MOVING

Deliverable 2.4: Open innovation systems state-of-the-art and beyond

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Executive Summary

The aim of this deliverable is to report on how MOVING is facing challenges concerning open leadership innovation. This includes the clarification of the terms open innovation and open leadership innovation, the state-of-the-art on open innovation systems, -platforms and -services (Section 2). Furthermore, we present the open innovation approach of MOVING (Section 3), the innovation potential of MOVING (Section 4), how to reach the target groups (Section 5) and updated risk factors (Section 6) before giving a conclusion (Section 7).

Therefore, the Deliverable D2.4 “Open innovation systems state of the art and beyond” is the completion of the preparatory work and framed with its principal need by the following deliverables:

- The month 10 Deliverable D4.1 “Definition of platform architecture and software development configuration” presents the technical documentation of the architecture of the platform with its working and training environment and the feasibility studies for the use cases.
- The month 12 Deliverable D1.1 “User requirements and Specification of the use cases” contains the requirements which refines the architecture of the platform with its working and training environment.
- The month 12 Deliverable D2.1 “Initial conceptual framework, curricula and technical prototypes for adaptive training support” shows the initial learning paths in the working and training environment on the platform, the general curriculum which defines the learning objectives, the semantic profiling and recommender system to offer suggestions while searching and the Adaptive Training Support to provide learner guidance.
- The month 12 Deliverable D3.1 “Technologies for MOVING data processing and visualisation v1.0” provides an initial common data model as well as an initial set of data acquisition, data processing, user logging and data visualisation component which will be part of the working environment.
- The month 12 Deliverable D5.1 “Dissemination and communication plan and activities - first report” initially introduces the set of major aims and instruments for disseminating the activities of the project.

Furthermore, the Section 5 on the MOVING target groups and the Section 6 on the updated risk factors have a strong connection with the upcoming Deliverable D5.2 “Exploitation strategy and user community building action plan”, due in month 18. Section 5 links the target groups with the appropriate instruments to address them that will be presented in more detail in the community building sections of Deliverable D5.2. In addition, Deliverable D5.2 will discuss future sustainability-related risks in more detail, including the risk factor identification and dynamics within a Delphi survey, and the group SWOTC exercise (SWOT with Challenges as additional factors).

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Abbreviations

Abbreviation	Explanation
AHS	Adaptive Hypermedia Systems
API	Application Programming Interface
ATS	Adaptive Training Support
CBS	Core Business Services
CDM	Common Data Model
cMOOC	Connectivist Massive Open Online Course
CMS	Content Management System
CT	Collaboration Tools
DSS	Decision Support Systems
EMEIA	Europe, Middle East, India & Africa
EPC	European Patent Convention
ESS	Expert Search Systems
FDC	Focused web-domain crawler
GALE	Generic Adaptation Language and Engine
GVF	Graph Visualisation Framework
GSA	Germany-Switzerland-Austria
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
ICT	Information and Communication Technologies
IP	Intellectual Property
JSON	JavaScript Object Notation
MOOC	Massive Open Online Course
OER	Open Educational Resource
OIS	Open Innovation Systems
REST	Representational State Transfer
RDF	Resource Description Framework
RS	Recommender Systems
SEC	Search-engine-based web crawler

Abbreviation	Explanation
SME	Small and Medium Sized Enterprise
SSM	Social Stream manager
SWOTC	Strengths, Weaknesses, Opportunities, Threats and Challenges (analysis)
TEL	Technology Enhanced Learning
TSA	Transaction Advisory Services
TDM	Text and Data Mining
USPTO	United States Patent and Trademark Office
VIA	Video Analysis
VLE	Virtual Learning Environment
WebGL	Web Graphics Library
XML	eXtensible Markup Language

1 Introduction

This section of the deliverable provides the history of the document and its purpose.

1.1 History of the document

Table 1: History of the document

Date	Version
04/07/2017	v0.1: ToC first draft
06/07/2017	v0.11: revised ToC
31/07/2017	v0.2: content ready version
08/08/2017	v0.3: revised version
11/08/2017	v0.4: version ready for quality assessment
22/08/2017	v0.5: version ready for quality assessment round 2
25/08/2017	v0.6: revised version
29/08/2017	v0.7: revised version
31/08/2017	v1.0: final version

1.2 Purpose of the document

This deliverable clarifies the open innovation approach for the MOVING project. It identifies the open innovation scope in the use cases and distinguishes the project approach as well as results from current approaches in open innovation systems. Furthermore, the deliverable defines precise and specific target user needs as well as how to address public administrations. It specifies the innovation potential of the MOVING platform in terms of scientific approach and technological development. Moreover, the deliverable identifies potential for technological innovation and strengthens the impact activities by clearly specifying target groups and identifying strategies for widening access to businesses and organisations while putting focus on competitiveness and sustainability of the project results during and beyond project lifetime. Deliverable D2.4 updates risk and mitigation measures related to the technology platform toward open innovation, target users and acceptance. Furthermore, a comparison between the DigComp 2.0 and the MOVING general curriculum is provided.

2 Definitions and state of the art

In this section, we define the terms *'open innovation'* (Section 2.1), *'open leadership innovation'* (Section 2.2) as well as *'open innovation systems'* (Section 2.3) and how we see MOVING in relation to these concepts. In particular, a state of the art on open innovation systems is presented which is the base for comparing the MOVING platform with existing systems. In the end (Section 2.4) it is described, how the MOVING approach extends the state of the art in open innovation systems.

2.1 Open innovation definition

The term open innovation first appeared in 2003, when Chesbrough (2003) described that the logic of closed innovation eroded through factors like "the growing mobility of highly experienced and skilled people", "the burgeoning amount of college and post-college training that many people obtained", "the growing presence of private venture capital", "the increasingly fast time to market for many products and services" and "increasingly knowledgeable customers and suppliers" (Chesbrough, 2003, p. xxii-xxiii). Thus, open innovation would replace closed innovation through the paradigm of using "external as well as internal ideas" (Chesbrough, 2003, p. xxiv). This transition from a closed to an open innovation process (Chesbrough, 2006) led to a rethinking of "the design of innovation strategies" (Huizingh, 2011, p. 3).

In a broader sense, open innovation can be understood as a premise "to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets, fostering a stronger culture of entrepreneurship" (European Commission, 2016, p. 11). Or as Commissioner Moedas put it: "Open Innovation is about involving far more actors in the innovation process, from researchers, to entrepreneurs, to users, to governments and civil society. We need Open Innovation to capitalise on the results of European research and innovation. This means creating the right ecosystems, increasing investment, and bringing more companies and regions into the knowledge economy." (European Commission, 2016, p. 86).

In a narrower sense, open innovation describes "a distributed innovation process based on purposively managed knowledge flows across organisational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organisation's business model." (Chesbrough & Bogers, 2014, p. 12)[1]. The knowledge flows can be described as inflows (external knowledge going into the organisation; outside-in process) and as outflows (internal knowledge going out of the organisation; inside-out process) as well as a combination of both (Chesbrough & Bogers, 2014). Within outside-in-processes external knowledge is "acquired to strengthen internal competencies and accelerate the innovation process in the company" (Vanhaverbeke, 2013, p. 6) to develop new products, businesses and to raise the competitive strength (Vanhaverbeke, 2013). When looking at inside-out innovation processes "internal knowledge is monetised through external paths to market" e.g. to sell the knowledge to another organisation (Vanhaverbeke, 2013, p. 6). The coupled process combines "the outside-in and the inside-out process by working in alliances with complementary partners" to jointly

[1] This definition by Chesbrough and Bogers (2014) is an extension to the first definition of open innovation by Chesbrough (2003) combined with followed research (Chesbrough 2006; Gassmann & Enkel, 2004; Dahlander & Gann, 2010; West & Bogers, 2013).

develop knowledge (Gassmann & Enkel, 2004, p. 1). Table 2 shows examples of business actions based on the above-described open innovation mechanisms.

Table 2: Open innovation mechanisms and the respective actions (DG Research and Innovation, Knowledge Transfer and Open Innovation Study; European Commission, 2016, p. 12)

Outside in actions	**Inside out actions**	**Coupled processes**
Licensing in	Licensing out	Alliances
Acquisitions	Divestments	Cooperation
Short term fellowship	R&D for other companies	Joint venture
Innovation driven by suppliers/competitors	Spinning-out	Joint R&D
Venturing		Co-creation
Spinning-in		
User driven innovations		

Chesbrough and Bogers (2014) further define innovation as “the development and commercialization of new or improved products, processes or services, while the openness aspect is represented by the knowledge flows across the permeable organizational boundary” (Chesbrough & Bogers, 2014). According to them, open innovation requires a modern organisation which allows crossing its borders, mainly by the use of ICTs (Köhler & Schilde, 2003; Lattemann & Köhler, 2004). In addition, they identify and sort processes cooperation on an inter-institutional as well as inter-individual level or of mixed character. Vanhaverbeke (2013) states that open innovation does more than simply supporting the process of developing new products or businesses. Especially in manufacturing daily commodities within low-tech manufacturing industries or service industries and governments, product innovation is not a goal (Vanhaverbeke, 2013). Vanhaverbeke (2013) proposes to set up “a collaborative strategy wherein the open-innovation activities of other companies (in different industries) help to improve the competitive strength of the former" (Vanhaverbeke, 2013, p. 10) by first identifying the strategic drivers of the business and then leveraging them through collaboration with potential innovation partners (Vanhaverbeke, 2013). Benefits of using this extended concept of open innovation are “innovating and improving services; processes; technologies; management practices; ideas/concepts, strategies, and business models; competence building; etc., regardless of the industry.” (Vanhaverbeke, 2013, p. 8).

2.1.1 Relation of open innovation to MOVING

We can consider MOVING in line with this extended definition proposed by Vanhaverbeke (2013). Industries and public services using the MOVING platform can leverage their strategic drivers in order to improve their competitive strength and to improve their services.

The Internet contains a lot of important information, which only need to be skimmed off to face the challenges of information overload. Public administrators as well as researchers cannot only improve their efficiency, but also their capacity for innovation by knowing how to deal with text and data mining methods. One really good example of this from a business perspective is the dynamic field of compliance in the financial sector. The enormous time expenditure connected with the

evaluation of the constantly emerging or updated regulations can hardly be mastered with conventional strategies. Much relevant information in this field are therefore discovered not at all or too late. This could not only mean legal difficulties for the companies concerned, but is possibly also connected with economic losses. Similar challenges also exist in the academic field: The data-savvy information professionals that are efficient and effective in handling of a large number of online available publications are here more and more the focal point of successful research activities in organisations. Background qualification of those research associates can be almost any academic qualification. However, most of the staff is lacking skills and awareness of necessity for successfully handling such tasks. In particular young researchers and public administrators should be made familiar with methods and new digital tools at the earliest possible point in their careers. With MOVING, researchers can conduct state-of-the-art research, find grants for funding, identify potential project partners or network with actors in- and outside the core organisation (see Section 3.3).

In line with the idea of Vanhaverbeke (2013) the MOVING platform is a part of the open innovation model within the coupled processes (inflow and outflow of knowledge) and on an inter-institutional as well as inter-individual level. Entities using the MOVING platform can use:

(1) Information retrieval and visualisation functions to obtain knowledge from the outside in order to generate knowledge for their business and/or to generate knowledge for the outside again (e.g. with publications).
(2) Community of practice functions with the intention to collaborate on specific topics/projects, to ask for or to offer support, etc.
(3) Partner search functions to identify appropriate partners for collaborating in projects and eventually connect with them.
(4) Training materials on information literacy, funding, etc. with the goal of getting knowledge from the outside in order to enhance competencies within the business or within the public sector (e.g. university).

These aspects are going to be further described in Section 3.

2.1.2 Outlook

When looking at the current state of the existing literature on open innovation, this concept is considered rather a phenomenon than a theory (Boger et al., 2017, p. 9). Open innovation is described and modelled by a variety of theories from economics, cognitive, educational and organisational psychology, innovation research and computer sciences. This is due to the applicability of the concept in different research categories, e.g. open innovation behaviour and cognition, strategy and design or stakeholders (Boger et al., 2017, p. 26) or information systems research. Even though several scholarly domains have shown interest in the topic there is no coherent, overarching interpretation based on the same terminology, nor is there always a fine awareness of the latest ICTs adoptable for such endeavour.

Most of the existing research “predominantly addresses the firm (or business unit) as the unit of analysis” (Boger et al., 2017, p. 11), although “users as innovators [...], innovation communities [...] or open software development [...] that do not necessarily consider the firm as the focal level of analysis” are also discussed within the literature (Boger et al., 2017, p. 9). Also, the European Commission states that “open innovation is constantly evolving and is moving faster from linear, bilateral transactions and collaborations towards dynamic, networked multi-collaborative innovation

systems" (European Commission, 2016, p. 11). Therefore, the term *'open innovation 2.0'* was introduced, which also shows that the respective innovations need to be viewed in the context of their social and economic environment (European Commission, 2014, p. 5). Furthermore, Chesbrough (2017) predicts the future of open innovation to "be more extensive, more collaborative, and more engaged with a wider variety of participants." He prognosticates, "it will extend beyond technology to business models, and it will embrace both product and service innovation." (Chesbrough, 2017, p. 38).

2.2 Leadership in open innovation

The term *'leadership'* is not defined precisely and therefore has different meanings, depending on "individual perspectives and the aspects of the phenomenon of most interest" (Yukl, 2010, p. 20). In the literature, one can find management oriented, psychological and innovation related approaches, predominantly. After reviewing various definitions, Yukl (2010) concluded that the common concept of leadership "involves a process whereby intentional influence is exerted over other people to guide, structure, and facilitate activities and relationships in a group or organization." (Yukl, 2010, p. 21). This ability to influence people is accompanied by the ability to motivate and "enable employees to contribute to the effectiveness and success of the organization". Furthermore, autonomy, critical thinking, empowerment and conscientiousness, as well as a mix of task-oriented and relationship-oriented behaviour make a good leader (Singh et al., 2014, p. 29).

Despite its many definitions, leadership is a concept which is very important for the effectiveness and success of an organisation. On the one hand, leadership is required for opening the innovation process. On the other hand, good leadership will foster open innovation continuously beyond the phase of its introduction. Therefore, we will first show the important role of leadership in the implementation process and then present the leadership characteristics which are especially needed in an open innovation environment. The latter will be complemented by a description of the challenges which come with the concept of open innovation. Finally, the relationship to MOVING is pointed out.

The terms *'open innovation leadership'*, *'open leadership innovation'*, *'open innovation for leadership'* and *'leadership in open innovation'* are used synonymously, whereby the term open innovation leadership is the one referred to in the literature and thus also used in the subsequent sections.

The term *'open innovation leadership'* is rarely used in the literature. The concept of leadership is usually only indirectly described in form of characteristics and skills. The reason for this is that in most cases companies - but also scientific institutions - underestimate the role of leadership in open innovation and therefore neglect it: "(...) most researchers have neglected the crucial role that team leaders play in integrating internal and external resources and connecting creative ideas in open innovation" (Chan et al., 2017, p. 87). According to that fact, there is no clear definition of open innovation leadership. Nevertheless, the following sections will try to outline the concept of leadership in an open innovation context more precisely.

2.2.1 Role of leadership in the implementation of open innovation

With their behaviour and practices, leaders influence this process to a great extent and ideally manage a successful transition from a closed to an open innovation model. More precisely, their impact on the employees' attitudes, motivation, behaviour and performance is a crucial success

factor: “It is essential that leaders do not sit back and wait for employees to become innovative; instead, they must actively extend an open invitation to open innovation” (Rus et al., 2016, p. 25).

However, this intra-organisational, micro-level foundation of open innovation implementation is often neglected and the main reason why many organisations fail to shift from a closed to an open innovation model. Also, most of the existing literature only investigates the macro-level perspective on open innovation but internal processes of the implementation, especially the role of leadership in open innovation, are left out.

In one study, which is addressing the role of leadership in open innovation, Rus et al. (2016) identified four significant aspects of open innovation implementation in which leaders fulfil the essential function of ensuring that organisations become more effective open innovators by “instigating and leading a significant organisational change process” (Rus et al., 2016, p. 4) and by redefining the tasks and boundaries inside the organisation (Salter et al., 2014, p. 2).

Rus et al. also describe strategies how to put these aspects into practice: The first aspect is that leaders need to convince their employees to follow the ideas of open innovation and accept the change that comes with the open innovation process. This can be best achieved by communicating a shared vision of a desirable future and by “mobilizing the support of (…) a wide array of stakeholders at an early stage of open innovation adoption” (Rus et al., 2016, p. 10). But not only the employee’s mindsets have to change also new reward systems can help to implement open innovation: “organizations need to build more flexible reward and promotion systems that enable and support openness. (…) This could include rewards for the identification of new external partners, the transfer of an external idea across the boundary of the firm, or the utilisation of an external resource on internal projects.” (Salter et al., 2014, p. 11). Secondly, it is important that leaders show serious and visible support and act as a role model, especially as “the impact of role modelling may be particularly strong during periods of organisational changes as these are typically characterised by uncertainty and ambiguity” (Rus et al., 2016, p. 12). Implementing open innovation is a long-term process that requires patience and determination. Therefore, employees need to see open innovation as a continual process. Third, a key element of effective open innovation implementation is to reshape the definition of success within the organisation by promoting collaboration instead of competition. Finally, leaders should invest in building employee capability, developing individuals and enabling internal connections (Rus et al., 2016, p. 25).

As the above text suggests, leadership is typically conceived from an individual top-down approach. However as we will see later (see page 17 of the current document), innovation (and even leadership) can emerge from bottom-up perspectives, if appropriate support is given. We summarise that role of leadership in the open innovation implementation process, especially the influence of leaders on their employees, is therefore crucial for a successful change to an open innovation model.

2.2.2 Characteristics and challenges in open innovation leadership due to organisational development and ICTs

Shifting from a closed to an open innovation process requires certain leadership characteristics and personal skills. This human factor of open innovation is important because “it is people who push the innovation process” (Singh et al., 2014, p. 21). Leaders need to motivate and support their employees during the difficult and time-consuming process of opening the innovation process. In addition to that, the leadership has to manage relationships with partners inside and outside the firm

and at the same time create an environment where people from different organisations trust each other and share information (Giannopoulou, 2011, p. 518).

