Knowledge management – from bottleneck to success factor

Concepts & practical guidance for co-learning systems in international development cooperation

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TABLE OF CONTENTS

INTRODUCTION

Knowledge is at the heart of global development. It is the critical resource for development organisations to work and collaborate successfully as well as for communities, cities, nations and regions to create wealth, quality of living, peace and sustainability. Knowledge is an essential element for the achievement of the Agenda 2030 and the Sustainable Development Goals, requiring the world's full attention.

2017 Global Knowledge for Development (K4D) Conference in Geneva[1]

Knowledge management in cooperative learning settings

Over the past two decades, researchers and practitioners from a wide range of disciplines have argued that knowledge is central to any innovation and learning processes within firms and organisations[2]. Likewise, knowledge management was shown to be the key factor for competing in global markets[3] as well as for achieving impact through international development cooperation.

However, when it comes to managing knowledge effectively, the field of international development cooperation poses complex challenges in terms of agenda coordination, promoting good practices and impact evaluation for the multitude of development organisations working at different levels – from local to global[4]. For such complex cooperative forms of learning (hereafter 'co-learning'), it is essential to gain a shared understanding of the terms, meanings and mechanisms of knowledge management in order to effectively grasp and govern their activities. This publication introduces a conceptual and methodological framework for the design and the implementation of effective knowledge management interventions for co-learning systems in international development cooperation. Becoming acquainted with this framework can enable practitioners to coordinate collaborative knowledge work more effectively and share experiences in order to achieve better project results and disseminate findings. The framework can be universally applied, adapted and further developed for any stakeholder setting and thematic focus in the field of international development cooperation.

The co-learning system of the NDC Support Cluster

Though universally applicable, the knowledge management framework presented in this paper has been inspired by discussions with and contributions from members of the NDC Support Cluster within

1 http://www.km-a.net/english/en-networking/k4d-geneva-2017/ [retrieved: May 2020].

2 For an introduction to knowledge management in firms and organisations, see Nonaka I., Konno N., 1998, The Concept of 'Ba': Building a Foundation for Knowledge Creation, California Management Review. For an introduction to computer mediated knowledge management in communities of practice and knowledge workers, Simone C., Wulf V., 2012, Knowledge Management in Practice: A Special Issue, Computer Supported Cooperative Work (CSCW).

3 Extensive literature is available on the subject. For a general overview, please refer to Davenport T. H., Prusak L., 1998, Working Knowledge: How Organizations Manage What They Know, Harvard Business Press.

4 Ferguson J., 2008, Knowledge management in practice: The case of international development, Knowledge Management: Research & Application 75 –112, Information Logistics and Innovation.

the International Climate Initiative (IKI)[5]. The cluster's vision is in fact to foster co-learning systems or, in the jargon of its practitioners, to build up a 'spiral-like' process of evolutionary learning that continually enhances existing capacity development knowledge for implementing Nationally Determined Contributions (NDCs) and raising climate ambition. During strategy meetings, however, the member organisations recognised a whole set of barriers and constraints hindering the envisioned 'collaborative think tank'[6] approach. In a situation where many of the partner organisations already struggled to realise an effective knowledge management system of their own, setting up an active co-learning approach spanning several organisations, especially in the absence of clear hierarchical structures, appeared to be an impossible task. Two fundamental barriers identified during the meetings were the divergent understanding of how knowledge creation and transmission work in a co-learning system (what we can refer to as the divergent 'mental models'[7] of member practitioners and the cultures of partner organisations) and a general misalignment concerning the meaning of knowledge management and the elements required to make it work effectively.

Amongst NDC Support Cluster member organisations there currently is widespread frustration surrounding this topic. In fact, knowledge management is seen as a bottleneck rather than a success factor. One reason is that knowledge management is seldom addressed systemically or comprehensively; the focus instead often remains on isolated elements. The observation of a member of the NDC Support Cluster during a knowledge needs assessment workshop is noteworthy in this regard: 'Often, when considering how to improve learning, we come up with solutions without properly analysing the requirements and problems that knowledge management would need to address. We build up a project website or propose wikis for collaboration, both of which are powerful tools, but do not fully comprehend the drivers and needs of a successful knowledge management system between participating stakeholders in the knowledge management process.'

Broadening and overcoming the bottleneck

The purpose of this paper is to help co-learning systems and their member organisations overcome frustration and transform knowledge management from a bottleneck into what it is meant to be: a success factor for international development cooperation. Based on the experiences of the NDC Support Cluster, one overarching question can be formulated:

5 The International Climate Initiative (IKI) situated within the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) is a key element of Germany's climate financing and funding commitments in the framework of the Convention on Biological Diversity (https://www.international-climate-initiative.com/en/?iki_lang=en). After the conclusion of the Paris Agreement under the UNFCCC, support for the implementation of the Nationally Determined Contributions (NDCs) became a focus of the IKI – both in terms of mitigation and adaptation to climate change. In 2016, the IKI NDC Support Cluster, which is comprised of important implementing organisations for IKI projects, was established (https://www.ndc-cluster.net/).

6 The NDC Support Cluster defines itself as a collaborative think tank which provides policy and strategic advice as well as knowledge brokering related to NDC support for the BMU's International Climate Initiative (IKI). These partners come together to identify, share and proliferate what works and what is needed for credible, ambitious and long-term NDC implementation in the partner countries. As a group of practitioners, the Cluster is in a position to go deeper into the 'granular level' at which implementation happens.

7 The 'mental model' theory of reasoning has been introduced in Johnson-Laird P.N., 1983, Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness, Cambridge University Press.

How can the mental models of various members of partner organisations be successfully reconciled and aligned with the goal of embarking on a joint knowledge management process?

From there, a series of other pressing questions emerges:

- How can practitioners avoid 'reinventing the wheel' and instead effectively launch new, more successful projects by building on hard-won experience?
- How can co-creation be fostered to minimise the parallel and inconsistent development of approaches?
- How can results and learning be retained to the later benefit of project owners and other stakeholders?
- How can the reach and recognition of innovations be effectively improved?
- How can the learnings of other stakeholders be effectively accessed?

This paper addresses the above questions by systematically analysing the underlying processes of knowledge creation and transmission. To provide insightful and satisfying answers, the paper examines how to identify, enhance and build on existing learnings within co-learning systems. In addition, critical processes that can inhibit access to knowledge are identified and the mechanisms that govern the successful knowledge creation and preservation across organisations explained.

How to work with this paper

This paper is structured in three chapters – from concepts to steps for implementation. Chapter 1 briefly touches on the importance of two basic social systems: the cooperation system and the community of practice (CoP). These two systems shed light on a third social system: the co-learning system. Becoming familiar with these social systems will pave the way for a better understanding of the fundamental knowledge dynamics that take place within them.

In chapter 2, a proposal for a knowledge management framework based on six principles is introduced. These principles stem from current research[8]. However, while they are mainly presented in the literature with reference to individual organisations or cooperation systems, the present paper extends the principles to the context of co-learning systems[9]. Chapter 3 presents the five main steps (and a number of sub-steps) towards a successful implementation of knowledge management: knowledge needs assessment, situation and requirement analysis, piloting, roll-out and institutionalisation. In chapter 4, final remarks on the use of the knowledge management framework, some general suggestions for knowledge management as well as information on an upcoming case study are provided.

This paper invites readers to take the first conceptual steps and embark on a journey towards more effective knowledge management in co-learning systems.

8 The knowledge framework proposed here is based on the approach discussed in Milton N., Lambe P., 2016, The Knowledge Manager's Handbook, KoganPage. It is a foundational reference point widely cited throughout the text. The authors of this paper extend this approach from the organisational level to the level of the co-learning system, while adding some specifics and enriching it with components related to the data value chain.

9 The approach has been developed by OneOffTech and commissioned by the GIZ Support Project for the Implementation of the Paris Agreement (SPA).

1 THE SOCIAL BASIS OF KNOWLEDGE MANAGEMENT

This chapter draws attention to some social systems[10] that are of special relevance to the knowledge management framework discussed in detail in the next chapter. Before introducing them, it is useful to point out some of our assumptions about the general connection between social systems and knowledge management.

Regardless of the specific field – be it in the natural or social sciences – it is important to keep in mind that ultimately it is always individuals who are the creators and bearers of knowledge. Nevertheless, individuals are always situated in social contexts, which are sources of – more or less prescriptive – behavioural norms (ranging e.g., from the implicit rules of a college classroom to company policies) that in various ways influence individual behaviour.

Ideally, a social system should be resilient enough to handle the inputs of its members and adapt its rules over time to suit their needs and protect their well-being. On the other hand, as members of the social system, individuals should always be willing to forgo part of their autonomy in the interest of the common good. What exactly constitutes the 'common good' and how this balance may be achieved is certainly beyond the scope of this paper.

However, one aspect should be outlined to better frame what follows. That is, a central aim of the various disciplines engaging in organisational development is precisely to develop analytical and operational tools that optimise the functioning of social systems to the benefit of their members' individual performance. This objective also applies to the discipline of knowledge management.

More specifically:

- The common good that members of a social system should pursue – as well as the individual well-being that the social system should secure – is knowledge, i.e., the know-how that allows individuals of a social system to discuss problems, find creative solutions and implement them efficiently and effectively;
- Amongst the multitude of social systems studied[11], some types are more suited than others to fostering the transmission and creation of knowledge;
- In the context of international development cooperation, some of these systems have been studied extensively and offer an important basis for knowledge management[12].

Having clarified these points, the chapter is organised as follows: first, the notion of cooperative systems is briefly recalled, then the notion of a community of practice (CoP) is introduced, and, finally, our central concept of the co-learning system is elaborated.

10 '[...] social system is the patterned network of relationships constituting a coherent whole that exist between individuals, groups, and institutions. It is the formal structure of role and status that can form in a small, stable group.' In https://en.wikipedia.org/wiki/Social_system [retrieved May 2020].

11 A vast amount of literature is available on this subject. For a bibliography of references, see Wenger E., 1998, Community of Practice: Learning, meaning and identity, Cambridge University Press.

12 Several recent approaches to capacity development at a systems level foresee iterative learning cycles to ensure that past errors are identified and corrected and the results fed back into policy formulation for the next learning cycle. Effective institutional learning cycles rely heavily, though not exclusively, on functioning knowledge management systems of the type elaborated in the present paper. For a discussion of governments in developing countries, refer to Andrews M., 2013, The Limits of Institutional Reform in Development, Cambridge UP; for civil society organisations to Green D., 2016, How Change Happens, Oxford UP; for project and programme management to GIZ GmbH, 2015, Cooperation Management for Practitioners – Managing Social Change with Capacity WORKS, Springer Gabler.

1.1 Cooperation systems

Cooperation systems are social systems that refer to coalitions of single and heterogeneous organisations (see Figure 1) that jointly work to achieve common goals in the framework of international development projects. In the context of international cooperation, five main types of stakeholder organisations can be identified: governmental bodies of partner countries, civil society organisations (CSOs), private-sector companies, international implementing organisations and academic organisations.

As clearly explained in Capacity WORKS[13], the organisational development model of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), cooperation systems and member organisations each follow a different logic. Whereas governance in traditional organisations works through hierarchy, cooperation systems are based on negotiation and steering mechanisms.

The internal complexity of organisations within cooperation systems as well as the economic conditions, cultural factors and political circumstances of different countries require organisational development tools. The notion of cooperation systems was established precisely to provide international development projects with a systemic framework for defining and creating tools to prevent – or at least mitigate – the effects of the most recurrent organisational obstacles to project planning and implementation. The key question for cooperation systems is indeed: 'How can we contribute to the successful cooperation of different organisations that are jointly seeking solutions to societal needs, problems or challenges?' Capacity WORKS outlines five main success factors:

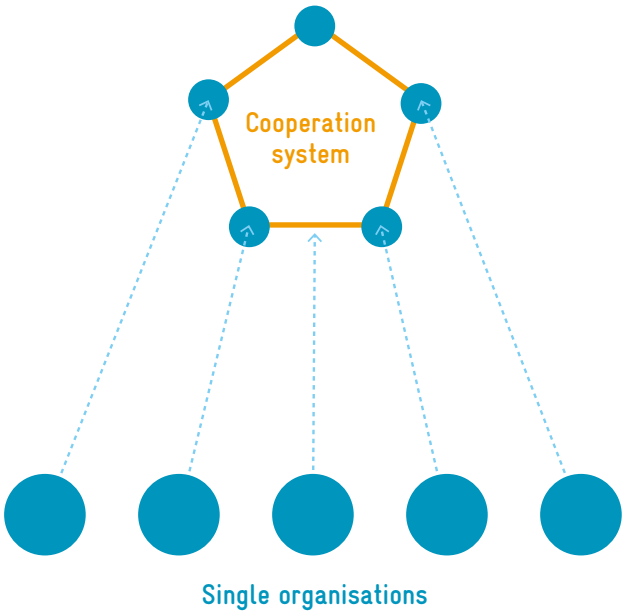

Figure 1 A cooperation system may consist of various organisations (source: OneOffTech).

