MANAGEMENT
DRR	DISASTER RISK REDUCTION
MEL	MONITORING, EVALUATION AND LEARNING
RWL	REAL WORLD LAB
TOT	TRAINING OF TRAINERS
WP	WORK PACKAGE

1. Introduction

1.1. Overview

This capacity development strategy explains the operationalization of the **Risk-Tandem Frameworke,** which combines tools, approaches, and methods from risk governance with the co-production processes derived from SEI's Tandem approach (Daniels et al., 2019, 2020). Its objectives are:

1. to build on requirements identified together with **Real-World Labs** (RWLs) to identify capacity needs of different actors to better integrate CCA and DRR information as well as the principles of systemic risk management within their decision-making processes.

2. to empower stakeholders, scientists, and modellers alike to develop their capacity in co-production and collaboration for risk governance (including facilitation and knowledge brokering skills) to enable the exploration of their respective risk context, needs of stakeholders, and integrating data and tools into decision-making, whilst also developing the capacity of modellers to integrate user needs into technical design.

Most importantly, this strategy underscores knowledge-based practice, referring to the insights of professionals in risk governance in their country contexts. The strategy is mainly developed by **Work Packages** (WP) **3 and 4** in the DIRECTED Project. WP3 is focused on developing the innovative and integrated risk governance framework for DRR and CCA – Risk-Tandem. The iterative application of transdisciplinary co-production processes as part of the framework are facilitated by WP4 in the DIRECTED Real World Labs coordinated by WP1. The capacity development strategy describes a central building block of the projects methodology and builds connections between all the Work Packages in DIRECTED (Figure 1).

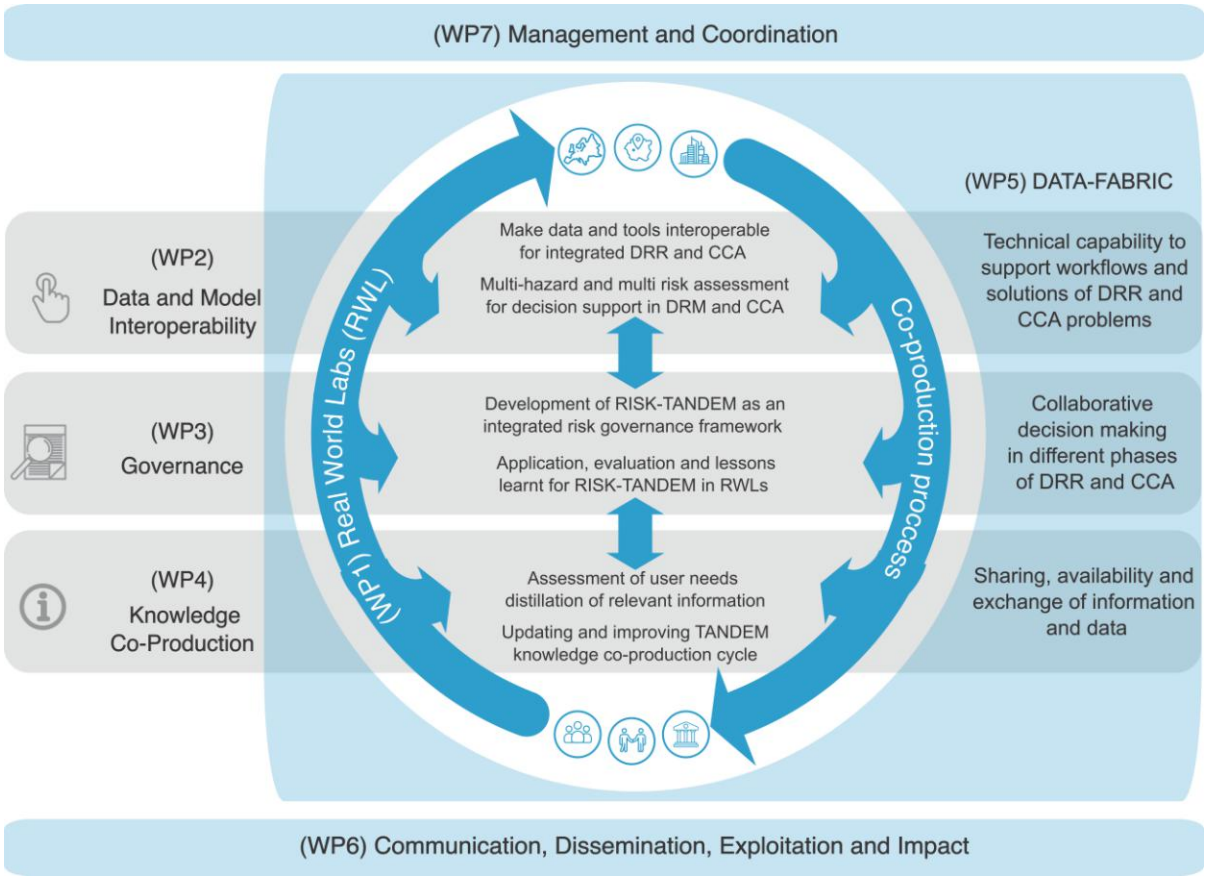

Figure 1: Overview of Work Packages in DIRECTED

To support the **Training of Trainers (ToT)** approach for applying Risk-Tandem and co-production in risk governance, this document offers insight into the theoretical background of the framework and its practical applications. Furthermore, it provides guidance on how to tangibly implement this agenda in the RWLs and information regarding data that can be collected throughout different activities as a part of **Monitoring, Evaluation and Learning (MEL).** Importantly, this strategy is evolving, with continuous updates based on RWL feedback. Thus, it should be approached as a guideline instead of a strict manual. Furthermore, it will be complemented by learning materials and **E-learning modules** to tangibly operationalize capacity development.

Co-production Trainer skills (including facilitation, co-design and co-creation skills) are central to this strategy. Based on SEI's Tandem Framework, this refers to an iterative process in which decision-makers, information providers, practitioners and citizens are brought together to improve the relevance, usability and legitimacy of risk information and planning. This focus on co-production pivots from mechanistic and reductionist conceptualizations of 'risk' to fostering trust, relationship-building, knowledge integration,

coordination, institutional strengthening, non-hierarchical collaboration, and capacity to cope with uncertainty and ambiguity.

The contents of this strategy are structured as follows

A brief introduction to the background and context of DIRECTED

An outline of risk governance, the principles of co-production, and the Risk-Tandem Framework.

An exploration of the intended timeline over the project's four-year span, including a deep dive into the primary components of the Risk-Tandem approach and elucidating tools and learning objectives, including the motivation behind the efforts of Work Packages 3 (governance) and 4 (co-production).

Monitoring, Evaluation and Learning (MEL) plays a pivotal role. RWL activities shall promote democratic and holistic risk governance via the co-production process (ideally contributing to strengthened resilience, improved decision-making and adaptive governance), as well as provide feedback to inform and improve DIRECTED capacity development. Thus, the design of activities incorporates careful analysis of risk governance systems and relationships between stakeholders dedicated to encouraging openness and discussion, capturing insights from the RWLs. Co-production will lay the foundations for understanding best practices from the RWLs, fostering scale-up of DIRECTED approaches, development and application of this strategy based on contextual needs.

The MEL plan is twofold.

In the first dimension, indicators and measures based on a mixed method contribution analysis will be developed to measure the effectiveness of ToT activities, referring to capacity development modules, serious game, and interactive exercises for co-production-based risk management activities and planning in RWLs.

Assessing how RWLs have designed, implemented, and sustained innovative risk management throughout DIRECTED's tenure. Indicators for this process remain dependent on RWL stakeholders' priorities and must be explored and discussed jointly over time.

1.2. Proposed timeline and implementation

The Risk-Tandem Framework design is led by WP3 (governance) and is implemented and evaluated in WP1 (real world labs) with the RWL over the 4 years of the project. Based on the Risk-Tandem, DIRECTED has been divided into four distinct phases (Figure 2), beginning from the foundation year of the DIRECTED Project during which RWLs are set up and established (from stakeholder engagement and analysis to setting priorities for action), and used to inform the iterative development of WP3/ WP4 approaches (including approach to multi-hazard risk governance and capacity development). This is followed by the year of Growth, which includes the implementation, facilitation, monitoring and evaluation of the co-production processes through Training of Trainers under the Risk-Tandem Framework. Capacity needs assessments will be a part of this process, in efforts to identify and respond to emerging needs throughout the project through capacity development. Years Learn and Sustain are interconnected, evolving assessments and MEL to identify best practices, and supporting the institutionalization of DIRECTED risk governance and co-production approaches where appropriate, and to facilitate lasting knowledge exchange toward wider impact.

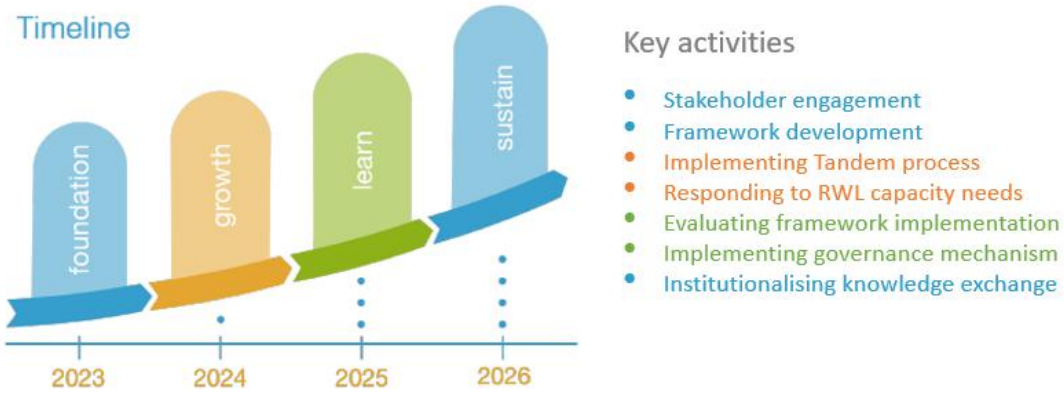

Figure 2: Proposed DIRECTED timeline

For the Foundation Year, preliminary trainings are suggested as per Figure 3. These are based on from insights as outlined in the proposal, literature as assessed under Deliverable 3.1 (Risk-Tandem Framework) and emerging needs from the RWLs. In addition, they have been proposed to support other efforts, including the development of the Data Fabric. The content of these trainings will be assessed with RWL hosts before their full development and delivery, in efforts to maximize their relevance to various working contexts, to ensure that they adequately respond to needs as identified within each RWL. These are explored in detail under chapter 3.3.1.

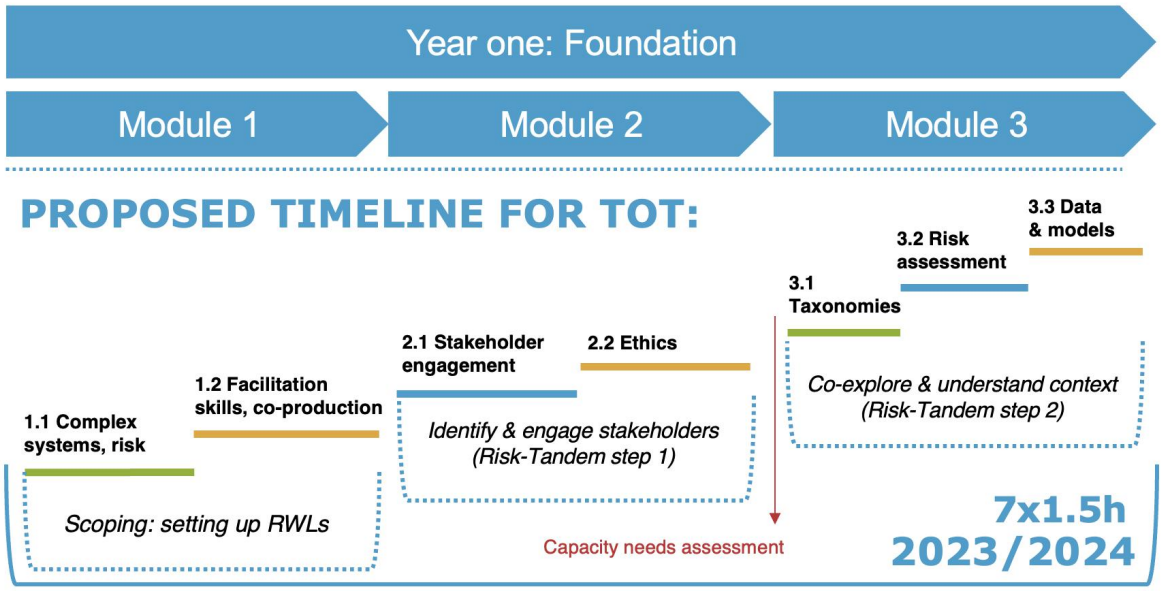

Figure 3: Timeline for the proposed modules for the Foundation year

To ensure that the co production process is successful it is necessary that various work packages, throughout the proposed timeline, actively seek input from the RWL using the recommended tools in this strategy, such as questionnaires, Miro boards, meetings and the like.

2. Rationale

This chapter outlines the rationale for capacity development under DIRECTED, by exploring the European risk landscapes and risk governance contexts in detail. Whilst similar to the literature review conducted under the Risk-Tandem Framework development (D3.1, due

M16), chapters 2.1 and 2.2. will emphasize the skills and knowledges required for managing complex and systemic risks in a polycentric governance setting. Chapter 2.3. will then briefly outline the Risk-Tandem concept to act as a reference for capacity development as discussed under Chapter 3. This was done to establish these deliverables as standalone documents that would not need cross-referencing to understand them, but the users of this strategy are encouraged to explore related deliverables to gain a holistic understanding of the work as envisaged by WP3 and WP4.