According to the study of Singh et al. (2014), when collaborating with other organisations, important leadership characteristics are mentoring and coaching, autonomy, empowerment, effective communication, joint problem-solving and decision-making (Singh et al., 2014, p. 70). The most important characteristic identified in the study is autonomy of the workers. Employees need to develop new and original ideas in open innovation projects. Thus, a creative work environment and an active exchange of ideas is required and there is no need for heavy leadership involvement in every stage of the project. Instead, a good leader should always be available to support and empower the team. Joint problem-solving and effective and constant communication both play important roles in collaborative projects, because "employees who belong to different organisations and (...) collaborating partners often have different perceptions of what to aim for and how to get there." (Yström, 2013, cited in Yukl, 2010). Also, leaders provide feedback and communicate ideas not only to their own team but also to partners. Therefore, an open innovation leader "needs to know the managerial tactics to influence the partners in a positive way by clear communication." (Singh et al., 2014, p. 78).

Becoming a successful leader of open innovation requires also certain personal skills such as optimism, passion, drive, curiosity and the belief that change can be good. Moreover, a leader needs to have the ability to identify main values of the open innovation process, the ability to communicate effectively with a wide variety of stakeholders and managing different networks and relationships at the same time (Lindegaard, 2010, p. 101-102).

A good open innovation leader is expected not only to have certain characteristics but also to deal with various struggles and difficulties that come with the concept of open innovation, namely inadequate resources or internal resistance from people who do not accept foreign ideas and prefer solutions coming from the inside (Lindegaard, 2010, p. 101). This last problem, also known as the "not-invented here syndrome", is often expressed indirectly by employees and therefore the leader has to play his part to ensure an unbiased evaluation of potential external innovation sources (Bogers et al., 2017, p. 13). The leader has to balance relevant risks involved in such open innovation investment. Solutions found in other industries often look like a "convenient shortcut" when they are "more fully developed, further along the R&D timeline, and often easier to modify for your application". Nevertheless, they have to undergo comprehensive evaluation and testing before being used in a company (Zynga, 2013). Also, the leader needs to have knowledge of basic change management in order to integrate the concept of open innovation into the organisation. This process often needs adjustment and a change of work routines and will cause disruption eventually. As already mentioned above the leader's responsibility "to find and fight the resistance to change" is important during the implementation process of open innovation but it is also relevant after the implementation: Open innovation leaders "[…] need to persuade the technical staff that, although the procedure is often hard and time consuming, it is worthwhile. The message should be clear: 'sourcing external innovation does not compete nor substitutes internal activities'." (Giannopoulou, 2011, p. 516). Moreover, employees can even see the transition to an open innovation model as a threat to their job, because they feel their work may become superfluous and could be replaced by external sources of innovation (Bogers et al., 2017, p. 14). This fear can be one of the varied reasons for the "not invented here syndrome" and thus can interfere with the open innovation model. Hence, leaders must not only manage expectations and shift mindsets of their employees but also show appreciation for their work, because "there's nothing like the recognition from above to affect

behaviour. So, recognition should be given equally to people who unearth solutions that succeed in market, whether they attracted them from outside or developed them in-house." (Zynga, 2013).

Lattemann and Köhler discussed *trust versus control* as a governance concept for virtual organisations and explain that "traditional concepts of organization adopted by governance research are increasingly questioned by the practice of virtual organizations" (2004, p. 720), which are of a much more open nature. Leadership thus cannot be based upon classical face-to-face management instruments like direct control of result and behaviour which are suitable in divisionally and functionally structured enterprises. Leading open innovation processes indeed needs to be "(…) supplemented or even replaced by concepts of social control; typically trust and confidence become the central mechanisms for the new forms of inter- and intra-organizational coordination" (Lattemann & Köhler, 2004, p. 720). Such perspective provides a good understanding of both the potential for ICT in leadership as well as the change in organisational behaviour.

We conclude that challenges in open innovation leadership are significant but are certainly not insurmountable. With the right strategies and a high level of awareness, leaders can overcome the internal barriers and can help make the change to an open innovation model as easy as possible.

2.2.3 Relation of open innovation leadership to MOVING

The MOVING project is an online platform that aims at supporting and promoting the open innovation process. Targeted users of MOVING are especially current and future leaders of open innovation processes in public administration, academia and business contexts. MOVING enables and trains these users to drive innovation with newly acquired skills relating to creativity (i.e. through using the visualisation functions, see Section 4.1.4), critical thinking (i.e. through reflective learning with the Adaptive Training Support widget, see Section 4.1.5), idea generation (i.e. through the exchange of ideas within the community of practise) and entrepreneurship (i.e. by working together on the platform which eventually can lead to formation of start-ups). These skills are all aspects of open innovation leadership as already stated above, with a special focus on the usage of social media technologies. Therefore, with its leadership training, the MOVING platform supports finding new ideas for innovative products and companies in an open innovation environment.

MOVING is also a collaboration platform that should provide means to find suitable partners and industries and work in a team of internal and external researchers from different fields. By teaching different ways of communication and by introducing the concept of sharing new ideas, the MOVING platform trains open innovation leaders whose competencies will directly influence the success of open innovation projects.

2.3 State of the art in the broad field of open innovation systems

Following the definition of open innovation in Section 2.1 and leadership in open innovation in Section 2.2, we present the state of the art in the broader field of open innovation systems. We have also identified different fields of research related to open innovation systems based on existing classifications like Munné and Garrido (2017) and Hrastinski et al. (2010). Each of these fields is directly motivated from OIS and presented in one of the following subsections. In Section 2.3.1, we start with discussing typical characteristics of open innovation systems in the sense of platforms and websites where users can submit and discuss ideas for product development and engineering (Hrastinski et al., 2010). As maintenance and provisioning of an expert directory is also a typical feature of open innovation systems (Hrastinski et al., 2010), we discuss expert search systems in

Section 2.3.2. Since submitting ideas and problems, solving problems, and evaluating them requires some collaboration functionality on an open innovation system (Munné & Garrido, 2017), we discuss in Section 2.3.3 the current state of the art in collaboration tools in Section 2.3.3. This also tackles another typical feature of open innovation systems, namely the marketplace (Hrastinski et al., 2010; Munné & Garrido, 2017). Furthermore, we discuss the state of the art in recommender systems in Section 2.3.4 , in order to address the question of recommending users, documents, or related ideas and problem solutions. Discovering topics lateral to a problem may contribute to achieve a greater diversity in solutions, acquire knowledge from different domains, and consider a problem from other perspectives (Damljanovic et al., 2012). This can be useful as innovative solutions often come from users whose competence is not in the topics directly found in the problem description, but rather from those who are experts in a different domain and can transfer the knowledge from one domain to another (Jeppesen et al., 2009). Finally, based on the definition on the holistic and interdisciplinary definition of open innovation in Section 2.1, and its approach for leadership in open innovation outlined in Section 2.2, one requires a form of training for future data-savvy public administrators and researchers, i.e. future leaders. Thus, we have identified the fields of research in adaptive hypermedia systems (Section 2.3.5), which focus on providing personalised training materials, decision support systems (Section 2.3.6) which aim to support users in understanding a piece of information or software and provide them guidance and technology-enhanced learning (Section 2.3.7), which is covering the training of users via the computer such as educating participants on open innovation and leadership management. Last but not least, there are past and ongoing projects that also relate to open innovation systems, but which do not easily fit in the previous fields of research and also advanced visualisation techniques that are described in Section 2.3.8. We conclude this section with a detailed summary of the different fields of research and their comparison with the MOVING approach, in Section 2.3.9.

2.3.1 Open Innovation Systems (OIS)

The term ‘open innovation systems’ is a young and emerging term discussed in different disciplines. Overall, the common goal of open innovation systems is to support and facilitate (open) innovation processes (Chesbrough, 2006). On the organisational level, open innovation systems deploy sophisticated technologies or platforms (often on the Web) to bring ideas and knowledge from the crowd into organisations. This information transfer takes place between people, companies, organisations and institutions and is crucial for the innovation process (Schuurman, 2015). The related literature describes different levels of how innovation systems can be analysed. Wieczorek and Hekkert (2012) (based on Schuurman, 2015) distinguish between “national or regional innovation systems (when a geo space is a unit of analysis), sectorial innovation systems (dealing with a whole sector of economic activity, often going beyond national borders) and technological innovation systems (evolving around a specific technology)”. It is worthy to note that national, regional, and sectorial terms refer to conceptual systems that indicate a set of methods, procedures, and routines for achieving an innovation. The above mentioned set of characteristics for OIS matches with the definition of “Living Labs”. Living Labs refer to user-centred, open innovation ecosystems based on a systematic co-creation approach in real life settings. On the contrary, technological innovation systems are already existing software services, platforms or websites. For the MOVING project, we will focus on the technological innovation systems. Thereby, we see the MOVING platform as a technological hub supporting innovation processes from the perspective of facilitated search and training of information literacy.

To get an overview of available open innovation systems or open innovation websites, Balaneji et al. (2013) and Munné and Garrido (2017) provide an analysis of such systems. Balaneji et al. (2013) analysed 100 websites, 22 web innovation platforms and 14 companies, all of which adopted best practices in open innovation. Munné and Garrido (2017) identified 101 tools and selected 54 which were classified in the following categories: *'inter-organisational communication'*, *'technology and technology solution provider scouting'*, *'provision of information on solution providers'*, *'relation management'*, *'collaborative technology design and development'* (CAE/CAM), *'idea to product management tools'* and *'patent and publication databases'*. In this analysis, it turned out that search functionality is crucial as such open innovation communities are diverse and often large and messy.

Klein & Convertino's (2015, p. 1) defined open innovation systems (also known as idea management, social ideation, idea contest or competition). According to them, these systems "represent a promising emerging approach where a customer (e.g a firm, organisation, public administration) describes a problem they want to solve and provides an (online) tool that allows potentially thousands of individuals to submit proposed solutions." To achieve this, a customer or manager of a company makes the problem publicly available and asks for possible solutions or their evaluation by means of ratings or discussion forums. From time to time, authors of winning ideas receive an award, financial or otherwise (Morgan & Wang, 2010). This example shows that crowds with thousands and more individuals interacting and proposing solutions need a structure and supportive tools to effectively organise the open innovation process. In this regard, MOVING provides solutions, which seem helpful to support not only single uses but even a community of adopters.

Hrastinski et al. (2010) classified 51 different open innovation systems and came up with four system types: idea management systems, problem solving systems, marketplace systems and innovation analysis systems. The first allows users to suggest, evaluate and discuss ideas openly; the second provides opportunities for defining problems and then suggesting, evaluating and discussing solutions; the third asks users to suggest solutions to problems defined by an organisation, using rewards and recognition as an incentive; the fourth offers sophisticated tools for evaluating and analysing the quality and potential of ideas and solutions. In addition, Hrastinski et al. (2010) extracted typical characteristics an open innovation system should provide. These characteristics consist of idea submission (users can submit an idea, often within predefined categories), problem submission (an organisation can submit a problem and other users can suggest solutions), problem solving and analysis, evaluation (users can assess the quality of ideas and solutions), collaboration, expert directory (expertise can be described and located), marketplace (innovators are connected with innovation seekers). One open challenge they identified for research and practice is "how collaboration technologies can be connected with more sophisticated opportunities for reflection and analysis." MOVING addresses this challenge by offering reflective questions provided by the Adaptive Training Support component (Section 3.1.1).

Diener and Piller (2010) presented an analysis of providers, as well as platforms for open innovation. They do not only described established models and tools for open innovation but also suggested possible partners for supporting the open innovation process. In one out of three mentioned models, they did not talk about open innovation systems per se, but call them "toolkits for open innovation". These toolkits aim at efficiently addressing a large number of customers' information need. In order to make a toolkit operate efficiently, it needs to fulfil five requirements: (1) trial and error learning (providing simulated feedback on a solution), (2) solution space (accepts only feasible solutions), (3) user friendliness (easy interaction with the toolkit), (4) modules and

components library (to base new solutions on existing ones) and (5) transferring customer solutions (best solution should be transferred to the manufacturer).

The literature is mainly concerned with technical support and facilitation of the open innovation process itself and transferring these insights into organisational innovation management. However, what is missing in literature is the explicit learning and training aspect, meaning how managers, researchers and employees can be trained to initiate, maintain and support open innovation in their corresponding organisations. This is exactly where MOVING is coming into play and provides a solution to fill this gap. By the end of the project, the MOVING platform will support training and learning for data-savvy professionals and which is also crucial for open innovation leadership.

2.3.2 Expert Search Systems (ESS)

An expert search system supports a user in their "expertise need" by identifying people with relevant expertise on the topic of interest (Hertzum & Pejtersen, 2000). Such a system can be useful in large enterprise settings with vast amounts of digitised information, where people are a critical source of information (Hertzum & Pejtersen, 2000). Typically, an expert search system associates a set of documents to each candidate expert, known as profiles, to represent their expertise in the system. Candidates are then ranked in response to a query using the expertise evidence in their profiles.

Various different methods for expert search have been proposed. Zhu et al. (2010) presented a language modelling approach which integrates multiple document features for expert finding. Macdonald and Ounis (2009) modelled the problem of ranking experts as a voting problem adapting data fusion techniques. They also applied query expansion in an expert search task to improve the accuracy of the generated candidate ranking (Macdonald & Ounis, 2007). They proposed two approaches for query expansion: one based on the initial ranking of documents for the query topic, the other based on the final ranking of candidates. Deng et al. (2008) presented three models for expert finding based on the large-scale DBLP bibliography and Google Scholar for data supplementation. The first was a weighted language model, the second a topic-based model and the third a hybrid model combining the previous two. Macdonald et al. (2008) investigated a new dimension to expert finding, namely whether – given a candidate's profile - some documents are better indicators of expertise than others. Balog et al. (2006) proposed two general strategies to expert searching in document collections, both formalised as generative probabilistic models. One directly models an expert's knowledge based on the documents that they are associated with, while the other retrieves specific documents for the respective topics and then finds an associated expert. Petkova and Croft (2006) introduce a general approach for representing the knowledge of potential experts as a mixture of language models from associated documents. One of the first expert search system was P@NOPTIC expert (Craswell et al., 2001), a web-based system which automatically identified experts in an area relying on the documents already published on an organisation's intranet. Stankovic et al. (2011) developed a method for expert finding that leverages the user traces (e.g., blogs, publications, and presentations) available in Linked Data. Expert Lookup[2] is a commercial online tool provided by Elsevier that helps users to identify scientific experts.

Expert directory is a desired feature for open innovation systems (Hrastinski et al., 2010), but finding users with expertise in a given topic is often not good enough. In web innovation platforms,

[2] https://www.elsevier.com/solutions/expert-lookup

such as Hypios[3], Innocentive[4] and NineSigma[5], companies can post problems and find innovative solutions. Experts submit their solutions and the seeker then selects the best contribution and acquires the rights to use it, often in exchange for a prize to the solver and any other due fees. Identification of the potential solvers and broadcasting problems is then important for web innovation platforms to boost the problem-solving activity (Speidel, 2010). These platforms also seek a greater diversity in solutions in terms of domains of knowledge they are coming from, as well as in terms of different perspectives on the problem (Damljanovic et al. 2012). Existing open innovation research argues (Jeppesen et al. 2009) that truly innovative solutions often come from users whose competence is not in the topics directly found in the problem description, but rather from those who are experts in a different domain and can transfer the knowledge from one domain to another. One way to identify and involve such users is to search for concepts indirectly related to the problem. Such concepts then might be contained in the expert's user profile, or possibly in existing solutions, as publications or patents (Damljanovic et al. 2012). Although finding experts is an important feature for open innovation, in general existing approaches the goal is simply selecting experts for a certain topic, which does not address the needs of open innovation scenarios, where the focus is on identifying experts to solve an innovation problem (Stankovic et al. 2012). Thus, the corresponding requirements for open innovation are more specific. In MOVING, advanced search and visualisation functions such as network graphs, enables users find key literature as well as key experts.

2.3.3 Recommender Systems (RS)

Recommender systems are software tools to suggest interesting items to users (Ricci et al. 2015). Items can be anything, e.g. movies, songs, products to buy, news, scientific papers, or even other users, user groups or communities. According to Adomavicius and Tuzhilin (2015), the roots of RS can be traced back to the works in cognitive science, approximation theory, information retrieval, forecasting theories, management science, and consumer choice modelling in marketing. Nowadays, RS are focused on the recommendation problem of guiding users in a personalised way to interesting items in a large space of possible options (Lops et al. 2011). Typically, RS are classified as either content-based, collaborative filtering, knowledge based, or hybrid (Ricci et al. 2015).

Content-based RS make suggestions that take into account the items that a user liked in the past (Lops et al. 2011). Collaborative-filtering RS generate recommendations of items to a user taking into a user users with similar preferences have liked (Felfering et al., 2013). Knowledge-based RS infer and analyse similarities between user requirements and features of items described in a knowledge base that models users and items according to a specific application domain (Dell´Aglio et al., 2010). Hybrid RS combine one or more of the aforementioned techniques in order to improve recommendations. With the evolution of the Web toward a global space of connected and structured data, known as the Linked Open Data cloud (Bizer et al., 2009), Linked Data based RS, a new kind of knowledge-based RS, has emerged. These RS take into account the knowledge available in the Linked Open Data cloud for accessing relevant knowledge that is otherwise not available (Figueroa et al. 2015, Di Noia and Ostuni, 2015).

[3] https://www.hypios-ci.com
[4] https://www.Innocentive.com
[5] https://www.NineSigma.com

Some RS related to the MOVING project are described in the following. Damljanovic et al. (2012) proposed two Linked Data-based concept recommendation methods for topic discovery in an open innovation scenario. CiteSeer[6] (Bollacker et al., 2000) is a well-known search engine and the first recommender system for scientific papers. Docear[7] (Beel et al. 2014) provides various features for scientists, an academic search engine, PDF reader, reference manager, word processor, mind mapping module, and recommender system. Another popular research paper recommender system is BibTip (Geyer-Schulz et al., 2002). A complete literature review of research paper RS is out of the scope of this document; further works are described by Beel et al. (2015) while a review of cognitive content recommendation relevant to MOVING is provided in Skulimowski (2017). The latter paper contains also a formal recommendation problem statement that makes possible merging cognitive query recommendation with creative decision processes (Skulimowski, 2011). In MOVING, semantic profiling and content recommendations are provided by the recommendation module of the adaptive training as described in Deliverable D2.1.