1. Jointly implement a strategy
2. Facilitate social change through cooperation
3. Negotiate decisions in steering structures
4. Use processes to shape social innovation
5. Safeguard sustainability through learning and innovation

This paper draws special attention to the last success factor listed, namely 'learning and innovation'. Since knowledge creation and transfer processes often involve multiple cooperation systems rather than just one, the next concept to be introduced is a broader concept of social systems: the community of practice.

13 GIZ GmbH, 2015, Cooperation Management for Practitioners – Managing Social Change with Capacity WORKS, Springer Gabler.

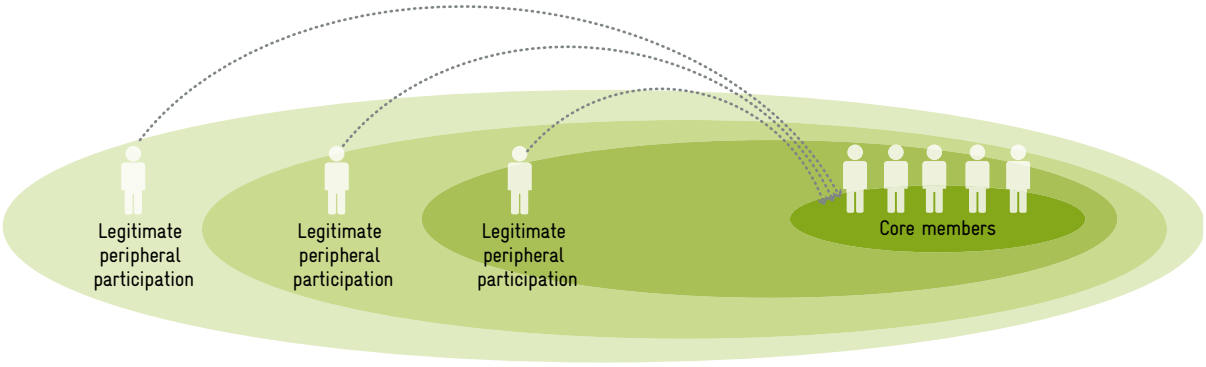

Figure 2 Community of practice: Taken together, the four green ellipses represent the community of practice (CoP), while the figures inside represent its members. CoPs are social systems that enable the interaction of peripheral members (light green ellipses) and core members (dark green ellipsis), and in so doing, ensure the growth of knowledge and its storage in shared artefacts (source: OneOffTech).

1.2 Communities of practice

The central idea behind the notion of a community of practice[14] (CoP) is that learning is a social process that depends on semantic negotiation (or the negotiation of meanings) among the community's members, i.e., the individuals taking part in a community.

Examples of CoPs range from software developers gathered around open source technologies, to research groups focussing on specific scientific themes and programmes, to communities of so-called 'knowledge workers' who in business contexts have proven to be crucial drivers of innovation (see for example the paradigmatic and often studied cases of Toyota and Xerox[15]).

In such communities, negotiated meanings are no longer ascribed to individual members, but rather a collective product resulting from the co-production of meanings by all CoP members. Each member continuously influences the community as a whole and is, in turn, continuously influenced by it[16].

Semantic negotiation in a CoP takes place through:

1. Legitimate peripheral participation: New or peripheral members may only learn from core members through active participation in a CoP (see Figure 2). As these groups interact, meanings can then be jointly revised through practice.
2. Reification[17] of meanings: Through a reification phase consisting of 'putting pen to paper' and inscribing meanings into shared artefacts (such as manuals, reports, schematics, etc.), CoPs build shared knowledge repositories for members' learning.

14 Wenger E., 1998, Community of Practice: Learning, meaning and identity, Cambridge University Press.

15 Nonaka I., Takeuchi H., 1995, The knowledge creating company: how Japanese companies create the dynamics of innovation, Oxford University Press.

16 'The negotiation of meaning is a productive process, but negotiating meaning is not constructing it from scratch. Meaning is not pre-existing, but neither is it simply made up. Negotiated meaning is at once both historical and dynamic, contextual and unique'. Wenger E., 1998, Community of Practice: Learning, meaning and identity, Cambridge University Press.

17 Reification stems from the Latin *res, rei* (thing). By extension, reification refers to the process of transforming an abstract entity into a tangible thing. It may also be described as the 'materialisation' of an idea or concept.

Core members in a CoP are defined by their reputation within the community, and are responsible for discussing strategic guidelines and making decisions in a participatory manner.

It is worth recalling here that a CoP is not the result of a top-down creation, but an existing phenomenon across established organisations (whether different companies or departments within the same company). These organisations can eventually facilitate a CoP but not create one from scratch. A CoP is the result of a spotaneous (or emergent) aggregation of experts interested in sharing experiences. A CoP evolves in directions that cannot be defined a priori, since the only criterion that establishes its development is the advantage that individual participants find in taking part in the community. The legitimate participation of newcomers is a salient element in this sense.

Whilst the members of a CoP develop a sense of belonging through participation and practice, the reification of meanings allows them to retain lessons learned and build the conditions for collective reflection and semantic negotiation. Thus, through these processes, members take a step towards sustainable learning within the CoP[18].

The collective cultural heritage of a CoP is precisely what allows it to gain legitimacy and its members to absorb and retain that common heritage while legitimately accessing, reusing and revising it. This dynamic is central to learning and community growth. Continuous semantic renegotiation results in learning: Members draw on and adapt existing solutions to new problems as they emerge. Community growth happens as member turnover is leveraged to reach out to new members and gain access to new skillsets.

A well-known CoP: Wikipedia and its practitioners

To illustrate the concept of a CoP, one can turn to a prominent and widely known example: Wikipedia.

How has a community been created around this platform?

1. First of all, with an idea, a product that is useful to users. An open, user-contributed encyclopedia.

2. Second, through a mechanism to ensure the quality of contributions: Wikipedia implements a transparent governance model that establishes the criteria for a contribution to be accepted and explains how the revisions work.

3. Finally, a business model, which in the case of Wikipedia is crowdfunding.

An open-source encyclopedia cannot be established by a top-down decision for the simple reason that contributors cannot be forced to write. Nevertheless, Wikipedia is a successful product; it combines the demand for knowledge and the supply of knowledge, and contributors are also users. That, in a nutshell, is what a CoP is all about.

Wikipedia contributors recognise the decision-making role of core members – those who set criteria and make decisions on the publication of contributions – based on a) members' actual commitment to support member contributions, b) members' experience and ability to solve problems and c) members' commitment to do everything possible to accept a contribution rather than reject it.

18 A community, in the sense of Wenger E., 1998, Communities of Practice: Learning, Meaning, and Identity, Cambridge University Press, is constantly engaged in a process of self-replication, which is based on the contribution, support and eventual exit of some of its members. In the course of time and through participation, members take up the social norms of the community and assimilate the practices in use in the community, thus developing their own identity as community members. They become part of a single process that Wenger describes as 'enculturation'.

Joint enterprise	Mutual engagement	Shared repertoire
This dimension, assumed by the relationship between practice and community, concerns the formation of a shared understanding of the problems and viable alternatives, objectives and priorities negotiated among the members, and a common awareness of tasks.	The more members work interconnectedly, the more they develop a sense of community, which in turn is recognised as part of a greater whole (society). Along this dimension, individuals interact and share experiences in order to nurture collective learning.	The relationship between practice and community generates a set of learnings, tools, artefacts and development processes, which conveys collective knowledge and preserves the memory of the community itself.

Table 1 The three main properties of a COP.

The continuous renegotiation of meanings within the community results in learning by adapting past solutions to new problems and by leveraging member turnover and reaching out to new members.

Taken together, legitimate peripheral participation the reification of meanings, the two central processes in the ongoing collective production of meanings, shape the three fundamental characteristics of a CoP[19] (see Table 1).

Now that the negotiation of meaning within the social system of a CoP has been explained, the next step will be to take a closer look at one special type of CoP: co-learning systems.

1.3 Co-learning systems

Cooperative learning systems, in short co-learning systems, can be seen as a special type of CoP, whose members are participants of different cooperation systems and whose structures are set up with the primary goal of enhancing knowledge production and transmission in a specific field (see Figure 3).

Co-learning systems are composed of cooperation systems which themselves consist of individual organisations. As shown in Figure 3 below, an individual can take part in multiple social systems: single organisations, cooperation systems and co-learning systems. The challenge, then, for the co-learning system is to be flexible enough to meet the different learning needs of its members, who stem from multiple cooperation systems and organisations.

The overall goal of a co-learning system's members is to strengthen the efficiency, effectiveness and sustainability of projects by channeling lessons learned and interim/final results throughout all participating cooperation systems.

More specific goals of a co-learning system may for instance include:

- avoiding the tendency to 'reinvent the wheel';
- making it possible to harness – even partially – project results as learning opportunities for others, thus avoiding the risk of losing all knowledge after a programme ends;
- counteracting the emergence of project-based silos across different programmes and promoting a culture of the commons[20].

19 Wenger E., 1998, Communities of Practice: Learning, Meaning, and Identity, Cambridge University Press.

20 'The commons is the cultural and natural resources accessible to all members of a society, including natural materials such as air, water, and a habitable earth. These resources are held in common, not owned privately.' https://en.wikipedia.org/wiki/Commons [retrieved May 2020].

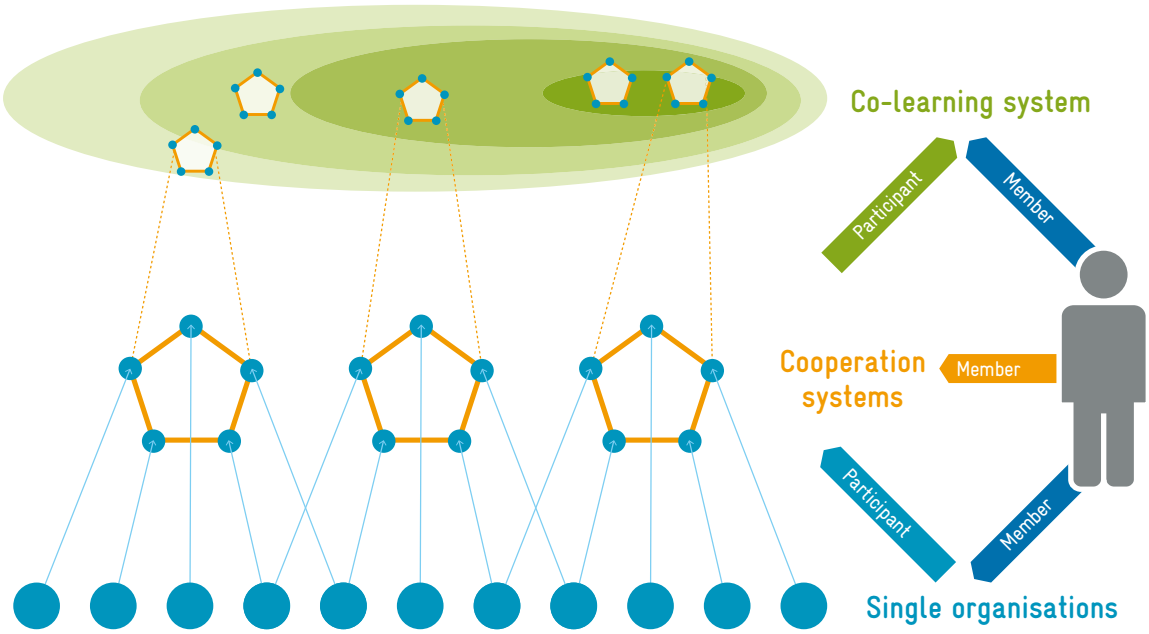

Figure 3 Outline of mutual relations between different types of social systems: organisations participate in cooperation systems which in turn participate/take part in co-learning systems. Individuals can therefore be members of organisations, cooperation systems and co-learning systems (source: OneOffTech).

