

Literature-based synthesis

Knowledge management in public administrations

Final report

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Responsible author:	Dr. sc. med. Jorgen Bauwens				
Affiliation:	Swiss School of Public Health+ (SSPH+)				
Co-authors:	Dr. Emily Reeves				





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Preamble

Leading authorities in public health must base decisions and policies on the latest knowledge available, hence they need to be fully informed of the current state of knowledge and related practices in the field. However, public health entails a wide scope of diverse domains with continuous scientific research generating considerable novel evidence and insights, particularly in Switzerland. Thus, efficiently monitoring, managing and processing this information becomes increasingly challenging. In light of the ongoing growth of information in public health sciences, it is essential to have a well-functioning knowledge management (KM) in place to ensure informed-decision making that is based on sound findings and evidence.

KM shows vast and important developments, driven through rapidly and constantly evolving information technologies (IT). This report synthesises the available literature on KM practices, experiences, and lessons learnt in public administrations to date. This study doesn't focus on science-policy interfaces, science communication, or KM in crisis situations.

The present document addresses theoretical aspects of KM in public administrations and highlights relevant examples of KM practices. This report outlines key components of KM and describes its relevance for public administrations. In support of this, strategic considerations, guiding principles and approaches to KM, as well as tools for implementing knowledge management are presented and discussed with relevance to their use and application for public administrations.

Updates to the previous report are written in blue.





Introduction

Background

Public administration refers to the field of service that is concerned with operations intended for the enforcement or fulfilment of policy. Specifically, it plans, organises, directs, coordinates, and controls operations at government, public sector, and non-profit organisations. Moreover, public administration is practised at all levels of governance, with specific goals that apply to all domains of society, including the public health sector. Crucially, it is intrinsically linked to public health as it defines the basis for all public health policy, i.e., the decisions, plans and actions that are taken to achieve specific health protection objectives in society (WHO, 2022). Specifically, it is necessary for the writing and passage of any law that determines government involvement in health policy, repealing or replacing laws that no longer work and enforcing existing policies. Functioning societies thus rely heavily on public administration in public health to adequately maintain and uphold the promotion of societal health, as well as to support disease prevention and manage responses to health threats and emergencies, to mention a few examples. However, although public administration is critical for ensuring necessary public health policies and actions for the benefit of society, there are many challenges to ensuring effective public administration in public health.

Challenges to ensuring effective public administration in public health

Firstly, dealing with societal problems, such as those relating to public health, often involves high levels of complexity and uncertainty. Problems can arise from complex social, economic, and political contexts. For instance, quickly changing public health circumstances, such as public health threats or crises can require immediate action, forcing timely decision-making and subsequent plans of action. Moreover, often multiple stakeholders with diverse perspectives, priorities, and high levels of interdependence are involved in these processes. Hence, problem solving at this level usually asks for multi-stakeholder approaches and the interweaving of diverse types of knowledge (de Wit, 2022), which affect public administration processes. The differing stakeholder perspectives can lead to difficulties in reaching consensus on problem definitions and solutions which hinders efficient, timely decision-making and problem resolution. Consequently, issues are often considered "relentless", i.e. that they "cannot be solved once and for all despite all the best intentions and resources directed at the problem and efforts to solve the problem can even have undesired consequences for other policy arenas as well" (Soo, Chen and Edwards, 2018). Furthermore, managers of public administrations can struggle to mitigate these types of struggles as they have relatively limited executive and administrative autonomy. Specifically, compared to managers in private sectors, they are





subject to more stringent control because of legal requirements which means that they may have smaller decision-making autonomy and flexibility, as well as a more restrictive budget processes (Bučková, 2015). Nevertheless, health policies can only be considered appropriate for implementation if they are based on sound knowledge, evaluation and reasoning. This demands that public health authorities are well-informed and possess extensive, reliable and current knowledge of the public health scope. Yet, public authorities are presented with a high volume of public health information that is at constant influx, with the sources of public health information needing to be adequately processed, i.e. evaluated and filtered for valid versus invalid data by professionals who are competent and knowledgeable in the field. In addition, as with many organisations, public administrations face the risk of losing professional work expertise due to changes in staff and retirements. Yet, studies demonstrate that there is a broad unpreparedness toward this issue in public administrations, pointing to a considerable need for systematic knowledge management (Schoop, Hesse and Breidung, 2016).

Knowledge and knowledge management

Knowledge emerges when information is put in context through critical thinking, evaluation, structuring, or organising, or by using logical inference on existing knowledge (ASTHO, 2005). Knowledge can be explicit, i.e. presented as a documented form of data and information ordered according to defined, formalised procedures or rules, or it can be tacit, i.e. it is understanding, insight, or instinct built through experience and training that resides within people (ASTHO, 2005). Information arises from data, such as facts, concepts, or instructions, that were appraised in some way, for example through categorising, filtering, or indexing (ASTHO, 2005).

Both explicit domain-specific knowledge and tacit knowledge, including soft skills, underpin expertise-based intuitive decision-making. Such knowledge plays an intangible role in the visible expression of leadership skills, and can thus be essential for the success of public sector-led initiatives (Hanif, Ahsan and Wise, 2020). Moreover, it is also relevant for public administrations as the collection of knowledge resources that are shared, consumed, and applied support the effective functioning of an organisation. Fundamentally, effective public administrations must especially evaluate what knowledge is important to utilise, store or discard, as well as to determine what knowledge is at risk of getting lost and decide how this loss could be compensated with future measures.



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Knowledge Management

Knowledge management (KM) aims to effectively use and produce in-house knowledge and develop organisational competences, to ensure that stakeholders not only have the right information at the right time, but that they receive it in a form that is understandable so that it may be used to effectively meet the objectives of the organisation (Ulewicz and Blaskova, 2018). KM actively uses synergy effects between three pillars, namely; 1) human resources, 2) organisational processes to collect, manage, and disseminate knowledge, and 3) technology infrastructure (e.g., hardware, software, networks) (Cepelova, 2014b). Moreover, different models of knowledge management can be found in the literature that share similar characteristics, although they are sometimes presented differently or with slightly divergent descriptions. A frequently referenced model is shown in Figure 1. According to the building blocks of this model, effective knowledge management in public administration consists of the following processes (Cichoń, 2020) :

- 1. Acquiring knowledge: a significant part of knowledge resources from external sources.
- 2. Developing knowledge: acquiring skills, improving existing processes, conducting market research.
- 3. Knowledge sharing and dissemination: providing access to individual information and skills so that they can serve the entire organisation.
- 4. Exploiting knowledge: Using existing knowledge resources of the organisation.
- 5. Preservation of knowledge: Preserving and accumulating acquired knowledge through selection, storage and updating.
- 6. Knowledge localisation: methods for discovering organisational knowledge and its rapid localisation.