2.3.4 Collaboration Tools (CT)

The term collaboration comes from the Latin word *collaborare* and means “work with” (Online Etymology Dictionary, 2017). Thus, collaboration involves several employees who combine their efforts to achieve a group goal. In this regard, collaboration engineering is an approach to design and deploy collaboration processes for high value recurring tasks (Briggs et al., 2003). Thereby, not only the design of the processes itself, but also of supportive information systems is a key goal (Kolfschoten and Vreede, 2009). Collaboration systems support users in performing tasks collaboratively (Cugini et al, 1997). Collaboration tools include a wide range of systems. Instant messaging, video conferencing, calendars, wikis, collaborative document management (such as Dropbox[8] or Google Docs[9]), collaborative software development (e.g. Git[10] for version control and the Jira[11] issue tracker), and also social media are some examples. Overall these systems mainly improve communication and work organisation, but they could also ease circulation of new ideas. For examples, users can propose new features in open source software development or specific issues can be discussed in social media (e.g. Twitter).

In addition to the general classification of collaboration systems, also domain specific collaboration tools can be found, see (Lanubile et al., 2010) for an overview of collaboration tools supporting the software engineering process. As open innovation processes are collaborative efforts, we consider collaboration systems of high relevance. In this regard, collaboration systems can increase the reach and the richness of open innovation processes (Sawhney et al., 2005). SciVal[12] is an Elsevier tool which also supports collaboration, although the latter is not its only feature. For example, it allows users to explore the collaboration network of their institution or to obtain statistics about the institutions´ performance. Collaborative filtering RS explore choices made by other users in a common computational environment driven and can also be regarded as a specific

[6] http://citeseerx.ist.psu.edu
[7] http://www.docear.org/
[8] https://www.dropbox.com/
[9] https://www.google.com/intl/en/docs/about/
[10] https://git-scm.com/
[11] https://www.atlassian.com/software/jira
[12] https://scival.com

CT. Another, yet more interesting link to another relevant class of systems is made possible with the exploration of creativity in CT that can convert them into creativity support systems (Skulimowski, 2016). MOVING is also a collaboration platform that provides means to find suitable partners and industries and work in a team of internal and external researchers from different fields and share ideas and challenges, as well as communicating about experiences and own activities.

2.3.5 Adaptive Hypermedia Systems (AHS)

Adaptive hypermedia systems automatically adapt the organisation, presentation and interaction of hypermedia content, i.e. hypertext with embedded media elements to its users by observing the users' interactions with the system and properly reacting to it (Scherp, 2014; De Bra et al., 1999a). To this end, AHS create and maintain three interconnected models, the diagnosis model, educational model and expert model (Scherp, 2014). The diagnosis model comprises assumptions and information about the level of knowledge of the user in a specific domain. The educational model provides a didactic concept of how to convey and present the learning materials to the users. Finally, the expert model contains domain-specific knowledge that the AHS wants to convey to the users. Due to these three models, AHS are closely related to intelligent tutoring systems (Scherp, 2014; Schulmeister, 1997).

One of the most well-known adaptive hypermedia system is AHA! by De Bra et al. (1999b). It has been redesigned and extended to the Generic Adaptation Language and Engine (GALE), which supports the distributed definition of adaptations and resources (De Bra et al., 2013; Smits and De Bra, 2011). AHS also support the use and reuse of social media resources such as the Adaptive Retrieval and Composition of Heterogeneous Information sources for personalised hypertext Generation (ARCHING) system (Steichen et al., 2011) and other open resources on the web like Slicepedia-AHS (Levacher et al., 2012). A comprehensive study of AHS has been conducted by Knutov et al. (2009). In MOVING, the adaptive training support (Section 4.1.5) is closely related to these systems, although some other typical functionalities they provide as semantic search, advanced visualisation and recommendations are also covered.

2.3.6 Decision Support Systems (DSS)

A decision support system (DSS) is an information system that aims to provide decisional advice to enable faster, better and easier decision-making (Morana et al., 2017; Turban et al., 2005). Thus, DSS are related to expert systems and knowledge-based systems including the use of modern analytic, uncertainty handling and knowledge representation methods and tools, such as Knowledge Graphs. An application of DSS is medicine, where the DSS are usually termed clinical DSS. An example in this field is a decision support system for cancer treatment based on Linked Data (Hu et al., 2014). Further areas of wide DSS deployment can be found in business intelligence, finance, security, and learning.

A recent analysis of different kinds of DSS providing decisional guidance, explanations and decision aids has been conducted by Morana et al. (2017). The result of their analysis is embodied in a taxonomy that organises DSS along ten dimensions. Central to open innovation systems and open educational systems in general are the guidance dimensions of *directivity*, *mode*, *invocation* and *timing*, which are mainly motivated by seminal works of Silver (2006, 1991) as well as Gregor and Benbasat (1999), and the guidance dimension of *intention* (Arnold et al., 2004). We briefly summarise the dimensions and discuss them in the context of open innovation systems. Directivity

refers to the form of guidance offered to the decision-maker and how it aims to influence the users' activity (Morana et al., 2017). In terms of the directivity dimension, guidance can be suggestive and make judgemental recommendations, e.g. where to invest money in the future or which field of research to explore. Other forms of directivity are informative guidance, i.e. information to enlighten a judgement but without suggesting how to act to it, and quasi-suggestive guidance which does not explicitly make recommendations but merely provides information from which recommendations can be inferred. In contrast to directivity, the mode of guidance refers to how guidance works (Morana et al., 2017), namely pre-defined at design time of the DSS, dynamic and thus adaptive by learning how the DSS is used or participative where users are involved in determining which guidance they receive. This dimension is highly related with AHS, where an explicit learner model is created by analysing the users' interactions with the system. This learner model is used in AHS to dynamically and adaptively generate new content to the users (see Section 2.3.5). Furthermore, the dimension of invocation refers to how guidance is invoked (Morana et al., 2017) and can be either automatically, based on predefined events, actively invoked by users on request or adaptive based on usage context. In the MOVING approach, we basically perform all three forms of invocation. In contrast to invocation, the dimensions of timing of guidance refers to when guidance is invoked (Morana et al., 2017). Here, one distinguishes concurrent, prospective and retrospective invocation. It refers to triggering the guidance during the actual user activity, before a user actually conducts an activity and after a user performed an activity. In the MOVING approach, we focus on the concurrent and retrospective invocation of training support. Finally, the dimension of intention refers to why guidance is provided (Morana et al., 2017). This guidance will provide learning and training support on the MOVING platform including (but not limited to) suggestions of new features to use ("learning-how-to-search") or content based on the curriculum. The adaptive training support of MOVING aims to support these types of guidance as described in Section 4.1.5.

2.3.7 Technology-Enhanced Learning (TEL)

Technology-enhanced learning is technology which is used to support and enhance learning by using technological tools, later on mainly seen as e-learning (Goodyear & Retalis, 2010, Köhler & Ihbe, 2006). Since the introduction of the Information and Communication Technologies (ICTs) it covers several approaches with meaning to open innovation mainly in the context of (Open) Educational Practice, including classical Virtual Learning Environments (VLE), Open Online Learning Communities - often with a linkage to professional training and social - as well as more Wiki-based Open Information Communities. All in all, Social media allow completely new educational patterns which however did not reach their full potential as educational institutions and their perspective educational professionals lack adopting it easily. Thus, innovative developments are often enough coined by the users outside the educational sector who seek educational experiences rather on the basis of private interests but not as part of their professional scholarly duties (Pscheida et al. 2013, 2015). Lately Openness received new attention throughout the educational digitisation with new formats like Open Educational Resources (OER) and Massive Open Online Courses (MOOCs) and their diverse specifications, where the co-constructive moment of innovative insight can be re-inserted into any educational practice by opening up to resources and stakeholders from outside the respective institution (Köhler & Kahnwald, 2013). Another scholarly approach deals with the often-used Online Conference Management and Online Journal Systems which allow a collaboration just around the so-called Peer Review (Raff & Köhler, 2008). Respective technologies are however rather seen as collaborative expert decisions systems and not as educational technologies - even though

recently the discussion about Open Peer Review as received an increased attention. In order to systematise the Educational Technologies some authors suggest sorting mentioned technologies due to its position in the educational lifecycle, i.e. along the changing needs of the educational production process (Kahnwald et al., 2016).

In MOVING a particular interest is user guidance in the sense of computer-supported reflective learning. Below, we discuss TEL with focus on reflective learning as a learning mechanism that serves to learn from experience. A very general process of work-related reflective learning is an iteration between making work-related experiences (their real working experiences or relevant experiences made in training), reflecting on these experiences with the goal to draw out implications for future work experiences, deciding on how to apply gained insights in future work experiences and making again – this time hopefully improved – work experiences (Boud et al., 1985; Krogistie et al., 2012; Krogstie et al., 2013). Reflective learning happens both directly within a work process ("reflection-in-action") and more systematically outside operative work processes ("reflection-before-action", "reflection-on-action") (Schön, 1983). In the social context of organisations, reflective learning must be understood not only as a cognitive process of the individual worker (individual reflective learning) but also as a social process (collaborative learning). Both organisational culture and technology can facilitate or hinder these processes, which rely on communication and sharing. (Pammer et al., 2012; Prilla et al., 2012; Prilla et al., 2013). With respect to technology, i.e. computer-support for work-related reflective learning, the research fields around personal informatics and Quantified Self share the central assumption that activity logging supports reflection by providing accurate data as basis for reflection (e.g. Choe et al., 2014, Li et al., 2011). The domains of this research are however mostly at an individual level. A transfer of these results to work settings is often not easy to realise for multiple reasons. (1) It is often not obvious what data can be captured in an automated manner that constitutes relevant aspects of work. (2) Captured data needs to be closely related to relevant entities in the work domain (e.g. the customer in person-centred domains or artefacts in the domain of knowledge work). (3) Even the best-educated users have difficulties in gaining actionable knowledge out of data (e.g. Pammer & Bratic, 2013, Dugan et al., 2012).

Our key insight from the previous work is that reflection guidance needs to be designed into computer-mediated reflection tools. Technology supported scaffolding techniques are an important topic in the field of self-regulated learning (e.g. Bannert & Reimann, 2012), where prompts or amplifiers are often used to foster self-monitoring and evaluating one's own learning or to initiate some activity by the learner (Davis 2003; Verpoorten, et al. 2010). Further issues in relation to reflection guidance are when to prompt (Thillmann, et al. 2009) and what context information to use, e.g. to avoid interruptions (Pejovic & Musolesi, 2014). Beside prompts or amplifiers, there exists also a plethora of other scaffolding techniques that support reflective learning, like for examples journals eportfolios diaries or different types of visualisations (Fessl et al., 2017b). However, it needs to be carefully considered, which tool to introduce in fast-paced and stressful work environments as time for reflection is often missing. Nevertheless, there exists some approaches showing that reflective learning at the workplace can work. For example, in Rivera-Pelayo et al (2017), described how mood tracking enriched with mandatory contextualisation (which is a type of prompt) for reflection influenced the work of call-takers in a call-centre setting and resulted in an improvement in their work performance. Another example (Fessl et al., 2017a) presented in the application of a general applicable reflection guidance concept. This concept consists of different types of reflection techniques like prompts, diaries with the goal to design reflection guidance as adaptive software components. Across four field trials at the workplace, they showed that reflection guidance

technology was used and accepted by different types of end users (e.g. call-takers, nurses) and that the interventions are overall perceived to be supportive for reflective learning. Visualisations that present or summarise actions taken by the user in the past can be worth being reflected on to influence actions in the future (Fessl et al., 2017a). Visualisations for reflective purpose was used in Malacria et al (2015). They designed an intervention that helps users to reflect about and learn how to use "keyboard shortcuts within Apple Keynote". They developed a skillometer for hotkey usage consisting of three parts: a bar-chart showing the time taken to select one of the last six used hotkeys, a meter that grades the user's performance and a motivational text promoting that hotkeys selections are faster.

Finally, as rather general issue, it needs to be considered that learning is not the key objective of work processes in organisational settings: Reflective learning is only a secondary work process. It is therefore crucial to well embed reflective learning into core business processes (either existing ones or re-designed ones). For technology design, this means that computer support needs to be tightly integrated within existing computing infrastructures.

2.3.8 Further related projects

As described above, early adoption of new technologies often takes place in sector overarching R&D projects similar to MOVING. In order to give further insight into typical approaches, a number of relevant approaches will be introduced briefly in this subsection

Dr Inventor[13] is an EU project and its main contribution is an analogy-based model to promote creative scientific reasoning among its users (O'Donoghue et al., 2014). It aims at finding novel and potentially useful creative analogies between academic documents and presenting them to users as potential research questions for further exploration. Dr Inventor's final structure may be best seen as a conceptual blending (Fauconnier & Turner, 1998) model. It provides a number of functionalities such as information extraction and visualisation (Ronzano et al., 2016), retrieval, and summarisation of scientific papers (Saggion et al., 2016). While both Dr Inventor and MOVING support scientists, the former address creativity while the latter focuses on information literacy to foster open innovation. Additionally, MOVING target users are not limited to scientists.

Science2Society[14] is an EU project that aims at improving innovation processes and their effectiveness in society. In order to do so, it studies the European innovation system and how it creates new businesses, turns technology into products and services, attracts financing and generally creates value from academic research. The purpose of this analysis is to understand which improvements may be possible. The focus is on schemes currently used to encourage innovation: co-creation of products in a virtual "ideas laboratory", co-location of industry laboratories in universities, as well as coaching and training provided by universities to Small and Medium Sized Enterprises (SMEs). Instead, the goal of MOVING is developing a training environment to improve information literacy leveraging text and data mining techniques.

Didactalia[15] is a large educational community for parents, teachers and students. The collection offers over 85,000 educational resources, from pre-school education to high school, structured according to the principles of Linked Open Data. Didactalia is based on linked data, dynamic semantic

[13] http://drinventor.eu/
[14] http://science2society.eu
[15] https://didactalia.net

publishing, and social tools as the learning communities. There is a focus on reusing open educational resources and social learning communities, redefining the learning habits of students, parents and teachers. Similarly to MOVING, this platform provides educational resources and exploits collaborative learning, but it focuses on basic education and does not provide advanced features as network visualisations and adaptive training support.

Learning Layers[16] developed technologies that support informal learning in the workplace, particular for SMEs within regional innovation clusters. The project developed mobile and social technologies for individuals so that they can learn in a personalised way. The LAYERS approach focuses on scaling of learning to support innovation processes in networks of organisations, i.e. SMEs. This means that the emergence of shared meaning of work practices at the individual (workers and practitioners), the organisational (SMEs) and the inter-organisational (cluster) level of the network should be guided to facilitate innovation processes. While Learning Layers also aim to reduce the gap between working and training environment as MOVING does, it address only SMEs and does not address open innovation and text and data mining.

MATURE IP[17] developed technologies to support knowledge maturation, i.e. the development of an idea to a patent or product. For that purpose, MATURE conceives individual learning processes to be interlinked in an organisational knowledge-maturing process in which knowledge changes in nature and innovation emerges. MATURE developed a set of maturity indicators to assess the knowledge maturation level and a set of supportive tools. A particular focus was also on supporting search, especially with regard to the facilitation of knowledge maturation. This approach is related to open innovation, but in contrast to MOVING, training is out of the scope.

MIRROR[18] developed technologies that are integrated in the daily work environment of employees to support learning-on-the-job and experience sharing through reflection. Thus, the overall objective of MIRROR was to empower and engage employees to reflect on past work performances and personal learning experiences in order to learn in “real-time” and to creatively solve pressing problems immediately. MIRROR helped employees to increase their level and breadth of experience significantly within short time by capturing experiences of others. A prerequisite for exploring innovative solutions in this context was to rely on human ability to efficiently and effectively learn directly from tacit knowledge – without the need for making it explicit. This approach shares with MOVING the support of training in daily work, but it does not meets the specific nature of open innovation processes.

TIB AV-Portal[19] is a web-based platform which distributes scientific videos on technology and engineering, architecture, chemistry, information technology, mathematics and physics. These videos can be recordings of lectures and conferences, simulations, experiments, interviews, or other learning material. The portal exploits of different automated video analysis techniques which enables advanced search features. In contrast to MOVING, the project focuses on videos and does not consider other learning resources, as documents and metadata.

OpenMinTeD[20] aims at creating an infrastructure that fosters and facilitates the use of text mining technologies for scientific publications. It builds on existing text mining tools and platforms

[16] http://learning-layers.eu/
[17] http://mature-ip.eu/
[18] http://www.mirror-project.eu/
[19] https://av.tib.eu/
[20] http://openminted.eu

and makes them discoverable and interoperable through appropriate registries and standards. It supports training of text mining users and developers and addresses several use cases from different scientific areas, ranging from generic scholarly communication to literature related to life sciences, food and agriculture, and social sciences and humanities. Primary content can be accessed through standardised interfaces by well-documented and easily discoverable text mining services that process, analyse, and annotate text. In addition, the project identifies patterns and extracts knowledge, which is used for structuring, indexing, and searching content. Although text and data mining are related to MOVING, our approach has a broader scope.

MOOC@TU9[21] is a joint project of the alliance of leading Institutes of Technology in Germany (TU9). The aim is to plan, develop and execute an English-language MOOC. Participants are able to *"Discover Excellence in Engineering and the Natural Sciences"*. This course has been specially designed for students living inside and outside Germany who would like to further their studies in engineering science at a German university. During the nine-week course renowned TU9 professors presented a total of 19 topics from nine focus areas. In addition to comprehensive information on each TU9 location, the professors shared knowledgeable insights into central issues, content, structures and working methods of various engineering science disciplines. As part of weekly live sessions, the professors answered individual questions from the online audience. Background information and tasks which have been jointly completed and discussed in the forum served to apply and thereby internalise the learned content. Openness is about becoming a new key principle in education, when learners and other enthusiast may connect with each other and even experts for different places all over the world. Most popular is how those persons jointly deal with creating innovative insight in the virtual surrounding of a MOOC. The TU9 MOOC is a fine example which is initiated and lead by TU Dresden since 2014. Although offering a MOOC is related to MOVING, our approach has a broader scope since it will be a connectivist Massive Open Online Course (cMOOC) and not a xMOOC as MOOC@TU9. The former focus on content creation and networking (Gamage et al., 2016) while the latter are more similar to traditional courses and typically have a specified syllabus of recorded lectures and self-test problems (Prpić et al., 2015).