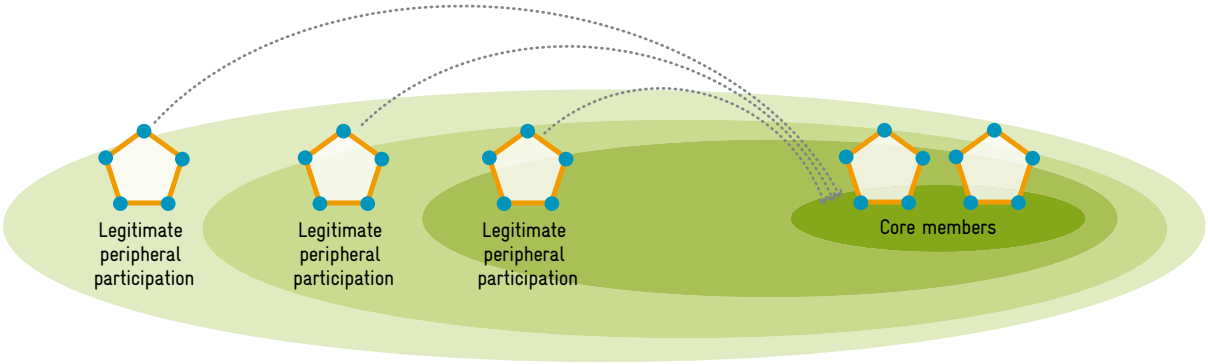

Figure 4 **A Co-learning system** is a special type of community of practice. The pentagons represent the cooperation systems taking part in the broader co-learning system (source: OneOffTech).

Let us now consider more closely the properties which characterise a co-learning system and thus distinguish it from a cooperation system. A co-learning system is identified according to seven characteristics:

- **Commons**: Members of a co-learning system agree on viewing data and knowledge as commons – as 'shared resources, co-governed by its user community according to the rules and norms of that community'[21].
- **Commoners**: Members of a co-learning system can be called commoners, meaning they are peer producers of the commons.
- **Input**: Commoners commit to sharing data and taking part in knowledge generation processes under agreed principles.
- **Synchronous communication**: Commoners need opportunities for regular discussion since learning is only possible through active participation.
- **Asynchronous collaboration**: The contribution of learnings by cooperation systems can happen at different times and the learnings repository evolves as each commoner independently accesses, uses, revises and shares knowledge with others.
- **Distributed coordination**: Coordination within a co-learning system works through indirect communication among commoners[22]. Bauwens proposes a useful analogy: 'Think how the ants or the termites exchange information by laying down pheromones (traces). Through this indirect form of communication, these social insects manage to build complex structures such as trails and nests. An action leaves a trace that stimulates the performance of a next action, by the same or a different agent'[23]. In the same way, cooperation systems coordinate the retention and dissemination of learnings throughout a co-learning system, for example by following common policies for the documentation and publishing of lessons learned.
- **Commons as output**: Each reuse and revision of the learnings repository is shared as part of the commons.

Through learning-by-doing[24], commoners absorb the experiential background of the co-learning system and contribute to its continuous updating. The legitimate peripheral participation of commoners in the negotiation of meanings and their reification in shared artefacts can be described through five levels of learning-by-doing[25] (see Figure 5):

1. Access: Members have access to the shared repertoire of experiences and learnings. Participation in a co-learning system requires, first of all, uninterrupted access. Participants are required to respect the existing community rules (e.g., governing the processing of personal data, non-distribution of illegal content, mutual respect, etc.) while the community is required to be transparent about these rules and sensitive to the needs of commoners, especially newcomers.

2. Reuse: Reusing the shared repertoire to tackle new problems. Exchanges amongst commoners (in whatever form they may take, be it discussions, readings or any other artefact) must promote and encourage the use of lessons learned without undue intellectual property constraints. To this end, the co-learning system must consistently safeguard intellectual property.

21 Bollier D., 2014, Think Like a Commoner: A Short Introduction to the Life of the Commons, New Society Publishers.

22 The self-organising process behind asynchronous collaboration phenomena is also known in the literature as a stigmergic process; see Heylighen F., 2016, Stigmergy as a universal coordination mechanism: Definition and components. Cognitive Systems Research, Elsevier.

23 Bauwens M., et al., 2019, Peer to Peer: The Commons Manifesto. Vol. 10, University of Westminster Press.

24 Kolb D. A., 1984, Experiential learning: Experience as the source of learning and development (Vol. 1), Prentice-Hall.

25 Also known in the literature as the R5 model of case-based reasoning, Aamodt A., Plaza E., 1994, Case-based reasoning: Foundational issues, methodological variations, and system approaches. AI Communications, 7, 39–59.

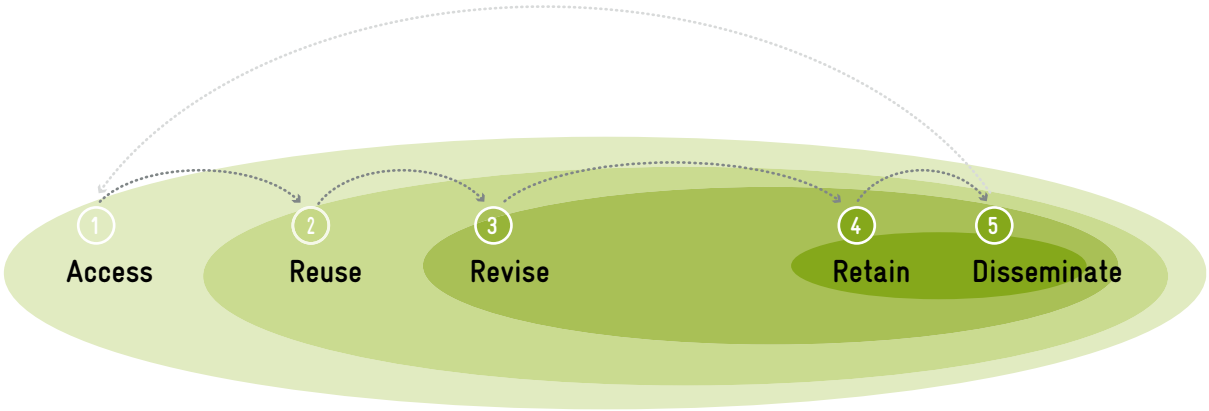

Figure 5 **Co-learning systems** are based on the five levels of learning-by-doing (source: OneOffTech).

3. Revise: Evaluating results and reviewing lessons learned. Without feedback, practice cannot mature into experience and learning. Though it is not mandatory, retrospective sharing of what has been learned, even through a conference call, is vital for co-learning systems. It is in the interests of the community to promote this exchange and to arrange and provide the conditions for revision processes to take place.

4. Retain: Retaining lessons learned, producing new artefacts and integrating them into the shared repertoire. A co-learning system must take care to provide tools and mechanisms for the retention of revisions made by commoners. This ensures that learning from practice and new knowledge can be easily replicated in social contexts and a culture for the systematic documentation of contributions developed.

5. Disseminate: Spreading new artefacts to new potential members. A co-learning system needs to promote the dissemination of produced artefacts and always be transparent about the distribution policies that the commoners must follow, including quality control processes for content released.

Recalling the previous description of core members and the example of Wikipedia, it can be said that a peripheral member of a co-learning system is mainly involved in the access and reuse of the knowledge found in the co-learning system. A core member, in contrast, plays a leading role in the review, retention and dissemination of knowledge.

From an international development cooperation standpoint, no matter the specific learning focus, a co-learning system thus works through cycles of the negotiation and reification of meanings contributed by members of the participating cooperation systems. On the one hand, through the open **access**, **reuse** and **revision** of lessons learned from projects, commoners pull[26] know-how and information into their respective cooperation systems. On the other hand, by following effective **retention** and **dissemination** strategies, they help push their lessons learned and project results throughout the entire co-learning system (see Figure 6).

Another very important aspect is the emergent nature of a co-learning system. Like CoPs (discussed in chapter 1.2), co-learning systems are spontaneous phenomena which can be identified and leveraged, but not 'constructed' according to any type of plan. Defining features facilitate their identification and analysis (see chapter 3, →step 1). As a starting point, co-learning systems will have forms of transversal collaboration in place, a feature which distinguishes them from the other types of social systems discussed here. The issue is therefore not how to create a co-learning system, but rather how to facilitate its functioning and accelerate its growth. Going back to the example of Wikipedia and framing it in the context of a co-learning system, it must be observed

26 The role of the push and pull of knowledge in learning will be addressed in the next chapter 2.1.

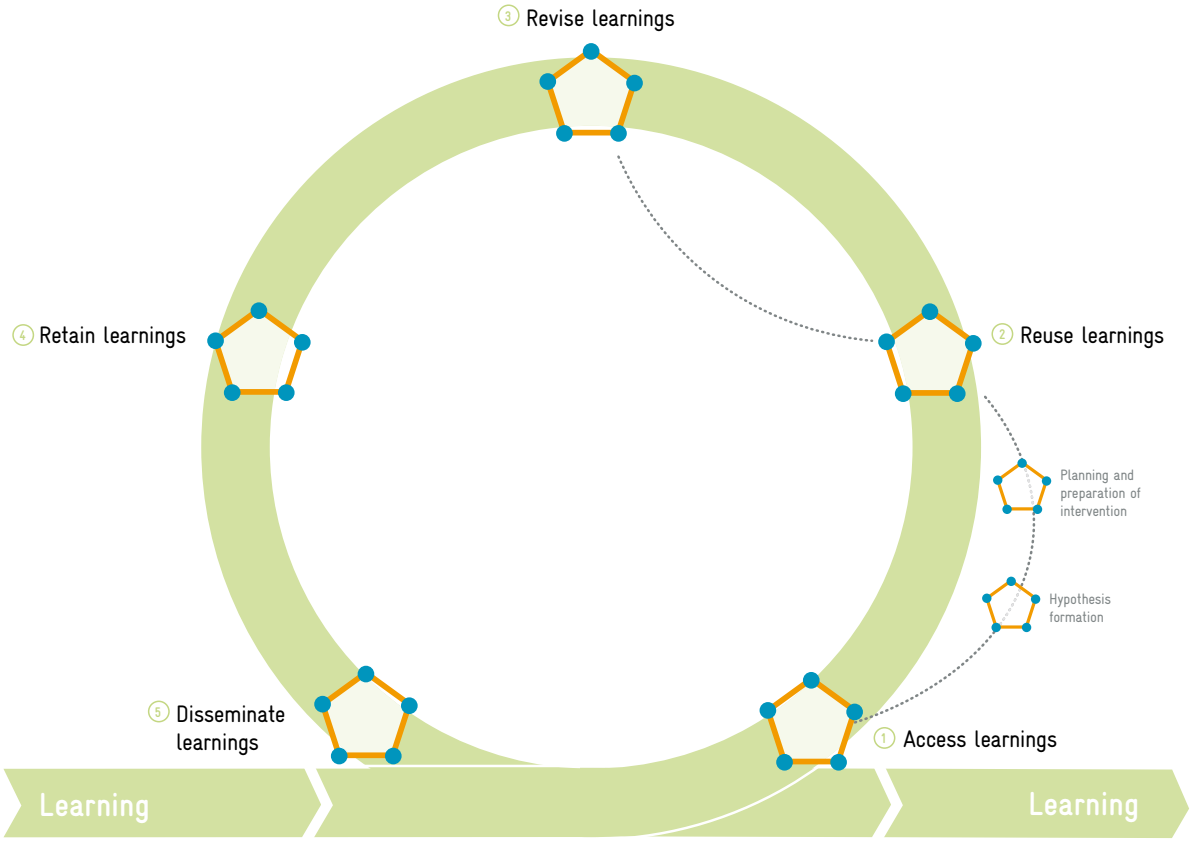

Figure 6 The diagram illustrates the life cycle of a co-learning system. Pentagons represent the participating cooperation systems. Access to the knowledge contained therein allows each commoner to reuse existing lessons for the purposes of their respective cooperation system, i.e., to generate hypotheses, plan and prepare interventions (dotted lines). After reuse, the lessons learned are analysed, shared with the co-learning system (retention phase) and finally disseminated in order to increase the visibility of the co-learning system and gain new members (source: OneOffTech).

as a social phenomenon. Although it certainly materialises in a technology, Wikipedia primarily performs a think tank function to screen the quality of contributions and ensure their retention, dissemination, access and reuse. In the case of Wikipedia, legitimate entry into the co-learning system requires Wikipedia contributors to invest their time and accept the policies of discussion, editing and publication of the material produced.