2.1 Changing landscape of risk

Emerging complexities and vulnerabilities: The issues of the 21st century now constitute unprecedented challenges for risk management, particularly for those seeking to navigate the interface of science, policy and practice toward change and increased resilience. Indeed, new constellations of risks are emerging – partly due to the progress of globalization – as witnessed in increasingly interconnected risk events with cascading and transboundary potential. On one hand, global supply chains and the mushrooming of shared digital and physical infrastructures continue to generate vulnerabilities and systemic issues embedded within the world system (UNDRR, 2022; Hochrainer-Stigler, et al., 2023). The COVID-19 pandemic, the triple-disaster of Fukushima Daichi in 2011 or the eruption of the Eyjafjallajökull in 2010, all demonstrate the destructive potential of ripple effects of hazards as triggers of vulnerabilities across systems (even when arising from a relatively isolated origin). Consequently, there is a need to begin thinking beyond single hazards and nations, in efforts to understand the networked complexity of risks, and how 'global' hazards may manifest in local disruptions as events travel through shared dependencies (Pescaroli, et al., 2018; Boin, 2018).

European context: Europe, with its intricate connections, is highly susceptible to such transboundary risks. Considering the magnitude of past impacts of disasters – including events associated with the low-pressure system Bernd in 2021 in the United Kingdom, Belgium, Germany, Netherlands, and Switzerland – urgent action is required to address the compounding risks across nations (Fekete and Rufat, 2023). Simultaneously, the continent was hammered by impacts of the COVID-19 pandemic and continues to face mounting risks

from climate change. Indeed, evidence suggests that changes in temperature, rainfall and sea level rise increase the likelihood of systemic failures across various sectors, made worse by persisting limits to adaptation arising from physical, social, economic, and technological factors (Kovats, et al., 2014). As of July 2023, heatwaves continue to distress the continent, much like in 2022 when several temperature records were broken, and Portugal, Spain and France experienced a highly anomalous (and destructive) wildfire season (Rodrigues, et al., 2023). Yet, long-term projections, taking into account such changes, and future scenarios are rarely integrated into disaster risk assessments and short-term programming (UNDRR, 2022). In consideration of the scale and complexity of risk issues affecting Europe, it is thus evident that there is a pressing need to develop novel approaches for pre-emptive and holistic risk management, including strengthening the capacities needed to cope with changing climate and the uncertainties/ ambiguities associated with changing landscapes of risk. More centrally, exploring risk reduction in terms of existing constraints to action is of monumental importance in terms of both individual and institutional capacity development priorities.

Socio-economic dimensions: Understanding risk also entails looking at socio-economic vulnerabilities. Instead of addressing risks as external threats, it is useful to emphasize how persisting economic stratification, poverty, inequality, and marginalization exacerbate and indeed create disaster risks (Blaikie, et al., 2004; Bankoff and Hilhorst, 2022; Oliver-Smith and Hoffman 2020; Lewis and Kelman, 2012). Yet, historical injustices and chronic structural conditions underpinning vulnerabilities continue to be neglected by risk management interventions, despite their centrality in sustainably addressing and mitigating disaster and climate risk impacts (IPCC, 2023; UNDRR, 2022; Wisner, 2020; Oliver-Smith and Hoffman, 2020; Sillmann, 2022). The lack of systemic interventions targeting these root causes of risk can be witnessed in the effects of COVID-19, for instance, heavily affecting those most vulnerable and marginalized without support due to disruptions to safety, employment, health, and mobility (UNDRR, 2022). Climate change bears similar systemic and destabilizing socio-economic impacts at a global scale. By eroding the stability of socio-ecological systems, it reduces the capacities to cultivate land and support ecosystem balances (Kelman, et al., 2015), thus reshaping vulnerability pathways. On-going loss of stable water supplies, inhabitable cities, loss of safe coastal zones, potential scarcity-related conflicts and increased human mobility are among the most pressing concerns. Consequently, the key to managing such risks (and climate change adaptation) is tied with vulnerability reduction – an ideal foundation of all efforts seeking to mitigate risks (UNDRR, 2022).

Way forward for Europe: For effective risk management in Europe, one must therefore consider institutional/ resource limitations, climate change impacts, socio-economic challenges, political and cultural factors, and other potential elements which exacerbate environmental degradation and maintain, create new or increase existing vulnerabilities vis-á-vis systemic risks. A just and inclusive approach is also required for integrating diverse actors and their knowledge (both local and scientific) to avoid maladaptive responses and those that increase inequity or further marginalize vulnerable groups (IPCC, 2023). These considerations underscore the need for innovation in risk management, to support long-term interventions that can account for systemic risk issues, climate change and disrupt the cycles of vulnerability or risk creation.

DIRECTED's role: Feedback from DIRECTED's RWLs points towards mainstreaming the above. Indeed, stakeholders of the initial workshops held in Copenhagen on 3rd of March 2023 discussed the role of enabling policies from national level, and the centrality of building back better in the aftermath of disasters. For instance, concerns were raised regarding rebuilding efforts following severe floods in 2013, taking place in heavily affected areas without considerations for the future. This is an example of how the probability of high-impact events can be replicated by a lack of adaptive governance and demonstrates the centrality of risk reduction perspectives in DIRECTED narratives and potential objectives of the RWLs in the dimensions of advocacy and transformational change toward resilience. Contextual challenges are further revisited in Chapter 2.4 as well.

2.2 Challenges of risk governance

2.2.1 Heterarchy of actors

Emergence of multi-scalar engagement: Facing an unprecedented acceleration of interconnected, cascading and transboundary risks that exceed the ability of top-down and expert-led managerial solutions to address them (Cosens, et al., 2021; Anisimov et al., 2023), the scope of risk governance interventions appears to be expanding. However, the landscape of actors taking part in 'governance' is also increasing in complexity, partly due to

the complexity of risks that could be argued to have necessitated the expansion of risk governance toward multi-scalar engagement (Djalante and Lassa, 2019). It is also useful keep in mind the longue durée socio-economic and political developments which have disenfranchised centralized controls, and contributed to the fracturing of hierarchical governance systems (Jessop, 1998; Braun, 2014; Rhodes, 2007). Consequently, actors of risk governance may find themselves in a heterarchy of polycentric networks in which no single actor has the capacity to steer its direction (Jessop, 1998; Klinke and Renn, 2019).

Siloed operations in Europe: Risk governance issues manifest at various scales in Europe. Findings of the ESPREssO Project suggested that within countries, stakeholders may struggle in integrating science into policy or DRR and CCA practice, and strategic coordination between actors at national and local levels is rare due to lack of shared vision (Albris, et al., 2020; Booth, et al., 2020). Actors in Europe tend to operate in silos: DRR is delivered by civil defense and disaster management authorities, CCA by environmental authorities, NGOs are often not included in formal risk management, and so on (Booth, et al., 2020). These issues are magnified at the regional level. Indeed, despite the European Union's strategic emphasis on regional integration, translating this agenda to practice in risk management has been limited – especially when compared to other and more institutionalized transboundary efforts globally, such as the ASEAN Regional Programme on Disaster Management (Giulia, 2019). As a result, isolated national thinking, lack of willingness to foster transboundary cooperation, sectoral gaps, and clash of DRR/CCA cultures or ways of working limit the effectiveness or holistic risk management in Europe (Booth, et al., 2020; Albris, et al., 2020).

Need for cross-scale collaboration: Addressing these challenges requires fostering collaboration and cooperation across scales (interoperability of risk governance systems), in efforts to reduce overlaps, mitigate redundancies, and to improve the management of transboundary risks – especially those which manifest in shared river basins. Some of these issues take different shapes depending on the context. Consider the Netherlands, for instance, with a strong national government spearheading risk management, and compare it to countries such as England which emphasize communities, resilience, and insurance markets (Wiering, et al., 2017). Thus, risk governance in Europe must be approached with multi-scalar solutions that can simultaneously support local and national level actors whilst taking into account their regional context. More resources are required for informal cooperation and the development of multisectoral strategies as well (Braunschweiger, et al., 2018; Booth, et al., 2020). Funding mechanisms, regulatory frameworks, and existing

networks for coordination should also form a part of any assessments seeking to improve European risk governance, in efforts to further understand the barriers (and possible opportunities) actors may face as they navigate the networks and frameworks of their governance contexts.

Incorporate socio-political context: Beyond the practical considerations focusing on strengthening collaboration, communication, or frameworks for legislation and financing, risk governance is inherently socio-political (Lim, 2011), shaped by culture (Walker, et al., 2010) and its underpinning economic system that tends to align with (and thus support) neoliberal governmentality (Ansell and Baur, 2018; Oulahen and Ventura, 2022). Consequently, one cannot approach 'risk governance' without paying attention to ideologies, hierarchies of power, values and perceptions which affect their operations (including relationships, communication, risk perception and behavior). For instance, economic deregulation may limit the abilities of risk managers to enforce policies that would limit the exposure of infrastructure to natural hazards (Oulahen and Ventura, 2022; Cheek and Chmutina, 2021). Similarly, growing emphasis on individual responsibility over risk management may exacerbate socio-economic vulnerabilities as welfare systems continue to erode (Mackinnon and Driscoll Derickson, 2013), particularly when read against evidence suggesting that nations with strong measures to support social welfare provisioning perform better in the longer term and have stronger economic growth (Tselios and Tompkins, 2019).

Influence of values on coordination an inclusion of marginalized voices: Values and perceptions influence risk governance. For example, perspectives of engineering and natural sciences have often dominated disaster management efforts over 'soft' solutions, affecting long-term vulnerability reduction and social change (Weichselgartner, 2001), as much as the preference for investing and emphasizing disaster response at the expense of DRR investments (Wisner, 2020). Therefore, and although belonging to the same 'network', some risk governance actors **may have less influence over decision-making** and research due to their status which is perceived as less relevant, or because it does not align with the priorities of the wider polity (irrespective of the value of their potential contributions to decision-making). Similarly, those affected by decision-making – referring to citizens and communities – tend to be excluded from top-down and expert-led processes (Gaillard, 2010; Gaillard and Mercer, 2013: Berkes, 2017). Hence, their perspectives are often poorly integrated into risk governance decision-making, which then limits the efficacy and contextual appropriateness of the intended solutions and constitutes a situation in which

those worst affected by natural hazards are stripped from their agency to take part in decisions shaping their lives.

Revisiting risk governance foundations: Ultimately, risk governance today has become a complex matter beyond the complexity of risks actors may face, given its manifestations in politically fractured, poly-contextual, and socio-economically non-neutral settings that may indeed contribute to create disaster risks as much as they aim to address them. Thus, capacity development and risk governance approaches must be founded upon a commitment to examining and address socio-political, economic, and cultural dimensions of risk governance, in efforts to advance risk management that can reach the root causes of risk issues, enabling change beyond the status quo.

2.2.2 Heterarchy of knowledge

Knowledge fragmentation: The issues of European risk governance do not limit to the complexity of challenges and the increasing number of actors taking part in these activities. Indeed, it is also facing a flood of information, competing knowledge systems, databases, and terminologies that are used in different ways across different disciplines. For example, despite their shared interests, actors involved in DRR often continue to describe risk issues from their context-specific viewpoints and in distinct ways, often talking past each other due to the absence of shared meaning (Weichselgartner and Pigeon, 2015). Renn, et al., (2011:233) describe this as *ambiguity* generated by the 'plurality of legitimate viewpoints', which suggests that there is no objective Archimedean point among disciplines, but merely diverse and equally correct ways of describing risk issues. Correspondingly, there is a need to begin integrating knowledges and terminologies between sectors, disciplines, and nations, and to advance coherence, for instance via the use of shared taxonomies (Booth, et al., 2020; Weichselgartner and Pigeon, 2015; Barrott et al.,2020).

Importance of co-production and application of knowledge: to be discussed in consideration of the values and interests of stakeholders at different scales to determine how they may shape risk management decisions (Renn, 2015). For example, expert-led efforts to quantify, assess and define risk problems may fail in corresponding to the cultural, ethical, and political elements of societies they intend to serve (Albris, et al., 2020; Gaillard and

Mercer, 2013). Dynamics of power are embedded into these negotiations as well. As can be explained through the concept of social pollution, the blending of traditionally defined roles and knowledges (for instance, by renegotiating the objectivity and role of natural sciences through co-production) can be perceived as threatening, which thus creates political struggles regarding authority over knowledge and its production (Flinders, et al., 2016). On the other hand, scientific information may lose traction due to limited translation which occurs when researchers simply assume that their findings are linearly diffused into policy and practice without further effort to contextualize their findings in society (Figure 4).

Translating science to action: discrepancies between producers and users of information contribute to barriers encountered in translating disaster and climate sciences into policy and action (Klein and Juhola, 2014; Sillmann, et al., 2022; Deubelli and Mechler, 2021; Spiekermann, et al., 2015; Fazey, et al., 2020). In climate services, such limitations have been described as the 'usability gap' (Lemos, et al., 2014), explaining how climate information may go unused if it does not meet the need of end users. In systemic risk management Sillmann, et al. (2022: 20) discuss the 'data-policy gap', following the limited integration of available risk information into policy making. As a result of supply and expert driven economies of knowledge, one must therefore move toward decision-makers and citizens as users of information to support the tailoring of information and information systems to contextual needs. In other words, instead of focusing on 'products', it is better to emphasize transdisciplinary knowledge co-production processes in which co-design and collaborative learning is the defining characteristic, and both stakeholders and modellers alike, develop their capacity to understand the decision context and the potential of data and tools.