FutureTDM[22] intends to develop policy and legal frameworks in order to reduce the barriers of Text and Data Mining (TDM) uptake and promote the awareness of TDM opportunities across Europe. Expected outcomes of the project are guidelines and recommendations to practitioners from various disciplines, as well as solutions for overcoming legal and policy barriers of TDM exploitation. Other contributions are a collaborative knowledge base and an open information hub to address the gap in TDM skills across different areas and facilitate data-driven innovation through creative knowledge exchange. This project intends to provide guidelines and recommendations, while the MOVING main contribution is the MOVING platform.

CATALYST[23] EU project developed and tested collective intelligence tools which were distributed as open source solutions to any interested communities. The considered use cases were oriented to boost local initiatives in the area of social innovation, increase awareness on new sustainable lifestyles, support eGovernance efforts of European cities and even empower citizens and the civil society in debating emerging issues for the new European Constitution. Although supporting collaboration is an important aspect also for MOVING, eGovernance is out of the scope of the latter.

[21] https://mooc.tu9.de/?page_id=33
[22] http://www.futuretdm.eu
[23] http://catalyst-fp7.eu/

OPERAS[24] is a project for a new European infrastructure that supports the development of open scholarly communication. It focuses on social sciences and humanities and its goal is to coordinate scholarly communication in this domain. As MOVING this project addresses Open Science, but it focuses on encouraging the adoption of Open Science and disseminating its results.

Some works which provide advanced visualisations have also been identified. Rexplore[25] addresses large-scale data mining, semantic technologies and visual analytics, to explore and better understand scholarly data. In particular, it allows users to detect important trends in research such as the emergence of new topics, to identify a variety of interesting relations between researchers, e.g. recognizing authors who share similar research trajectories, to perform expert search, to analyse research performance and to automatically classify book collections, authors, conferences and other research entities according to the associated research topics. Open Knowledge Maps[26] can generate an explorable visualisation of the documents retrieved for a given user query. As previously described, Dr Inventor also provides some advanced visualisation features. However, all these works miss the other features supported by MOVING.

2.3.9 Comparison of the fields of research

In Table 3, we compare the various fields of research presented above with each other and with the MOVING approach. We group the relevant features into three clusters which represents the three key areas of MOVING (as detailed in Section 3.2): working environment, training environment and community of practice. As can be seen from the table, OIS cover the community of practise, while they lack all the features of the training environment. Only expert directory is addressed regarding the working environment. This feature is also the only one supported by ESS, although they may also profile their users to personalise the search. RS are limited to content recommendation and profiling. CT are suited for the community of practise, but they do not provide any features for the working and training environment. AHS do focus on the training environment of the proposed MOVING approach, but do not support the community of practise and typically do not have all features of the working environment. DSS mainly recommend content and profile users, although they may also provide some functionalities for visualisation. TEL systems focus on the training environment and usually allows to collaboratively build knowledge in the community of practise. However, they do not address the working environment. While the other systems focus on a specific area or on few features, MOVING is the only approach which supports all of them. Its key features are integrating the training and working environment which allows people from all societal sectors (companies, universities, public administration) to improve their information literacy by training how to take advantage of text and data mining methods in their daily research tasks, as explained in Section 4.1.1. Additionally, MOVING also provides the community of practise, which is essential for going the next step in opening up innovation by bringing together different stakeholders and disciplines (Section 2.1).

[24] http://operas.hypotheses.org
[25] https://technologies.kmi.open.ac.uk/rexplore/
[26] http://openknowledgemaps.org/

Table 3: Comparison of the different fields of research with the MOVING approach. Legend: not supported: -, partially supported: (X), fully supported: X

Field of research / Features	OIS	ESS	RS	CT	AHS	DSS	TEL	MOVING approach
Working environment								
Semantic search	-	-	-	-	X	-	-	X
Faceted search	-	-	-	-	-	-	-	X
Cross-modal search	-	-	-	-	-	-	-	X
Expert directory	X	X	-	-	-	-	-	X
Advanced visualisation	-	-	-	-	X	(X)	-	X
Evolution-aware search	-	-	-	-	-	-	-	X
Content recommendation	-	-	X	-	X	X	-	X
Training environment								
Guidance with tutorials	-	-	-	-	(X)	(X)	-	X
Videos	-	-	-	-	(X)	(X)	-	X
Glossary	-	-	-	-	X	-	-	X
Profiling	-	(X)	X	-	X	X	X	X
Reflective learning	-	-	-	-	X	-	X	X
Community of practise								
Collaborative knowledge management	-	-	-	X	-	-	X	X
Idea submission	X	-	-	-	-	-	-	X
Problem submission	X	-	-	-	-	-	-	X
Problem solving	-	-	-	(X)	-	-	-	X
Proposal evaluation	X	-	-	-	-	-	-	X
Marketplace	X	-	-	-	-	-	-	X
Communication of users	-	-	-	X	-	-	-	X
Work organisation	-	-	-	X	-	-	-	X

2.4 MOVING beyond the state-of-the art in open innovation systems

From the discussion of open innovation and its definition in Section 2.1, it is very clear that companies require opening their innovation and research processes in order to be competitive in the future, but fear that they are losing control over their development processes. Similar concerns can

also be found in other areas of the digitalisation of the workplace and sectors including the design and manufacturing of high-tech products like cars, production of machines and tools, construction of houses and non-material services like digitalised library services. Deficits in knowledge and skills (competencies) usually hide behind this. It is therefore necessary to systematically provide further education for developing and expanding these competencies for the implementation of open innovation processes. Likewise, tools for organising and conducting these processes are missing.

A variety of OIS already exist and they mainly support collaborative idea generation, as showed in Section 2.3.1. However, the generation of ideas is not the biggest challenge of open innovation processes. Innovation managers are challenged with effectively obtaining an overview of regulations, patents, products, current trends, funding opportunities etc. as a first step towards deriving appropriate innovation strategies. Such information is usually open and available in digital and textual form. However, innovation teams lack the time, strategies and tools to efficiently extract from these texts the necessary knowledge and to make them easily available (e.g. by visualisations). In order to address these challenges, the MOVING approach provides three main contributions beyond the state of the art:

(1) The provision of tools for the analysis of large amounts of text and other media, the so-called *'working environment'*. This is complemented with the provision of training programs to use these tools and organise open leadership innovation processes in general.
(2) The MOVING platform provides several different components from the research areas discussed above such as search for documents and experts through data analysis, visualisation of networks, adaptive training support etc. that – in such a combination – cannot be found elsewhere.
(3) The integration of the working and training environment with a *community of practise* such as building up leaders in a community, sharing ideas and challenges, as well as communicating about experiences and reflecting on own activities.

The MOVING approach accesses these needs and provides tools and measures to cover them. It also implements a qualification concept that meets the specific nature of open innovation processes which is shown in the following sections.

3 Open innovation in MOVING

In this section, we describe how the MOVING platform goes beyond existing systems to enable open leadership innovation through the combination of different services and a training curriculum. It is also shown how we approach open innovation within the two use cases (use case 1: Research on business information by public administrators; use case 2: Managing and mining research information).

3.1 Overall open innovation approach of MOVING

The MOVING project provides an innovative training and working environment to improve the innovation capacity in different societal sectors (public administrators, academia and business). As stated in Section 2.1 the concept of open innovation describes the appropriate use of knowledge entering and leaving the company by using internal and external marketing channels in order to generate innovation. It is about problem solving by looking beyond company boundaries to the outside world and its experiences and discoveries as part of the innovation process, instead of relying exclusively on the internal skills of one's own researchers and developers. A company's ability to innovate is the key to its success. So is the ability of research institutes to continuously improve and innovate through research ideas and methods. The strategic and systematic opening of internal innovation processes to include external knowledge — in other words, open innovation — can result in significant competitive advantages. Having information-savvy professionals is the key to open innovation competencies and to the success of both public administrators and researchers.

With the MOVING platform, we provide a web-based support system to train users to become information-savvy professionals – a goal that ultimately enables open innovation. Data-savvy information professionals are needed to face the core challenge of our current knowledge society: managing information in a professional way (Section 2.2). Understanding, using and developing data mining strategies will become a basic cultural technique and will determine whether society will succeed in exploiting the data produced and develop innovation. In fact, one of the basic cultural competencies today is information management. The MOVING project therefore takes one important step towards a society of data-savvy information professionals. Open leadership innovation is ensured by training information professionals that are able to initiate and maintain open innovation processes. Consequently, the added value of the MOVING platform is the merging of analytical tools and visualisation techniques on the one hand, and qualification and training aspects on the other hand in order to achieve the open innovation challenges addressed. Using the MOVING platform shortens the innovation process and raises its potential by quickly identifying entities of interest such as experts, organisations for collaborating and funding opportunities. The platform offers the means for researchers, public administrators and financial professionals (as primary target users) to improve their skills for open innovation by training their competencies in the field of information literacy (Section 3.2).

3.2 Information literacy to enable open leadership innovation

The MOVING platform will consist of the three different environments working, training and community of practice (see Figure 1) as well as the mix of working and training to enable open

leadership innovation.

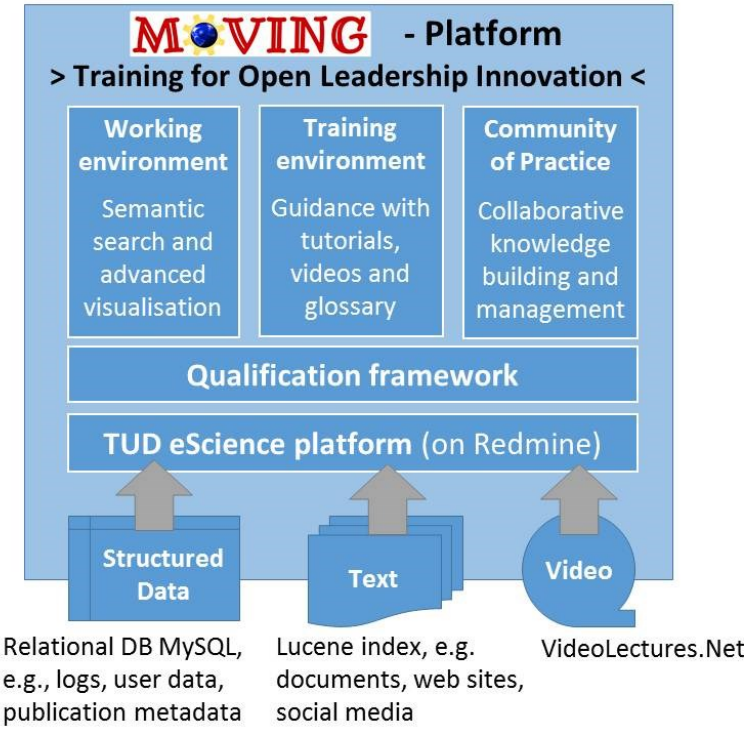

Figure 1: Architectural diagram of the MOVING platform and its three key areas (MOVING GRANT AGREEMENT, 2016, pp. Part B - 20).

The MOVING general (digital) information literacy curriculum is the base for MOVING's training environment (see Deliverable D2.1), e.g. for the connectivist Massive Open Online Course (cMOOC). This section presents the comparison between the *'Digital Competence Framework for Citizens'* (DigComp 2.0) (Vuorikari et al., 2016) and MOVING's information literacy curriculum (as developed in Deliverable D2.1, Section 3.1.2). This comparison is helpful, because the DigComp 2.0 is the state-of-the-art, when speaking about training digital competency. The defined aims for both projects are giving a first impression about the differences.

- **DigComp 2.0 aim:** "It is a tool to improve citizens' digital competence, help policy-makers formulate policies that support digital competence building, and plan education and training initiatives to improve the digital competence of specific target groups." (Vuorikari et al., 2016, pp. 3).
- **MOVING aim:** "The **vision of the MOVING project** is to **develop an innovative training platform** that enables people from all societal sectors (companies, universities, public administration) to **fundamentally improve their information literacy** [...]" (MOVING GRANT AGREEMENT, 2016, pp. Part B - 3, bold in original).

The DigComp 2.0 is focusing on digital competency, while MOVING is focusing on (digital) information literacy. Digital competencies are part of information literacy as for example the digital and information literacy framework (Reedy & Goodfellow, 2012) shows. New concepts of information literacy (as shown in the Deliverable D2.1, Section 3.1.1) are facing all aspects of a today's (ongoing) digitised world (Beutelspacher, 2014). A relationship exists between information literacy and digital competency, but the latter is broader and for all citizens, while information literacy is narrower and focuses especially on research (Cordell, 2013). Digital competency is also including issues like computer safety, privacy protection and hardware skills (Department of

eLearning, 2015) and e.g. understanding the difference between satire and facts (Cordell, 2013), which are not MOVING issues. MOVING's target groups have already basic digital competency as identified within the interview results (see Deliverable D1.1). These results are the base for the further concept development in Deliverable D2.3. Information literacy is the ability, which enables to determine, select, procure, process, convert and create information efficiently and with appropriate media types as well as to communicate them over appropriate channels (Stoecklin, 2012): "Information literacy and digital literacy are not competing concepts; they are complementary areas for students in higher education. Further, digital literacy concepts and skills can provide the fundamentals of managing digital environments that students need to succeed in Information Literacy and their other areas of study" (Cordell, 2013, pp. 182). Furthermore, the comparison between digital competency (nowadays digital literacy) with information literacy would be random in the context of many existing and sometimes synonym terms, e.g. Information literacy, Digital literacy, Computer literacy, Technological literacy, Media literacy, Scholarly competencies (Hjørland, 2008). The definition of all terms is not the claim of this document. Much more we follow our understanding of modern (in a knowledge society/in a digitalised world) information literacy (see Deliverable D2.1, Section 3). "The core issue is the critical understanding of knowledge production and knowledge claims and how to be able to make rational decisions in overloaded information ecology" (Hjørland, 2008, p. 16).

The following tables compare the Digital Competence Framework for Citizens (DigComp 2.0) with its Competence Dimensions 1, 2 and 3 to the MOVING general (digital) information literacy curriculum with its Knowledge Units, Subunits and learning objectives (see Deliverable D2.1, Section 3.1.2). The DigComp 2.0 Dimensions (Vuorikari et al., 2016) are defined as follows:

- "Dimension 1: Areas identified to be part of the digital competence" (Vuorikari et al., 2016, pp. 6).
- "Dimension 2: Competence descriptors and titles that are pertinent to each area" (Vuorikari et al., 2016, pp. 6).
- "Dimension 3: Levels of proficiency for each competence" (Vuorikari et al., 2016, pp. 6).

Table 4 shows the comparison between the DigComp 2.0 (Vuorikari et al., 2016) and the MOVING general curriculum (see Deliverable D2.1, Section 3.1.2).

Table 4: DigComp 2.0 Competence areas Dimension 1 vs. MOVING general (digital) information literacy curriculum Knowledge Units

DigComp 2.0 Competence area Dimension 1	**MOVING general (digital) information literacy curriculum Knowledge Unit**	**Comments**
Information and data literacy	Search, Verify, Knowledge	
Communication and collaboration	Delineate, Share	
Digital content creation	Knowledge, Delineate, Share	
Safety	NA	Safety is not a MOVING training issue.

Table 4 shows the comparison between the Dimension 1 of the DigComp 2.0 and the Knowledge Unit of the MOVING curriculum. It is visible, that MOVING is not focusing on DigComp 2.0's issues as safety and problem solving. This general comparison illustrates the different structure of the DigComp 2.0 (Vuorikari et al., 2016) and the MOVING general curriculum (see Deliverable D2.1, Section 3.1.2). The following table presents the comparison between DigComp 2.0 and the MOVING general curriculum in a more detailed way by comparing the DigComp 2.0 Competence Dimension 2 with the MOVING general (digital) information literacy curriculum Knowledge Subunits.