Likewise, in a co-learning system,

- the cooperation systems must be willing to recognise the importance of some of the project members taking an active part in the processes of discussion (semantic negotiation as defined in chapter 1.2) and editing (reification of meanings as defined in chapter 1.2). On the other hand on the initiative of the core members, the co-learning system must establish mechanisms such as a 'board of commoners' to guide and orchestrate discussions on community rules (how to participate, which criteria are applied to determine the quality of information, which processes are in place to contribute information and knowledge, etc.), govern compliance (with policies defining when to accept or reject contributions) and offer tools that facilitate their execution on the contributor side. In the field of international development cooperation, this role is normally assigned to think tank entities, such as those mentioned in the introduction to this paper.

In order to observe co-learning systems through a knowledge management lens – the central objective of this paper – the next chapter describes the cornerstones of the knowledge management framework to be used for leveraging co-learning systems.

2 THE KNOWLEDGE MANAGEMENT FRAMEWORK

When it comes to knowledge management, the introduction of basic concepts is often overlooked. In a very famous passage of his Confessions[27], the Christian theologian and philosopher St. Augustine[28] says about the concept of time, 'If no one asks me, I know; if I want to explain it to a questioner, I do not know'. The same applies to a certain extent to the concept of knowledge.

Knowledge is intuitively referred to as an obvious phenomenon because without it there would be no culture, no science or technology. But, if one begins to enquire into the differences between what is called 'knowledge', 'information' or 'data', and how and why knowledge, information and data work in social systems, the answers become less and less obvious.

If even from a philosophical perspective it is difficult to agree on a unanimous definition of 'knowledge', the question becomes even more critical in practice when considering what is meant by 'knowledge management'. This chapter is therefore dedicated to an introduction to the basic concepts of knowledge management.

Building on Milton and Lambe[29], six principles of knowledge management are introduced (see Table 2). These six principles have been synthesised from relevant literature in the domain of knowledge management[30], organisational studies[31] and computer science[32], as well as from practical work experience in international development cooperation projects. Subsequently, a knowledge management matrix is proposed which allows practitioners to work with the elements described in the knowledge management framework on a practical level. Finally, the steps for knowledge management implementation are introduced and discussed.

2.1 Principle 1: Push and pull – the two sides of knowledge management

Before dwelling on the above-mentioned difference between information, data and knowledge (chapter 2.2), it is important to start by specifying one of the main tenets[33] of knowledge management. It states that *any knowledge development life cycle (whatever knowledge is) always involves two sides, one representing the demand for knowledge (the pull side) and the other one standing for the existing offer of knowledge (the push side).*

As in economics, push without pull (or supply without demand) leads to a knowledge surplus, and ultimately to the destruction of knowledge value; on the other hand, pull without push creates a market. But, like in any market, supply is essential.

27 Saint Augustine, Confessions, section XI, paragraphs 14 and 18.

28 https://en.wikipedia.org/wiki/Augustine_of_Hippo [retrieved May 2020].

29 This framework is based on the approach discussed by Milton and Lambe and is a foundational reference cited throughout the paper. The present paper extends Milton and Lambe's approach from the organisational level to the level of the co-learning system, while adding some specifics and enriching it with components related to the data value chain. See Milton N., Lambe P., 2016, The Knowledge Manager's Handbook, KoganPage.

30 Davenport T. H., Prusak L., 1998, Working Knowledge: How Organizations Manage What They Know, Harvard Business Press.

31 Nonaka I., Takeuchi H., 1995, The knowledge-creating company: How japanese companies create the dynamics of innovation, Oxford University Press.

32 Simone C., Wulf V., 2012, Knowledge Management in Practice: A Special Issue, Computer Supported Cooperative Work (CSCW), Springer.

33 Amongst many sources, these guiding principles are described comprehensively in Milton N., Lambe P., 2016, The Knowledge Manager's Handbook, KoganPage.

THE SIX PRINCIPLES OF KNOWLEDGE MANAGEMENT

	Push and pull	The knowledge life cycle in social systems always involves two sides: • the **offer** of **knowledge** (push side) • the **demand** of knowledge (pull side) Knowledge management seeks to balance push and pull.
	Data vs information vs knowledge	Data and information refer to the '**know-what**', knowledge to the '**know-how**'. • data is any machine-readable string • information is about the context of use • knowledge involves the adoption and exploitation of data and information for decision-taking and problem-solving
	Knowledge types	Six different knowledge types in co-learning systems: • **practitioner knowledge:** competencies and experience related to specific topics • **technical knowledge:** theoretical skills • **strategic knowledge:** political understanding of business domains • **analytical knowledge:** ability to identify links between crosscutting topics • **knowledge about content production:** capacity to reach stakeholder groups • **operational knowledge:** management capacities and skills • **communication and facilitation knowledge:** media-supported communication skills
	Data types	Three different types: • information in the form of **structured data**, like in databases • information in the form of **semi-structured data**, like social media posts • information in the form of **unstructured data**, like images
	Knowledge value chain	Four main phases: • phase 1: **discussion** • phase 2: knowledge **documentation** • phase 3: knowledge **synthesis** • phase 4: knowledge **search and adaptation**
	Data value chain	Four main phases: • phase 1: data/information **collection** • phase 2: data/information **publication** • phase 3: data/information **uptake** • phase 4: data/information **impact**
	The '4 organisational legs'	Knowledge and data value chains involve four major organisational dimensions: • **people:** who does what • **processes:** which workflows are in place • **technology:** which tools are used • **governance:** how are decisions made

Table 2 The elements of knowledge management in a nutshell (source: OneOffTech).

Therefore, the value of knowledge (and, thus, of information or data) depends on the purposes for which knowledge (or information or data) is required and, ultimately, on the match between the needs of its users and the needs of its suppliers. Thus, whenever knowledge management comes into play, five preliminary questions need to be asked and understood:

- What are the purposes for which knowledge (or information, data) is required?
- What are the needs of those who require that knowledge (or information, data)?
- Which sources of knowledge (information, data) are available?
- To what extent is the supply (or push) and demand (or pull) of knowledge (information, data) in a state of equilibrium?
- Which changes can be applied to the social system to overcome bottlenecks to learning and innovation?

2.2 Principle 2: Data, information and knowledge are not the same

Despite some overlaps, it is important to understand that knowledge differs intrinsically from data and information (see Figure 7).

Data refers to any type of inscribed artefact and sign (like a machine-readable string), irrespective of its context of use. For example, it could be a single word like 'Easter' on a data sheet that might be meaningful per se but is most likely meaningless without additional information.

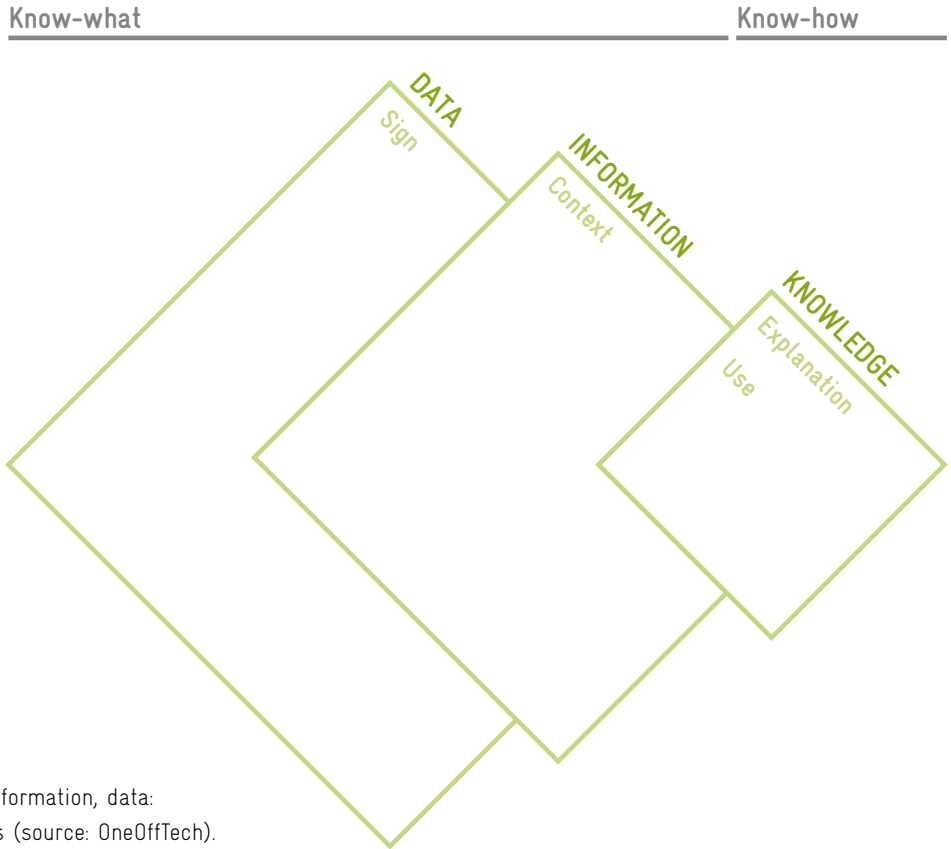

Figure 7 Knowledge, information, data: differences and overlaps (source: OneOffTech).

Information is about the context of use; it connects data with contextualising elements. This connection happens either explicitly (for example the data set representing a route to Easter Island on an electronic nautical chart) or mostly implicitly (for example the list of data – words, icons, highlights, headers, etc. – representing meaningful statements and messages when scrolling a web page about South Pacific travels).

In (everyday) sensemaking[34] processes, the more explanation and experience are required to understand data, the more knowledge comes into play. In the same way that information gives meaning to data by framing it into contexts of use, knowledge allows information to be put into action (for example the course charted by a ship's captain after reading the route to Easter Island on a nautical chart), codifies experience into patterns (for example interpreting a nautical chart requires information on the route, the weather, and the ship's resources, plus rules to determine their correlations) and enables learning through updates to existing patterns (if the captain were to choose an overly complex route for an inexperienced crew, the crew's skill level and confidence would surely be taken into consideration for the next voyage).

2.3 Principle 3: **Knowledge is divided into knowledge types**

Knowledge is not an indistinct entity. Instead, depending on the specific fields of application, it is always specialised and classified into different typologies. Starting from Davenport's pioneering work[35] on the types of knowledge in social systems and extending it to international development cooperation frameworks, seven different knowledge types are considered:

- **Practitioner knowledge** is what you usually find in professionals with at least 15 years of experience in their field. This type of knowledge consists of competencies and experience in specific topics like sectoral strategies, policy reform, applied sustainable land management, energy efficiency, biodiversity, etc. As the name suggests, practitioner knowledge is acquired through practice and experience and refers to what is commonly known as 'expertise'.
- **Technical knowledge** is usually possessed by those who have studied a subject and know its methodologies. It includes theoretical skills like knowledge of physical models for the study of climate impacts or epidemiological methods to grasp the outbreak of a virus, or usage/management/digital programming skills related to information technology (IT) tools. Unlike practitioner knowledge, technical knowledge has its basis in theory and refers to technical skills developed in the course of specialised studies.
- **Strategic knowledge** is what you want to find when looking for someone with a strategic vision of a particular topic; especially an understanding of the overall politics of a given business domain (like policy frameworks that govern funding) in order to shape the direction of investment and communicate priorities that impact policy decisions.
- **Analytical knowledge** is what you will ideally find in personnel who know how to identify connections between different topics. It encompasses the capacity and ability to link crosscutting topics, like planning local

34 'Sensemaking or sense-making is the process by which people give meaning to their collective experiences. It has been defined as "the ongoing retrospective development of plausible images that rationalize what people are doing" (Weick, Sutcliffe, & Obstfeld, 2005, p. 409).' In https://en.wikipedia.org/wiki/Sensemaking [retrieved May 2020].