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Figure 1. Building blocks of knowledge management. (Probst, 1998)

The four-dimensional structure of KM processes further demonstrates the extent of KM in organisations:

- 1. Knowledge centred culture: reflecting a guiding framework for instituted practices, rules, norms and procedures that are centred on organisational knowledge;
- 2. Competitive orientation: reflecting the organisation's orientation towards the outside;
- 3. Formal knowledge management practices: groups' organisational actions developed around formally instituted processes, centred on knowledge of a mainly explicit nature;
- 4. Informal knowledge management practices (i.e. the informal interactions occurring in the organisation which facilitate social construction of knowledge) (Brito and Cardoso, 2012).

Importance of knowledge management in public administrations

Information and knowledge are a strategic resource. The proliferation of data presents an opportunity for governments to provide better services and involve citizens in digital governance. Specifically, information systems can be a source of information and knowledge, help track public-service performance, and devise



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ways of providing better services (Chen, 2017). In addition, opening government data empowers citizens and civic groups to understand and share information about government services and provides citizens with a way to make governments more accountable for their actions (Chen, 2017). Equally, governments can leverage information to propel innovation (Chen, 2017). Forward-looking governments thus develop their knowledge and build creative economies, and they use information and knowledge strategically for research, development, and innovation (Chen, 2017). Governments are in a unique position to advance information and knowledge management for digital governance (Chen, 2017). They can be engines of growth and innovation by moving toward a knowledge-intensive economy (Chen, 2017). In doing so, governments can ensure that they keep up with the expectations of citizens, who are accustomed to available high quality online services and remain responsive and accountable.

Governments routinely collect and analyse digital information to offer services, resulting in a rapid growth of data and information. Consequently, governments face the significant challenge of managing fast-growing digital information, along with their existing responsibilities of information stewardship (Chen, 2017). The unique challenge of governments is to serve as information steward, trusted with preserving information and records as well as being the ultimate guarantors of public information and services (Chen, 2017). This demands that a government keeps paper and digital information, while dealing with a wide variety of document types and data formats (Chen, 2017).

Given their stewardship role and the knowledge-intensive nature of public administrations, the value of developing a strong KM capability is highly relevant, if not a prerequisite, for public administrations. The benefits of KM for public administrations are numerous. Firstly, KM demonstrates a direct positive effect on policy development in public administration (Amiri *et al.*, 2017), for example it contributes to improving novelty and agility in policy development and service delivery (Pee and Kankanhalli, 2016). In addition, KM supports four essential indicators of public service, namely: providing service focused on citizens, transparency, traceability, and image (Batista and Matos, 2014). Furthermore, the need to better manage knowledge is likely to intensify as public organisations increasingly seek to engage citizens and businesses in co-creating public policies (Pee and Kankanhalli, 2016). KM has also been proven to foster collaboration among individuals and institutions by sharing and transferring organisational knowledge (Cahyaningsih, Sari, *et al.*, 2016). Moreover, KM is valuable for improving organisational effectiveness and is well suited to tackle many challenges of public administrations, such as reducing human capital loss due to employee turnover, as well as helping to increase knowledge stock and flow due to advances in information technology (IT) (Pee





and Kankanhalli, 2016). Equally, knowledge sharing and mature KM can also help to reduce organisational and personal stress in public administrations (Marques *et al.*, 2019), as well as help to eliminate ineffective habits and practices of individuals in public administrations, thus having a positive knock-on effect on the organisation as a whole (Bučková, 2015). It has also been shown that KM and resource sharing — both among administrative units and with civil society – increase the organisational ability to perform well in crisis situations (Schomaker and Bauer, 2020). Particularly, how the lessons learnt from a situation are stored, and how these insights are made available when a next crisis breaks out, determine an organisation's preparedness (Schomaker and Bauer, 2020). However, to effectively implement and use the principles of KM in public administrations, the current processes of an organisation must be identified and there must be willingness to educate employees in the long term, as well as a commitment to implement a series of changes in the organisation (Bučková, 2015).

KM in public administrations tends to be underdeveloped and undervalued (Špaček and Gatarik, 2017). Although often no formal knowledge management instruments are used, public administrations – such as the Swiss administration of justice – resort to a variety of ways to manage knowledge, thereby unconsciously applying the basics of storytelling and knowledge maps to share and document knowledge (Jakob, 2015). Nevertheless, installing knowledge management should not be done hastily. One should be aware that effective knowledge management is a long and challenging endeavour, and that blindly using any knowledge management tools should be avoided but rather tailor-made solutions should be adopted (Jakob, 2015).

The KM cycle of government human capital management (GHCM) consist of the following five activities (Cahyaningsih, Sensuse, Arymurthi, *et al.*, 2016):

- 1. Acquiring: discovering knowledge through searching, reading, and analysis;
- 2. *Verifying*: through expert inquiry from experiences, associate discussions with colleagues, group discussions, workshops to gather the knowledge and experiences, comparing with past cases;
- 3. *Storing*: keeping and maintaining knowledge to be easily retrieved for future reference, e.g. in databases or repositories, recording by writing notes, internalising knowledge in the mind as experiences, and filtering important information as knowledge;
- 4. *Sharing*: transferring knowledge among individuals in an organisation, e.g. through meeting, discussion, information exchange, storytelling, socialisation to disseminate new knowledge to a large number of people;





5. *Utilising*: applying knowledge embodied in individual assets, combining existing knowledge to create new knowledge, applying knowledge to solve problems or for decision-making, externalisation to document knowledge.





Methodology

We searched for academic literature through the 'Web of Science' and scopus search engines and screened grey literature, using keywords "public administration" and "knowledge management". Given the rapid development in the area of KM, we limited our searches to the most recent 10 years, i.e. the period 2012-2022. We retrieved 126 articles, of which 81 were included. Of the remaining articles, 13 were excluded because they did not concern public administrations and 38 were excluded because they did not address knowledge management (6 neither addressed knowledge management nor public administration). Additional articles and sources were identified through snowballing (i.e. additional articles were identified from the reference lists of selected articles).



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Findings

Strategic level

Embedding or liaising KM with an organisation's strategy and adopting a clear KM strategy means that knowledge should go beyond information and data and consider intellectual capital (IC), which consists of knowledge, experience, technologies, relations with clients / stakeholders (relational capital), and skills. IC is mainly carried by the staff of an organisation and stakeholders, who are the most important resource of the organisation in knowledge-based economies (Ulewicz and Blaskova, 2018). In today's knowledge-based environment, it is important to identify, measure, manage and report IC, and to use IC as a strategic management framework to face challenges and opportunities in the public sector (Sposato and Puntillo, 2012). Organisations can adopt a knowledge strategy that defines the organisation's overall approach to align its knowledge, resources and capabilities to the intellectual requirements of its strategy. Specifically, strategic knowledge management (SKM) relates to the processes and infrastructures used to attain, create and share knowledge for formulating strategy and making strategic decisions (Ferreira, Mueller and Papa, 2018). It considers the interaction between technological and intellectual resources, including global knowledge networking (Ferreira, Mueller and Papa, 2018). A key aspect of knowledge creation and innovation is the ability to absorb external knowledge through a set of dynamic capabilities to acquire, assimilate, transform and apply to external information. This absorptive capacity could enhance the organisation's capabilities to facilitate knowledge exchange processes, which could in turn increase innovation performance (Ferreira, Mueller and Papa, 2018). The major relevant questions that are thus raised in SKM are (Ferreira, Mueller and Papa, 2018):

- What resources can be used to create, acquire and integrate knowledge in knowledge-intensive processes?
- How can knowledge-intensive processes be designed, redesigned and adapted to changing technological and market conditions?
- What resources and capabilities can be used to design the processes?