Bridging Knowledge Gaps: The lack of capacity and cultural awareness among multiple stakeholders concerning climate change threats is also critical barrier in implementing integrated multi-hazard, DRR and CCA strategies. Therefore, capacity development supporting new and existing DRR and CCA tools and models at regional, national, and local levels is necessary, alongside increasing awareness regarding the importance of data interoperability, datasets, tools, and workflows toward more effective implementation of integrated DRR and CCA strategies. This is especially important considering the number of databases that exist across Europe. They are often established in isolation from one another across levels, and may contain multi- or single-hazard data, or map anything from losses and damages to solutions at different scales (Baills, et al., 2020). Consequently, it is important to begin bridging participants and their knowledge systems together by leveraging

knowledge co-production and integration to support data interoperability (Daniels, et al., 2020).

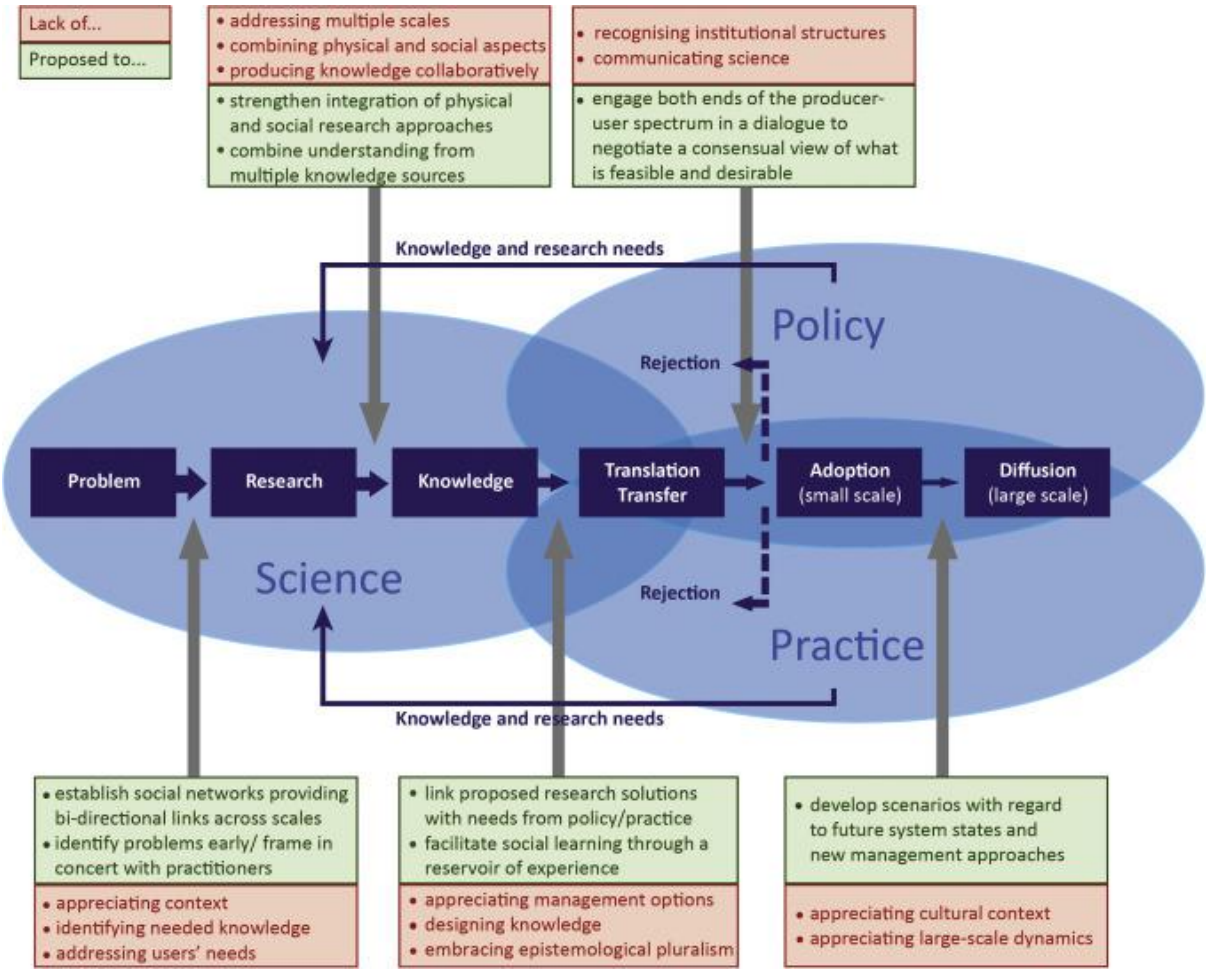

Figure 4: The pitfalls (red) and propositions (green) for maximizing the potential of DRR research in policy and practice (Spiekermann, et al., 2015).

Emphasizing knowledge transfer: science and policy continue to operate in vastly different domains, characterized by divergent interests and differing valuations for knowledge, bridging epistemological gaps by supporting multi-scale transboundary exchanges of knowledge can also mitigate issues as discussed in this chapter (Albris, et al., 2020). To support integration, one must identify ways in which DRR/CCA knowledge is (or is not) transferred from science to policy domains, with a focus on the competing interests of and frictions between actors (ibid). Overall, there is a persisting lack of platforms and structures that could serve such purpose (Amaratunga, et al., 2017), despite them being essential for enabling knowledge exchange between major stakeholders (Weichselgartner and Pigeon, 2015; Spiekermann, et al., 2015). Furthermore, limited resources have been dedicated to

improving knowledge management structures at different spatial levels (ibid). Thus, there is a need to develop the capacity of mediating and facilitating actors, institutions and platforms that support these ambitions (Albris, et al., 2020), based on the principles of knowledge integration.

2.2.3 The RWL context

Whilst theoretical challenges of risk governance as outlined in the previous chapters are, in many cases, applicable to DIRECTED RWL contexts, it is important to tie this strategy to issues as identified by stakeholders themselves. To bridge this, we've summarized insights from deliverable D1.1. RWL *Description and Set-up*. This sets the stage for addressing emerging needs for knowledge integration, promoting inclusive risk governance, ensuring data compatibility, and managing multiple hazards, drawing from theoretical insights where applicable. Naturally, needs and priorities are also likely to emerge and shift during DIRECTED implementation, due to which the RWLs will also be consulted separately throughout the project to identify opportunities for tailored support later on.

Capital Region of Denmark (RWL 1)

RWL 1 is led by a regional public institution, the Capital Region of Denmark (RegionH), together with the Technical University of Denmark (DTU). Their primary areas of interest focus on the catchment of the Vaerebro River and Roskilde Fjord, selected due to their exposure to regular riverine and coastal flooding, respectively. These areas are also identified as high-risk areas for flood damage an issue worsened by climate change leading to erratic rainfall and cloudbursts that may instigate overflows of rivers and compromise sewer infrastructure. Drought has also been identified as a relevant hazard, as demonstrated by the 2018 heatwaves.

Numerous emergency management, DRR and CCA agencies from several municipalities operate in these areas, thus rendering risk governance a complicated task (as is often the case with polycentric governance operations). In general, the primary responsibility over hazard and risk governance lies with municipalities and their emergency management agencies, often complemented by policies enacted by national emergency management and other governmental authorities. In principle, regions work on these matters jointly through

facilitation, coordination, and financing, often convening through regional development projects.

However, actors operating in this sphere face numerous challenges. For instance, very few are experienced in managing drought-related risks. Stakeholders of the first RWL1 workshop also highlighted how municipalities and emergency management agencies require more funding and efforts to conduct joint preparedness drills, and how lack of knowledge regarding high-risk areas in cities hinder prioritisation. Improved public communication, awareness and strengthened alignment of data systems between municipalities were also highlighted, in efforts to nurture the integration of CCA and DRR practice. In terms of internal RWL capacities, the need to support stakeholder engagement has been outlined as an on-going gap, particularly in terms of identifying which actors to involve. As a response, this strategy includes a module and training materials seeking to strengthen the RWLs skills increase the scope of their stakeholder engagement to support co-production and inclusive risk governance. Another issue outlined the difficulty of translating complex project ambitions and balancing them with contextual needs. Thus, this strategy will premise the development of materials to aid in on-going translation of work between stakeholders to mitigate top-down nature of programming by aligning DIRECTED with stakeholder's perceptions and priorities (a wider issue already discussed under Chapter 2.2.2.).

Emilia-Romagna Region (RWL2)

RWL 2 in Emilia-Romagna is led by the Agency for Civil Protection of the Emilia-Romagna Region (ARSTPC-ER) together with the ARPAE Hydrometeorological Service Civil Protection Centre (responsible over DRR, CCA and DRM planning). The selected regions for the work of RWL2 focus on the Rimini coastline, highly exposed to marine ingressions and windstorms (including the municipalities of Bellaria-Igea, Rimini, Riccione, Misano Adriatico and Cattolica), alongside two municipalities of the Ferrara Province with high wildfire risks (Comacchio and Mesola). As such, this RWL presents complex multi-hazard challenges for DIRECTED and stakeholders from Emilia-Romagna. Further, demonstrated by the major floods of May 2023 – involving a complex interplay of preceding droughts, severe rainfall, associated landslides and a storm at the Adriatic Sea preventing rivers from draining – the need for holistic approaches becomes evident.

Whilst ARSTPC-ER and ARPAE Hydrometeorological Service Civil Protection Functional Centre maintain authority over CCA and DRR, already identified challenges include limited coordination between various first responders, public bodies, service managers and

volunteers during emergencies, as well as complexities originating from large amounts of data gathered by a vast monitoring network. Thus, the RWL hosts have expressed the need to strengthen cooperation, communication, and knowledge integration (latter pertaining to integrating data on climate change and natural hazards in particular). Lack of capacity development and cultural awareness regarding climate change in general was also discussed as a critical barrier hindering the implementation of integrated DRR and CCA. As such, this strategy comprises a proposal to strengthen capacity of Trainers (and stakeholders) to support the development of platforms and tools for data integration (and by extension, the Data Fabric) when needed, as well co-created modules seeking to facilitate stakeholder engagement toward improved coordination.

In terms of internal programmatic challenges, stakeholder engagement was also highlighted as a difficulty due to the high number of organizations involved (leading to inability to involve firefighters and some initially targeted Prefectures). As a response, it is hoped that by co-creating materials on stakeholder engagement WPs 3 and 4 can support and thus jointly address these issues with RWL2 over the early stages of DIRECTED.

The Danube Region (RWL3)

RWL3 is led by Genillard and Co, a consulting company and reinsurance broker known for their role in developing and implementing risk management strategies for the insurance market. They work together with the Potsdam Institute for Climate Impact Research and the Mathias Corvinus Collegium of Hungary in efforts to support their RWL (which is further subdivided into three labs to provide a model transboundary risk governance in the Danube region). The three sub-labs are in Vienna, Austria, Zala County of Hungary, and Belgrade, Serbia. As such, they represent immense geographical diversity and differing governance systems, all requiring a tailored approach to fully understand hazard and climate related challenges, transboundary governance issues, and their potential for co-produced solution making towards resilience.

To begin with the City of Vienna, its location at the banks of the Danube contributes to exposure to floods following rapid snow melt and heavy rainfall, particularly in spring and early summer. It is also vulnerable to droughts as the region regularly undergoes periods of reduced precipitation. Both hazards are governed by a diverse network of public authorities, private institutions, and public organizations across the levels of governance, often under the mandates of the Government of Vienna responsible for developing and implementing protection policies and projects. Environmental agencies and water management authorities

collaborate closely, and at the national level, numerous ministries convene on multi-stakeholder protection plans.

In Zala County (Southwestern Hungary) is mostly characterized by hillsides and low mountains. However, its edges also border the Lake Balaton – which bears significant influence over the local climate – and is traversed by the Zala River, tributary of the Danube. Hazards affecting the county include flooding, storms, drought and wildfires, all necessitating multi-risk thinking and habitual coordination and collaboration amidst a network of actors at different levels of governance, especially in terms of implementing the County Council's climate strategy.

In Belgrade, the City's position at the confluence of the Danube and Sava Rivers (and its high rate of urbanization leading to impermeable surfaces and disruptions to natural runoff) constitute numerous riverine flood risks, particularly in association with torrential rains. Albeit urban development plans exist, their implementation remains inconsistent. Furthermore, high concentrations of housing and infrastructure have also reduced green areas common to many other cities in Europe, thus increasing the risk of 'heat island' effects during summers. In Serbia, risk management operates through three levels: local, national, and regional autonomous authorities. At the national level, the Ministry of Defence and Ministry of the Interior are primarily responsible for legislating DRM, DRR and emergency policies, complemented by provincial authorities who plan and develop civil protection in their territories. The latter also enforce cooperation and coordination with other stakeholders on CCA and DRR. Local municipalities maintain responsibility over implementation, planning and preparing for response with the support of State Police and the Army, as well as training staff in direct cooperation with relevant departments and agencies.

Considering the diversity of these three sub-RWLs, the Danube thus represents unique challenges for risk management. Not only do they act as a model for assessing transboundary risk governance in the region, but also introduce their context-specific challenges to DIRECTED requiring tailored support. When combined with the effects of climate change (likely to exacerbate flooding, and high temperatures with various impacts on agriculture, wildfire risks, water supplies and public health), intense cross-boundary cooperation is required to strengthen climate adaptive, multi-risk management in the target areas.