35 Davenport T. H., Prusak L., 1998, Working Knowledge: How Organizations Manage What They Know, Harvard Business Press.

interventions that account for different social, political and technical levels. Or, for instance, compiling and systematically comparing experiences from different case studies to study patterns and cross-country measures, or similar abilities.

- **Knowledge about content production** is what you want to find when looking for a journalist, for example, who knows how to disseminate technical content to a non-technical audience, for example guidelines for rural users in the form of educational materials (radio, video, brochures), training materials, etc.
- **Operational knowledge** is often possessed by project managers or similar personnel with management capacities and the necessary skills for planning, coordination and decision-making.
- **Communication and facilitation knowledge** is what you need, for example, when you want to develop a website. This requires communication skills mediated by both digital and analogue media.

2.4 Principle 4: The stages of the knowledge value chain

The dynamics of knowledge creation, standardisation and sharing in organisational contexts follow a number of patterns that are widely studied in the relevant literature[36]. These dynamics, or the knowledge value chain presented here, always start in social contexts where interpretations of problems and potential solutions can be confronted and discussed. Knowledge then becomes tangible through the production of artefacts that record the results of those discussions and are finally picked up by those who, although not having taken part in the early discussions, are interested in the issues being addressed. An effective knowledge value chain is thus composed of the following phases:

Discussion: Knowledge is always created by people and primarily evolves through discussions and encounters. Formats such as team meetings, workshops, conferences, brainstorming sessions are concrete examples that illustrate the key role played by discussion, resulting in knowledge-building exchanges and the growth of knowledge types within and across organisations.

Documentation and synthesis: Nevertheless, to speed up the problem-solving process and streamline learning, organisational knowledge also needs to be preserved and inscribed into artefacts that can be shared and consulted by colleagues and other stakeholders.

Content-wise, a knowledge artefact includes *learning points and heuristics used by experts during the accomplishment of specific tasks, accounting for what went well, what did not, and why. It may also be described as something any novice practitioner should know and cannot acquire through handbooks and theoretical studies alone, because it comes solely through experience and practice.* The format of such a knowledge artefact may vary from a narrative (as in the case of 'best practices') to a more systematic structure (as in the case of rules-based protocols) depending on the target users' needs. There are two types of knowledge artefacts:

- **Documented knowledge**: This type of knowledge artefact includes lessons learned that can be found, for example, in project evaluation reports and best practice descriptions. Documented knowledge is

36 Nonaka I., Konno N., 1998, The Concept of 'Ba': Building a Foundation for Knowledge Creation, California Management Review, 40, 40-54.

- mainly community-based; it inscribes knowledge produced through discussion and it is often expressed through jargon and 'insider' terms
- **Synthesised knowledge**: Methods and guidelines that represent a summary of multiple sources of documented knowledge. Having a wider target audience, synthesised knowledge usually follows more systematic standards than documented knowledge (similar to guidelines versus case studies).

Search and adaptation: The next step in the knowledge value chain, after discussion, knowledge documentation and synthesis, consists of knowledge finding by others who have not taken part in the knowledge creation process but are interested in the content. They seek out the knowledge, question it and adapt it to their needs. This adaptation and adoption of found knowledge represents a crucial moment: knowledge is consolidated, enriched by new case studies and/or revised in some parts.

An effective knowledge value chain is thus one that leverages the stages of discussion, documentation, synthesis, search and adaptation.

2.5 Principle 5: The stages of the data value chain

Data and data structures are the building blocks of information whose content may either illustrate and contextualise documented and synthesised knowledge (like in the case of fact sheets) or be required by experts to conduct analyses and make decisions (like in case of statistics and analytics). The data value chain involves four main stages[37]:

Collection: The collection of data and information refers to the phase in which a data set is created. In this phase, data requirements are defined, for example data formats (e.g., date format) as well as data structures and schemes like database tables or labels to be used for tagging web resources. The definition of a data and information collection campaign is therefore always prepared through an analysis of the intended use of data and information (why the data is collected and for what use by whom) and the interoperability requirements that the data and information must meet (depending on data integration and exchange across multiple digital platforms).

Publication: The publication stage consists of publishing collected data sets and information in a way that conveys useful, understandable and easy-to-access information to target users. Beyond legal issues of licences and copyrights, publicly available data and information must also deliver clear examples of data usage and contexts of use to prospective users.

Uptake: Data uptake refers to the stage at which users understand the potential benefits of the data and information that can be accessed. In order to facilitate data uptake, user experience strategies need to be developed, for example concerning the usability of interfaces for accessing and maintaining data and information.

Impact: The final phase, data impact, refers to the actual use that users make of the accessed data and information. In this phase, strategies and mechanisms to promote data-driven decision-making processes are typically defined, such as the definition of processes and tools to use data and information for project monitoring and the evaluation of results.

37 Curry E., 2016, The Big Data Value Chain: Definitions, Concepts, and Theoretical Approaches, in Cavanillas J., Curry E., Wahlster W., New Horizons for a Data-Driven Economy, Springer.

Avoiding misunderstandings: Taking into account the technologist's view and the differences between informational and knowledge artefacts

To successfully execute knowledge management programmes, it is of utmost importance to consider two different phenomena which are often a source of confusion. On the one hand, if data and information are inscriptions and if knowledge can be inscribed as well, one might wonder about the extent to which these two types of inscriptions differ. In other words, what is the difference between informational artefacts and knowledge artefacts?

On the other hand, as knowledge management is situated somewhere between data and knowledge, it is always subject to a precarious balance: Knowledge bearers (for example the practitioners of a specific field of expertise) often have little knowledge of what constitutes data and information for IT specialists. And similarly, IT specialists are most often unaware of the knowledge content of the data they work with and the information they are called upon to organise. This leads to a communicative asymmetry – also widely studied in the literature[38] – between domain knowledge experts and IT experts: What is clear and evident for the former (an understanding of interesting content within a particular knowledge domain) is indiscernible for the latter. And what is clear and evident for the latter (an understanding of data and information from a digital and machine-based perspective) is unfamiliar to the former.

In order to shed light on these two phenomena and pave the way towards a full understanding of the principles on which knowledge management is based, we first provide a brief analysis of how technology experts view data and information, and then explain the differences between information artefacts and knowledge artefacts.

The technologist's view of data and information

When a technologist looks at data, she or he takes two possible standpoints: either an interest in the data itself and its technical quality, for example, verification of the correct entry of all values in a table (whatever 'correct' means in a given context), or a concern with the structure in which data is to be organised, for example, the specific data schema, layout or encoding to be used in a certain situation. In the first case, the technologist will usually speak of data (that may be missing, biased, corrupted, raw, etc.), and in the latter case of data structures or formats (such as database tables, PDF files, or encoding standards for electronic texts or images). Depending on the degree of organisation, data can be structured (like SQL tables), semi-structured (like a spreadsheet) or unstructured (like text files).

Depending on the type of data, the supporting IT tools will work very differently. Structured data is normally handled via dedicated systems, so-called database management systems (DBMS). For semi-structured and unstructured data, specific management tools are normally used, namely digital archives, digital libraries and document management systems (see Table 3).

38 Davenport T. H., Prusak L., 1998, Working Knowledge: How Organizations Manage What They Know, Harvard Business Press.

Type of data	Definition	Example	Digital tools
Information in the form of structured data	Organised collection of data (traditionally tables in databases), whose format is normally explicitly formalised for computer-based queries and retrieval	GIS data	Database management systems (DBMS), structured query languages
		Data from automated collections (e.g., weather stations)	
		Databases	
Information in the form of semi-structured data	Data that does not fit into a structured database system, but is nonetheless partially structured (for example through tags) to create a form of order and hierarchy	Emails, social media posts, complex spreadsheets	File or document management systems (DMS), full content search and big data handling
Information in the form of unstructured data	All data not following a formal structure	Plain text files (like .txt documents), videos, audio files, images	Files and file management systems (FMS), full content search

Table 3 Basic classification of data structures from a technologist's point of view (source: OneOffTech).

Informational artefacts vs knowledge artefacts

An informational artefact provides context to give meaning to data sets (either structured, semi-structured or unstructured inscribed artefacts). A user can draw on informational artefacts in making decisions, for example, deciding to attend a conference once the dates are known and feasible, or choosing an energy provision optimisation strategy when armed with data on energy consumption. But taken alone, informational artefacts never explain precisely how to interpret information to make a subsequent decision. Knowledge artefacts[39], in contrast, also provide explanations and tell how to interpret information for decision-making purposes (see Figure 8). They might, for example, acquaint users with good practices for the sustainable reduction of emissions in a specific country, so they may learn the underlying logic and adapt those solutions to different countries.

In any case, the actionable content conveyed by data types and channeled through the supporting IT tools depends heavily on the users reading and interpreting it. In other words, the degree of information and knowledge conveyed by data sets (what is called 'data content') is always determined by users and never by the data itself. The following example explains how this happens.

Three perspectives on viral outbreak data:

Perspective 1 – the clinical practitioner: In the eyes of a clinical practitioner, clinical records in the form of semi-structured files such as PDFs may contain both information on the medical history of patients and explanations of good practices and diagnosis pathways for infectious diseases. Similarly, for the practitioner, a spreadsheet containing protocols for the treatment of infected patients may convey information on the personal data of patients or analytical knowledge in the form of formulas for calculating drug doses under the given clinical conditions of patients.

Perspective 2 – the epidemiologist: If an epidemiologist is conducting a study on a virus outbreak, data are mandatory: for example, figures on hospitalised patients, the percentage of the infected population and mortality rates. This information provides the epidemiologist with input which can be further processed by applying technical knowledge. The resulting analysis will most probably include a background section where the data are explained and will also give details on the adopted analytical methods and results. Methods as well as results characterise the report as a knowledge artefact.

If a different epidemiologist who consults the same data set comes to a different conclusion (assuming the data is not biased), the discrepancy between the two studies will concern the different methods adopted by the two researchers, not the data. In this sense, the comparative analysis between the two studies takes place at the level of technical knowledge, not at the level of information about mortality and infection rates provided by the input data.

Perspective 3 – the health ministry: If a national health ministry is interested in compiling and publishing daily statistics on the number of new virus infections, the methods for data collection must be taken into account. It is not enough for hospitals to publish patient data; instead, all data sources must follow the same data collection

39 For an analysis of knowledge artefacts and their role in communities of practices, see Cabitza F., Colombo G., Simone C., 2013, Leveraging underspecification in knowledge artifacts to foster collaborative activities in professional communities, International Journal of Human-Computer Studies, Elsevier.

strategies. In this sense, each hospital is called upon not only to share patient data, but also to explain how the data was collected and how local data collection methods could possibly bias the statistics. In this case, the element of knowledge pertains more to the method of data collection than to the epidemiological analysis.

Knowledge artefacts are characterised by their documented effectiveness in helping users to solve problems and make decisions. Knowledge artefacts frequently also contain information and always foster learning processes. Knowledge in the form of examples, best practices or project reports can be consulted by managers to avoid reinventing a (broken) wheel. In any event, contributions of new knowledge from current project implementers are always required for designing new wheels or replicating existing good practices.