KM implementation in public administration human capital can be formalised through the following strategies in each of the three pillars of KM (Cahyaningsih, Indra Sensuse, *et al.*, 2016; Cahyaningsih, Sensuse and Noprisson, 2017):

- Human resources pillar:
 - Considering appropriate employee replacement and staff redistribution



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- Fostering knowledge enhancement through development, training, KM processes
- Increasing knowledge transfer among employees and leaders through collaboration
- Improving Human Resource (HR) teamwork and participation in all activities
- Increasing the commitment, integrity and loyalty in support of KM and public services
- Encouraging the leaders to be more open, be mentors, and centres of knowledge
- Organisational processes pillar:
 - Aligning HR development processes with knowledge requirements
 - Making training needs assessments / designing staff development according to the needs of knowledge
 - Improving HR development processes by opening up greater opportunities
 - Promoting a culture of sharing and transferring knowledge and information to change employees' mindset
 - Enhancing dissemination of knowledge and information through media technology
 - Leaders supervising KM processes by directly engaging. monitoring and evaluation
 - Preparing regulations, policies, and technical guidelines implementation
- Technology (IT) pillar:
 - KMS planning and implementation
 - Improving KM process infrastructure

The reforms of the Austrian federal administration's KM reflect the importance of a strategic alignment and basis. Based on an initial study, the following recommendations were formulated and implemented (KDZ - Zentrum für Verwaltungsforschung, 2020):

- Creating a federal strategy for ministries, taking into account the effect on knowledge due to staff cuts and demographic developments;
- Establishing a coordination function (e.g. a KM working group) to provide instructions and recommendations (strategies, standards, definitions, goals, tasks);
- Creating clarity about the tasks of knowledge managers;
- Personnel management to serve as a starting point for the integration of KM;
- Analysing the status of KM in downstream/outsourced departments (e.g. aspects of control options and the loss of knowledge).





It has been shown that KM is relevant in management sciences, human resources, strategic management, leadership, organisational culture, and behaviour (Lartey *et al.*, 2021). Analysing KM from a resource-based view shows that the three pillars of KM are highly interrelated: physical KM resources (e.g. technology, training, support) interact with organisational (e.g. organisational structures and senior management championship), as well as human resources (e.g. expertise and social capital). These interactions can be enforcing or suppressing: for example, particularly senior management championship, but also social capital and staff's expertise enhance the effectiveness of physical KM resources whilst a restrictive organisational structure had a suppressing effect (Pee and Kankanhalli, 2016).

Knowledge-based strategies play a central role facilitating change implementation. KM makes institutional changes feasible and generates organisational capacity to implement solutions and promote sustainable development (Brito *et al.*, 2019). An Australian case study on the networked and collaborative characteristics of Public Value Management (PVM) revealed inter-relationships between KM strategy, adopting a person-centred approach to service provision, and sustainability of change implementation (Soo, Chen and Edwards, 2018). Organisations' knowledge capture and sharing systems and processes can implement change in a way that generates long-term benefits for both public sector employees and clients, thanks to these relationships (e.g. by key stakeholders engaging to share knowledge and develop insights to generate innovative solutions) (Soo, Chen and Edwards, 2018).





Guiding principles and approaches

This section introduces major principles, requirements, approaches, and techniques that form a basis for successful KM implementation, specifically but not exclusively in public administrations.

The Indonesian "NUSANTRA" model for government human capital KM is a comprehensive model addressing the diverse aspects of KM, which illustrates the width and complexity of establishing a KM system. This "NUSANTARA" model consist of eight layers (Cahyaningsih *et al.*, 2017):

- 1. Vision and mission: Describes the organisation's vision and mission of KM;
- 2. Critical success factors:
 - a. Human: motivation, human capital, commitment, innovation and creation, goodwill and integrity;
 - b. Organisation: HR processes, KM processes, regulation, leadership, organisational culture, teamwork, environment, monitoring and evaluation, stakeholder, network, opportunity, cost, change management;
 - c. Technology: IT and infrastructure.
- 3. *Knowledge mechanism and technologies*: Activity mechanism and technological features of knowledge discovery, knowledge sharing, knowledge capture, knowledge application;
- 4. KM system: Information Technology (IT) supporting the:
 - Knowledge discovery system: electronic discussion groups, email, web based access to data, repository of information, chat groups, video conferencing, lesson learnt database, data mining);
 - Knowledge capture system: best practice database, lesson learnt system and database, best practice system, computer based communication, daily activity database, Artificial Intelligence (AI) based knowledge acquisition, expert system, computer based simulation;
 - c. Knowledge sharing system: electronic discussion groups, video conferencing, email, expertise locator system, repository of information, web.based access to data, team collaboration tools;
 - d. Knowledge application system: work performance system, web portal, information management system, case-based reasoning system, enterprise resource planning system, decision support system, expert system, physical repository of information.
- 5. KM cycle: Cycle of acquiring, verifying, storing, sharing, utilising knowledge;



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- 6. *KM processes*: Consist of knowledge combination, externalisation, internalisation, socialisation and routines;
- 7. Organisational core knowledge: Representing the knowledge map of government human capital management, including: public services, regulations, human capital management, monitoring, bureaucratic reforms, organisational knowledge, human capital development, research and assessment, innovation, higher education management, recruitment and selection, human capital planning, human capital retention and retirement, IT, communication, and leadership management;
- 8. *Outcome*: Government public services for government human capital management, including planning, requirement assessment, recruitment, selection, development, retention, retirement, work performance, allowance, rewards.

Knowledge Governance

Knowledge Governance (KG) has proven to be more effective than KM for addressing wicked problems through multi-level governance and system innovation (de Wit, 2022). The transdisciplinary field of KG focusses on structures and techniques that influence knowledge sharing and creating processes, as well as the implications of knowledge types on policy (de Wit, 2022). The KG concept relies on five principles (de Wit, 2022):

- 1. Combined decentralised, interactive, and self-organisation (in contrast, KM is implemented through a top-down, centralised approach);
- 2. Transdisciplinary knowledge production and dissemination, going beyond disciplinary fields and aiming for unity of knowledge (expanding the interdisciplinary perspective of KM);
- 3. Social learning about policies to be able to change them and enhance policy innovation;
- 4. Reflexivity, critically analysing knowledge processes (while KM takes knowledge for granted);
- 5. Need for boundary management and improving the knowledge-policy interplay.