Localized risk assessments, visualised information, long-term cooperation, and partnerships for flood risk management have already been expressed as potential focus areas by the stakeholders of the Danube RWLs. Internally, the hosts of RWL 3 have identified communication challenges arising from language differences, but also highlighted difficulties

in reaching out to stakeholders in culturally diverse contexts with differing risk perceptions. Thus, the strategy and associated training for trainers seeks to build on these, in efforts to support tailored stakeholder engagement with respect to the needs of each country/stakeholder needs.

Rhine-Erft Region (RWL4)

RWL4 is in the federal state of North Rhine-Westphalia, Germany. Currently, it comprises the districts of Euskirchen and Rhein-Erft, which together include 21 municipalities. It is an area exposed to flooding – particularly in areas belonging to the North German Lowlands – altered by legacies of agriculture and open-pit lignite mining. Thus, and alongside relatively high flood risks, the hydrology of the region will continue to shift; particularly following the planned termination of lignite mining activities that will reduce groundwater extraction (from the current 509 million cubic meters per year). To add to these burdens, fluctuations in rainfall and temperatures (often exacerbating natural hazard impacts) have been recorded in association with climate change, thus necessitating improved communication and coordination of DRR and CCA processes across scales. Most importantly, linking municipal-level data management systems and information streams to national level structures has been outlined as a priority, alongside harmonizing existing data systems across different actors to support the flows of information pertaining to hydrometeorological hazards. Consequently, modules and training involving data, coordination and communication will be integrated into the training program, in continuous consultation with RWLs and WP5.

In terms of risk governance, responsibilities have been spread across numerous agencies. Within the federal system, civil protection agencies maintain responsibility over water-related hazards, whereas the district within each county maintain responsibility over disaster management. Municipalities coordinate and organize response, and some intermunicipal flood protection and private sector corporations are also involved in the RWL4. Internally, support for broadening the scope of stakeholder engagement has been expressed by the hosts of the RWL, and thus the ambitions as outlined in this strategy are geared towards providing support for this process during the early stages of DIRECTED.

2.2.4 Links to other Directed activities

Besides addressing knowledge transfer in RWLs through capacity development, the DIRECTED project also has developed a Knowledge Transfer Plan which identifies the Key Exploitable Results generated from project activities as the Risk-Tandem Framework and Data Fabric and seeks to encourage their use in training and educational activities. As outlined in deliverable D6.3 Gaps and Opportunities Assessment, training and educational programmes and activities targeting students, DRR/ CCA professionals and others within and beyond the RWLs and consortium partners will be co-designed and piloted during the project. These knowledge transfer mechanisms will likely tailor and repackage the learning materials in the ToT capacity development modules to amplify their impact and ensure their accessibility on an e-Learning platform beyond the project's lifetime. The influence of such training and educational activities will be monitored through 'impact pathways', to understand, for example, the changes in knowledge, skills, and attitudes towards collaborative DRR/CCA. These commitments to knowledge transfer further ensure tangible impacts and empower others to continue exchanging information beyond the project's geographical and organisational scope (Figure 5).

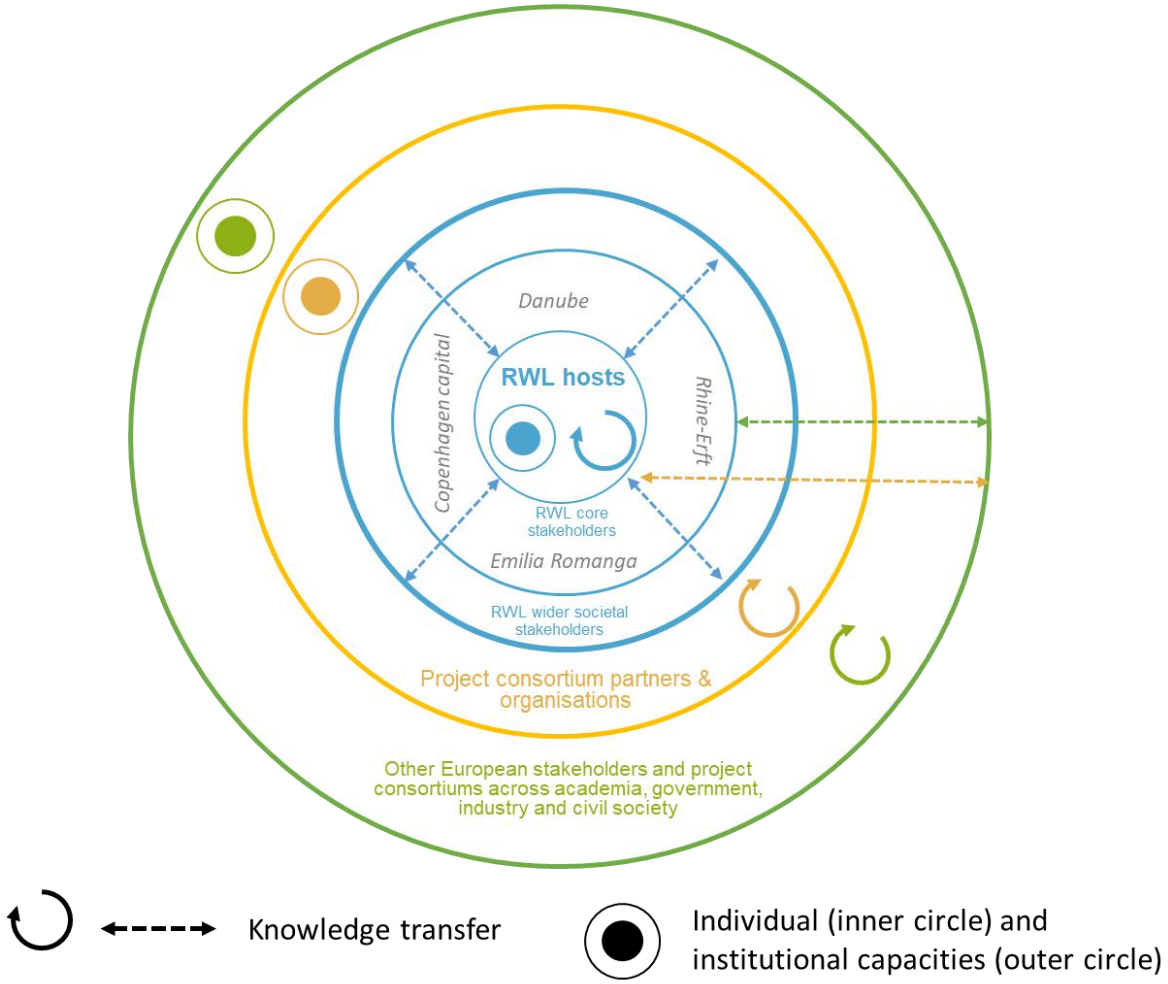

Figure 5: Knowledge transfer plan for DIRECTED

Thus, capacity development as outlined in this strategy aims to enhance both individual and institutional abilities for effective knowledge transfer, informed by the DIRECTED knowledge transfer plan. This will start with fostering integration, collaboration, and coordination, complemented by efforts designed to support the practical application of gained knowledges and the changing of attitudes toward multi-stakeholder collaborative processes and knowledge co-production (both of which have been identified as currently missing in European risk governance efforts). For further information, please refer to the D6.3. *Gaps and Opportunities Assessment for Knowledge Transfer through Training and Education.*

2.3 Risk-Tandem: managing complex and systemic risks

Based on the earlier chapters and RWL descriptions, it is thus evident that **innovative approaches for managing risks and capacity development** are required. That's where the Risk-Tandem framework comes into play. Currently, in development (as part of deliverable D3.1.), this framework offers a robust set of tools and approaches for enabling innovation and transformative programming toward holistic multi-hazard risk governance through the perspective of complex systems thinking. It not only supports the integration of DRR and CCA, but also provides a foundation for coping with the **complexity of risks and ambiguity of governance systems**. More centrally, it seeks to support capacities required to facilitate communication, coordination and co-production of knowledge vis-à-vis transboundary risks, cascading events and uncertainty. While rooted in theory, **Risk-Tandem is highly practical,** emphasizing collaborative solutions guided by trained leaders identified within the RWLs. The following chapter provides a summary of the Risk-Tandem approach grounding the capacity development within the efforts of Work Package 3 of DIRECTED.

Risk-Tandem combines SEI's Tandem Framework for Co-production, IRGCs Risk Governance Framework, the SHIELD model developed under the ESPREssO Project, as well as a tool to support the prioritization of risk issues (risk-layering).

Why these frameworks? These frameworks have been selected to: a) support and structure systemic and complex risk governance (IRGC & risk layering); b) further integrate DRR and CCA based on previous European projects (SHIELD), and; operationalize risk governance tools and approaches from the aforementioned frameworks via methods of co-production (Tandem).

Firstly, the **IRGC** framework **and risk layering** will provide approaches to cope with complexity, uncertainty and the identification of solutions suited for the challenges of the 21st century. In practice, they can guide the process of establishing 'boundary conditions' for

complex risk management (for example, to identify the boundaries for risk issues through screening and hazard identification methods), as well as structuring the process of pre-assessing and appraising risks toward their management during the later years of DIRECTED (Figure 6). Futhermore, the framework's cross-cutting aspects of stakeholder engagement, communication and context are well aligned with the principles of co-production, and the capacity needs regarding collaboration, coordination, and knowledge transfer as identified in chapters above.

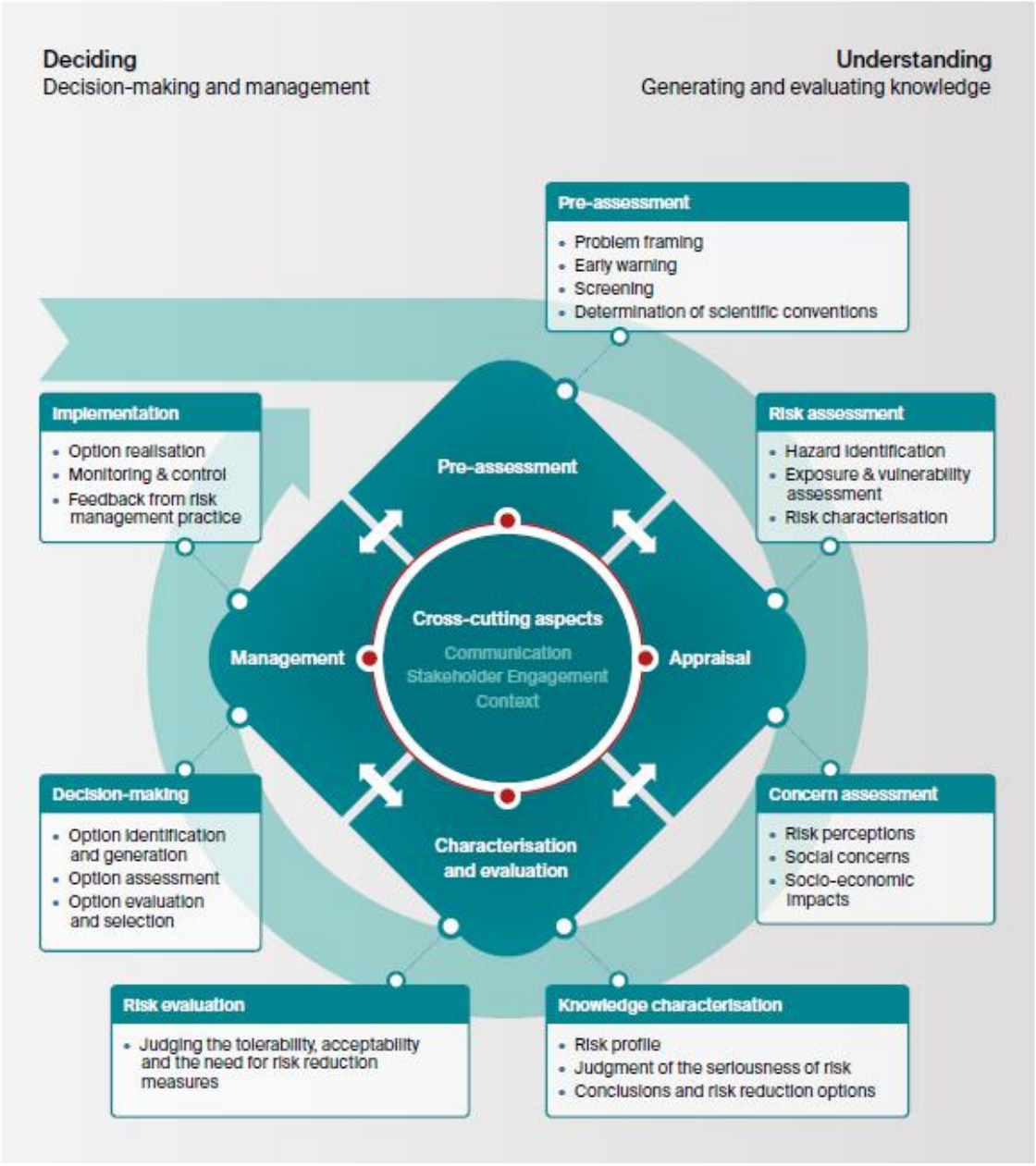

Figure 6: The IRGC Risk Governance Framework (IRGC, 2017)

This will be further supported by applying a **storyline-based** risk layering approach, initially intended for insurance applications by Hochrainer-Stigler and Reiter, 2021. This categorization scheme can be used in all phases of the IRGC Framework for determining the foci of work for stakeholders that refers to entry points for risk management interventions to complex risk issues. This simplified method can be used to distinguish appropriate solutions and responses based on the probability (or frequency) of events, including identifying possible frictions and overlaps across the processes and policies of different stakeholders (Figure 7**).**

	Risk Reduction	Risk Financing	Assistance
Frequent events			
Infrequent events			
Extreme events			

Figure 7: Risk layering for categorization of responses to risk issues

However, the frameworks as outlined above **are generic and theoretical devices**, and do not necessarily pay attention to the **everyday practices** of risk governance (Boholm et al., 2012). That's where the **SHIELD model** steps in, to provide insights on enhancing practical capabilities beyond problem framing, based on the ESPREssO Project (Lauta et al. 2018). It is centred around the Disaster Risk Management Cycle and its associated phases (i.e., response, recovery, prevention, preparedness) but recognises how these phases are dependent on various institutions, policies and structures and the need to support new sets of skills, such as cross-sectoral coordination and public engagement (Figure 8). The model also illustrates the interdependencies and interlinkage between management and governance in DRR and CCA.