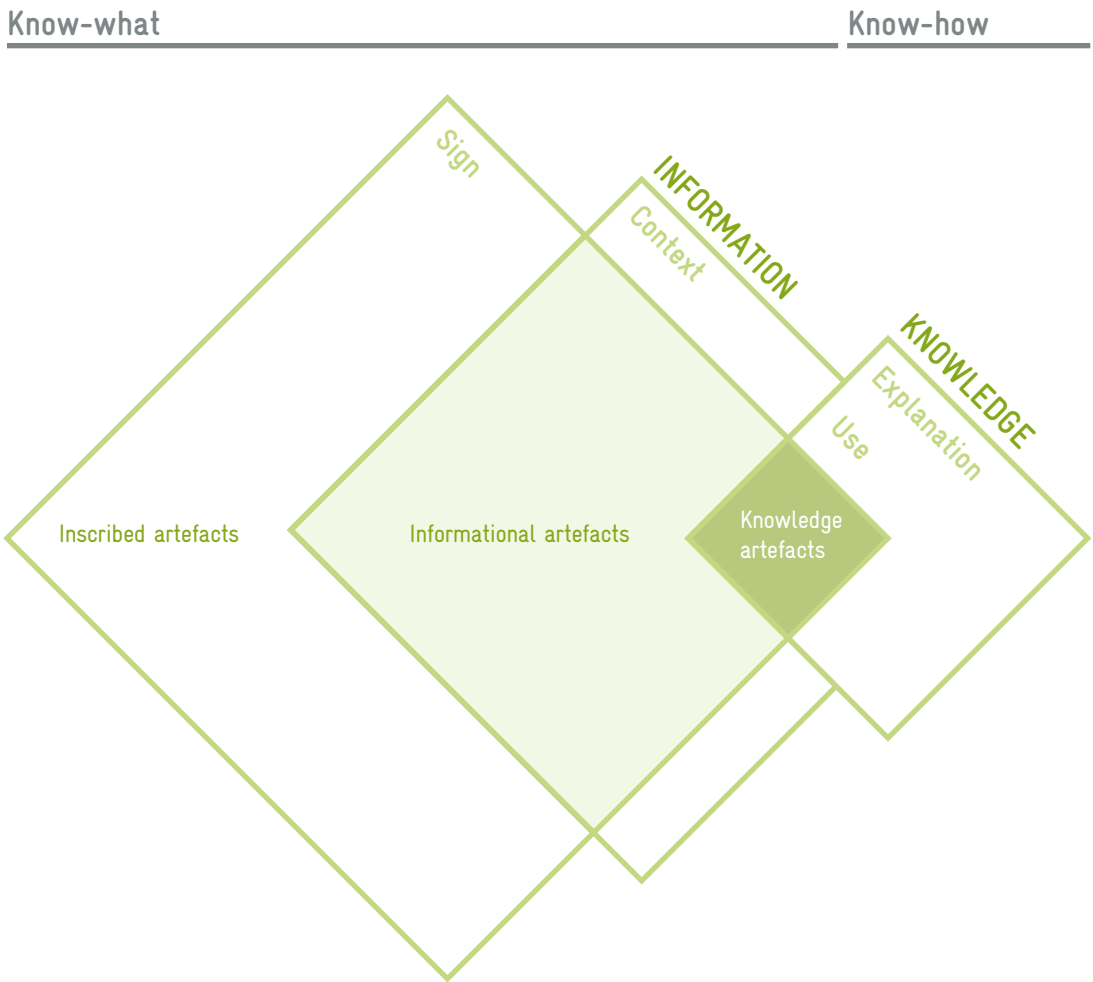

Figure 8 The difference between knowledge artefact (green diamond) and informational artefact (light green diamond) runs parallel to the difference between information and knowledge and lies in the respective content expressed to the user (source: OneOffTech).

2.6 Principle 6:
The four organisational legs[40]

Both the data value chain and the knowledge value chain take place in social contexts and involve four major organisational dimensions: people, processes, technologies and governance. It is through these dimensions that the data and knowledge value chains begin to flow and deliver.

People: Knowledge management is so system-specific that any effort to support it must be shaped by the experiences, priorities and aspirations of practitioners. As such, they should be empowered and involved in the development of the knowledge management framework from the early stages. Clear responsibilities and shared ownership of the knowledge management framework are pre-conditions for successful knowledge management in practice.

Processes: Understanding established processes is essential for identifying knowledge management priorities, for example through the identification of available knowledge and data sources, the assessment of knowledge gaps as well as knowledge needs and data requirements. Understanding and addressing the organisational processes that determine data and knowledge flows across given communities is also important to explaining why the proposed knowledge management interventions make sense and what could be achieved in a changing organisational context.

Technology: Technology has strong implications for social systems[41]. Tools shape users' way of working to the extent that any technology replacement or upgrade may have a tremendous impact on processes and performance. Hence, the introduction of new tools to support the daily practice of a community always requires an in-depth understanding of the practices the technology is expected to aid, proactive user involvement in the analysis and design of the solution to be adopted, adequate time to pilot the solution, the collection of user feedback and a clear plan for the execution of change management strategies[42].

Governance: A knowledge management framework must be in line with the overall strategy of the stakeholder organisation or community and requires coordination mechanisms (i.e., top-down mechanisms for single organisations, steering mechanisms for cooperation systems, or self-regulating mechanisms for co-learning systems and networks) that support actors in the definition of objectives, the adoption and adaptation of policies, as well as the monitoring of processes and results.

40 The metaphor of organisational 'legs' is taken from the previously mentioned handbook on knowledge management that represents a reference point for the work presented here, i.e., Milton N., Lambe P., 2016, The Knowledge Manager's Handbook, KoganPage.

41 Savaget P., Geissdoerfer M., Kharrazi A., Evans S., 2019, The theoretical foundations of sociotechnical systems change for sustainability: A systematic literature review, Journal of Cleaner Production, Elsevier.

42 It should be noted that most people do not welcome radical change in their daily lives or their workplace. Moreover, an initial negative experience with a new technology is likely to leave a long-lasting impression and negative view (both objective and subjective) of this technology.

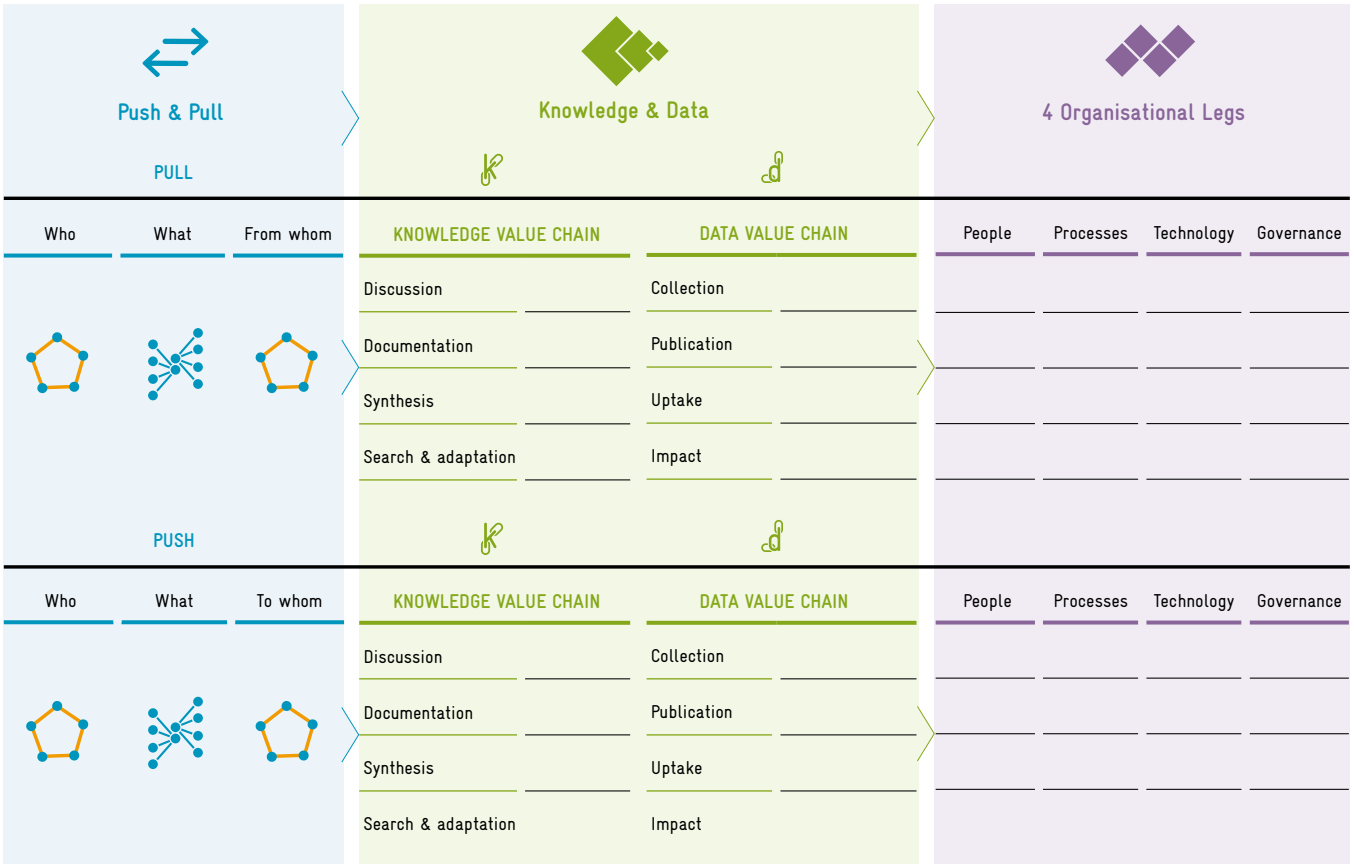

Table 4 The knowledge management matrix integrates the six principles of the knowledge management framework. It provides a model for needs assessment, situation and requirement analysis for co-learning systems, as well as for the preparation of use cases to pilot knowledge management interventions in co-learning systems (source: OneOffTech). A larger print version can be found in Annex II.

2.7 The knowledge management matrix

For practitioners, the six principles of the knowledge management framework can be fleshed out in the knowledge management matrix (Table 4 above). The blue portion of the matrix represents the actors who take part in 'push and pull' dynamics; it provides an impulse to ask who is either offering (push) or demanding (pull) what knowledge, and who is providing or receiving it. The green portion of the table includes the two value chains (knowledge and data), while the purple part refers to the 'four legs' or the organisational dimensions in which the push and pull of knowledge and data/information takes place.

The matrix can be used to report the results of a needs assessment or gap analysis and facilitate participatory revision amongst stakeholders.

3 IMPLEMENTATION JOURNEY

Regardless of whether the focus is on organisations, cooperation systems or co-learning systems, there is no widely accepted standard for the effective implementation of knowledge management. Nevertheless, some general steps can be outlined (and individually adapted) for every intervention. This paper identifies five main steps, along with several related sub-steps, for the successful integration of knowledge management practices into the routine work of organisations, cooperation systems and co-learning systems. Those main steps are (1) knowledge needs assessment, (2) situation and requirement analysis, (3) piloting, (4) roll-out and (5) institutionalisation. In the following, all five steps and sub-steps are briefly described and underpinned with guiding questions. These steps are universally applicable to any type of social system and sector. At the end of this chapter, Table 5 provides a comprehensive overview of the implementation process.

A separate publication (forthcoming) will offer a comprehensive toolbox and detailed descriptions of the different instruments for each step.

STEP 1

3.1 Knowledge needs assessment

This first step is crucial to link the current reality in which a specific co-learning system exists with the ideas and changes it wants to see in the future. Perceived knowledge needs serve to bridge the gap between the current situation of knowledge creation and transmission and an envisioned future. The aim of the knowledge needs assessment is thus to define the overall knowledge management strategy and gear the interventions towards the real and practical needs of the co-learning system. This assessment consists of the following five sub-steps, which can each be phrased as a guiding question.

Identify common goals

Which goals will knowledge management help to achieve in the co-learning system?

The first activity of the knowledge needs assessment in a co-learning system is to identify which goals should be achieved through improved knowledge management and which constraints have to be overcome to achieve them. Knowledge management should never be planned solely for its own sake. Instead, it is an approach for tackling challenges in co-learning systems related to specific knowledge domains. Depending on the characteristics of the participating cooperation systems, different tools can be used in this step (one-on-one interviews, focus groups, workshops, etc.) to reflect on knowledge needs and agree on goals. Within co-learning systems, it is important to balance the knowledge needs and goals of the individual organisations and cooperation systems and identify common denominators, for example by enhancing cross-project learning and the exchange of lessons learned. This step creates a solid basis for the further planning of knowledge management interventions designed to strengthen the co-learning system.

Define the thematic focus

What is the thematic focus of the improved knowledge management approach?

The next sub-step is to define the thematic areas within the knowledge sector or domains for which the knowledge management interventions will be applied. It is important to be as specific as possible in describing the focus, which for example might be 'the integration of Nationally Determined Contribution (NDC) targets for the Agriculture, Forestry and Other Land Use (AFOLU) sector in agricultural development plans'.