The holistic KG approach enables the clarification of concepts, understanding the links between data, information and knowledge, and making them available to different segments of stakeholders. KG is recommended for assessing information in a coherent way for multiple contexts. (Pinho, 2020) The successful KG in public administrations requires (de Wit, 2022):

- Creating an institutional culture of system thinking and knowledge creation;
- Reconceptualising the concept of knowledge and address its inherent power imbalances;



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• Enhancing active and meaningful multi-stakeholder participation in public decision-making processes.

The Swedish national system for knowledge-driven management (NSKM) adopts some KG principles. It is a meta-instrument that prescribes the use of particular instruments to achieve certain policy goals, based on a specific understanding of the policy process (Falkenström and Svallfors, 2022). It is sustained by an instrument constituency which is a policy network centred on policy solutions, formed around policy instruments (Falkenström and Svallfors, 2022). Policy instruments attempt to organise social relations between the state and a target population through the use of incentives and prescriptions (Falkenström and Svallfors, 2022). The instrument is legitimised by a functional promise, namely that the instrument will contribute to solving policy problems, while the constituency is held together by a structural promise, namely that the instrument will provide them access to resources and position (Falkenström and Svallfors, 2022).

Readiness for KM

Among the features of knowledge oriented public administrations, scholars have listed building knowledge acquisition potential, multifunctional roles involving collaboration with other organisations; referral; strategic thinking; creating conditions for improving the quality and effectiveness of operations; learning to develop ever better public services, to improve processes, to disseminate new ideas and processes, to increase knowledge and shape mechanisms for its acquisition and dissemination; treating every activity as a learning opportunity, openness to the environment (Cichoń, 2020). Continuous education, acquiring more knowledge and skills allows public administration staff to improve both their performance and their relationship with citizens. (Bučková, 2015) This requires implementing KM and is associated with an entire process of complex changes. Before this can happen, an organisation must correctly identify the processes of the organisation, there must be willingness to educate employees in the long term, and to identify and implement a series of changes in the organisation of work. (Bučková, 2015) Critical success factors affecting KM readiness include (Bučková, 2015) :

- Knowledge sharing: the activities of how organisational members exchange their knowledge to improve organisational learning capacity, stimulate the creation of new knowledge and, eventually, enhance the organisation's competitiveness.
- Organisational culture: a knowledge supporting culture to ensure efficient knowledge flow among staff's resistance to change, motivation to share knowledge, and leadership commitment



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- Organisational structure: the ways in which tasks are formally segregated, classified and coordinated. Since organisations are knowledge integrating institutions, designing the internal structure of a company, especially the hierarchical design to empower decision-making, standardised rules and procedures and integrating members and work are highly important.
- Technology infrastructure: an essential enabler in knowledge-based economies, because such infrastructure plays a vital role in the knowledge management system of an organisation. Developing a comprehensive IT infrastructure and incorporating various technological platforms facilitates creating and using new knowledge, and sharing of existing knowledge.

Knowledge management maturity model

A Canadian organisational and KM maturity model identifies 5 phases which can be useful to assess the actual state of KM, plan KM implementation, and/or monitor the roll-out of KM in public administrations (Lemay *et al.*, 2012):

- 1. *Initial phase*: "ad-hoc"; no formal process, transfer of knowledge is the initiative of people. Requires a continuous and significant managerial "push" to move to the second phase.
- 2. *Procedural phase*: formal knowledge transfer oriented or standardised and related to tasks. Requires a continuous and significant managerial "push" to maintain momentum and develop organisational synergy.
- 3. *Analytical phase*: analysis of skills, planning of work-force and career management, participatory culture for the sharing of implicit knowledge. Analysis of the strategic environment: trends, opportunities and threats, positioning; stakeholder management. These are functional and specific to a division, a department.
- 4. *Managed phase:* a process for managing strategic knowledge is established during this phase. Moreover, intermediaries of strategic knowledge at all organisational levels, and formal and informal means of sharing knowledge are identified. Available KM methods and tools can be used anywhere in the organisation.
- 5. Optimised phase: the design of the "organisation" can be extended to the system of constituent organisational units of the same public service. A capacity for reflection about the content and process of KM is developed, that contributes to innovation and strategic organisational development. The whole organisation is concerned with continuous development and it has integrated learning into its practices.





Science to policy and practice

Integrating expertise and research is essential for evidence-based, risk-informed decision-making. An Australian-Canadian study identified a set of actions that can be undertaken quickly to improve the science-policy nexus, as well as longer term actions (Hickey *et al.*, 2013):

- Quick actions without significant financial commitment
 - Disseminating knowledge
 - Pushing research coordination initiatives
 - Creating a mechanism to help experts by providing advice in proposals
 - Translation
 - Using clear and simple language when asked for scientific advice
 - Creating knowledge broker/science translator positions
 - Communication
 - Reaching out to scientists/policy analysts through conversations and engagement
 - Making critical information more easily available
 - Promoting brainstorming sessions on how to better integrate science and policy
- Increased networking
 - Internal
 - Convening an inter-departmental working group on science activities
 - Establishing a formal dialogue process
 - Creating an informal forum for dialogue
 - Fostering horizontal (across agency) teams to bring people and issues together
 - External
 - Engaging with external partners including the federal government and universities
- Longer term actions to improve science–policy nexus
 - Contextualising science
 - Promoting the embedding of science advice in social and political context
 - Systematically incorporating science in briefing notes
 - Promoting knowledge sharing
 - Employing more knowledge translators/brokers
 - Making knowledge sharing a larger component of publicly funded research



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• Reaching out

- To external organisations
 - Instituting a more systematic external collaborative approach to science
 - Working with the KM branch to engage external science expertise more broadly
- To the public
 - Creating open and transparent processes that use science information to engage the public on policy
 - Providing the public with access to more science-based information
- Accountability
 - Requiring senior management to bring science and policy teams together
 - Establishing performance goals in strengthening the science–policy nexus
- Improving skills
 - Mandating specific communication skills when hiring staff
- Institutional change
 - Creating new systems for capturing, storing and analysing of knowledge
 - Creating joint scientist and policy analyst teams to determine what knowledge is required to achieve objectives
 - Working towards continually developing a flexible multi-disciplinary approach to decision-making
 - Developing inter-departmental task groups to exchange knowledge and areas of expertise

Particularly in emergency situations, knowledge plays a vital role. Obviously, an emergency KM framework should be designed ahead of crisis situations. Thereby, the following critical factors should be considered (Généreux, Lafontaine and Eykelbosh, 2019):

- 1. Blending the best of traditional and modern approaches;
- 2. Fostering community engagement;
- 3. Cultivating relationships;
- 4. Investing in preparedness and recovery;
- 5. Putting knowledge into practice;
- 6. Ensuring that there are sufficient human and financial resources.



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Keeping those critical factors in mind, useful knowledge-to-action strategies such as mentorship programmes, communities of practice, advisory groups, systematised learning, and comprehensive repositories of tools and resources could be deployed (Généreux, Lafontaine and Eykelbosh, 2019).