In practice, the SHIELD model provides **practical guidelines and approaches** for strengthening knowledge sharing, harmonizing capacities, institutionalizing coordination, engaging stakeholders, leveraging investments, and developing communication when facing an abundance of information (Lauta, et al., 2018).

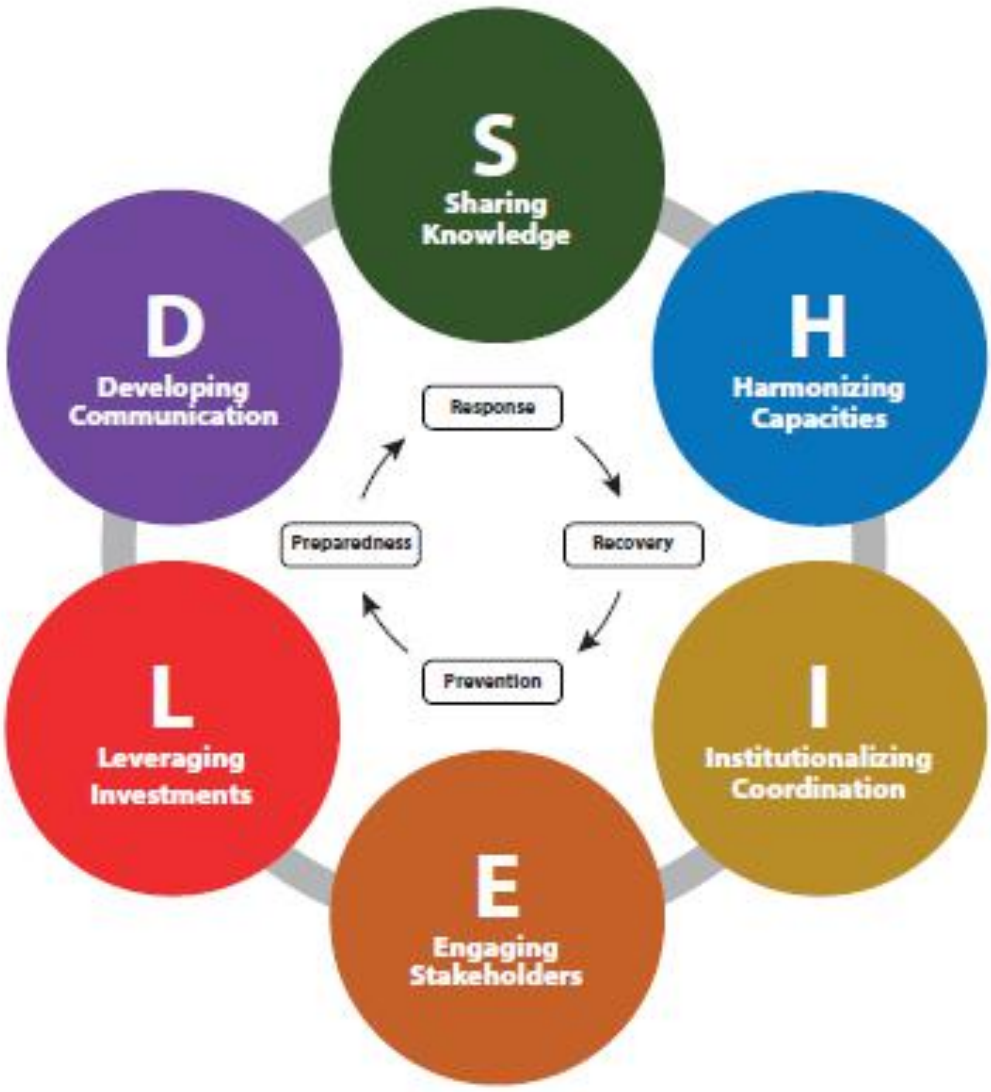

Figure 8: The SHIELD Model revolving around the four disaster management phases (Lauta, et al., 2018)

The Role of Co-production:

Finally, these frameworks will be applied via the principles of co-production, supported by the Tandem Framework. Instead of approaching risk governance as an expert-led effort, the Risk-Tandem Strategy recognizes the importance of co-producing transdisciplinary

knowledge, **avoiding sectoral fragmentation and siloes and co-creating solutions for managing complex risks and sustainability challenges** (as discussed by Miller and Wyborn, 2020; Cosens, et al., 2021; Norström, et al., 2020). Since 'traditional' scientific efforts often fail in meeting the needs of complex risk issues as described under chapter 2., one must advance transdisciplinary collaboration processes and simultaneously avoid social and techno-scientific determinism that may create tunnel vision (Jasanoff, 2004; Daniels, et al., 2020; Cosens, et al., 2021). As such, co-production of knowledge and solutions may increase the accuracy of knowledge when exploring risk issues whilst broadening the scope of available solutions with transformative potential (Cosens, et al., 2021).

For instance, if utilized to co-produce knowledge regarding systemic risk through the mapping of interdependencies, layers, networks or actors within a system and its sub-systems, it may produce more contextually accurate rich pictures by integrating transdisciplinary perspectives on complex risk issues. Furthermore, by involving a wide range of stakeholders across the science-society interface and a wide range of disciplines and knowledge types (including academic, practitioner and practice-based knowledge) it may improve climate or disaster risk models by bridging user needs with information/data providers. This can only strengthen the contextual applicability of available information (discussed in the context of climate services by Daniels, et al., 2020). It may also introduce added benefits to risk governance beyond knowledge co-production and solution co-creation, by the development of shared goals, improved institutional coordination and collaboration.

Furthermore, co-production supports non-structured exchanges, dialogic problem-solving, improvisation and adaptive governance (Slater and Robinson, 2020), all of which are required to respond to complex risks in the European context. More centrally, it may also broaden the scope of 'governance' by fostering long-term transdisciplinary collaboration and informal relationships beyond isolated disciplines. Since risk governance has been criticized for its top-down and expert-led nature that tends to disenfranchise local authorities, citizens, and communities (Wisner, 2020; Gaillard, 2010), co-production can support expanding the scope of stakeholders beyond experts and authorities at the national levels. In other words, it can break the boundaries between the governing and the governed (Berkes, 2017) to support the democratization of risk governance. Co-production is also useful to support informal collaboration, referring to the creation of spontaneous regimes that organize themselves around common purposes (Schiff, 2017). During crises, informal mechanisms often mobilize faster, and can advance more intense coordination within existing institutional mechanisms and formal arrangements due to their closer networks (Booth, et al., 2020).

Most importantly, this perspective also allows the recognition of credibility of knowledges and lived experiences of persons working at the grass-root levels, thus enabling their integration to more traditional and hierarchical notions of expertise that may fail to address local problems (Durose, et al., 2017).

Yet, **co-production isn't without its challenges,** and its application remains inconsistent (Miller and Wyborn, 2020). The idea has also been criticized due to its aspirational nature that tends to neglect socio-political dimensions underpinning the process – even when they may fail to facilitate change (Turnhout, et al., 2020). The issue is widely linked to the issue of monitoring and evaluating co-production; in 2015, a review revealed that 80% of the studied co-production literature did not discuss outcomes at all (Voorberg, et al., 2015). To address these concerns, the **steps of the Tandem Framework** (Figure 9) will be applied to structure, guide and evaluate co-production efforts under DIRECTED, to help account for socio-political dimensions and as a process to deliver risk governance approaches from IRGC, risk layering and SHIELD. It contains a set of questions and tools for facilitating non-structured and non-hierarchical collaboration, advances in stakeholder engagement beyond consultation (by emphasizing trust and relationships), and seeks to improve the coordination, collaboration, and communication between stakeholders across scales. When combined with methods, tools, and approaches from the selected risk governance frameworks, DIRECTED thus seeks to provide novel approaches toward inclusive risk management via the democratization of decision-making, risk assessments and co-produced solutions to real-world challenges as they are faced and experienced in the RWL contexts across Europe.

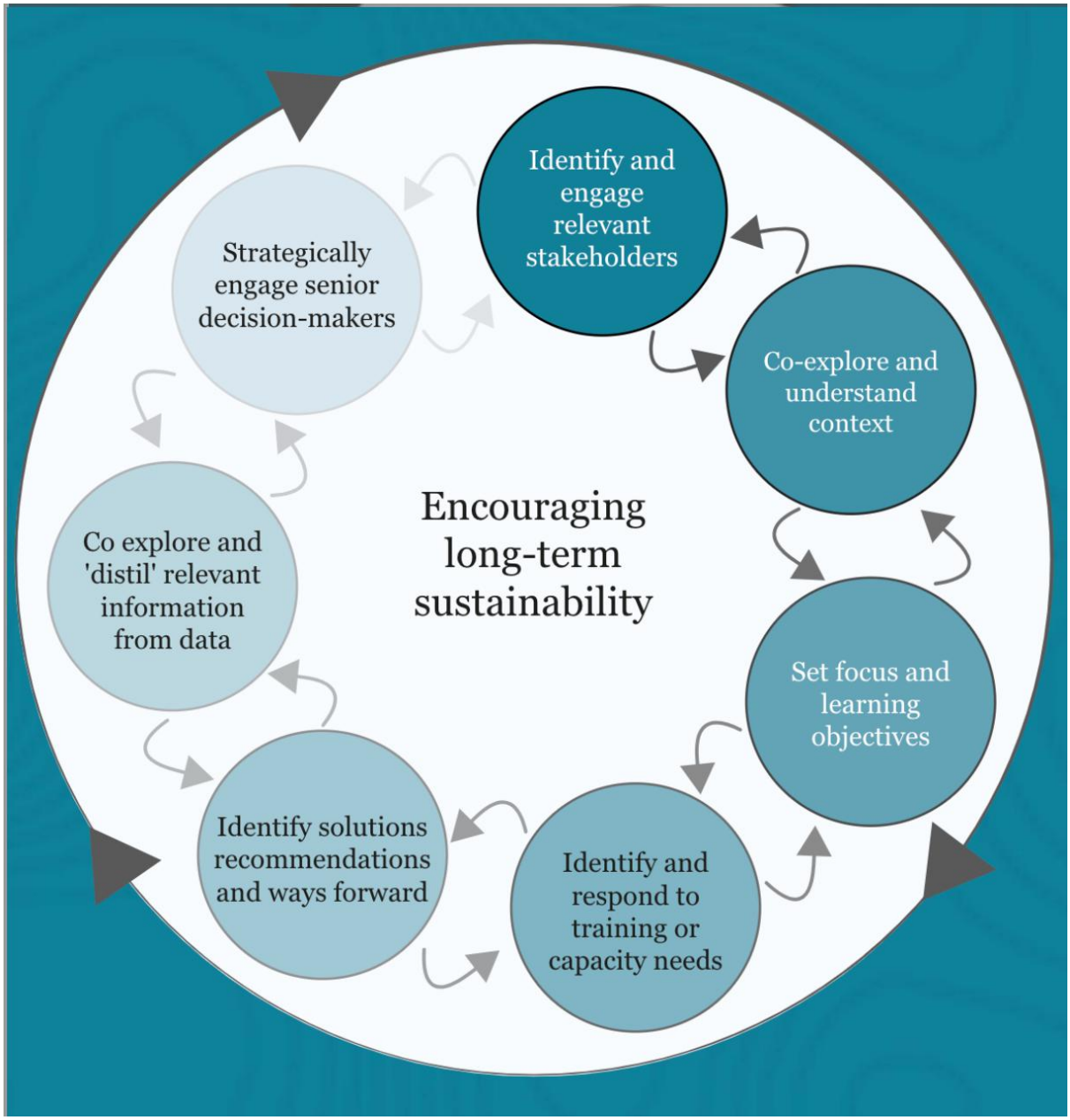

Figure 9: The Tandem Framework (SEI, 2023)

Considering the framework's roots in climate services (Daniels, et al., 2020), Tandem also supports DIRECTED's ambitions regarding improved data interoperability (WP2) – an aspect not fully integrated into risk governance frameworks as discussed in this chapter. If applied strategically, co-production can aid in tailoring available information and data to user needs, with a focus on understanding the decision contexts in which information is used. Lessons from the WISER project also demonstrate how data/ information products should be decision-driven and process-based, encouraging the integration of knowledge into action via shared understanding and new perspectives (Carter, et al., 2019). Under DIRECTED, these practices will be applied to support and inform the development of the Data Fabric (WP5).

Tying it All Together:

Risk-Tandem was thus developed by **combining these frameworks**. The goal is to harmonize them in a concise and approachable manner whilst emphasizing DIRECTED aims regarding interoperable risk governance and data systems. They were conceptualized as nested within each other, bridging strategic risk governance gaps that each alone would neglect (Figure 10).