Table 5: DigComp 2.0 and MOVING curriculum in detail

DigComp 2.0 Competence area Dimension 1 + Competence Dimension 2 (for explanations and every Dimension 2's Dimension 3 see Vuorikari et al., 2016, p. 8-9)	**MOVING general (digital) information literacy curriculum Knowledge Unit + Subunit (for explanations and every subunit's learning objectives see Deliverable D2.1, Section 3.1.2)**
Information and data literacy	***Search, Verify, Knowledge***
"1.1 Browsing, searching and filtering data, information and digital content" (Vuorikari et al., 2016, p. 8)	• Recognise and express the need for information/knowledge • Find resources (identify different information resources) • Choose resources (the use of different information resources) • Segregate information (identify and document information)
"1.2 Evaluating data, information and digital content" (Vuorikari et al., 2016, p. 8)	• Verify the relevance of a topic • Verify the factual accuracy • Verify the formal accuracy • Verify the completeness
"1.3 Managing data, information and digital content" (Vuorikari et al., 2016, p. 8)	• Formulate/process information • Compare information • Integrate information • Organise information
Communication and collaboration	***Delineate, Share***
"2.1 Interacting through digital technologies" (Vuorikari et al., 2016, p. 8)	• Linguistic simplicity • Semantic redundancy • Cognitive structuring (structure a topic well) • Cognitive conflict (arouse interest on the topic) • Use networks
"2.2 Sharing through digital technologies" (Vuorikari et al., 2016, p. 8)	• Mark citations • Name resources • Use networks
"2.3 Engaging in citizenship through digital technologies" (Vuorikari et al., 2016, p. 8)	• Use networks

"2.4 Collaborating through digital technologies" (Vuorikari et al., 2016, p. 8)	• Compare information • Organise information • Use networks
"2.5 Netiquette" (Vuorikari et al., 2016, p. 8)	• Linguistic simplicity • Semantic redundancy • Cognitive structuring (structure a topic well) • Cognitive conflict (arouse interest on the topic) • Use networks
"2.6 Managing digital identity" (Vuorikari et al., 2016, p. 8)	• Use networks
Digital content creation	***Knowledge, Delineate, Share***
"3.1 Developing digital content" (Vuorikari et al., 2016, p. 9)	• Formulate/process information • Compare information • Integrate information • Organise information • Linguistic simplicity • Semantic redundancy
"3.2 Integrating and re-elaborating digital content" (Vuorikari et al., 2016, p. 9)	• Formulate/process an information • Compare information • Integrate information • Organise information • Cognitive structuring (structure a topic well)
"3.3 Copyright and licences" (Vuorikari et al., 2016, p. 9)	• Clarify terms of use
"3.4 Programming" (Vuorikari et al., 2016, p. 9)	NA (Programming is not a MOVING training issue.)
Safety	***NA (Safety is not a MOVING training issue.)***
"4.1 Protecting devices" (Vuorikari et al., 2016, p. 9)	
"4.2 Protecting personal data and privacy" (Vuorikari et al., 2016, p. 9)	
"4.3 Protecting health and well-being" (Vuorikari et al., 2016, p. 9)	
"4.4 Protecting the environment" (Vuorikari et al., 2016, p. 9)	
Problem solving	***Delineate, Share, feature-based Adaptive Training Support, Tutorials***
"5.1 Solving technical problems" (Vuorikari et	NA (Solving technical problems is not a MOVING

al., 2016, p. 9)	training issue.)
"5.2 Identifying needs and technological responses" (Vuorikari et al., 2016, p. 9)	Different tools will be available and explained on the MOVING platform. This will be part of the tutorials and the feature-based Adaptive Training Support.
"5.3 Creatively using digital technologies" (Vuorikari et al., 2016, p. 9)	• Linguistic simplicity • Semantic redundancy • Cognitive structuring • Cognitive conflict • Use networks
"5.4 Identifying digital competence gaps" (Vuorikari et al., 2016, p. 9)	Identifying knowledge gaps and satisfy them by aiming and follow them self-directed as new learning objectives beyond the curriculum by searching for proper learning material to increase knowledge (e. g. MOOCs, videos, tutorials).

The table shows mappings between DigComp 2.0 (Competence area Dimension 1 and Competence Dimension 2) and the MOVING general (digital) information literacy curriculum (Knowledge Unit and Subunit). To comprehend these mappings, it is necessary to read also Dimension 3 of the DigComp 2.0 (Vuorikari et al., 2016, p. 8-9) and the learning objectives of MOVING's general (digital) information literacy curriculum (see Deliverable D2.1, Section 3.1.2). Furthermore, the table shows, that the DigComp 2.0 issues "3.4 Programming […] 4.1 Protecting devices […] 4.2 Protecting personal data and privacy […] 4.3 Protecting health and well-being […] 4.4 Protecting the environment […] 5.1 Solving technical problems" (Vuorikari et al., 2016, p. 9) are no MOVING training issues. Due to specific requirements of the target group's on information literacy (see Deliverable D1.1), these issues are no MOVING issues and not on the above mentioned issues. Moreover, issues as safety can be considered as presupposed. In general, the Digital Competence Framework for Citizens, the DigComp 2.0 (Vuorikari et al., 2016), and the MOVING general (digital) information literacy curriculum (see Deliverable D2.1, Section 3.1.2) are quite similar, but each approach follows different structures to reach different sub aim. Moreover, the DigComp 2.0 is for Citizens and thereby broader, e.g. the training of safety aspect is not a MOVING issue. Altogether, the DigComp 2.0 supports the definition of learning objectives on the micro content level for the MOVING (digital) information literacy curricula. If you, for example, can SEARCH to find out the State-of-the-Art, VERIFY the information you found, connect it with your KNOWLEDGE and ideas to create something new, can DELINEATE your ideas to different target groups and SHARE it in a proper way to find partners or funding opportunities, then you have started an open innovation process. The systematic training of knowledge and skills is necessary for the implementation of open innovation processes, for example using data mining methods as a basic component of information literacy: Users get the opportunity to test different methods and analysis steps in a practical problem setup addressing their current tasks, while they are supported by individually configurable information and training opportunities provided on the platform. Thus, usual transfer losses between training and practice are omitted. Moreover, users are encouraged to document best practices as further educational content for other users.

The intent of the MOVING qualification concept is to teach basic knowledge and skills for the extraction of knowledge from large amounts of information (text and other media) in terms of

(digitalised) information literacy. The MOVING platform goes beyond the state-of-the-art by not only educating the users how to search, but also how to organise and interpret vast amounts of information. In addition, it will teach the users how to interpret and apply the data analysis features offered by the MOVING platform such as identify key topics, topic trends and network visualisations of key researchers in certain fields. This self-reflection by the users on the use of particular data analysis features enables the users to become more confident in what they are doing on the platform and conduct an even more targeted search, organisation and application of the literature to obtain innovative results. Users are educated by means of a cMOOC as well as using visualisations of topic- or co-author networks and other analysis results. In addition, the MOVING consortium members will conduct user workshops to lower the barriers to potential users and customers to access the MOVING platform. With this mix of training information literacy and the use of, the platform helps people to start or participate in an open innovation process in a digitalised world. Therefore, MOVING focuses on the implementation of the following aims:

- Training will be possible to accompany the work process and use of data mining techniques.
- Adaptive training will be made possible, as learning processes are focused on the interests and knowledge of users.
- Knowledge will also be conveyed in practical problem setups related to the user's tasks.
- Different forms of learning material (also within the cMOOC) will be used in order to meet the different learning styles of users.
- The training environment will facilitate individual and collective learning.
- Training materials will be provided not only by the project team, but also by the user community to include the knowledge units DELINEATE and SHARE.

The platform enables public administrations and researchers to drive innovation with newly acquired skills. This challenge is addressed by developing and applying curricula to train public administrators in the use case of EY and researchers in the TUD use case. Training addresses different aspects of innovation leadership: (1) Beyond creativity: the MOVING training makes people more open-minded because part of the curriculum is to always question the state-of-the-art to follow the aim of reaching active learners. (2) Critical thinking: MOVING trains the users to prefer transparent search results on open data rather than, just following the established path' such as provided by mainstream search engines. (3) New ideas: using the MOVING platform more often and open offers an active open innovation process. This increase in idea generation is further supported by encouraging users to explore unexplored paths, for example through our innovative data visualisation tools. (4) We provide the users with more advanced visualisations like topic lifecycles, network views, etc. to "think out of the box". Fifth, an increase in idea generation and in particular the ability for finding collaboration partners and industries on the MOVING platform strengthens entrepreneurship. This supports finding new ideas for innovative products and can potentially lead to the founding of start-up companies.

Open leadership innovation needs information-savvy people. The chosen concept of information literacy was adapted to the needs of open innovation processes in the knowledge societies (see Deliverable D2.1, Section 3.1.1). Based on this, a curriculum was developed (see Deliverable D2.1, Section 3.1.2). This curriculum is the base for the use case specific curricula development, influenced by the use case specific empirical findings (see Deliverable D2.2). In the following section, we describe open innovation in the context of this different use cases.

3.3 Use cases, target users and open innovation needs

In this section, we explain how the MOVING use cases, which were specified in Deliverable D1.1, relate to open innovation. The first subsection identifies aspects of open innovation in the two use cases and describes the requirements' implications in open innovation. The second subsection addresses the needs of researchers and public administrators in relation to the MOVING platform and how the MOVING platform is better than the state-of-the-art systems described in a previous section and better serves the needs of our target users.

3.3.1 Open innovation scope of the MOVING use cases

Open innovation is characterised by a multi-layered, open search and solution process between multiple players across enterprise boundaries. According to the official European Commission definition of open innovation, the goal is "to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets, fostering a stronger culture of entrepreneurship". This opening up of the innovation process creates a great deal of new innovation potential. We understand open innovation as the systematic and methods-based exploitation of this potential. By collaborating with external players, organisations have improved access to detail about information on needs and an expansion in the sources of solution information. In this way, the knowledge and creativity of external players that was previously unavailable is integrated into the process. This represents a departure from the traditional idea of the innovation process as being located largely within the company, which can be described as a closed innovation model.

Open innovation scope for use case 1

The MOVING platform allows companies like EY to better educate their professionals, particularly the world-wide 60,000 auditors dealing with large amount of publicly available information. The challenge is to enable public administrators to drive innovation in and through the public sector. In use case 1 on public administrators, the MOVING platform enables EY's public administrators to effectively and efficiently keep track on the changes relevant in the business sector such as national and European financial laws and regulations. For example, it is crucial to know which changes in national and European financial law have to be adopted regarding, e.g. country-by-country reporting, base erosion, profit shifting, exchange rate risks, cash-management, foreign corrupt practice act and so on. The compliance officers at EY take an active role in guiding their customers (SMEs, large industries, universities and research institutions) who have to abide by the law and modify their business in order to be compliant with the changes. Public administrators in financial departments will better understand and obtain an overview of current regulations and discussions on topics like administering publicly funded projects. Decision makers in public administration of research institutes and other public bodies will be able to identify research and innovation topics based on an automated analysis of scientific papers, websites, social media etc., and identify calls for funding relevant to their work and organisation. Compliance officers obtain an overview of the current discussions, experiences and practical trends of how their clients can organise their administration to become and stay compliant to national and European laws and regulations. For example, public administrators like compliance officers and employees at financial departments of research organisations learn how to "learn which changes occurred in finance and other business regulations" on national as well as European level.

Innovation activities are subject to the imperatives of effectiveness and efficiency — in other words, doing the right thing in the right way. The efficiency and effectiveness of innovation are determined by the company's access to knowledge. The organisational structure of a company and the selection of appropriate methods play an important role in open innovation readiness. Corresponding mechanisms and methods can be used to support absorptive capacity, e.g. the transfer and exploitation of knowledge. Organisational measures can also prove helpful in developing an open innovation culture. Due to the difficulty of documenting and influencing a corporate culture, organisational mechanisms and methods offer a convenient means of optimisation. The use case partner EY is planning to increase open innovation readiness and develop and grow the company's open innovation culture. EY has an established GSA (Germany-Switzerland-Austria) Innovation strategy where integration of the MOVING platform is considered one of the most important building blocks. This will most definitely also help with EY's goal to expand open innovation culture and readiness. Innovation@EY in GSA is a foundation for the transformation journey in GSA. As innovation is about a common language, an innovation culture, the innovation environment, the structure and the governance to ensure innovations, EY has developed a roadmap for four areas of innovation:

(1) Internal innovation at EY,
(2) Service and product innovation,
(3) Co-innovation with clients and business partners,
(4) Innovation management methods and tools.

The MOVING platform falls under all of these four areas of the roadmap and will be integrated to support the process.

Open innovation scope for use case 2

Moreover, the MOVING platform allows universities such as TUD and UMAN and non-university research institutes authorities like ZBW, GESIS and CERTH, to better educate their researchers, in particular young PhD students and Master' thesis writers to search and to organise knowledge in the vast amount of documents and scientific literature available today and to easily collaborate with other universities, companies and employment sectors. These activities will extend to other cooperating academic institutions, such as the AGH and Jagiellonian universities in case of PBF. In the context of open innovation and Science 2.0, the challenge is to assist universities in becoming open innovation centres for their regions while cooperating with companies and public authorities and to help universities enhance their capacity to engage in Science 2.0 and open innovation. Having the means of the freely accessible innovation training platform MOVING can effectively increase capabilities for joint innovation between universities and companies, which is an important characteristic of open innovation.

Training researchers in the tasks of searching and organising knowledge through the use of state-of-the-art search functions and visualisation functions such as network graphs (use case 2; scenario 1), enables them to extract new ideas from the publicly available scientific literature in a faster manner than before, to enhance their capacity in finding key literature as well as key experts. Researchers learn how to assess other researchers' work and how to approach the key researchers (use case 2; scenario 2) to connect and build professional networks. Moreover, they will learn how to identify trends and key research questions, allowing them to define new goals and research challenges, which will in return enhance the university's competitive strength. These skills, once learned and perfected, will enable open innovation through co-creation of new knowledge by means

of scientific discourse across research groups and national borders within the community of practise which is built on the platform.

The MOVING platform stimulates local collaboration with other researchers from the same institution, as well as remote collaboration with researchers from other organisations and countries. A major factor of this stimulation is the offered option to organise knowledge by creating joint document folders on specific topics (such as statistical data analysis, financial laws and others). In addition, the MOVING platform implements the idea of a "flipped conference" as a novel method for knowledge sharing and collaboration. To this end, PhD students (and other researchers on the platform) generate videos of their research for other researchers and make them available to the public. The videos stimulate discussion among the researchers and the public. However, their content can also be reused in the creation of next-generation, personalised MOOCs, by taking advantage of CERTHs' advanced features such as automatic user-driven collection, temporal fragmentation and concept-based annotation in the videos. In addition, the MOVING platform supports sharing information and collaboratively collecting literature regarding specific topics. Users can exchange comments on their literature collections and thereby start a discourse on the collected materials. Through integrated databases of funding opportunities, decision makers from research institutes and other public bodies are enabled to search for such opportunities in order to quickly identify topics and calls relevant to their work and organisation. This shortens the innovation process.

3.3.2 Needs of the MOVING target users (public administrators, researchers)

In MOVING, the description of public administrators includes both state employees and financial auditors performing public services. These are the target users of use case 1. Particular attention was paid to auditing professionals with their knowledge on accounting and auditing, transactions experts, compliance officers, taxation consultants and advisory professionals, innovation team members. For use case 2 the target users are researchers, in particular PhD students and Master thesis writers, but also decision makers within the administration. The needs of the target users have been analysed and collected as part of Task 1.1 of Work Package 1, and listed and described in Deliverable D1.1 made available in month 12 of the project's first year.

Needs of public administrators in relation to the MOVING platform

Within use case 1 the users are mostly junior and senior professionals working in companies offering services affiliated with their description such as auditing companies that include transactions, taxation and advisory services. As part of the exploitation plans, including business models that will be described and detailed in Deliverable D5.2, EY is planning to integrate the MOVING platform into internal and external (clients) content management systems (CMS). By doing so, EY can reach more than 60,000 professionals worldwide, internally and even more externally. More importantly, the focus will be on the GSA Innovation@EY team members who can use the MOVING platform purposefully to improve their open innovation skills and expand the open innovation culture within EY. GSA Innovation@EY is a cross-service line and cross-functional initiative in GSA and supported by the entire leadership in GSA. The team consists of professionals who have innovation roles in their respective service lines and Core Business Services (CBS) functions that have been nominated by their leadership. As the team spans all major functions, it acts as a sounding board to improve their ideas. The team evaluates and routes open innovation ideas to the GSA Innovation Council for decision making and resource allocation. Active open innovation projects are managed by the team.

Making open innovation an integral part of EY's business is a strong enabler for the future of the company and a key element on the way to achieving EY future vision ambitions. Fostering innovation across all service lines inspire professionals to drive innovation by sharing and discussing ideas. This helps bring new services to the market and to generate a competitive advantage. To foster innovation and open innovation across all service lines at EY and to create an environment in which we can unfold our full potential, inspire each other and innovate across all service lines, a new learning route was developed: The Innovation Journey with its four competency levels CATALYST, INTERMEDIATE, MASTER, and EXPERT, it is open to all EY people independent from Rank or Service Line.

To be more exact about how the needs and the requirements are connected to open innovation, we will further refer to the use case 1 user scenarios. According to scenario 1, the compliance officer Mr. Clark has been assigned the task to identify potential risks how the economic and financial changes in law and regulations in the European market may affect the organisation's compliance. For example, we can imagine that his company plans to extend its business to other European countries and the company needs to conduct a so called "country by country reporting", which refers to a requirement of the EU to companies to split up financial reports by the different countries in which they have businesses. The MOVING platform with the implemented requirements resulted from the analysis performed in D1.1, will provide the user with the appropriate tools to solve this task efficiently and effectively: Mr. Clark uses the MOVING platform to analyse political, economic, social and technological factors. When performing SWOT and PEST analyses, he can use platform features such as Topic-based filtering, Faceted search, Tag cloud, Topic network, Network Centrality, Topic time-frame. All these features of the MOVING platform required by professionals to reach their goals, are extensively described in D1.1.

Scenario 2 of use case 1 addresses innovation in advisory services and across service lines at EY. In this context, the MOVING platform enables the user to work on a step-by-step application of the same features as listed for scenario 1. These features will allow the user to perform broad and flexible searches for service trends and think "out of the box".

More specifically for the user stories of use case 1, as described in D1.1, the financial professional user of the platform needs to align his work with the international standards on auditing (ISA). For example, the user requirements for understanding the entity and the environment (ISA 315) include faceted search features, search profile management and various visualisations. By using these features implemented on the platform, open innovation will be enabled, as the user understands the entity and the environment, which means understanding the need of the client and therefore increases innovative thinking. A very similar case of training innovative thinking can be found in the user story regarding related parties search (ISA 550) where the professional needs to understand related party relationships (in this case transactions). Therefore, his needs correlate with MOVING features such as visualisations (network analysis and tag visualisations) and faceted search. Moreover, using the community features to build networks of professionals interested in the same topic will enable the growth of an open innovation culture. According to ISA 500, the professional is required to be able to scan for other information available. This strongly relates to the main goal of the platform, creating data-savvy researchers and professionals. Similarly, all user stories requirements relate to open innovation in the way that the platform provides access to information through all the features of the platform and supports open search and solution processes between multiple players across enterprise boundaries.