Knowledge acquisition

Knowledge acquisition — defined as the change in the collective knowledge of groups over time — is influenced by the homogeneity of knowledge at the group level and by perceptions of knowledge applicability, while prior-related knowledge can either encourage or obstruct knowledge acquisition (Richards and Duxbury, 2015). Middle managers can provide contextual information that supports staff understanding the relevance of external knowledge, which in term helps to boost the impact of knowledge application (Richards and Duxbury, 2015). These findings allude to the importance of training staff in teams to build homogeneity of knowledge and indicate a need to ensure that middle managers understand the organisation's strategy, as well as their roles in the knowledge-utilisation process (Richards and Duxbury, 2015). In fact, a study on the use of best practice projects as a strategy for knowledge management in Spain concluded that more contextualised and realistic information is more likely to be effectively utilised and transferred (Barbieri Muttis and Fierro Fidalgo, 2019).

Effective knowledge development in public organisations depends on a strategic action plan that defines the knowledge and skills that the staff of an organisation should have. Specifically, knowledge development is largely determined by the preparedness and ability of management to continually develop skills and to adopt changes. Moreover, knowledge development can be supported by awakening the desire for continuous development by the organisation, combining learning and work, and management setting a good example for staff willingly to develop their skills and knowledge (Cichoń, 2020). Public administrations that are effective in knowledge acquisition and development become better at increasing and applying their knowledge, improving processes and disseminating new ideas (Cichoń, 2020). Handling information and knowledge, which an organisation acquired through learning, plays a principal role in the KM process. Learning is a long-term process and requires an active approach from staff, effectively using information, knowledge and skills (Cepelova, 2014a). Thereby, an important component of KM and the formation of competence profiles is accepting the learners' learning style preferences (Krpálek *et al.*, 2021). In addition to traditional knowledge identification and maintenance processes, generating competence matrixes and systematically mapping the





loss of competencies due to demographic evolutions is important to indicate the required qualifications to replace staff (Zimmerling *et al.*, 2017).

A "building-block" approach to knowledge management

A useful approach to knowledge management which can be applied to public administrations is known as the gradual, "building-block" approach to implementing KM. It builds on existing resources and systems, provides an immediate return on investments on knowledge resources, and ensures that each step is a building block that provides a foundation for future enhancements (Dataware Technologies, Inc., 1998). It proposes the following seven step approach (Dataware Technologies, Inc., 1998):

- 1. Identify the organisational problem: a clear identification of the organisational problem to be solved and an alignment of the KM project with overall organisation's objectives.
- 2. Prepare for change: KM goes beyond application of technology and involves cultural changes in the way staff perceive the knowledge they develop. A successful implementation of KM also requires endorsement from management.
- 3. Create a KM team: a well staffed team with a strong team leader and "cross departmental" expertise is essential.
- 4. Perform a knowledge audit and analysis: identify sources of knowledge required to solve the organisation's problem. It begins to organise knowledge by developing categories that reflect how the organisation operates. It does not have to be long or complex, but aims to answer key questions.
- Define the key features of the solution: a checklist of required key features to ensure that acquired KM technology will help solve the key organisational problems while enhancing the overall IT infrastructure.
- 6. Implement the building blocks for KM: using a phased approach and a smooth "onramp". Each phase of the implementation addresses a specific part of the KM solution, lays the foundation for the next phase, and provides immediate and measurable benefits. Encompasses:
 - a. accessing existing knowledge silos to get immediate results from existing resources;
 - b. implement knowledge mining for more efficient access;
 - c. automatically categorising to deal with new knowledge;
 - d. building a knowledge warehouse to make knowledge widely available;
 - e. enabling end-user contributions to allow increased knowledge flow;
 - f. expanding the use of metadata and taxonomies for effective categorisation of knowledge.



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7. Link knowledge to people: a knowledge directory inferring what employees know to locate the experts in the organisation, elaborated with content management dealing with gathering and editing knowledge.

Strengths, weaknesses, opportunities and threats (SWOT) mapping

Strengths, weaknesses, opportunities and threats (SWOT) mapping of internal and external knowledge has been used to evaluate and inform strategic decisions as well as the daily work practices of employees in public settings. (Dos Santos and Damian, 2018) This proved useful to improve organisational processes involving knowledge (Dos Santos and Damian, 2018).

Community of Practice (CoP)

Several public administrations, for example in Spain and Italy, use "Community of Practice" (CoP) as a tool for KM and as a lever for the development of learning processes and personal, professional and organisational change (Gairín Sallán et al., 2012; Canonico et al., 2020). CoP relies on groups that interact constantly, both in person and through networks or communities (Gairín Sallán et al., 2012), aiming at generating both organisational and individual learning along with innovations that contribute to improving the public administration (Rodríguez-Gómez and Gairín Sallán, 2014; Canonico et al., 2020). The objective is an exchange of experiences by sharing proposals and projects and creating new knowledge (Gairín Sallán et al., 2012). In CoP, community interaction crossing personal, organisational, sectoral and social boundaries bolsters individual knowledge through a process of continuous, dynamic interaction between personal or collective tacit or explicit knowledge, which includes moments of socialisation, externalisation, combination and internalisation of knowledge (Rodríguez-Gómez and Gairín Sallán, 2014). This way, knowledge and lessons learnt become totally integrated into its social practices without treating them as isolated processes separate from the day-to-day reality. Furthermore, it contributes to a shared identity and values (Rodríguez-Gómez and Gairín Sallán, 2014). A Spanish study defined guidelines and recommendations in four important dimensions for successfully implementing CoP, namely the organisational setting, dynamic of the operation of the CoP, personal characteristics of the participants, and results of the CoP (Gairín Sallán et al., 2012).





Case method

The case method¹ portrays tacit knowledge, and systematises and records relevant experiences. It enables evidence-based situational learning to be transformed into learning comparatively across cases. This method has been used in the public sector as an organisational learning tool to create, acquire, develop, transfer and retain knowledge (Santos and Figueiredo, 2020).

Performance dialogue

Performance dialogue can be used for organisational learning in public administration, as applied in a Finish city administration. In dialogue with a strategy team, human resources and financial specialists, which all have their own existing networks, analysts work in teams that gather and piece together the relevant information and prepare strategic decision-making (Laihonen and Mäntylä, 2017). In this knowledge-based management culture, data and advanced analytics are used and organisational knowledge is transferred through continuous performance dialogue to support better decision-making and organisational learning (Laihonen and Mäntylä, 2017). As with any KM implementation, a performance-driven management culture requires the understanding and support of managers and that individuals are capable and willing to participate in the dialogue. This is not self-evident because some people may perceive a knowledge-based management and open discussion culture as a loss of control and power. (Laihonen and Mäntylä, 2017)

Knowledge conversion

Codifying knowledge is a key characteristic of KM. This field of knowledge conversion is mainly formed by freelancers, also in public administrations for example in Spain (Gonzalez-Cristiano, no date). The practices followed by freelancers typically differ from the organisation's routines and processes for acquiring, assimilating, transforming, and exploiting knowledge because they need to compensate for their lack of internal processes by relying on external ones (Gonzalez-Cristiano, no date). Therefore, when relying on freelancers, a general knowledge transfer process occurs where freelancers aim to understand and codify the client organisation's knowledge (Gonzalez-Cristiano, no date). Through dialogue between client and designer, the use of metaphors and boundary objects, this process starts with creating an abstract, general, concept which is then turned into stories, keywords and more concrete concepts that will result in a final design reflecting a shared understanding (Gonzalez-Cristiano, no date).