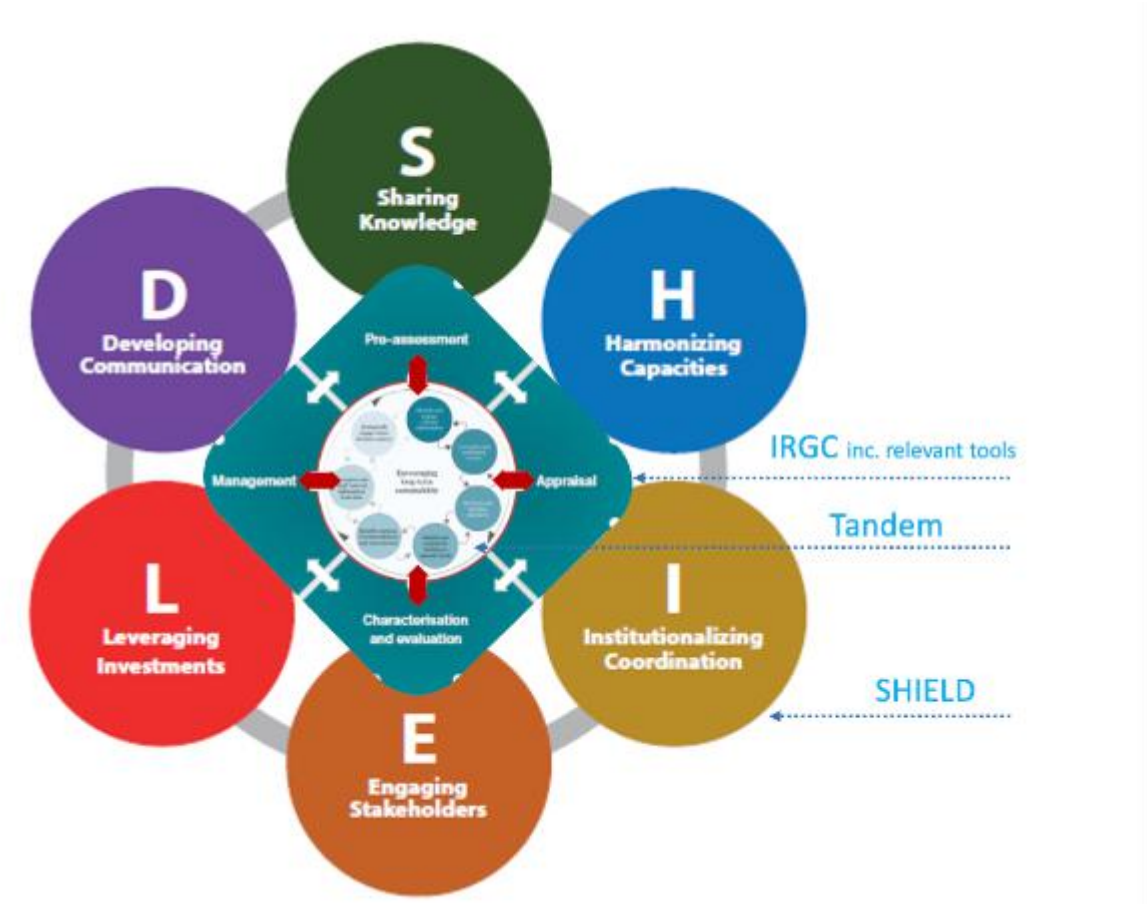

Figure 10: The integration of Tandem, IRGC and SHIELD Frameworks

Firstly, to facilitate the application of risk governance tools via co-production, the Tandem Framework was embedded within IRGC and SHIELD. The **primary goal** is to co-produce knowledge on risk governance as a process, complex or systemic risks and potential solutions in the RWLs. This helps identify areas for alignment between existing governance processes, modelling tools and data systems to support **interoperability and the Data Fabric** (WP5). More importantly, Tandem seeks to guide the scope of work beyond products, toward improved **transboundary and multi-scale** collaboration and coordination processes, thus aligning with the objectives of SHIELD as well. For the purposes of DIRECTED, this integration of frameworks is then expressed in the **Risk-Tandem Model**

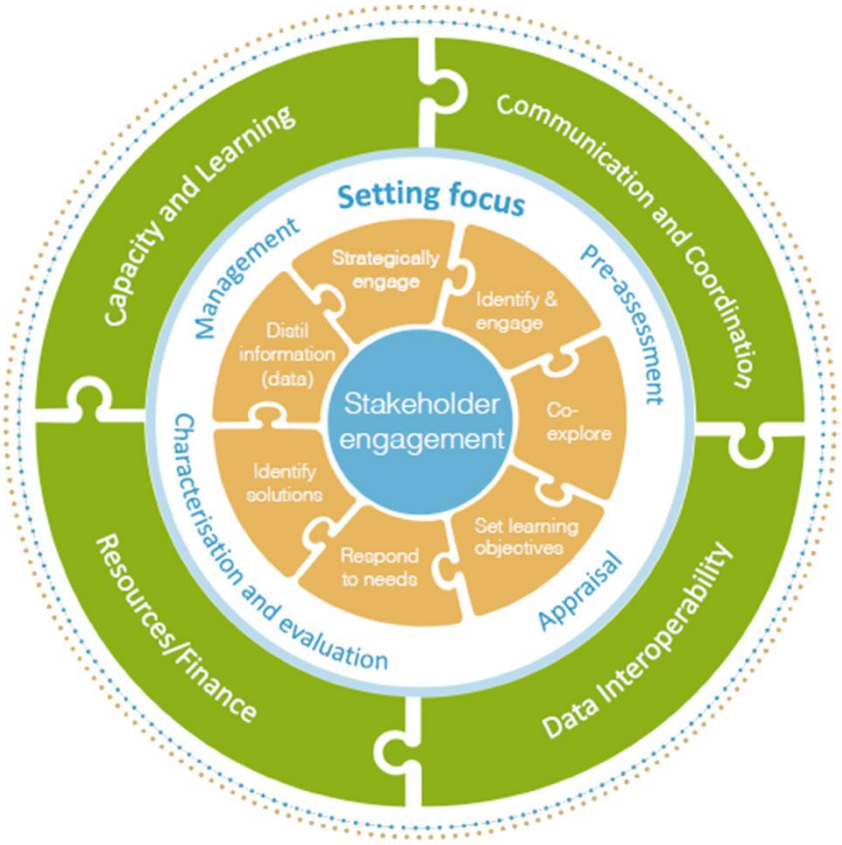

Figure 11: Risk Tandem Framework (under development within D3.1)

The two innermost circles – stakeholder engagement through co-production – bridge a connection through all the frameworks as discussed above and follow the structure of the Tandem steps to structure co-production of risk governance in DIRECTED. The white circle has been linked to these to illustrate the connections of Tandem stages to the IRGC process, followed by the green layer which illustrate strategic priorities for interventions and capacity development (inspired by the SHIELD framework and associated tools).

3. Capacity development

Based on the identified risk-related challenges, the Risk-Tandem Framework is designed to provide approaches for managing them, this strategy outlines **how the framework can be operationalized** via the delivery of online and in-person training sessions, planning workshops and complementary activities to enable the Trainers to deliver co-production based risk governance activities in their RWLs. In other words, this chapter outlines t**he 'practice' of Risk-Tandem,** beginning by providing a definition of the term capacity, and an approach to learning.

Given that contemporary risk and sustainability challenges necessitate innovation, transformations, institutionalizing of learning processes and contextually appropriate solution making (Cosens, et al., 2021), this chapter will emphasize skills that support holistic risk management operationalized via co-production. Importantly, the core focus will be on Trainers – trained to operate in the 'complex problem space' (Keating, et al., 2015:2944) – who can apply these in their contexts, to **enable local implementation based on stakeholders' priorities**. As such, this document should not be treated as a blueprint that should be replicated in each RWL. Instead, it presents **a collection** of theories, tools, and approaches **adaptable to diverse risk governance situations**. This applies to modules outlined under Chapter 3.3. as well. Whilst they have been initially designed to align with the Risk Tandem Framework, their exact content will be tailored to meet the needs of the RWLs.

3.1. Defining capacity: the goal

However, before delving further into translating the Risk-Tandem Framework into learning and practice, one must begin by addressing the issue of 'capacity development'. As pointed out by Hagelsteen and Becker (2014:298) in the context of DRR, there is no shared definition for the term capacity, which thus constitutes a great 'Babylonian confusion' following terminological ambiguity. In the realm of "practice", capacity development can refer to almost anything, in the absence of shared understanding, standards and best practices.

These issues are made worse by lack of academic research targeting capacity development and DRR – a field within which frameworks and best practices are still emerging (Scott, et al., 2014; Hagelsteen and Burke, 2016).

Consequently, one must define 'capacity' and 'capacity development', with a focus on context, purpose and the challenges as outlined in Chapter 2. Firstly, since the complexity of risks today exceeds the ability of traditional policy responses and isolated natural science solutions to manage them (Biermann, et al., 2010; Cosens et al., 2021: Fazey, et al., 2020), discussion must extend beyond mere technical and 'hard' capacities seeking quixotic control. These, usually associated with subject matter expertise, engineering, or procedural knowledges (UNDRR, 2018) are apt for assembling interventions in domains of technology, but often fall short when facing complexity, ambiguity, and uncertainty (Hagelsteen and Becker, 2019; Orsini, et al., 2019). By working through the assumption that others simply suffer from a knowledge deficit, they may fail to capture tacit knowledges required for collaboration, sharing of information, or the mobilization of resources (including relationships and trust), as well as practical knowledge upon which implementation of activities often depends (Fisher and Jasny, 2017; Sharpe, 2021). Consequently, one must look toward capacity development not as a blueprint for knowledge gain, but as an emergent property that is nurtured through 'flexible, adaptive and locally driven process of change and learning' (Hagelsteen and Becker, 2019:9), reflecting the context in which its development is applied.

Based on Chapter 2 and other complementary literature, it is possible to outline some themes (or 'wisdoms') for capacity development to support the processes of integrating DRR, CCA and complex risk management through the co-production of risk governance (in alignment with Risk Tandem). These are best perceived as an assemblage of process-based capacities and skills that can support the leveraging of existing knowledges to instigate shifts in science-science/ science-society relations, mobilize others and bridge connections, instead of hard skills alone (Steen and Tuurnas, 2018:83). These interlinked aspects can be summarized as follows (whilst keeping in mind that tenets of co-production are integrated within each):

Table 1: Capacities for complex and systemic risk management

Capacity to facilitate and enable	Description	Sources
1. Integrating and co-producing knowledge to understand and manage complex risks through collaboration	Bridging different knowledges and disciplines through co-production to gain information and mutual understanding about complex socio-ecological and polycentric systems, DRR, CCA, and risk. (These support the practical application of all Risk Tandem activities and other skills outlined in this table).	Berkes (2017), Cosens, et al. (2021), Daniels, et al. (2020), Norström, et al. (2020), Ostrom (1996)
2. Communicating and transferring knowledge between scales, sectors, and disciplines	Existing and co-produced knowledge or data cannot remain in silos. Learnings must be transferred across scales of governance and different disciplines to support their wider uptake.	Lauta, et al. (2018), UNDRR (2018), Cosens, et al. (2021)
3. Cross-scale stakeholder engagement	Actors must be able to foster trust and relationships with others in their non-hierarchical networks (and expand it beyond 'traditional' stakeholders), leading toward increased social capital that supports communication, coordination, trust and diverse co-production.	Fisher and Jasny (2017), Orsini, et al., (2019), McKay, et al. (2017)
4. Coping with and understanding uncertainty	Facing a complexity, actors must be able to understand and cope with uncertainty embedded in complex risk management.	McKenzie, et al., (2009), Hagelsteen and Becker (2019), Orsini, et al., (2019)
5. Adaptive governance and unlearning	Ability of stakeholders to respond to stressors by modifying existing assumptions, norms, values, and behaviors to anticipate or reduce risks, and acting upon this knowledge.	Fisher and Jasny (2017), Berkes, (2017), Adger (2003)
6. Technical and complementary capacities.	'Traditional knowledge'. Includes risk layering, risk assessments, hazard/climate modeling, policy development, program management and other 'hard' knowledges that support the work of RWLs (including the data fabric and integrated data systems), explored via the perspective of co-production.	Refs...

However, these are capacities identified in relation to Risk Tandem. It should be kept in mind that **additional capacity needs may emerge** during DIRECTED, through consultations with RWLs. Thus, not all skills and needs can be predicted for Trainers, and these must be defined through capacity assessments as discussed under chapter 3.3. and Theory of Change.

Besides defining capacities, it is also useful to examine **capacity levels** Figure 12.**,** which also correspond to the levels of knowledge transfer (D6.3) as outlined in Figure 5. This capacity development strategy focuses on t**he individual level (Trainers and hosts of RWLs)**. Considering that they are experts of the DRR/ CCA structures, policies, budgets, strategies and frameworks of their setting, the intention is to leverage existing skills and knowledge to contextualize DIRECTED co-production and risk governance ambitions via locally led implementation of Risk Tandem without overtaking or overshadowing local priorities. After all, capacity development is usually most effective when it is built upon existing capacity (UNDRR, 2018), such as specialized and organizational knowledges. Furthermore, it is hoped that focus on the individuals can enable change at the organizational level – if deemed necessary – as they use gained knowledges to navigate and influence their operational context, potentially influencing broader systems like rules, laws, policies, and financing.

Figure 12: Capacity levels based on UNDRR (2018)

As evident, strengthening capacities as outlined above cannot be achieved with one-off training, but require a **set of interlinked and complimentary activities** from training to workshops, learning materials and sustained effort to engage (e.g., mentoring and communication between training etc.). Institutionalization of knowledge will contribute to this aim beyond short-term training and workshops, through learning modules and activities outlined in this strategy will be linked to the knowledge transfer plan (D6.3) and disseminated via the identified e-Learning platform for knowledge transfer and/or other learning networks (such as MOOC platforms, training academies and the global online adaptation learning platform, weADAPT.org).