Determine expected results

Which interim results are required to achieve the identified goals?

To break down the previously identified goals into a doable plan, concrete (expected) results must be determined. The focus should be on anticipated changes in the processes or behaviour of the co-learning system. For example, cooperation systems within a co-learning system might be expected to agree on methods for documenting lessons learned such as the use of a joint digital platform for collecting information.

Describe preliminary knowledge needs

Which innovation(s) and/or adaptation(s) must be introduced to close perceived gaps?

Once the goals, thematic focus and expected results have been identified, a first assessment of the underlying knowledge needs can be conducted. 'Knowledge needs' are perceived gaps identified by the different cooperation systems that form the co-learning system. As mentioned above, these needs connect the current situation to a future state in which the expected results have been achieved[43]. For example, if an expected result is the use of a joint digital platform to collect information, but each cooperation system currently uses its own digital tools, one knowledge need might be to introduce digital solutions that can be easily integrated with the tools of the individual cooperation systems. The co-learning system would then need to procure specific IT knowledge.

In this early phase, the list of knowledge needs can only be hypothetical and preliminary. It mainly serves the purpose of steering the co-learning system towards a reflection on possible innovations and adaptations that should take place in order to achieve the expected results and contribute to the identified goals. In the next step, this preliminary list of knowledge needs will be further detailed through a situation analysis and specified in terms of knowledge management requirements. Before moving on to →step 2, however, one last sub-step must be considered as part of the knowledge assessment.

Develop user stories

How can personal expectations help identify necessary innovations and adaptations?

To ensure that the different cooperation systems within the co-learning system have a mutual understanding of their shared knowledge needs, it is helpful to develop user stories[44]. With the help of small and simple examples, such stories showcase the knowledge needs as well as the expected results that a knowledge management intervention should focus on. User stories are potent tools that help to steer and direct all further steps of knowledge management implementation. They should be written in the first person, for example from the viewpoint of a commoner[45] of co-learning system A: 'As a commoner, I want to chat with other commoners without needing to run multiple applications or installing software other than what I use as member of my cooperation system'. After formulating such needs, user stories are further developed and transformed into use cases in the next step.

43 For a description of the needs assessment methodology here followed, please refer to Cockburn A., 2000, Writing Effective Use Cases, Longman Publishing.

44 For an in-depth explanation we refer to Cockburn A., 2000, Writing Effective Use Cases, Longman Publishing.

45 Refer to chapter 1.3 for an introduction of the notion of 'commoners'.

STEP 2

3.2 Situation and requirement analysis

During the second step, the knowledge management matrix introduced in chapter 2.7 comes into play. While the focus of the first step was on envisioning an improved knowledge management approach for the co-learning system, in →step 2 the focus shifts towards an analysis of how the current status quo could realistically evolve into the envisioned knowledge management system. To this end, it is crucial to assess existing knowledge practices within the co-learning system to identify gaps that must be bridged before achieving the defined goals and expected results.

To conduct a situation analysis, the knowledge management matrix is used to frame goals and expected results within the existing knowledge creation and transmission processes of a specific co-learning system – and detect possible gaps. In this way, the knowledge needs of the users, drafted in →step 1 and illustrated by user stories, can be transformed into requirements that a knowledge management intervention (i.e., solution) must satisfy.

Identify push and pull dynamics

Who is requesting/providing what knowledge from/to whom?

In this sub-step, the push and pull dynamics (see chapter 2.1) across the cooperation systems participating in the co-learning system are identified. This makes it possible to identify the gaps by analysing whether the various demands for knowledge, information and/or data are satisfied by the supply – and whether that supply meets a real demand.

Identify knowledge, information and data types

What specific kinds of knowledge, information and data are created and transmitted?

This analysis focuses on the different types of knowledge, information and data created and transmitted within the co-learning system. The aim is to further specify and characterise the possible gaps within the push and pull dynamics identified in the previous sub-step.

Map knowledge and data value chains

Which challenges emerge along the knowledge and data value chains?

This sub-step consists of mapping the gaps identified during the two previous steps onto the knowledge and data value chains. It also permits an assessment of their impact on the creation and transmission of knowledge, information and data within the co-learning system.

Analyse the '4 organisational legs' (drivers and challenges)

What role do people, processes, technologies and governance play in the knowledge and data value chains?

Building on the previous step of mapping the knowledge and data value chains, this step takes into account the '4 organisational legs' (see chapter 2.6). For each stage of the knowledge and data value chains, the potential organisational drivers and challenges in terms of people, processes, technologies and governance are assessed. This analysis paves the way for the definition of change strategies to leverage organisational strengths and to mitigate potential stumbling blocks to achieving the common goals and expected results.

Define change strategies, success factors and metrics for change

Which knowledge management solutions must be implemented to achieve the expected results?

In this sub-step, the change strategies for enhancing the balance of the '4 organisational legs' are defined and success factors as well as metrics to assess progress towards the expected results and goals are established. If, for instance, a change at the level of data collection is foreseen for the co-learning system, one appropriate change strategy could be to involve users of the various cooperation systems in the selection and/or design of new digital tools. The success factor for change could be the engagement process and the user statistics for the new tool(s) the possible metrics.

Develop use cases

How can user stories be enriched with the results of the situation and requirement analysis?

In this sub-step, the user-stories developed in →step 1 are transformed into use cases, which are much more technically detailed and less narrative[46]. Put differently, the user story is enriched with the results of the situation and requirement analysis.

Define the roadmap and budget

Which resources do we need to pilot the knowledge management system (financial, staff, time, etc.)?

In this last sub-step of the situation and requirement analysis, the roadmap and budget for implementing the use cases and planning the knowledge management interventions are defined. Proper planning is crucial not only for the piloting phase (→step 3), but also for the roll-out (→step 4). The long-term sustainability of knowledge management plans must also be addressed at this point and a business model elaborated and agreed on among participating cooperation systems.

STEP 3

3.3 Piloting

The aim of this step is to apply the knowledge management measures defined in →step 2 in a succession of small-scale trials that do not necessarily involve the co-learning system as a whole. Instead, the individual pilots should be sufficiently representative of the expected results defined for the co-learning system in →step 1. Depending on the size and complexity of the knowledge management measure, a pilot can make a great deal of sense. Or it can be skipped altogether and the project immediately advanced to the roll-out phase (→step 4). If a pilot is implemented, well-timed and effective monitoring of pilot results must be ensured. In iterative (sprint) retrospectives, necessary changes to the original pilot roadmap should be promptly discussed and applied. Making use of agile principles is recommended in this context[47].

46 While a user story might be something along the lines of 'As a commoner, I want to chat with other commoners without needing to run multiple applications or installing software other than what I use as member of my cooperation system', a use case is much more formal. For example, the use case will detail the different software used in the cooperation systems, describe where the new solution should be plugged in, and explain the organisational changes this innovation could imply. The objective of a use case is in fact to harmonise all findings of the situation and requirement analysis into a document which clearly shows how knowledge management should work and which measures should be implemented.

47 Milton N., Lambe P., 2016, The Knowledge Manager's Handbook, KoganPage.

Set up a pilot team

Which members of the cooperation systems will be part of the pilot team?

In this first sub-step, members of the co-learning system must agree on which cooperation systems and members will be involved in the pilot as well as their respective roles and responsibilities.

Establish pilot processes

Which pilot team member is doing what and when?

Communication and decision-making processes to be followed during the pilot are established. Special attention should be paid to the definition of mechanisms for potential adjustments to activities and ongoing retrospectives of the pilot results.

Monitor pilot implementation

How to track pilot implementation and measure results?

Appropriate monitoring methods to measure the progress of the pilot should be applied in order to identify critical issues promptly.

Adapt the pilot (if needed)

How to react if critical issues are identified?

If the pilot is not on track or if barriers to implementation arise, the procedures and mechanisms for adapting the pilot (defined in the last two sub-steps) are now implemented. Here, too, the adoption of agile principles is particularly recommended.

Assure broadly usable documentation of the pilot activities

Which processes need to be documented and in which format to ensure broad usage?

Established methods to document the pilot results should be used so that the lessons learned can be shared and potential failures can serve as a learning opportunity for others.

Evaluate the pilot results

To what extent are the actual results in line with the expected results?

The pilot results should be carefully compared to the expected results identified as part of →step 1. If there is a mismatch, a retrospective should be conducted, and results of the analysis reported and documented.

Plan the roll-out strategy and change management interventions

What are the organisational impacts and necessary steps to scale up the pilot?

Once the pilot has concluded, it is time to decide on the next steps and whether to proceed with the roll-out (→step 4). One crucial aspect to be considered is the assessment of the organisational implications of the roll-out. Once the roll-out decision has been made, a plan for its concrete implementation must be carefully drawn up.

STEP 4

3.4 Roll-out

In this step, the pilot results are extended to the greater co-learning system. The roll-out and institutionalisation phases (→step 5) might overlap, depending on the overall time frame of the knowledge management initiative and how impactful the changes are for the individual cooperation systems within the co-learning system. The greater the impact of knowledge management interventions at the co-learning system level on the routine work of participating cooperation systems, the more that institutionalisation will start to gain importance.

Adapt the '4 organisational legs'

What needs to be adapted to integrate the pilot practices into everyday work activities?

Policies and existing governance models at the cooperation systems level, as well as the roles of people, processes and technologies, must be adapted to the new knowledge management mechanisms established at the co-learning system level. Discussion among commoners and agreement on the organisational changes to be adopted by the participating cooperation systems must be seen as success factors for knowledge management in co-learning systems.

Train and coach people to adopt the new '4 organisational legs'

How to manage the transition to new processes and technologies?

Capacity development for the adoption of new processes and technologies as well as the definition of new knowledge management policies is provided to the participating cooperation systems. To ensure the future institutionalisation of the co-learning system, a programme for training the trainers should be also foreseen.

Define temporary backstop services to support institutionalisation

What additional support is needed to make the new organisational set-up sustainable?

Organisational support, either remote or face-to-face, has to be provided to the participating cooperation systems. Depending on their specific needs, the backstop might be related either to the use of new technologies, the steering and adoption of new processes, or the introduction of the knowledge framework to new commoners. For the provision of backstop services, the adoption of agile methodologies[48] is recommended. The roll-out can be considered complete when the organisational changes induced by knowledge management are experienced by the participating cooperation systems as an effective part of their own 'daily business' and no longer require specific support.

STEP 5

3.5 Institutionalisation

This step consists of maintaining the results achieved at the end of the roll-out. Institutionalisation means that knowledge management becomes part of the co-learning system and the participating cooperation systems' organisational DNA. In contrast to the roll-out phase in →step 4, during the institutionalisation phase it may no longer be necessary to have knowledge management teams in place for training or providing backstop services to cooperation systems.

Ensure that the new knowledge management system is part of the organisational culture

How to make the new knowledge management system an enduring reality?

The knowledge management performance of the co-learning system must be monitored and any critical issues promptly recognised and communicated between the cooperation systems and the overarching co-learning system. The new knowledge management practices are further promoted and support is provided at the request of any cooperation system.

48 'Agile' is an umbrella term for a set of methods and practices based on the values and principles expressed in the Agile Manifesto (https://agilemanifesto.org/ – retrieved May 2020). Agile management means organising projects in feedback and learning loops; it emphasises regular exchange with users and partners, the co-design of technologies, regular learning, verification and reflection. The adoption of agile methodologies supports coordination across different cooperation systems and helps to fine-tune an existing knowledge management framework in a succession of pilots.

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
Knowledge needs assessment	**Situation and requirement analysis**	**Piloting**	**Roll-out**	**Institutionalisation**
Step 1.1 Identify common goals.	**Step 2.1** Identify push and pull dynamics.	**Step 3.1** Set up a pilot team.	**Step 4.1** Adapt the '4 organisational legs'.	**Step 5.1** Ensure that the new knowledge management system is part of the organisational culture.
Step 1.2 Define the thematic focus.	**Step 2.2** Identify knowledge, information and data types.	**Step 3.2** Establish pilot processes.	**Step 4.2** Train and coach people to adopt the new '4 organisational legs'.	
Step 1.3 Determine expected results.	**Step 2.3** Map knowledge and data value chains.	**Step 3.3** Monitor pilot implementation.	**Step 4.3** Define temporary backstop services to support institutionalisation.	
Step 1.4 Describe preliminary knowledge needs.	**Step 2.4** Analyse the '4 organisational legs' (drivers and challenges).	**Step 3.4** Adapt the pilot (if needed).		
Step 1.5 Develop user stories.	**Step 2.5** Define change strategies, success factors and metrics for change.	**Step 3.5** Assure broadly usable documentation of the pilot activities.		
	Step 2.6 Develop use cases.	**Step 3.6** Evaluate the pilot results.		
	Step 2.7 Define the roadmap and budget.	**Step 3.7** Plan the roll-out strategy and change management interventions.		