¹ The case method calls for discussion of real-life situations that business executives have faced (Hammond, 2002).



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Quality certification

Quality certification (such as ISO9001) has shown to positively impact formal KM practices in public administration (Brito *et al.*, 2020).

External knowledge acquisition: university-industry partnerships, social networks,

crowdsourcing

In the context of external knowledge acquisition, particularly through subsidised entrepreneurial university-industry partnerships, it is worth mentioning the occurrence of dual behaviours (collaborative and opportunistic) and its effects on expected intellectual outcomes. Such dual behaviours can be prevented or controlled by implementing knowledge management mechanisms, to maximise the quality of innovation and innovation performance, production of intellectual capital, and returns to the society (Guerrero, Herrera and Urbano, 2019).

Organisational knowledge resources are inevitably limited and social networks can present innovative contributions to knowledge acquisition, development, and management (Gu-dan and Yuan, 2013). Specifically, social networks can influence knowledge management from three perspectives of the strength of tie, structural hole and social capital (Gu-dan and Yuan, 2013). The integration of social knowledge — i.e. dispersed societal knowledge emerging in contemporary information societies — by governments through learning supports the development of new research agendas and new intellectual tools to meet the needs of contemporary knowledge-driven societies (Pyrozhenko, 2020).

The inclusion of virtual communities — crowdsourcing — combined with organisational openness to new external knowledge can be a way to involve citizens as clients who are interested in participation in decision making (Lenart-Gansiniec, 2017). Crowdsourcing especially allows leveraging the dispersed knowledge of individuals and groups as bottom-up crowd-derived inputs. It relies on top-down engagement from organisations through IT to solve problems, complete tasks or generate ideas (Lenart-Gansiniec, 2020). Moreover, it contributes to acquiring and sharing knowledge, constitutes support for the processes of accessing and managing knowledge, and allows for organisations to learn (Lenart-Gansiniec, 2017). Public organisations are encouraged to treat organisational learning as priority because it leads to positive development and fosters organisations ability to adapt to changing conditions and to the expectations of interested parties, as well as to creating new solutions (Lenart-Gansiniec, 2017). In this approach, crowdsourcing shows potential for facilitating the acquisition of new ideas, contents, data, ways of solving





problems, and access to human knowledge resources, which are located outside the organisation (Lenart-Gansiniec, 2017). Crowdsourcing has become popular in local governments to stimulate citizens' involvement in the generation of information, development of solutions to public and social issues, and policy creation. Specifically, It may lead to policy innovations, generating information, creating solutions, reporting crisis situations, solving public problems, shaping policies (Lenart-Gansiniec, 2020). Furthermore, it can help to implement and design public policies and programmes, as well as open new areas of intervention (Lenart-Gansiniec, 2020). Crowdsourcing can empower citizens, enhance political legitimacy, public administration staff's openness and willingness to cooperate with citizens. Crowdsourcing may be a tool to stimulate organisational learning (Lenart-Gansiniec, 2016, 2020). However, such initiatives can be resource intensive and require more staff, so digital ways to bridge connections with people with different beliefs, educations, and backgrounds should be explored. Nevertheless, thus far, the impact of online solutions, such as e-petitions, on policy is low (Seitkazin, 2018).

Evaluating knowledge management

KM involves a general organisational approach that promotes learning and information sharing as well as implementing specific methods and tools, but KM processes are often unregulated in public administrations. Evaluating these processes allows identification of weaknesses and can provide a basis for implementing improvements. KM includes responsibility at the organisational and individual levels, covering information process effectiveness, integration of collective knowledge from civil servants and constant learning, timely competence assessment and training (Dneprovskaya *et al.*, 2018). This must be reflected in the key indicators to measure the level of KM in public administrations: assess levels of competency, continuity of learning, and intellectual activity (Dneprovskaya *et al.*, 2018). The so-called Knowledge Management Maturity Model is another instrument for the assessment of KM in the Brazilian public administration. It comprises seven criteria, namely: KM leadership, process, people, technology, knowledge processes, learning and innovation, and KM results (Batista and Quandt, 2016). Local level public administrations in Colombia used a set of quantitative and qualitative variables including knowledge generators, sources, organisational aspects and processes that add value to the KM (based on the KPMG consulting model), to evaluate the current state KM and indicate areas where changes need to be implemented (Ordoñez and Guzmán, 2018).





To evaluate KM in organisations, performance auditing can be carried out. This combines common auditing and management consultation to evaluate the utilisation of an organisation's sources, and serves as an advisor for management by assessing information and intra-organisational systems and instructions (Moharrami and Afshari, 2012). As such, it can play a crucial role in the optimisation of organisational knowledge (Moharrami and Afshari, 2012).



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Knowledge Management Tools

A wide range of tools can be used to manage knowledge. In this chapter, we present some essential types of tools with their key characteristics, and refer to sources for further information.

The Austrian knowledge platform aims to place the knowledge and considerable practical experience of public administration employees at the centre of innovative administrative development. On this <u>website</u>², both theory and practices of KM can be found and shared, and more importantly, a <u>toolbox</u> listing and describing best practice KM methods and techniques that can be used throughout the different KM phases, as presented in <u>Figure 2</u>.

Wissenskontinuum Prozessschritte		Exter- nalisiert	Fakten & Infor- mation	Know- How	Handlungs- anleitendes Wissen	Do-How	Internalisiert				
Vorgelagerter Prozess	Kriterien- Definition	- Leitfragen-Interview									
Phase 1	Identifizieren & Planen	 Lettragen-Interview 									
Phase 2	Sammeln, Gewichten & Aufbereiten	Wissenslandkarte Mapping-Verfahren/Mind-Maps Struktur-Lege-Technik RepertoryGrid									
Phase 3	Sichern	 Protokoll Check- liste Leit- faden (Halb-) Strukturiertes Interview Critical Incident Technique 									
Phase 4	Übertragen, Verteilen & Erweitern	DMSLaufwerk	• Wiki	 Meeting 	 Thinking aloud verfahren 	Debriefung	 Wissens- Mentoring Tiefen- interview 				
Phase 5	Nutzen	• ELAK	 Intranet 	 Story- Telling 	 Qualitäts- zirkel 	Community of Practice	 Soziales (Wissens-) Netzwerk 				



² https://www.wissensmanagement.gv.at/Wissen_managen



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Ontology

With respect to knowledge management, three different kinds of data exchange exist within large organisations, namely; 1) exchange of knowledge between people; 2) exchange of understanding between people and information systems and 3) exchange of data between disparate information systems (Debruyne and De Leenheer, 2013). However, a semantic gap often makes any of these exchanges inefficient. A well-developed ontology³ captures the necessary semantics for rendering information exchange processes more efficiently and provides a reference point for data governance questions such as what does the data mean, where and how is the data utilised, who is responsible for the data (Debruyne and De Leenheer, 2013). Using an ontology facilitates sharing a common understanding of the structure of information among users and developers, enabling the reuse of domain knowledge, making problem domain knowledge explicit, separating domain knowledge from operational knowledge, and analysing domain knowledge for application development (Miah, Islam and Samsudin, 2016).