3.2. Approach to learning: triple loops and co-production

Since capacity development must always **begin with the context** (Hagelsteen and Becker, 2019; UNDRR, 2018), it is not possible to simply 'deliver' capacities as outlined in Table 1 to Trainers and stakeholders of DIRECTED. Given that capacities required for complex and systemic risk management extend beyond technical knowledges (involving co-production, processes, action, trust, and behavioural change), this strategy will emphasize learning activities and exercises that convey knowledge and action, in efforts to support Trainers of the RWLs to translate these ambitions into their working context. This approach is less about 'teaching' but more about enabling change through co-production in the RWLs by providing innovative tools and support for risk management through jointly working with local stakeholders trained with principles as outlined under this strategy. Before discussing modules, learning materials and timelines through which these are put to practice, however, it is necessary to examine the approach to learning **beyond top-down delivery of technical knowledges**. Based on the work of Bateson (1972) and later Argyris and Schön (1978), it is possible to distinguish three types of learning:

> The first, described as ***single-loop learning*** is usually most common, encouraged and easily adopted (Argyris and Schön, 1978). It emphasises the question **'Are we doing things right?',** often leading to short-term solutions and changes in strategy or tactics without questioning underlying goals or assumptions (Gupta, 2016).
>
> ***Double-loop learning*** is similarly based on error detection and correction but asks the question **'Are we doing the right things?'.** It focuses on unpredictable situations that do not fit into existing patterns and seeks new insights when encountering problems that cannot be corrected by short-term solutions (Johannessen, et al., 2010; Gupta, 2016).
>
> ***Triple-loop learning*** is concerned about critically reflecting and discovering underlying values, norms, and perceptions behind the processes of learning. It asks the question '**How do we decide what is right?'**, in efforts to question existing

governance context, including protocols, mechanisms, frameworks and policies (and dynamics of power) to further understand what limits the potential to change, and how to innovate facing complexity and uncertainty (Cosens, et al., 2021; Gupta, 2016).

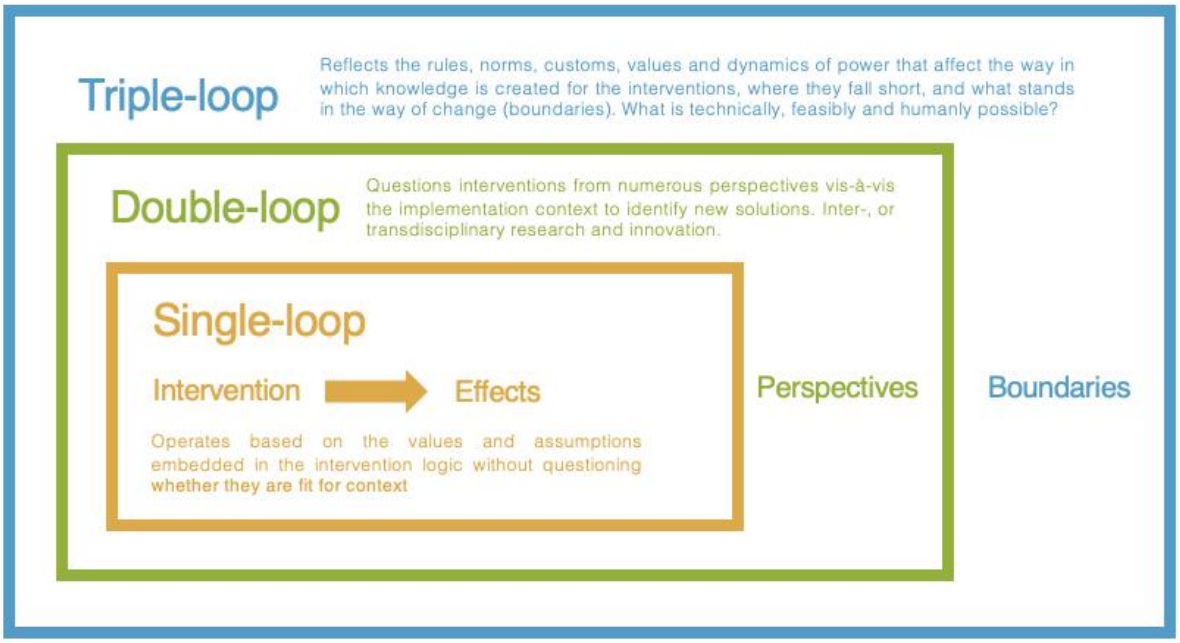

Figure 13: Three loops of learning

These dimensions can be visualized as follows:

For example, single loop learning (Figure 13) can take place between flood modellers seeking to diagnose issues in their data and software, without consulting other stakeholders if the model has enough geographical coverage, encompasses the right indicators (such as landslide risks associated with floods, or aspects of social vulnerability), or if a flood model is even needed. This may also constitute a barrier: sectoral specialization may enforce certain mental models and working approaches that prevent learning from mistakes, thus repeating path dependencies and oversight ad infinitum (Johanessen, et al., 2019; Cosens, et al., 2021).

Double loop learning would seek to incorporate stakeholder perspectives as well to improve the modelling efforts. Triple loop learning could encourage the redesign of guiding norms to address failures of formal institutions, adapting structures to encourage participation beyond consultation, and shape working relationships toward improved trust and long-term

collaboration (Johannessen, et al., 2019). It could also lead to questioning, for instance, why so much time is spent on highly technical and expert-led modelling efforts when more support for response, recovery and risk reduction would be needed instead. As such, it holds the promise for transforming knowledge production and action to inform shifts in system states toward resilience (Cosens, et al., 2021). After all, informed decisions can only be made if available information and pre-existing knowledge are used via a commitment to learning, referring to the 'effective application of one's mind in order to understand context-specific information' and its utilization (Spiekermann, et al., 2015:107). The third loop is problematic, however, since it is difficult in an unstructured setting with diverse perspectives that is characterized by competing knowledges, discourses and sciences that require unlearning and transformative learning toward consensus (Gupta, 2016). Consequently, great care and analysis must be invested in its application.

All capacity development activities will be guided by the premise of triple loop learning, which can be put to practice through methods of co-production (Cosens, et al., 2021). DIRECTED aims to train hosts of the **RWLs to become** boundary-spanning ***applied trans-disciplinarians*** (Cosens, et al., 2021) or ***learning champions*** (Johannessen, et al., 2019) capable of simultaneously understanding and navigating their risk contexts, disciplines or relationships with stakeholders involved, and the complexity these interactions generate. More importantly, all training will emphasize facilitating triple loop learning in their DRR/ CCA contexts, in efforts to contribute to **their organizational risk governance context** in a manner that deviates from straightforward and technocratic risk management approaches. Eventually, this has potential for triggering change at an organizational level (assuming that the skills and capacities are applied consistently).

3.3. Practice, modules, and timeline (Foundation year)

The early Foundation-phase of DIRECTED involves creating online learning modules to enhance capacity development. The **approach** was selected partly due to limitations of the project budget and geographical distances, but also because it was outlined as the preferred choice of the RWL hosts as identified in the D6.3 Knowledge Transfer Gaps and Opportunities Assessment Figure 14.

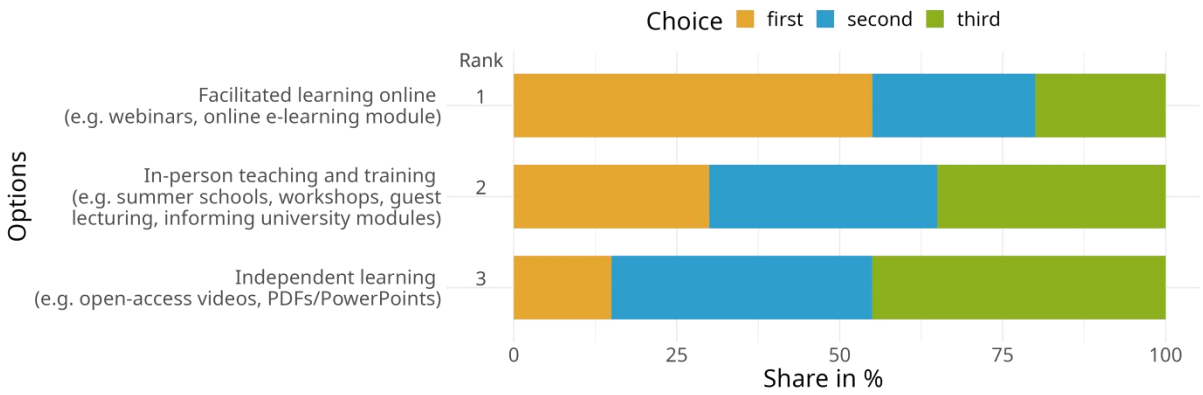

Figure 14: Q11 regarding the prioritization of learning approaches for delivering training within DIRECTED. Facilitated learning online (80% first choice), independent learning (60% second choice) and in-person teaching (60% last choice)

Initially the training modules focus on understanding of capacity-as-processes as outlined in Table 1. to apply the principles of Risk Tandem Framework in the RWLs. In the **Growth and Learn phases**, we will shift from individual Trainers, to shape organizational and systems levels through the nurturing of knowledge, skills and attitudes that foster trust and social capital between their selected stakeholders. This will support the establishment of DRR/ CCA **plans for RWLs,** referring to the goals they want to achieve **during the next four years**. After these plans have been established, the second, more iterative **capacity development phase** will be implemented. This involves assessing the specific needs of each RWL, ensuring that WP3 and WP4 aligns with local DRR/ CCA priorities. This is followed by the **co-production of modules, training activities, and learning materials.**

The first set of training modules is informed by the challenges as described under D.1.1. *RWL Description and Set-up*, emerging needs, as well as the D6.3. *Knowledge Transfer Gaps and Opportunities Assessment,* which can be leveraged toward assessing initial needs (whilst acknowledging that they cannot replace a capacity assessment).

The modules themselves draw from literature reviews, RWL consultations and public-facing learning materials that will accompany online classes. The modules design will be two-fold. Facilitated learning events will include co-production exercises to support engagement and practical learning. A feedback activity (Summary and Self-Assessment, step 1) will be conducted after these facilitated trainings, to capture information to refine these modules to self-directed learning units (SDLU, step 2). The development of SDLUs will use the MOOC Learning Management System, also used in the EU Citizen Science Platform[12]. This

[1] https://eu-citizen.science/static/site/files/EU-Cit.Sci_Training_module_design_guidelines_v1.pdf

consists of a content design template[3] which is used to support the interoperability of educational material as they will be transferred across different MOOC systems (thus also aligning with knowledge transfer ambitions in D6.3 and ensuring a legacy beyond the Directed project).

3.3.1. Module descriptions (Foundation year)

This section provides a brief overview of the proposed module descriptions, including the timeline (Figure 15). Full literature reviews, learning materials and descriptions will be provided with each module as they will be developed during Q3-Q4 of 2023 and Q1-Q2 of 2024. All modules will be aligned with the Risk-Tandem steps, although they can be implemented iteratively, and returned to depending on the needs of the RWLs since they are progressing at different speeds.

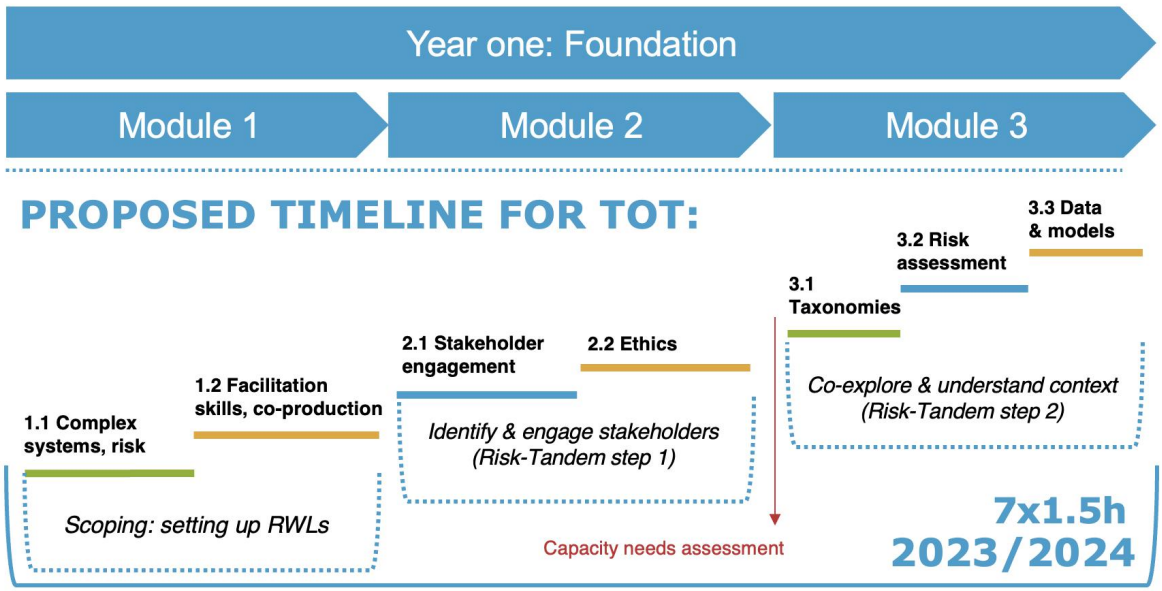

Figure 15: Proposed module for the foundation year

[2] https://zenodo.org/record/5820263#.ZDQjZHbMIQ8
[3] https://docs.google.com/document/d/15uyn_Ue1pgYI0YCDxfwi_7Wq_y3ZLEkknrvVk8eII2k/edit

Module 1. RWL set-up

This module reframes risk issues, promoting integration of DRR, CCA and systemic risk management from the perspective of **complex systems**. It will also raise awareness and build skills, knowledge, and capacity for changing the processes for risk assessments, by:

Learning component 1.1 – will focus on the theory of complexity as it pertains to risk issues and emphasizes how co-production exercises can be used to examine them through different knowledge systems, perspectives, and values, in efforts to establish boundary conditions for risk management with local stakeholders. This links to capacities 1, 4 and 5 identified in Table 1. It involves practical exercises (e.g., on Miro) that can be easily transferred to workshops in RWLs. Learning component 1.2. will focus on **facilitation skills.**, in acknowledgement of the fact that there is no one-size-fits-all approach to co-production, and that co-production does not simply happen (Reed and Abernethy, 2018; Turnhout, et al., 2020). Indeed, facilitators must think on their feet, using knowledge, skills, and judgement to activate co-production activities in their contexts (Sicilia, et al., 2019). Procedural factors emphasized to support this will, for example, outline different communication strategies, provide guidance for preparing workshops, conflict resolution, or enabling trust, demonstrated via practical exercises that explore the challenges of facilitation in action. It will also elaborate (often overlooked) factors that cause co-production to fail – including unequal power relations and depoliticization, and how these could be managed (Turnhout, et al., 2020). Although socio-political disparities are often beyond the immediate control of facilitators, it is possible to mitigate them, for instance via informed participation recruitment that reduces selection bias (Maria francesca, et al., 2019). In short, it examines the conditions for co-production thus linking to Module 2: identifying and engaging stakeholders.