Needs of researchers in relation to the MOVING platform

The needs of researchers and university employees as addressed in use case 2 are quite similar when it comes to searching and visualising information. Mrs. Brown is a young researcher, looking for an emerging subject within her area of interest and for a funding opportunity for her PhD. When looking for the state-of-the-art in a research topic she remembers that within the process of writing her Master's thesis she perceived the discrepancy between the theoretically offered wealth of information and the practical possibilities of their exploitation as problematic. To conduct a successful state-of-the-art research, analysing provenance of discourses as well as identifying research desiderata and key actors, she is in need of a service, system or tool to help her detect these aspects and find her way through the above-mentioned information overload. Mrs. Brown therefore would welcome automated analysis of large literature corpora with text and data mining tools and results visualisation, i.e. network graphs. But, since she is a social scientist, she has no background in understanding how these tools actually work. Therefore, she needs training on how to use, choose and reflect data and text mining tools to understand and interpret the results. The MOVING platform meets Mrs. Brown's requirements. In every step of her search, Mrs. Brown is assisted by the Adaptive Training Support widget. It offers recommendations on how to filter her search or which visualisation to use. Additionally, she is invited by this widget to reflect her own usage of the platform and to learn about the search process with micro-learning content. Combining the two areas of working and training, Mrs. Brown is able to manage information in a more efficient and sustainable way. This means that she exploits the existing data and information in a more professional manner than before. In return her work increases the competitive strength of the university. It drives open innovation.

After searching for the state-of-the-art, Mrs. Brown has detected an interesting emerging field in which she decides to do her PhD. When looking for funding, Mrs. Brown asks her supervisor Professor Adams for help. She knows that with MOVING she can look for funding opportunities on a national and international level. As Professor Adams is also very keen on Mrs. Brown's new research area, she has the idea to collaborate. Professor Adams introduces Mrs. Brown to the MOVING functions for finding project funding and project partners. Mrs. Brown detects key actors in this area via the network graph visualisation function. By clicking on the actors, she sees to which institution they belong and how to connect with them. In the best-case situation, these authors are already in the so-called community of practise implemented on the MOVING platform where it is possible to engage directly with persons on a common task, subject or purpose and to share learning resources. Mrs. Brown could promote the project idea on the platform by sending it to the research groups or experts that she wants to collaborate with. This direct collaboration implements a crucial aspect of open innovation.

Mrs. Brown not only needs to find partners; she is also looking for funding. Supported by a "how-to-video", she knows how to use the search for funding on the MOVING platform in order to get results which she can propose to Professor Adams. Mrs. Brown finds an interesting research group, an SME which is working in the respective area and a funding call which fits into the research question. Her needs to find a research question, a funding opportunity and partners for collaborating on the subject are all fulfilled by the MOVING platform.

3.3.3 State of the art coverage of target users' needs

One of the main goals of the MOVING project is to construct and provide an open innovation platform that offers more features than the usual platforms. As it can be seen in the features table 3 in Section 2.3.9, where different features of the MOVING platform are listed in comparison with features offered by state of the art systems, there is no system that offers a combination of both working and training environment. Three main categories are compared: the working environment, the training environment and the community of practice. The seven features of *working environment*, partially and fully supported by MOVING, are only scarcely checked by other state-of-the-art systems. AHS systems have most features in common with MOVING. When analysing the *training environment* category, three features out of five are fully supported by AHS systems, as they are also supported by MOVING. However, AHS systems lack many characteristics that MOVING supports. Therefore, the MOVING platform is a better system by supporting a significant higher number of features. When it comes to *community of practice*, state-of-the-art systems that have many commonalities with MOVING support none or only marginal features of working or training environments. Systems supporting fewer characteristics fail to completely satisfy the needs of our target users.

4 Innovation potential and contribution beyond state of the art

The following section presents scientific and technological novelties of the MOVING platform (4.1) with a detailed focus on the integrated working and training platform (4.1.1), the combination of components and technologies (4.1.2) as well as specific components (4.1.3-4.1.6). In chapter 4.2 we are describing the strategy on intellectual property within MOVING.

4.1 Scientific and technological novelties of the MOVING approach

"In a world of increasing global knowledge flows with better potential access to domestic as well as international external R&D providers and collaboration partners, innovation management is increasingly challenged to access and relate to the right sources, for the right knowledge at the right time, to ensure long-term innovative performance" (Knudsen, Tranekjer, Cantner, 2017, p. 15). The MOVING platform, in supporting the overall goals of enabling timely access to the right information and knowledge and also advancing the information literacy of its users, exhibits three main novelties:

(1) MOVING is a platform that **combines working and training in a single platform**. A major novelty of the MOVING platform thereby consists of the merging of analytical tools and visualisation techniques on the one hand and a qualification and training concept on the other hand.

(2) MOVING **integrates a rich set of heterogeneous components and technologies** for data analysis, visualisation, search, etc., in a combination that cannot be found in any other single platform. This combination of components is another major novelty of the MOVING platform.

(3) The **integration of the working and training environment and the components of MOVING (first two items) with a community of practise** that is common in Open Innovation Systems. This threefold approach of working, training and practise enables the MOVING approach to build up leaders in a community, finding and sharing ideas and challenges, as well as communicating about experiences and reflecting on own activities.

In addition to this, several of the individual components of the MOVING platform are implementing **techniques that, even in isolation, exhibit considerable novelty at a scientific level**, advancing the state of the art in their respective scientific fields, e.g. knowledge graph exploration, adaptive training support, and others (this is briefly discussed for two individual components in the sections below, but the reader is referred to the MOVING technical Deliverables D2.1 and D3.1, as well as upcoming editions of WP2 and WP3 technical deliverables for details on how each of the many different individual technologies of MOVING advances the state of the art in its field).

4.1.1 Combination of integrated working and training platform

The mix of a working and training environment on one platform form the two sides of the same coin, because they can develop their full potential only by complementing each other. People dealing with an ever-growing flood of information need sophisticated tools that allow fast and accurate evaluation and visualisations of the analysis results. The platform can only be effective, if the persons using it have at least a basic understanding of how to deal with data mining techniques and how to interpret the results. Likewise, any measures in further education, training or support are only really

successful if they are based on real practical questions or closely connected to such. Moreover, the practical application is usually the most effective way of training. Therefore, **the MOVING platform wants to overcome any artificial distinction in practice and training.**

4.1.2 Combination of components and technologies

The MOVING platform integrates a rich set of heterogeneous components and technologies for data analysis, visualisation, search, etc. that are working in concert with each other. No other previously developed platform or system provides such a heterogeneous and varied combination of technologies. The integrated MOVING technologies are presented in Table 6.

Table 6: MOVING technologies

Name of the component	**Input**	**Output**	**Description of the component**
Focused web-domain crawler (FDC)	Domains	HTML pages	The focused web-domain crawler crawls specific websites inserted by the platform's users, converts the data to the *'Common Data Model'* (CDM) and feeds them to Elasticsearch.
Search-engine-based web crawler (SEC)	Topics	HTML pages and video metadata	The search-engine-based web crawler uses web search APIs to search the web for specific topics inserted by the platform's users. Videos that are retrieved, are sent to the Video Analysis (VIA) web service, and the metadata extracted are converted to the CDM and along with the text content retrieved are fed to Elasticsearch.
Social Stream Manager (SSM)	Topics	HTML pages and video metadata	The Social Stream manager crawls popular social media like Twitter and Youtube for content relevant to topics inserted by the platform's users. Videos that are retrieved, are sent to the Video Analysis (VIA) web service, and the metadata extracted are converted to the CDM and together with the webpages extracted from the social media posts (and also converted to CDM) are fed to Elasticsearch.
Biblio-graphic Metadata Injection	RDF Dataset + Schema Query	Result list (JSON objects)	The SPARQL query using a combination of RDF types and/or properties is entered into a semantic search system. Thus, the system is able to identify relevant datasources within the crawled LOD dataset. In a subsequent step, all identified datasources can be harvested by means that the contained information is extracted. The information is automatically parsed and exported into JSON objects following the common data format. See also Deliverable D3.1 Section 3.5.4.

Name of the component	Input	Output	Description of the component
Author Name Disambiguation	Metadata for a collection of scientific papers	Author-disambiguated metadata for the input collection	The service iterates over all author names in a collection of scholarly papers, provides a deterministic normalisation of author names as well as document features needed for disambiguation (publication titles, dates etc.), looks up all name instances on documents (*'mentions'*) and provides author name disambiguation for each of the mentions, annotating each mention by a unique authorID, together with a confidence factor. As required, the service returns a set of (mentionID, authorID) pairs as well.
Video Analysis (VIA) web service	videos	Temporal fragmentation and visual concept annotation results	This is a REST web service that performs shot/scene segmentation and concept detection. The service can handle videos hosted on file servers or download from some video hosting platforms as Youtube. Communication between the MOVING platform and the service is done via HTTP POST and GET calls, and the processing results can be retrieved in XML and JSON formats.
Search	User query	Search results list (JSON objects)	MOVING-enhanced semantic search over full-text, titles, videos etc. using the advanced retrieval methods like HCF-IDF. Basic visualisation provided via Kibana[27]. Results can be used by KC for advanced visualisations.
Graph visualisation	Search results	HTML + WebGL canvas	The scalable, WebGL-based *'Graph Visualisation Framework'* (GVF) visualises multiple heterogeneous graphs in different windows, and provides means for comparing and exploring relationships between different graphs. Context summaries and node aggregations are proposed to reduce clutter and support user orientation and exploration.

[27] https://www.elastic.co/products/kibana

Name of the component	Input	Output	Description of the component
Adaptive Training Support (ATS)	User interaction tracking, User Profiles, ATS Database, Curriculum	Interactive HTML Widget	The Adaptive Training Support assists users in learning-how-to-use the platform. "Learning-how-to-search": Presents search behaviour with regard to the used MOVING tools and functionalities on the platform and provides reflective questions motivating the user to reflect on their own search experiences. "Curriculum Reflection" (in planning): aims at supporting the user to complete the selected curriculum and provides reflective questions to reflect on the progress. It gives recommendations which documents or activities to do next w.r.t. the curriculum.
MOVING web application	User input	The MOVING platform functionalities and results	The MOVING web application hosts the user-visible part of the MOVING platform. It is a Ruby on Rails web application. Responsive design ensures the MOVING platform UI always makes best use of the available screen size. On desktop computers with large screens the full UI is available. As the screen size decreases, more and more controls are replaced by simpler alternatives or are hidden in collapsed drawers. This makes the application usable on all form factors while maintaining the best possible usability.
User interaction tracking and dashboard	User input	Interaction data (JSON objects), analysis report (interactive visualisations)	Low-level interaction with the MOVING platform UI is captured, from mouse moves to window events. Designers can use the analysis dashboard to create pattern-based queries designing the sequences of events to find. Interactive visualisations are then created based on the results of these queries, so that the results can be explored directly without any further data processing. A RESTful service provides an abstraction layer to the captured interaction data, so that other services can query this data.

Platform functionalities can be categorised into three main components: the data acquisition and processing component, the user logging component and the data visualisation component. The overall architecture is illustrated in Figure 2.

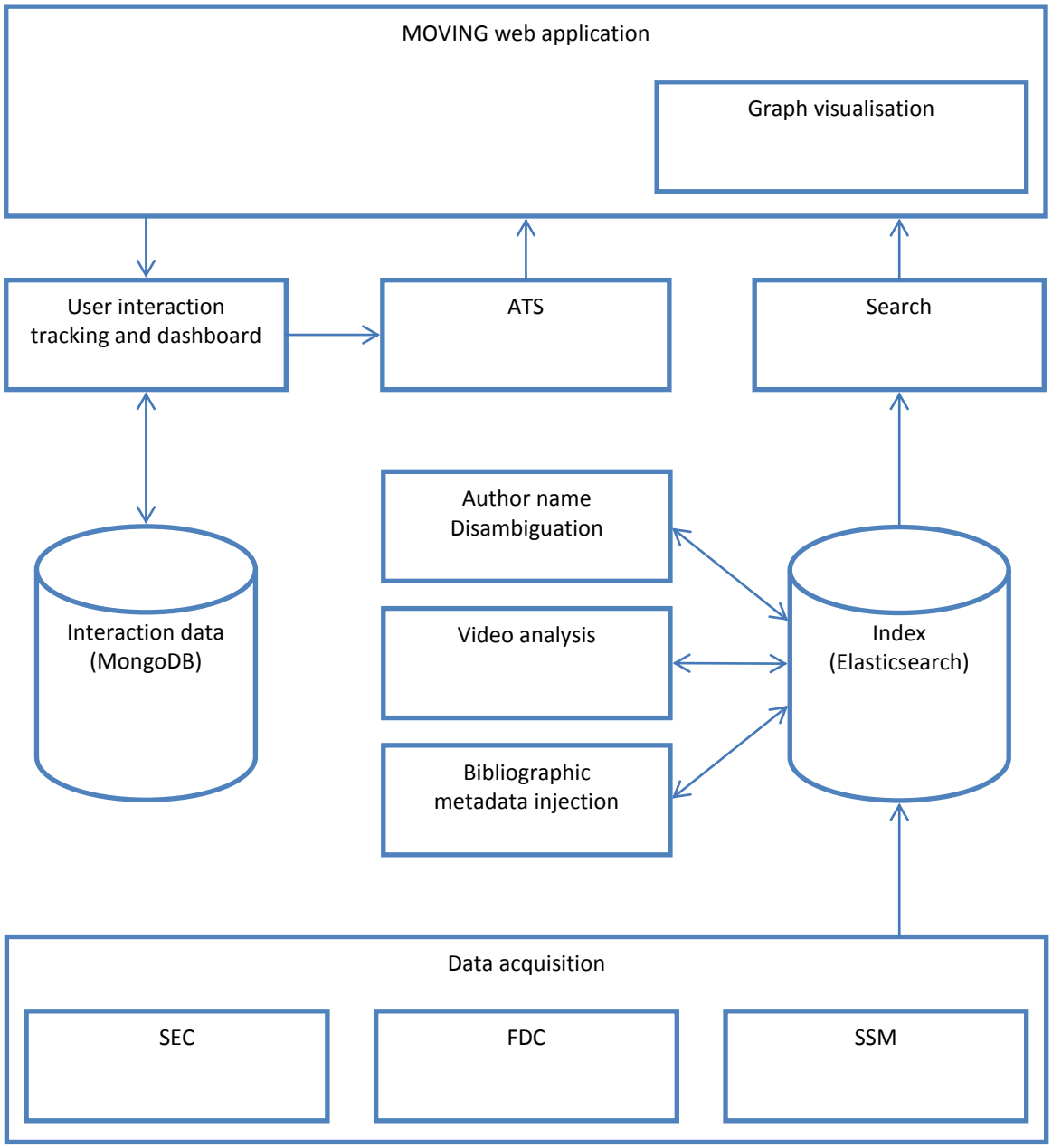

Figure 2: Architecture of the technical components of the MOVING Platform

4.1.3 MOVING Search Engine

The MOVING platform needs to process huge amounts of text data coming from different data sources. These datasets contain different document types, e.g. bibliographic data from the ZBW economics dataset (see D6.2: Data management plan for an exhaustive listing and description), crawled web pages as well as the video transcripts. In order to handle these data sources efficiently and effectively, MOVING's search engine needs to provide a scalable real-time search, support for multiple document types per index, multitenancy[28], different file formats and different programming languages. To this end, we compared several state-of-the-art search engines and decided to use Elasticsearch to implement the MOVING search engine. We developed a novel ranking model, called

[28] http://www.elastic.co/blog/found-multi-tenancy

HCF-IDF, as a plugin in Elasticsearch for the ranking of search results based on their relevance to the user query (Nishioka & Scherp, 2016). More details about the ranking models we used in MOVING are described in D3.1 and D3.2.

MOVING combines its own datasets with other existing ones. In order to generate our own datasets, we have developed and used different crawlers. A web crawler is an Internet bot that systematically browses (crawls) the web following specific rules. The crawled data is indexed for efficient search. In order to retrieve data from the web, there are two separate requirements to be met in MOVING. One is topic-based search on the web and the other is the crawling of whole websites. We utilise web search APIs to perform topical search in the web. Web search APIs include Google custom search API. Crawling specific websites requires a web crawler (e.g. Scrapy framework[29]). The current prototype of MOVING platform contains of around 20k of harvested crawled websites.

In addition, we developed crawlers to extract the bibliographic metadata from the Linked open data (LOD)[30] cloud. The initial version of MOVING contains around 181k of harvested bibliographic metadata.

The current prototype (month 17) of the MOVING platform contains also the following datasets:

- Videolectures.net - this dataset consists of around 20k metadata records of videos of educational video lectures with transcripts. The lectures are given by scholars and scientists at the most prominent events of their domain like conferences, summer schools, workshops and science promotional events.
- ZBW Economics Dataset - this dataset consists of metadata records for around 413k scientific English publications from economics.

Moreover, the platform will also contain other data sources. For instance, GESIS Dataset which contains of around 2,8 million metadata records and 5.400 open access full texts.

MOVING search engine is powered by faceted search functionality to filter the search results based on different criteria (e.g. document type, author name, date, venue, etc.). Figure 3 shows a screenshot of the search results page, and the faceted search widgets.

[29] https://scrapy.org/

[30] http://lod-cloud.net/

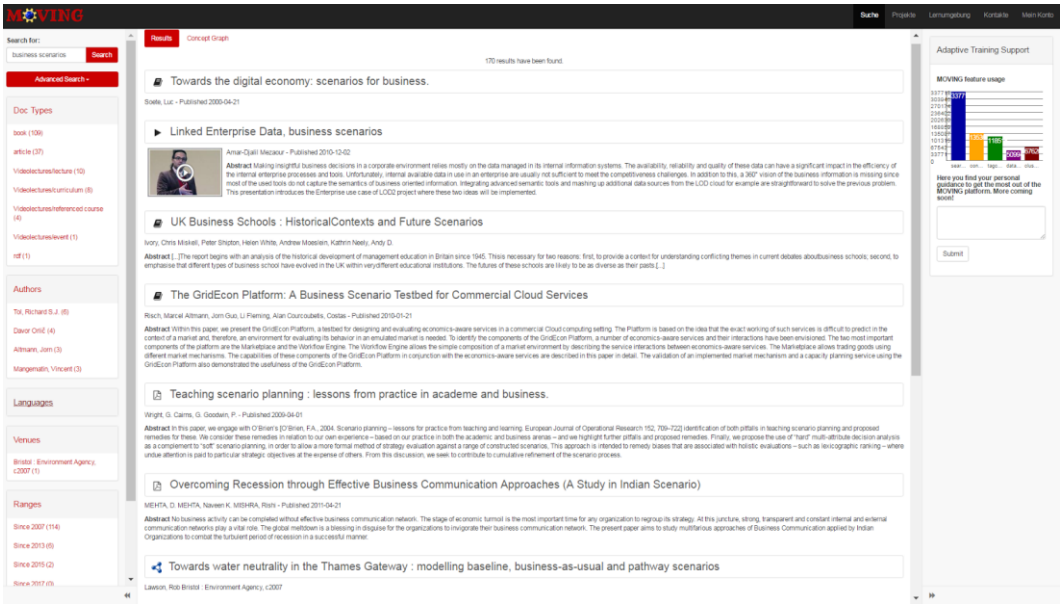

Figure 3: Screenshot of the search results page

4.1.4 Knowledge graph exploration

The number of results that can be returned by a user's search query in the MOVING platform may be high. Typically, the user focuses on the first results, potentially missing useful information in the remaining ones as ranking´s goal is to give priority to more meaningful resources. However, such a ranking may not be enough notably in scenarios where completeness is important (e.g. guaranteeing law compliance). In addition, important relationships and inter-dependencies remain obscured when presenting results in a standard list format.