Ontology has been applied in various problem domains – such as health, public administration – to develop models for effective knowledge modelling, i.e. ontological knowledge representation or an ontology-based approach to knowledge management. Such knowledge modelling helps to structure knowledge components and the relationships among them within a problem domain. Moreover, they can help to provide a transparent approach for enhancing design thinking and comprehension for both users and system developers (Miah, Islam and Samsudin, 2016). This makes the ontology technique a prominent technique for designing system solutions in a context-sensitive manner (Miah, Islam and Samsudin, 2016). An ontology-based approach for intellectual decision support can also prove useful in the process of innovative project management. Based on ontological engineering and the semantic integration of data and knowledge, a comprehensive tool can be formed as an integrated model for representing and processing knowledge at various stages of innovative project management processes (Chernyakhovskaya and Nizamutdinov, 2019).

An ontology encapsulates the logic and present definitions of a phenomena but also highlights gaps in them (Ramaprasad, Sánchez-Ortiz and Syn, 2015). Hence, ontology can be used to systematically map the state-of-the-research, state-of-the-policy and the state-of-the-practice, discover the gaps and reveal opportunities in research and between research and practice or policy, and formulate an implementation

³ An ontology encompasses a representation, formal naming, and definition of the categories, properties, and relations between the concepts, data, and entities that substantiate one, many, or all domains of discourse. More simply, an ontology is a way of showing the properties of a subject area and how they are related, by defining a set of concepts and categories that represent the subject ('Ontology (information science)', 2022).



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strategy to bridge the gaps. Particularly for a domain without a standard definition, the ontology can serve as the nucleus of a standardised definition (Ramaprasad, Sánchez-Ortiz and Syn, 2015). It articulates the components and fragments which constitute phenomena using structured natural English sentences and phrases (Ramaprasad, Sánchez-Ortiz and Syn, 2015). Thereby, it should apply a systemic rather than technology-based conceptualisation (Ramaprasad, Sánchez-Ortiz and Syn, 2015). It serves as a multi-disciplinary lens to study a topic that draws upon concepts from information systems, knowledge management, public administration, and information technology (Ramaprasad, Sánchez-Ortiz and Syn, 2015). The ability to extend and refine an ontology allows for looking at phenomena with different levels of granularity in different contexts (Ramaprasad, Sánchez-Ortiz and Syn, 2015).

Moreover, an ontological approach can also be applied to the competences of public servants to manage staff. The work behaviour required for successful performance in a given position can be described by a set of competences (Altukhova, Vasileva and Mirzoyan, 2018). Evaluating these competences can be linked with the application of ontologies that encompass a set of terms and concepts with the concrete requirements of tasks or functions (Altukhova, Vasileva and Mirzoyan, 2018). A decision support system can then be used to align the competences of public servants with the demands made on their functions, allowing HR to efficiently select the appropriate personnel for vacancies (Altukhova, Vasileva and Mirzoyan, 2018).

Business Semantics Management (BSM)

Business Semantics Management (BSM) is a fact-oriented approach to knowledge modelling and ontology engineering that is grounded in natural language (Debruyne and De Leenheer, 2013). It relies on the following principles (Debruyne and De Leenheer, 2013):

- 1. *ICT Democracy*: an ontology should be defined by its owning community, and not by a single developer.
- 2. *Emergence*: semantic interoperability requirements emerge autonomously from community evolution processes. Business semantics serve "open" information systems, and hence the requirements and limitations for semantic interoperability cannot be entirely known before completion.
- 3. *Co-evolution*: ontology evolution processes are driven by the changing semantic interoperability requirements. Agile methods perform short milestone-driven revision iterations to cope with dynamic environments.





- 4. *Perspective rendering*: ontology evolution processes must reflect the various stakeholders' perspectives. There is no generally applicable ontology, as each application will generate a contextualised model to match local needs and functionalities.
- 5. *Perspective unification*: relevant parts of the various stakeholder perspectives serve as input for the unified perspective of the common ontology.
- 6. *Validation*: explicit rendering of stakeholders' perspectives allows capturing of the ontology evolution process, and validating the ontology against these perspectives.

Often, certain types of ontologies already exist and can be used as a base for developing an organisation's own ontologies through following these four steps (Klarin and Čelar, 2013) :

- 1. Domain: identifying the domain and defining the scope of the project / task;
- 2. *Knowledge*: designing the domain knowledge structure by using elements of the identified ontology, and possibly upgrading the organisation's own ontology with specific concepts and rules;
- 3. *Support*: modelling and implementation of a new software solution in the information system's environment;
- 4. Application: connecting new software solutions with business systems from the environment.

Technologies

Information and Communication Technologies (ICT) support knowledge management, development and implementation within public sector organisations (Romanelli, 2019). Specifically, they contribute to the creation and use of knowledge which serves to improve public services quality, accessibility, productivity, and innovation (Romanelli, 2019). Notably, recent developments in the creation and leveraging of information and knowledge resources include big data, crowdsourcing, and data visualisation (Chen, 2017). Using ICT not only supports KM processes but also facilitates citizen participation and governance. Moreover, technology helps public organisations to use knowledge as an important strategic source to achieve sustainability (Romanelli, 2019).

Digital transformation tools

From a KM perspective, the digital government is an essential aspect of innovation, co-production, transparency, and the generation of public value (Alvarenga *et al.*, 2020). Specifically, the success of digital governments is related with the quality of the organisations' KM that is complementary to each other and helps to achieve significant improvements in the public sector (Alvarenga *et al.*, 2020). The level of digital



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administration correlates to the quality of KM, which is a decisive factor determining the successful digital transformation in public administrations (Krpálek *et al.*, 2021). Importantly, KM can provide the overall strategy and techniques for eloquently managing digital government content to make knowledge more usable and accessible and to keep it current (Alvarenga *et al.*, 2020). Knowledge expresses its maximum potential when it is adequately exploited through internal and external sharing processes and thus it is encouraged to implement KM systems that guarantee access to more information (Di Vaio et al., 2021). Moreover, links between innovation and sustainability reveal that digital transformation tools positively contribute to the value creation process over the long-term (Di Vaio *et al.*, 2021). For example, digital innovation impacts organisations' performance and improves efficiency and the quality of knowledge in organisational and strategic processes, favouring the combined use of human and technological resources (Di Vaio *et al.*, 2021). In this context, the Italian public administration recently went through a paradigm shift by committing to digitalisation through knowledge management patterns, with a Smart Governance approach (Berardi, Cifolelli and Ziruolo, 2021).