Module 2. Identifying and engaging stakeholders (Risk-Tandem step 1)

Module 2 will be designed to support the early set-up and workshops of the RWLs. Its components are:

Learning component 2.1 will provide advice on **mapping and engaging stakeholders**, as well as examining relationships between them. As such, it links to capacities 2 and 3 as identified in Table 1. and intends to respond to some of the

challenges as outlined in Chapter 2. Indeed, guidance for cross-scale stakeholder engagement is foundational when assessing complex sustainability, climate, or risk issues which necessitate widening the scope of hierarchical approaches by involving actors across disciplines and levels of governance to include all relevant persons whose expertise, values, and concerns matter in the decision-making context (McKay, et al., 2017; Berkes, 2017). Furthermore, it will discuss the inclusion of vulnerable groups, in efforts to ensure that co-production remains inclusive by including citizens and communities from the margins of decision making (Amann and Sleigh, 2021). Transdisciplinary perspectives are required to build a better understanding of complex risks – a process contingent upon the abilities of stakeholders (not only modellers!) to identify key dependencies, pathways, emerging properties, and uncertainties embedded in the system under assessment. Furthermore, it may be beneficial for altering organizational cultures that may hinder innovation for systemic risk management, DRR and CCA. For instance, organizational cultures (shaping mental models, communication, values, worldviews, and social roles) influence on decision making (McKay, et al., 2017). Whilst homogeneous groups are likely to repeat and reinforce shared perspectives, heterogeneous assemblages representing diverse disciplines and scales of governance are more likely to challenge each other's views. As such, this learning component links to capacities 2, 3 and 5 as identified in Table 1. Learning component 2.2. will focus on **ethics**. Since co-production is a sensitive process, and because DIRECTED will involve research based on qualitative data gathered from the RWLs, it is essential that facilitators (Trainers) consider ethical dimensions involved in co-production practice and research. In the context of medicine and health research, it has been suggested that co-production should be guided by a set of values, seeking to maximize the good of the public whilst ensuring that all stakeholders' interests are considered and represented (Page, 2022). Naturally, this requires the facilitators to be willing to address imbalances of power (beginning with awareness) and prioritize the tenets of beneficence and justice. Furthermore, this module will explore ethics involved in DIRECTED research, to support the ability of Trainers to convey this information to stakeholders in their RWLs and respond to privacy or confidentiality concerns. Sometimes stakeholders may also be reluctant to take part in co-production due to lack of trust resulting from inherent power structures that impede open communication (Amann and Sleigh, 2021). Thus, ethics must be explored with reference to stakeholder engagement, in efforts to accommodate competing priorities, beliefs, values and attitudes via a commitment to conflict resolution.

Module 3. Co-exploring risk context (Risk Tandem step 2).

Module 3. will emphasize technical capacities skills related to risk governance and the Data Fabric, contextualized via Risk-Tandem and co-production. This set of learning components will be developed to support the Trainers' ability to enable co-produced exploration of the RWL risk landscape with their stakeholders (Risk Tandem step 2) and begin outlining priorities for risk management (including learning objectives, step 3).

Learning component 3.1 can also support exploring the ways for establishing a common language on risk governance (which could contribute to an open-source taxonomy). This will build on outcomes from T2.1 and WP1 (RWL), to connect RWLs with the Data Fabric (thus supporting its interoperability across regions and potentially models). This enhances the ability of Trainers to facilitate the sharing of different knowledges through practical exercises, linking to capacities 1 and 6 from Table 1.

Learning component 3.2 explores risk assessment tools and approaches from the perspective of co-production. By building on the work of WP3. It enables Trainers to turn theoretical approaches into actionable tasks within RWLs.

Learning component 3.3. involves a deep dive into different models and modelling approaches through co-production, developed jointly with WP5 to align it with the needs of the Data Fabric. Inspired by work done in the field of climate services (for instance, Daniels, et al., 2020), can aid RWL hosts facilitating learning-focused workshops that seek to map user needs, perceptions and priorities that can be then used to inform the development of the Data Fabric infrastructure.

3.4. Capacity development plans and needs assessment for the years Growth (2024) and Learn (2025)

Overall, the constitution of modules for the Trainers will support them in facilitating workshops in a co-productive mode. However, co-production is not universally advantageous (Ostrom, 1996:1082), and should be designed by local stakeholders leading its implementation as deemed appropriate. However, the explicitly normative commitment to the values of egalitarian and non-hierarchical collaboration, inclusion and democratic risk governance is likely to bring direct and cascading benefits to all risk governance operations taking place in the RWLs. These modules will support RWL workshops throughout the early stages of DIRECTED, aiming to create a clear action plan for each RWL based on their stakeholder inputs (Risk-Tandem step 3., setting objectives).

After Risk-Tandem step 2 and 3 – which can be returned to if necessary – the RWLs will then progress toward steps 4 (responding to identified needs), building towards identifying and implementing solutions (step 5). To support this, a full capacity needs assessment will be designed and delivered in Q4 of 2023 and Q1 of 2024, in efforts to fully align future training modules with contextual needs in each RWL, based on their priorities for action. While the primary focus remains on the Trainers, there's flexibility to offer training to stakeholders, consistent with Risk Tandem and related guidelines. This continues Task 4.2. (comparison and assessment of needs through learning, capacity development and knowledge exchange, M9-M36, that will be completed toward the end of 2025. However, since the exact capacity development needs for Trainers and stakeholders after the initial first phases of Risk-Tandem are uncertain, and vary among RWLs, they will be developed based on needs assessment and complementary research later (aligned with guidance from Chapter 3.3).

4. Monitoring, evaluation, and learning (MEL)

The MEL approach for DIRECTED operates on two levels. Firstly, we outline the MEL for capacity development, whereas MEL for RWL objectives will be co-produced with the stakeholders based on their plans for DIRECTED (linking to Tasks 1.3 and T3.3. on evaluating DIRECTED impacts and outcomes). Such an approach was selected, since it is equally central to understand the delivery and impact, especially in public service contexts (Osborne, et al., 2018). It is crucial to examine how Trainers apply acquired knowledge and the resultant impact of co-produced risk governance. Assessing RWL impacts – whilst linked – is a somewhat separate effort, since it requires establishing a MEL plan for each RWL based on their priorities and plans of action, with a reference to the effects of ToT. However, both are essential for assessing the effects of co-produced risk governance to support further development of Risk-Tandem and associated capacity development activities on co-production, especially since the impacts and outcomes of co-production remain poorly researched (as discussed by Jo and Nabatchi, 2018; Bovaird and Loeffler, 2016). In 2015, literature review assessing work on co-production revealed that 80% of the studies did not discuss outcomes at all (Voorberg, et al., 2015).

To address this, a rigorous strategy for MEL must be designed and implemented with the RWLs to gauge the contribution of co-production training to project results. Given that co-production emphasizes change in terms of processes and relationships, capacities, collaborations as well as communication across the landscape of actors (Daniels, et al., 2020; Brandsen, et al., 2018; McEvoy, et al., 2016), evaluating 'performance' must leverage adaptive approaches that capture information beyond linear results chains (McEvoy, et al., 2016). In the context of DIRECTED, it is thus not enough to measure the number of software developed and trainings delivered, or reports, plans, policies, and roadmaps produced, simply because such indicators do not lend themselves to understanding change, nor the impacts they may have had.

Table 2: DIRECTED Outcomes involving WP3 and WP4 as outlined in the proposal (part B p. 45)

Expected outcomes of DIRECTED involving WP3 and WP4 (1, 2, 5 and 6)	Associated outputs and indicator (as outlined in the proposal)
1. Improved dialogue and cooperation among scientific and technical communities, stakeholders, policy-makers and local communities.	Real world lab case studies and summary reports demonstrating the increase in interactions and co-production with transdisciplinary stakeholders
2. Enhanced community engagement for prevention, preparedness, response and recovery and learning from climate events.	Co-production methodology for disaster resilience developed and used with at least two municipalities (incl. co-produced planning reports).
5. Development of new governance strategies and robust decision-support methodologies for integrated risk reduction and improved adaptation to extreme climate events.	Governance workflows agreed by stakeholders, implemented into a management system.
6. Improved understanding of enablers and barriers to multi-risk governance frameworks and multi-risk thinking, by involving interdisciplinary teams in different fields.	Policy brief outlining barriers and enablers to multi-risk governance. Demonstrated up-take by at least one DRR/CCA agency.

However, if one compares the expected outcomes alongside associated outputs and indicators as outlined in the proposal, the latter alone are indeed not enough to capture how, for instance, dialogue and cooperation have improved through co-production (in relation to ToT activities as discussed in this strategy in particular), or how community engagement has contributed to improved prevention, preparedness, response and recovery.

For assessing (and learning from) these, it is best to leverage contribution analysis; an approach that examines cause-effects through a mixed-method theory-based evaluation that can infer (instead attribute) causation (Brix, et al., 2020). This is especially useful for

analyzing the outcomes of co-production programs consisting of complex and interacting variables which, in essence, constitute a social phenomenon (ibid). Whereas attribution analysis would focus on simple and technical problems or products (such as the Data Fabric), ToT and RWL activities require a thorough mixed method 'contribution story' (Funnell and Rogers, 2011), that does not necessarily represent ultimate truths, but instead offers reasoning why, and sufficient conclusion of how co-production interventions have contributed to given outcomes in ambiguous contexts (Dahler-Larsen, 2018; Brix, et al., 2020; Visman, et al., 2022).

4.1. MEL for ToT

For DIRECTED, the MEL process will be further enhanced by establishing a unified evaluation framework, negotiated with other stakeholders (Dahler-Larsen, 2018). There is a need to establish a clear and transparent local link between the co-production intervention strategy and expected outcomes, in efforts to assess whether this link between the two holds (Brix, et al., 2020; Visman, et al., 2022). This cannot be done without establishing and operationalizing context-specific outcome indicators for ToT, given that co-production is and will be dependent on individual and organizational, sometimes spontaneous acts (Pestoff, 2014). Although the process of co-evaluation with stakeholders across the levels of governance is challenging due to issues of power and differing perspectives (Brix, et al., 2020), it is foundational for generating an understanding of the success of co-production as perceived and deemed effective from and by the grass-root levels. Furthermore, a robust MEL plan can help in improving co-production and, thus improve its expected outcomes (Visman, et al., 2022).

Consequently, a MEL plan for ToT will be firstly developed at the individual level, through collaboration with the RWL hosts. In detail, the plan must outline what co-production promises to offer in each context (the issue) and what skills are required to address them. One can begin co-exploring potential sources of evidence to demonstrate the contributions of co-production to impact. Durose, et al., (2017) et al., propose utilizing a process of 'appreciative inquiry' as a way of distilling experiences, memories and perspectives of individuals through interviews and other methods (such as key informant interviews and surveys) to collectively identify critical elements of success. If combined with a contribution analysis, it is possible to begin assessing change over time, especially when the evaluation

purpose, key questions, indicators and plans are negotiated with stakeholders throughout the process (ibid).

4.2. MEL for RWLs

Setting up MEL to monitor, evaluate, improve and to learn from ToT during the implementation of training is only a part of the wider planned MEL framework for DIRECTED. Indeed, whilst useful for evaluating and iteratively developing training for trainers during the implementation of the project, MEL must also extend to assess the outcomes and impacts of each RWL beyond what DIRECTED aims to achieve; indeed, it must reflect what stakeholders themselves wish to achieve, in alignment with the values and principles of co-production. This will be further negotiated and planned jointly with WP3 to support Risk Tandem, with RWLs and with WP1 to align monitoring with the interests and priorities of stakeholders involved in DIRECTED (beyond the project's internal monitoring and reporting requirements which, whilst necessary, do not necessarily reflect the interests of RWLs involved in it).

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