To address these issues, we make use of graph visualisations. Graphs (or node-link-diagrams) are used to represent different entities and relations between them. Entities are visualised as nodes which are connected by links representing relations. Each graph is represented by a specific visual layout, which specifies the positions of the nodes, for example force-directed placement algorithms (Fruchterman, 1991) and the geometry of the links such as edge bundling methods (Holten, 2009). Different types of entities and relations, as well as metadata can be visualised through different visual variables for our proposed visual encoding concepts.

We build a knowledge graph consisting of the results and relevant concepts from a vocabulary, thesaurus, or ontology, in order to guide the user in exploring the results. In our case, results comprise educational resources such as books, research papers and video lectures. Furthermore, metadata can also be integrated; thus, the graph does not only present typical results and concepts, but is also enriched with authors and venues (e.g. conference, journal, etc.). Based on such a graph, we can provide advanced visualisations and content recommendations, which rely on the initial user query, but also on additional information, such as the user profile, the number of citations or views, and the length (in pages or minutes) of the resources. The visualisations provide easy-to-use user interactivity empowering users to explore the graph and discover new information depending on their particular interests. The recommendations may also consist of concepts and authors. This could help find potential problem solvers in open innovation scenarios which can support the user to discover the right topics, directly or indirectly related to an innovation problem and identifying experts in such topics. Another important aspect is time. Our graph can enable the analysis of temporal evolution of topics. For instance, some concepts can include only old papers which may

suggest that researchers were not interested in those concepts lately, while other concepts have publications in the current year. Other possible trend indicators are the number of publications and citations over time (if they grow, the interest is increasing). Initially, we focus on the economics domain, but other domains can be considered in future.

We integrate our GVF[31] which is currently under development into the MOVING web application. GVF is a web-based framework designed to support interactive analysis of large, complex networks which may consist of documents, topical concepts, authors, venues, locations and other named entities, as well as relationships arising from co-occurrences, hierarchies, discourses, reading orders etc. To ensure scalability and provide smooth animated transitions, GVF is implemented using WebGL[32] based rendering. Special focus is put on visual representation of metadata and novel graph aggregation metaphors (Kienreich, 2012) conveying relevant properties of nodes and relations in sub-graphs. These metaphors are currently in the design phase, with drafts designs introduced in the following subsections.

Building on these visual metaphors, we introduce powerful interaction models for explorative navigation, filtering (Hasitschka, 2017) and visual querying of the graph data. The graphs we want to visualise in MOVING contain multiple types of nodes connected by different types of links. Additionally, these graphs might grow large and complex since a lot of hits may be received. The resulting visualisation is likely to be too cluttered due to many link crossings and overlapping nodes, leading to overwhelming the user. We propose a concept that enables the user, who focuses on particular information, to visualise this information in detail.

To avoid clutter, the rest of the graph is summarised in a way that allows users to identify and explore other potentially relevant graph areas. To avoid information overload, the user shall initiate the exploration of the graph beginning from a small set of selected nodes, such as the most relevant results and the named entities extracted from these results. The user can explore the rest of the graph by clicking on nodes of interest, which triggers the expansion of the visible portion of the graph by showing nodes and relations which surround the current node(s) of interest. Graph regions, which are out of the user's focus, are aggregated visually and represented by a less complex visual summary. This summary provides information on what the user can expect to find, if she or he decides to explore that particular area of the graph. However, identifying relevant graph areas and finding nodes containing interesting information might be hard due to a mass of nodes and edges which are characterised by rich metadata. Thus, our concept focuses on supporting explorative navigation of the graph, by providing means for interest-driven, selective expansion of the visible graph areas.

Figure 4 shows an example from MOVING graph visualisation of the search results. The knowledge graph empowers the user to easily find relevant entities (e.g. documents, authors, venues etc.). Furthermore, it allows discovering relationships between these entities by providing sophisticated visual aggregation metaphors. Based on these aggregation metaphors, we offer powerful interaction techniques for navigating and filtering the graph. Combining both of our concepts, the exploration and aggregation, our tool provides possibilities to unveil obscured information in a huge amount of different domains.

[31] https://git.know-center.tugraz.at/summary/?r=~phasitschka/gvf/core.git
[32] https://www.khronos.org/registry/webgl/specs/latest/

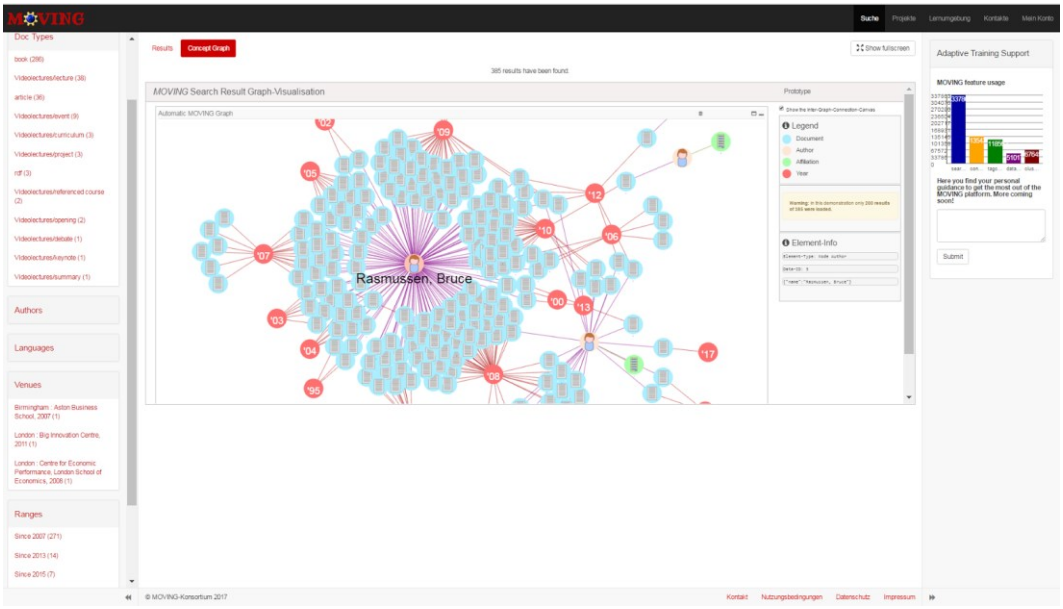

Figure 4: Graph Visualisation example

4.1.5 Adaptive Training Support

The ATS implements reflective learning technologies from the domain of TEL to the domain of learning how to search. Reflective learning theory has the goal to achieve a behaviour change of the user after reflecting on own experiences (Boud et al., 1985). The novelty is less of technological nature, rather than of conceptual and domain-specific nature. Particularly, the question is how to adapt reflective learning technologies to the domain of learning how to search and how to facilitate innovation processes. Therefore, we will develop the following two widgets, which will be integrated into the MOVING platform:

- "Learning-how-to-search" widget (see Deliverable D2.1)
- "Curriculum Reflection" widget (see Deliverable D2.3)

"Learning-how-to-search" widget

In the case of learning-how-to-search, the experiences to reflect on consist of the user's search behaviour with regard to the used MOVING platform tools and functionalities. Users will be guided to become experts in searching with the MOVING platform, as reflecting about own search behaviour triggered by reflective prompts should raise the user's awareness and reflection on the own search behaviour. Combining the triggers for reflection (in form of reflective questions) with recommendations of rarely or not used MOVING features or visualisations (e.g. "You have never used the graph visualisation. Please try it out.") can lead to new search experiences on the MOVING platform and pursue a change or improvement in the user's search behaviour - which is the major goal of reflective learning. A first version of the "learning-how-to-search" widget is implemented until month 18. This version will provide a bar-chart representing the MOVING feature usage (e.g. how often the graph visualisation was used), as well as reflective questions that either relate to the feature usage visualisation or recommend a new feature (the performance indicator – announced in D2.1 – is skipped for the moment because we need user data as basis to implement this feature and as the MOVING platform is not online and in use, we cannot develop this at the moment). The reflection guidance model keeps track of users' experience in using the MOVING platform features, e.g. faceted search queries submitted so far. Depending on this experience, prompts are selected and

presented to the user. In an earlier stage this could be a prompt asking about the feature which the user has used the most. In a later stage, a prompt may ask the user about recognised improvements in searching or learning behaviour. Figure 5 shows the "Learning-how-to-search" widget visualising feature usage and prompting the user about its most used feature.

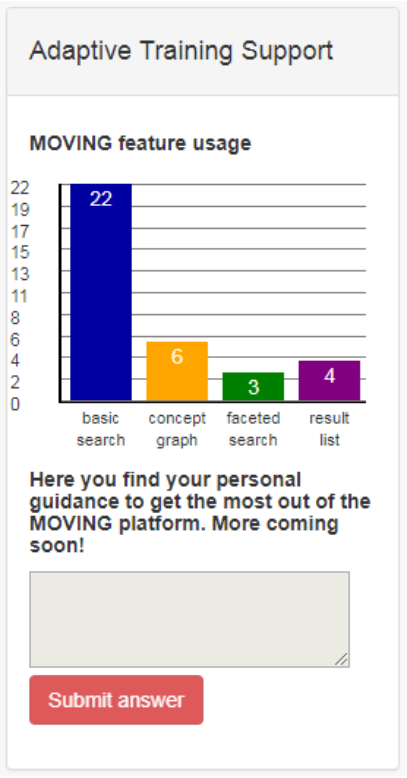

Figure 5: "Learning-how-to-search" widget visualising feature usage and prompting the user about its most used feature

"Curriculum Reflection" widget

First ideas of how to implement this widget already exist. On the one hand, the "Curriculum Reflection" widget aims at supporting the user to complete the selected curriculum, on the other hand it provides reflective questions to reflect on the progress and to give recommendations which documents or activities to do next. In this regard, the curriculum delivers advanced input for defining and prompting the reflective questions.

Progress beyond state of the art

From the above described state-of-the-art, we tackle two major challenges:

(1) How to transfer technologies for reflective learning into the domain of search and particular to support open innovation processes?

(2) What is a suitable timing-strategy to support reflection in work contexts and particular in the context of learning how to search?

Regarding (1), reflective learning technologies are used to support learning in formal settings as well as in work environments. We find that the nature of prompts and the reflective questions themselves are very specific to the learning goal. Due to this, reflective prompts and questions cannot easily be transferred to other domains or to other learning tasks. So far we found no literature on how to implement reflective learning technology to support learning how to search. Hence, the major contribution of the research around the ATS is to identify suitable indicators, reflective questions and prompts to support the technology-supported reflection about "how to

search". Combining search functionalities provided by the MOVING platform with different reflection guidance technologies is a new approach with the goal to improve and enhance a user's search behaviour and to educate data-savvy professionals.

Regarding (2), the second major advancement should be achieved with regard to investigating the timing of the reflection. This is an open challenge in relation to reflective guidance technologies (Fessl et al., 2017a, Fessl et al., 2017b, Rivera-Pelayo et al., 2017) as the question when and how to motivate for reflection is not clear at all (Thillmann et al., 2009). Building on related work from the domain of recommender systems, we investigate different suitable timing strategies.

Adaptive Training Support, its relation to open innovation and the progress beyond state of the art

Open innovation (see Section 2.1) and open innovation systems (see Section 2.3) aim at facilitating innovation processes in general and open innovation processes in particular. The MOVING project provides a learning- and training platform to facilitate innovation processes in different societal sectors and situations. From the latest developments around the topic of open innovation, three major challenges arise:

(1) The provision of tools for collaborative analysis of large amounts of text and other media,
(2) The provision of training programs (a) to use these tools and (b) to organise open innovation processes in general and
(3) The provision of suitable triggers to start and to facilitate open innovation processes.

The MOVING project addresses these needs and provides tools to satisfy them. The challenge thereby is to implement a concept that meets the specific nature of open innovation processes. This is where the ATS comes into play. The ATS does not directly support the open innovation process and can also not be an open innovation system itself. However, the ATS supports the open innovation process by providing valuable guidance for using the platform. Hence, integrated into an open innovation system, MOVING in general and the ATS in particular can enhance the functionality of an open innovation system and facilitate open innovation and corresponding open innovation process.

Thus, the "learning-how-to-search" widget aims at supporting the user to improve the search behaviour by providing guidance on which tools (e.g. visualisations) to use for organising and conducting efficient and effective searches to get a quick overview of regulations, patents, products, current trends, funding opportunities or scientific publications. This guidance is particularly important in open innovation, as new and unusual perspectives are important triggers for innovation processes. It values a broad scope of opportunities for initiating open innovation and thereby fulfils an important requirement for innovation systems. This reflection about the use of particular data analysis features enables the user to become more confident in working with the platform. With the gained expertise, the user is able to conduct an even more targeted search and learns to organise and apply the literature, which in turn results in more innovation. Also, bringing different and maybe distinct groups together can facilitate (open) innovation processes. The ATS supports this in particular by analysing large amounts of data and data traces and by providing suitable reflection points. The capabilities of the ATS will also be enhanced by applying content recommendation based on detecting cognitive features of users' behaviour.

4.2 Intellectual Property (IP) protection in MOVING

According to the previous sections, MOVING is implemented as a web-based software platform that will contain individual technologies of text and video analysis, as well as data visualisation algorithmic methods. Thus, researchers and public administrators will not only use the platform for their daily

tasks but will also be trained to improve their information literacy. The following IP types have been identified as relevant to the MOVING platform:

- **Invention-methods** including *methods and algorithms for text analysis* (such as finding data sources containing relevant information on the web for a given information, or clustering techniques to determine common temporal patterns, or semantic profiling and recommender systems, methods for author name disambiguation and duplicate detection of documents, *methods and algorithms for video analysis* (such as machine learning and visual information analysis and retrieval techniques), *visualisation methods* (such as graph-visualisation of MOVING search results techniques), *recommendation methods* (such as algorithms for cognitive search strategy recommendation in knowledge repositories (Skulimowski, 2017)) and *strategic planning methods* of knowledge repositories and digital libraries).
- **Software** that is either specific to the *MOVING platform* (the MOVING web application) and to its *individual technologies*, which include the implementations of the aforementioned theories and mathematical methods, a tool for querying interaction log data (data analysis) a software that is more flexible, scalable and pluggable than existing systems, a tool for scientific figures based on extracted text, as well as software development of two widgets the adaptive training support for improving user's search behaviour, the "learning-how-to-search" which visualises the user's search behaviour, and the "curriculum reflection" which visualises the user's learning progress.
- **Materials** including *production and provision of educational videos*, and *filmed videos with metadata* from important MOVING events.
- **Product design** including the *MOVING platform* and the *@VideoLectures.NET* production and materials.
- **Know how** including *collection of feedback and requirements* specific to the needs of junior and senior financial auditing professionals, regarding the business model canvases, for the MOVING exploitation, and *tutorials and guidance videos* with instructions on how to produce one's own (video) content in order to actively participate in the MOVING platform.
- **Scientific articles** for the *aforementioned methods and software*.

For each IP type, there are specific IP protection methods that are suitable for them; see for instance the EU's document "Fact Sheet How to manage IP in Horizon 2020: project implementation and conclusion" page 5[33]. In the table below (Table 7), in accordance with the suitable IP protection methods discussed in the above referenced EU document, we summarised the MOVING IP types and the corresponding IP protection methods that the consortium has decided to adopt.

Table 7: MOVING IP types and selected protection method

Matter/Subject	Copyright	Confidential Information	Trade Mark	Patent	Industrial Design
Invention method	x	x		x	
Software	x	x			

[33] https://www.iprhelpdesk.eu/sites/default/files/ newsdocuments/Fact-Sheet-IP-Management-H2020-Project-Implementation-and-Conclusion.pdf

Matter/Subject	Copyright	Confidential Information	Trade Mark	Patent	Industrial Design
Materials	x				
Product design	x		x		x
Know-how		x			
Scientific article	x				

For the IP of type *invention-method*, some details may be retained as confidential information, while others will be reported in scientific articles for which, in turn, copyrights are claimed. For the IP of type *software*, some parts of it will be open-sourced and copyrights will be claimed, while other selected parts of it will be protected as confidential information. Any materials produced in the course of the project will be copyrighted as well as any product design that will be developed. For the latter, trademarks and industrial design will be also used as forms of the respective IPs protection. The IP of type *know how* will be protected as confidential information. Protection by patenting, although not completely excluded as a possibility, does not seem to be the most appropriate protection means for the above IP, due to (1) the partial exclusion and/or debate on the patentability of scientific theories, mathematical methods, and software, according to Article 52 of the European Patent Convention (EPC), and (2) the high cost associated with the submission and support of a European patent application. Nevertheless, specifically for the methods and algorithms for cognitive search strategy recommendation in knowledge repositories, we will examine further the possibility of pursuing a patent in the United States Patent and Trademark Office (USPTO) or other algorithm patenting authorities.

The MOVING IP protection strategy, highlighted above, will be further analysed per IP type and per specific method in Deliverable D6.3: IPR plan that will be submitted in month 18.

5 MOVING target groups and how to access them

Defining the target groups is a fundamental component, vital for the dissemination and communication plan of MOVING. Target groups are the recipients of the project results and can act as delegates for disseminating further the project activities. These target groups of course include the MOVING platform target users discussed in Section 3.3 above, but are not limited to them; they extend to the broader community that should be made aware of MOVING and its results. In order to build the overall MOVING dissemination strategy, we initially identified four main different types of target groups. These types are the **general public, the scientific community, the policy makers and the industry/innovators** (these groups were identified in accordance with the proposed dissemination and exploitation strategy in Horizon H2020, presented at the H2020 Coordinators' day on March 2017, slide 3[34].