Table 5 Steps towards knowledge management implementation (source: OneOffTech).
An extended print version, including the guiding questions, can be found in Annex II.

4 FINAL REMARKS

The knowledge management framework presented in this paper can be universally applied to any co-learning system in an international development cooperation setting.

It does not pretend to be a 'silver bullet', but rather co-exists with other knowledge management approaches and can be flexibly adapted as needed. It can be used in two main ways:

1) To enhance knowledge management in an existing co-learning system following the six principles of the knowledge management framework

Whenever organisations and cooperation systems want to address knowledge management gaps in their collaboration, participants should start by developing a common conceptual framework which combines different mental models as well as existing knowledge management systems. The six principles that shape the knowledge management framework, presented in chapter 2, can be used to facilitate this process and provide the basis for a comprehensive checklist.

2) To design and implement concrete knowledge management measures following the five steps for implementation

The full potential of the knowledge management framework emerges when applied to design and implement concrete knowledge management measures in co-learning systems. The five steps for implementation presented in chapter 3 help to design knowledge management interventions by (1) structuring the knowledge needs of specific co-learning systems, (2) identifying the organisational changes required to meet them, (3) establishing pilots to test their feasibility, (4) supporting the roll-out and (5) institutionalisation.

Successful knowledge management in international development cooperation settings always requires a **mindset shift** on the part of responsible project planners and managers. For this to happen, the following general suggestions should be considered for any knowledge management intervention:

- **Remember the basics**: Knowledge management must be an integral part of the overall strategy of social systems like organisations, projects (cooperation systems) and co-learning systems. It is not merely about introducing new technologies or adding another task into a project framework; successful knowledge management rather demands a comprehensive framework in itself.
- **Think of change management**: If knowledge management is planned and introduced into social systems, it inevitably leads to organisational changes. Change management interventions must always be carefully planned and embedded in the strategic plans of a given social system.
- **Do not forget decision-making**: Successful knowledge management requires the endorsement of top management. High-level decision-makers should be involved from the very start and informed throughout concerning the progress of the interventions and any obstacles to their achievement. In the case of co-learning systems, decision-makers from participating cooperation systems should always actively engage in knowledge management exercises.
- **Emphasise roles, responsibilities and competencies**: Co-learning systems require the presence of intermediaries from each cooperation system who can transmit information and knowledge through different social systems. Map out who has to do what and how with respect to the transmission of data, information and knowledge.
- **Data, information and knowledge demand different competencies**: Knowledge domain experts (whether their expertise is in climate change, reproductive health or human rights) and IT professionals have different competencies. Yet both expert groups are central to the smooth functioning of knowledge management. In the case of co-learning systems, each participating cooperation system should consider having both expert profiles on board.
- **Focus on feedback and learning loops**: The implementation of knowledge management

frameworks may become more effective through the use of agile methods. 'Agile' is an umbrella term for a set of methods and practices based on the values and principles expressed in the Agile Manifesto[49].

- **Follow the Principles for Digital Development**: To create sustainable technologies in the context of international development cooperation, open source applications and the Principles for Digital Development[50] should be followed throughout any knowledge management intervention as the baseline methodology for all eventual technical work (for example technology design and development, the development of good practices, evaluation of results, etc.). Do welcome the use of local tools but work to integrate them throughout the co-learning system.
- **Start small and think big**: Successful knowledge management should be based upon a clear definition of goals, a knowledge needs assessment, and the identification of expected benefits and evaluation metrics. Small and well-delineated pilots with a limited number of stakeholders should be designed in a way that allows immediate benefits to be shown and possibly scaled up to wider groups of practitioners in the co-learning system.

As mentioned in the introduction, the elaboration of the presented knowledge management framework strongly benefited from its parallel application in a practical case of a co-learning system comprising some of the member organisations of the IKI NDC Support Cluster. The findings and methodological lessons learned from this case study as well as a comprehensive toolbox for each of the five implementation steps described in chapter 3 will be compiled and made available as a separate paper in 2020[51].

49 https://agilemanifesto.org/ [retrieved May 2020].

50 https://digitalprinciples.org/ [retrieved May 2020].

51 For information please contact: Gianluca Colombo (info@oneofftech) or Andre Fabian (andre.fabian@giz.de).

ANNEX

Annex I – References

Annex II – Print version of Figure 4 and Table 5

Annex I – References

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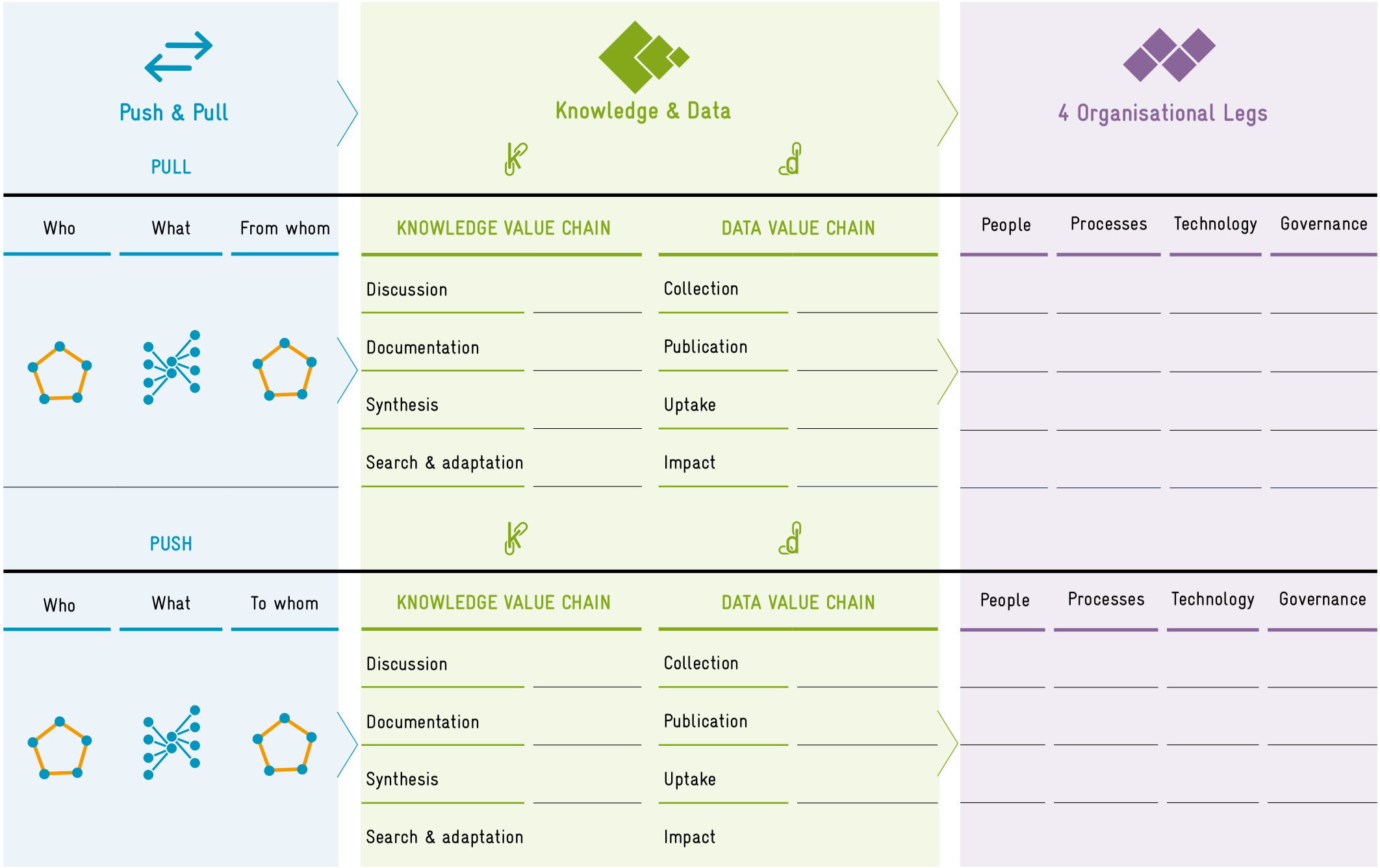
Annex II – Print version

Annex II.1

Figure 4 – Print version
The knowledge management matrix
(source: OneOffTech), p.41

Annex II.2

Table 5 – Print version
Steps towards knowledge management implementation
(source: OneOffTech), p.42



Annex II.1 – Figure 4 The knowledge management matrix (source: OneOffTech) – Print version

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
Knowledge needs assessment	**Situation and requirement analysis**	**Piloting**	**Roll-out**	**Institutionalisation**
Step 1.1 Identify common goals. **Guiding question:** Which goals will knowledge management help to achieve in the co-learning system?	**Step 2.1** Identify push and pull dynamics. **Guiding question:** Who is requesting/providing what knowledge from/to whom?	**Step 3.1** Set up a pilot team. **Guiding question:** Which members of the cooperation systems will be part of the pilot team?	**Step 4.1** Adapt the '4 organisational legs'. **Guiding question:** What needs to be adapted to integrate the pilot practices into everyday work activities?	**Step 5.1** Ensure that the new knowledge management system is part of the organisational culture. **Guiding question:** How to make the new knowledge management system an enduring reality?
Step 1.2 Define the thematic focus. **Guiding question:** What is the thematic focus of the improved knowledge management approach?	**Step 2.2** Identify knowledge, information and data types. **Guiding question:** What specific kinds of knowledge, information and data are created and transmitted?	**Step 3.2** Establish pilot processes. **Guiding question:** Which pilot team member is doing what and when?	**Step 4.2** Train and coach people to adopt the new '4 organisational legs'. **Guiding question:** How to manage the transition to new processes and technologies?	
Step 1.3 Determine expected results. **Guiding question:** Which interim results are required to achieve the identified goal?	**Step 2.3** Map knowledge and data value chains. **Guiding question:** Which challenges emerge along the knowledge and data value chains?	**Step 3.3** Monitor pilot implementation. **Guiding question:** How to track pilot implementation and measure results?	**Step 4.3** Define temporary backstop services to support institutionalisation. **Guiding question:** What additional support is needed to make the new organisational set-up sustainable?	
Step 1.4 Describe preliminary knowledge needs. **Guiding question:** Which innovation(s) and/or adaptation(s) must be introduced to close perceived gaps?	**Step 2.4** Analyse the '4 organisational legs' (drivers and challenges). **Guiding question:** What role do people, processes, technologies and governance play in the knowledge and data value chains?	**Step 3.4** Adapt the pilot (if needed). **Guiding question:** How to react if critical issues are identified?		
Step 1.5 Develop user stories. **Guiding question:** How can personal expectations help identify necessary innovations and adaptations?	**Step 2.5** Define change strategies, success factors and metrics for change. **Guiding question:** Which knowledge management solutions must be implemented to achieve the expected results?	**Step 3.5** Assure broadly usable documentation of the pilot activities. **Guiding question:** Which processes need to be documented and in which format to ensure broad usage?		
	Step 2.6 Develop use cases. **Guiding question:** How can user stories be enriched with the results of the situation and requirement analysis?	**Step 3.6** Evaluate the pilot results. **Guiding question:** To what extent are the actual results in line with the expected results?		
	Step 2.7 Define the roadmap and budget. **Guiding question:** Which resources do we need to pilot the knowledge management system (financial, staff, time, etc.)?	**Step 3.7** Plan the roll-out strategy and change management interventions. **Guiding question:** What are the organisational impacts and necessary steps to scale up the pilot?		

Annex II.2 – Table 5 Steps towards knowledge management implementation (source: OneOffTech) – Print version

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