- **The general public target group** includes multiple groups of interest, that collectively amount to a large part of the society such as general public, social media users, innovation/tech blogs users, TV/audio users, and VideoLectures.NET users. These should still be informed, although they might be beyond the scope of the project's specific communities as they could potentially spread the benefits of MOVING in society.
- **The scientific community target groups** are informed about project results and make them available (not restricted due to the protection of intellectual property, security rules or legitimate interests) in their own work. These groups refer to researchers in research institutions and universities. Their feedback on the MOVING platform and technologies will help shape future project activities.
- **The policy makers target groups** are also informed about the project results and make them available in their own work. These groups refer to policy makers, auditors and public administrators. With their feedback, they will help shape future project activities.
- **The industry/innovators target groups** cover all groups and entities that are making concrete use of the project results for scientific, societal and economic purposes. This includes businesses and third-party organisations which will invest in project ideas. The MOVING project will have possible collaborations and foster interconnectedness with them.

With regard to the MOVING purposes, these types are further specified in more concrete categories as shown in the Table 8 below.

Table 8: MOVINGs' target group classification

General target group category	**Concrete subcategories**
General public	• General public (includes social media users and TV/radio users). • Special interest user communities (includes innovation/tech blogs users and VideoLectures.NET users).

[34] http://ec.europa.eu/research/participants/data /ref/h2020/other/events/2017-03-01/8_result-dissemination-exploitation.pdf

Scientific community	• Academic and research networks (includes members of the Leibniz Research Alliance on Science 2.0[35], of the EconBiz partner network[36], of the Education Portal Saxony GmbH[37], of the State of Saxony Rectors Conference[38] and Society of Media in Science[39] and of Knowledge 4 All Foundation Ltd (K4A)[40]). ○ The Leibniz Research Alliance examines the effects of Science 2.0 on science and society focusing on the research priorities "new working habits", "technological development" and "user behaviour research". It advises political decision makers and research funding bodies on national and international level on the establishment of research funding programmes on Science 2.0 and related topics. It includes 37 partners from different disciplines, which are university and non-university research institutes from Germany, Austria and Switzerland. ○ The EconBiz partner network fosters the transfer of knowledge and cooperation among its affiliates. It also promotes the EconBiz service on an international level and the research output of its partners, which are institutes, university faculties, or university and institutional libraries that focus on business and economic studies. ○ The Society for Media in Science (GMW) supports the research and the use of media as an integral part of research and teaching at universities. GMW promotes the testing of media-based learning scenarios and facilitates the critical reflection on the potentials of new media in all fields of its development at universities. Further it aims the promotion of media competency of its members and combining the individual activities at universities in terms of media use. The GMW sees itself as a network of interdisciplinary communication between theory and practice, between science and industrial application at the German and European level. ○ The Rector's Conference Saxony of the state (LRK) is a merger of the rectors or the presidents of higher education institutes with the aim of cooperating between the Saxon universities. LRK ensures the collaboration of the universities in the fulfilment of their tasks. It elaborates statements and recommendations on issues of higher education and science, as well as questions affecting all universities. Further, LRK

[35] http://www.leibniz-science20.de/
[36] https://www.econbiz.de/eb/en/about/econbiz-partner-network/econbiz-partner-network/
[37] https://www.bildungsportal.sachsen.de
[38] http://www.lrk-sachsen.de
[39] http://www.gmw-online.de
[40] http://www.k4all.org

	informs the universities about current developments in the higher education field and sees itself as a voice of the Saxon universities in the public eye. ○ The Saxony Education Portal (BPS) is a joint e-learning initiative of universities in Saxony. It provides professional e-learning services and modern software applications for the support of education, communication and organisational processes for companies, educational establishments and public organisations. The BPS works with a wide range of services and software applications, especially from the open source area. Key foci of the initiative are located within competence building, transfer of knowledge and coordination of digital media use in education. BPS is further the operator of the academic teaching and learning platform OPAL, which is currently used by more than 70,000 university members in Saxony. ○ The Knowledge 4 All Foundation Ltd (K4A) is one of the most important research and development centres in the field of artificial intelligence in Europe. The aim of the Foundation is to reduce the current gap between new trends in education, on the one hand, and advanced technologies in artificial intelligence, on the other, with the ultimate goal of securing the future of open education. K4A supports more than 1000 researchers and 62 member institutions, co-funding more than 260 events, more than 60 machine learning challenges and has 20.000 academic video lectures. Moreover, two K4A trustees are holding the UNESCO Chairs for OER (one is the UNESCO Chair in Open Technologies for OER and Open Learning, the other is the UNESCO Chair in technologies for the training of teachers by OER). • Individual academics and researchers (this includes master/PhD students, faculty members in higher education and young researchers).
Policy makers	• Academic support officers. • Public administrators (such as compliance officers in companies, auditors, tax advisory professionals - e.g. transactions specialists and advisers from the EY's Transaction Advisory Services (TSA) service line).
Industry/Innovators	• EY's clients (this includes audit clients, users of EY's Centers for Medicare & Medicaid Services (CMS) and professionals in primary digital industries such as: (1) automotive & transportation, (2) consumer products & retail, (3) health care & life sciences, (4) diversified industrial products, and clients with focus accounts in EY EMEIA (Europe, Middle East, India & Africa). • EY's employees (this includes stakeholders with global priority

	accounts and strong positioning in Europe, such as team members of the TSA service lines that are working on the global priority accounts in the aforementioned digital industries, employees in service lines in GSA (Germany, Switzerland and Austria) who daily use the organisation's innovative tools and GSA Innovation@EY team members). • GSA Innovation@EY is a cross-service line and cross-functional initiative in GSA and supported by the entire leadership in GSA. The team consists of professionals who have innovation roles in their respective service lines and CBS (Core Business Services) functions that have been nominated by their leadership. As the team spans all major functions, it acts a sounding board to improve EY's professional's ideas. The team evaluates and routes innovation ideas to the GSA Innovation Council for decision making and resource allocation. Active innovation projects are project managed by the team. • Silicon Saxony members. Silicon Saxony is an industry association which connects over 320 member companies in the field of micro- and nanoelectronics, software, applications, smart systems and energy systems. As a communication and cooperation platform for its members it connects manufacturers, suppliers, service providers, universities, research institutes and public institutions in Saxony. Silicon Saxony has the aims of strengthening the economic sustainability in the region of Saxony and strengthening the representation of Saxony as a location for information and cooperation technology on a national and international level. With its offers, it is the most successful industry network in Europe. • IT specialists and organisations (this includes integrated system and application developers, IT companies, content and service providers, commercial and non-profit organisations in the areas of web data analysis and analytics, multimedia and video applications, data archiving, educational applications). • Knowledge professionals (this includes knowledge workers who deal with knowledge (find, create, learn and transmit) in their daily work life. E.g. people in human resource departments who continuously update their knowledge about labour law topics or engineers who need support to perform on new, very complex tasks). • Innovative companies, entrepreneurs in general.

The overall communication, dissemination and exploitation strategy of MOVING aims at reaching the above specified target groups, with the aim to:

- Raise awareness of the potential of the platform for the sectors of the information technologies, decision science and education.
- Raise societal awareness of the platform and its potential.
- Disseminate the activities, the results and the scientific achievements in the platform.
- Build user communities around the project platform.

- Determine to use the MOVING not only as a working environment but also as a general training platform for professionals.
- Make available the use of the MOVING platform as part of next generation information infrastructure services.
- Carry out applied research in third-party funded projects.
- Sell the platform as service to business companies' customers.
- Support business companies' strategic decision making.
- Foster possible collaborations and interconnectedness with third party companies.

A successful dissemination and exploitation strategy requires identification of effective and efficient communication, dissemination and exploitation instruments that will help in reaching the aforementioned target groups during and after the project's lifetime. Each target group has its own sphere of communication and - implementing the dissemination and exploitation strategy depicted below - we take advantage of the respective instruments whereby we can reach each target group effectively. Figure 6 was created in accordance with the figures proposed in dissemination and exploitation of Horizon H2020 at the H2020 Coordinators' day, 1st March 2017 slides 7 and 9[41] by adding specialised activities that server in the best way the project needs.

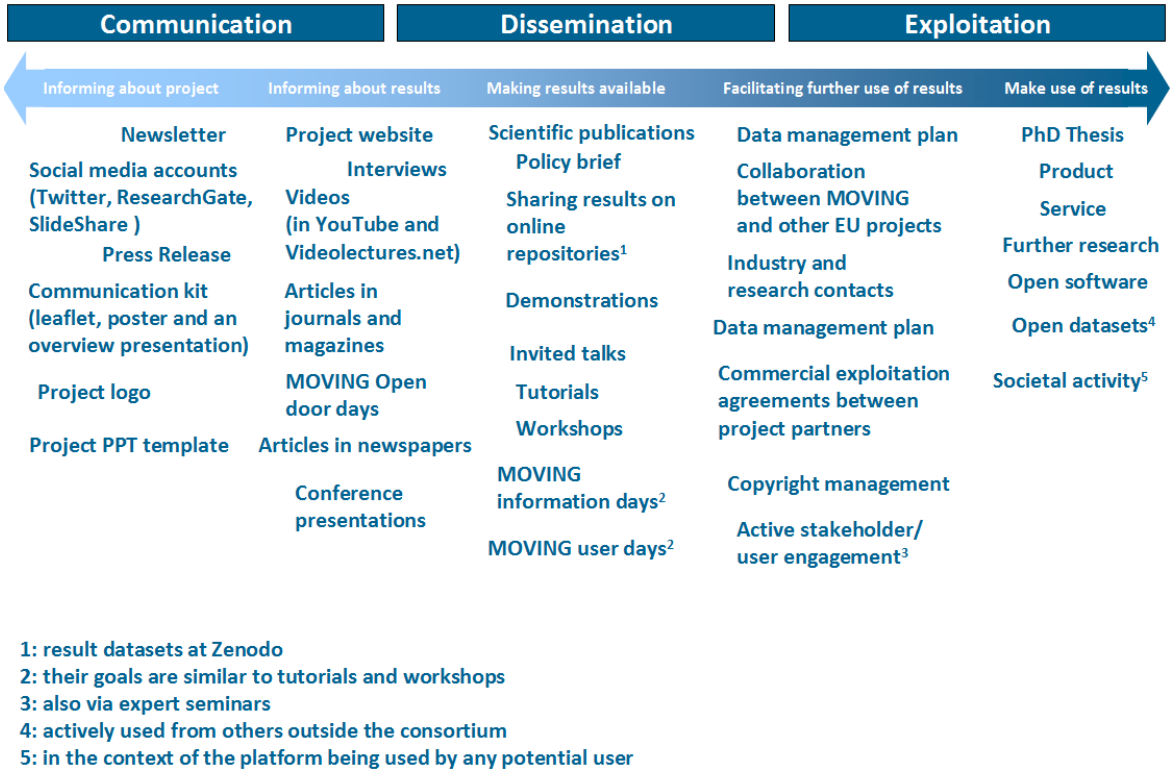

Figure 6: The MOVING instruments

The following table depicts which instrument of MOVING's dissemination and exploitation strategy is addressing which target group.

[41] http://ec.europa.eu/research/participants/data/ref/h2020/other/events/2017-03-01/8_result-dissemination-exploitation.pdf

Table 9: Relations between instruments and target groups

Communities / Instruments	General public	Scientific community	Policy makers	Industry/ Innovators
Newsletter	x	x	x	x
Press release	x	x	x	x
Social media accounts (Twitter, ResearchGate, SlideShare)	x	x	x	x
Communication kit (leaflet, poster and an overview presentation)	x	x	x	x
Project logo	x	x	x	x
Project PPT template	x	x	x	x
Project website	x	x	x	x
Videos (in YouTube and Videolectures.net)	x	x	x	x
Interviews	x	x	x	x
Articles in journals and magazines	x	x	x	x
Articles in newspapers	x	x	x	x
MOVING Open door days	x	x	x	x
Conference presentations		x	x	x
Scientific publication		x		x
Policy brief			x	x
Tutorials		x		
Invited talks		x		
Workshops		x	x	x
Demonstrations	x	x	x	x
Sharing results on online repositories	x	x	x	x
MOVING information days (including organised workshops)	x	x		

Communities / Instruments	General public	Scientific community	Policy makers	Industry/ Innovators
MOVING user days (including organised periodic seminars and user workshops)		x	x	x
Data management plan		x	x	x
Collaboration between MOVING and other EU projects		x	x	x
Industry and research contacts		x	x	x
Commercial exploitation agreements between project partners		x	x	x
Copyright management		x	x	x
Active stakeholders/user engagement		x	x	x
PhD Thesis		x		x
Product				x
Service				x
Further research		x		x
Open software		x		x
Open datasets		x		x
Societal activity	x			x

According to the table above, the derived dissemination and exploitation strategy – the first version of the latter will be elaborated as a part of Deliverable D5.2 – suggests that all instruments identified are necessary and should be employed in order to achieve the highest possible outreach to the different types of target groups.

In addition to the above strategy, in MOVING we are in the process of identifying a concrete *'sustainability dissemination and exploitation strategy'* by extending the access to the project outcomes until after the end of the project lifetime. This is the main aim of the Deliverables D5.4 (final strategy) due in month 35. Already identified elements of this strategy include:

- The project website that will remain online for at least 5 years after the end of the project.
- Since the project website includes the communication kit, the newsletters, the press releases, the social media accounts, and other materials, the availability of the above as long as the website remains online is ensured.

- The scientific publications that are posted in the Zenodo repository to remain permanently available.
- The MOVING platform and all the technology components that will remain available in accordance with the D5.2 exploitation strategy deliverable. The deliverable will be provided at the end of month 18 of the project.
- The user communities that will emerge around the MOVING platform will be organised in a way allowing their members to exchange experience with the use of the platform and provide support to each other. The development of these will be proposed in the community building action plan which will be a part of the above-mentioned deliverable D5.2. The MOVING community building will also strongly benefit from the overall dissemination activities.

Finally, we should mention that in MOVING we foresee separate deliverables for dissemination, communication and exploitation plans and that will provide updated content according to the progress and emerging results of the project in month 18 with D5.2: Exploitation strategy and user community building action plan, in month 24 with D5.3: Dissemination and communication plan and activities - second report, in month 35 with D5.4: The MOVING platform final exploitation strategy and in month 36 with D5.5: Dissemination and communication plan and activities - third report.

6 Risks and mitigation measures of the MOVING platform

In this section, we present an updated risk table, extending the initial table provided in the Description of Action (part A, p. 30). These risks are concerned with the realisation of the MOVING platform novelties, access to public administrators, user platform acceptance and use of platform by public administrators. For each risk, we provide mitigation measures.

Table 10: Risks and mitigation measures

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
R15	Access to public administrators and financial auditors	WP1	We devise extensive dissemination activities, carefully designed in order to clearly present the platform and increase motivation.
R16	Acceptance (platform is not accepted by users)	WP1, WP4	We conduct extensive user acceptance tests to ensure that design decisions and features provided by MOVING are accepted by the users. These acceptance tests are used to make decisions on how to change the features and how to proceed, if needed.
R17	Platform usage (public administrators)	WP1	We plan focused disseminations targeting public administrators employed by the state.
R18	Realisation of platform novelties	WP4	This is a risk related to R9. The mitigation of this risk will be performed as follows: The MOVING work plan design will allow for early identification of any potential problems regarding technical integration and solving these problems by devoting additional effort or falling back on a plan B. Moreover, the mitigation strategy can include continuous updates and monitoring of the databases, continuous improvements of data processing and indexing, keeping up with technology developments and available algorithms, and continuous improvements of visualisations capabilities for large datasets.

In another risk analysis dimension, risk factors that may be relevant for the future sustainability of the MOVING platform have been identified and analysed within a Delphi survey that has been organised as a component of WP5. The results of this risk analysis based on the survey results are contained in the Deliverable D5.2, due in month 18.

7 Conclusions

This Deliverable D2.4 “Open innovation systems state-of-the-art and beyond” provides a detailed definition of key concepts regarding the MOVING approach, compares the MOVING platform to different related fields of research and demonstrates where the MOVING project contributes beyond the state of the art. Key to this holistic view and joint understanding of what MOVING is and how it contributes to open innovation and leadership in open innovation are the definitions in Sections 2.1 and 2.2. Another notable contribution is the detailed analysis of the existing systems for open innovation, expert search, recommender systems, collaboration tools, intelligent learning and decision making tools like adaptive hypermedia and decision support systems, as well as generally technology-enhanced learning and other projects in Section 2.3.

Based on this detailed study, a common understanding of the support for open innovation through MOVING, its use cases and its contribution to information literacy to enable open leadership innovation has been given in Section 3. Since the innovation potential and contributions beyond the state of the art are manifold, Section 4 has provided in details the scientific and technological novelties made by the MOVING platform, including a discussion of IPR and its protection in the MOVING project.

As an approach, that embraces a working environment and training environment through a unique combination of technological components and the integration of working and training in a community of practise, the MOVING platform reaches out to various target groups. In Section 5, we have clearly laid out who are those target groups in the context of the project, how they can be reached and how the MOVING project does involve them.

Pursuing the MOVING approach and implementing it in an operational system, the MOVING platform, is a complex task in terms of technology that is developed and integrated as well as organisational challenges emerging from interdisciplinary research and development and access to the target groups. Thus, we have provided an updated risk table and corresponding mitigation measures in Section 7.

Overall, this Deliverable D2.4 on “Open innovation systems state-of-the-art and beyond” of the MOVING project reflects a concise and common understanding of the interdisciplinary research and development carried out in the project as both theoretical and methodological innovation. It will help to further foster the ideas and contributions to open innovation and leadership in open innovation through the MOVING platform and serve as a guide through the further developments. Since the field of open innovation and the research areas tackled by the MOVING platform are very active, a continuous observation of these developments and more importantly significant contributions to open innovation through the MOVING platform ensure an impact of the project results and longevity of the MOVING approach.

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