Internet of Things (IoT) - Big data

In the current globalised world, Internet of Things (IoT) strategies, combined with KM systems, constitute an engine for the development driven by innovative practices, towards sustainable development, which increases the degree of social responsibility and enhances an organisation's reputation (Di Vaio *et al.*, 2021). IoT tools contain vast amounts of data and simplify the ways of identifying exploitable knowledge along the entire organisational chain (Di Vaio *et al.*, 2021). This fits under the open innovation paradigm, which promotes a holistic, cognitive approach to governance, based on cooperation between internal and external resources for the creation of value (Di Vaio *et al.*, 2021). Specifically, open, innovative systems can help to develop an integrated strategic capability, based on sharing and exchanging multidisciplinary knowledge, re-defining organisational models in which knowledge develops horizontally (Di Vaio *et al.*, 2021). The degree of transfering, sharing, and exploiting knowledge requires the cooperation of all departments, through the implementation of collaborative and inter-organisational learning processes that exploit large flows of information (Di Vaio *et al.*, 2021). In this context, it is worth noting that KM systems play a major role in the implementation and governance of big data and should ideally be structured to include big data, to facilitate governance and support effective strategic decisions (Di Vaio *et al.*, 2021).





e-government

In Switzerland, the non-profit association <u>eCH</u> promotes, develops and adopts e-government standards in cooperation between the federal government, cantons and representatives from the private sector and science. Specifically, their eCH-process-platform is set up for dealing with knowledge and information and for users to share processes, engage in discussions and ask questions. Moreover, it helps to connect people working on similar topics, and thus transfer, share, multiply, and apply knowledge (eCH, no date).

An agile knowledge-based e-government system has been developed and funded under the European Commission's Framework Programme 6. The so-called "SAKE" solution is a holistic framework with supporting tools that are flexible so that they can be adapted to diverse environments and needs. This solution comprises a semantic-based change management system and a semantic-based groupware system (European Commission, 2009) This solution harmonises change management and knowledge management strategies (Ko, Kovacs and Gabor, 2013).

Modelling

When relying on IT solutions for KM, the importance of modelling arises. Models are not only used for schema or software generation but also for information value creation (Efendioglu, Woitsch and Karagiannis, 2015). The collaboration for developing the modelling method involves multiple experts from different domains (from software engineering and modelling, business process modelling and analysis, knowledge and learning management, and public administrations) to capture the relevant semantics in addressing domain specific needs (Efendioglu, Woitsch and Karagiannis, 2015). The development approach should thus be appropriate to the varying backgrounds of those experts (Efendioglu, Woitsch and Karagiannis, 2015). Modelling methods must also consider aspects related to business processes such as motivation, organisational structure and roles, knowledge resources, learning goals, and performance measurements (Efendioglu, Woitsch and Karagiannis, 2015). Further, existing technologies should be considered, and the modelling language should be flexible enough to be implemented on different (electronic) platforms. The project Learn PAd provides a relevant example of a new way of designing, and consequently in developing modelling. It used the modelling platform <u>ADOxx</u> to apply a model-driven approach for technology enhanced learning and knowledge management in the domain of public administration.





Technological ecosystems

Technological ecosystems allow for effectively managing the knowledge that is generated in organisations. These ecosystems are a set of different components that are related to each other through information flows and are supported by a physical environment where the users are part of the ecosystem (García-Holgado, Cruz-Benito and García-Peñalvo, 2015). An example of an eLearning ecosystem is one that is adopted by Spanish public administration which is composed of four layers and a set of elements (see Figure 3) (García-Holgado and García-Peñalvo, 2014). The Spanish public administration is composed of heterogeneous public organisms, ranging from research centres to public companies, where variants of this ecosystem are used to manage knowledge (García-Holgado, Cruz-Benito and García-Peñalvo, 2015). The four layers are:

- First layer "infrastructure": includes all services that provide a set of basic functionalities for the proper operation of the software components located in the upper layers. It has three components: a mail server supporting asynchronous messaging, notifications, alerts, subscriptions, etc. that can be carried out from other components; centralised user management (authentication process and users' data); monitoring of information flows taking place within the system to provide a centralised management of statistics to support decision making processes. For example a mail service, indexing service, user management.
- Second layer "*static data management*": only in case a data set exists that is used by most of the ecosystem components, for example a repository.
- Third layer "*services*": software components covering specific needs of an organisation. Users interact with the ecosystem through the components provided by this layer. This layer has a high flexibility and adaptability degree to allow addition, modification, and removal of different software components without affecting the rest of the architecture. It has two basic tools: a tool to support decision making processes based on the management of information flows, and the software component for monitoring (described in the infrastructure layer).
- Fourth layer "presentation": an architectural layer uncoupled from the services layer's functionality to present the uniqueness among the different software components within the ecosystem, and allowing accessing the ecosystem from any devices. It has two input streams to the ecosystem: a methodological base to support the definition and operation of the system, and project and risk management to ensure the implementation of the methodology and the ecosystem evolution over time. For example: a web portal, a social network, a knowledge bank.







Figure 3: Architectural pattern for eLearning ecosystems (García-Holgado and García-Peñalvo, 2014; García-Holgado, Cruz-Benito and García-Peñalvo, 2015).

An Indonesian KM system for managing the government human resources using ICT determined 37 features of KM processes that should be implemented into such a technological ecosystem. The features with the highest priority included a work performance system, video conferencing, electronic discussion groups, a best practice database, and email functionality (Cahyaningsih, Sensuse, Wibowo, *et al.*, 2016).





Multilingual knowledge management infrastructure

A relevant initiative for KM in multilingual environments is the Public Multilingual Knowledge Management Infrastructure (PMKI) action that was launched by the European Commission (EC). It aims to create a set of tools and facilities, based on Semantic Web technologies, to establish semantic interoperability between multilingual lexicons (Schmitz *et al.*, 2018). Ultimately, this should help to harmonise and align internal and external multilingual language resources using a standardised representation with respect to a defined core data model under an adequate architecture to facilitate interoperability (Schmitz *et al.*, 2018).

Web 2.0

Second generation web technologies (Web 2.0) such as social media and networking sites are increasingly used by governments for digital activities ranging from public relations to knowledge management (Sivarajah, Weerakkody and Irani, 2016). These Web 2.0 technologies are more interactive than traditional models of information provision and bring opportunities for public authorities. Though traditional KM systems are applied to structured knowledge, Web 2.0 applications (social software, folksonomies, and wiki) are particularly effective in enabling the sharing of informal and tacit knowledge internally, among employees (Sivarajah, Weerakkody and Irani, 2016).

Notably, Web content management platforms (WCM) can act as enablers for knowledge management by facilitating the transition from an organisation where knowledge is mostly tacit to an organisation where access to information is generally available and where parts of tacit knowledge is converted into explicit knowledge (Zaharia-Rădulescu *et al.*, 2015). Furthermore, implementing WCM solutions led to higher efficiency in performing work activities (Zaharia-Rădulescu *et al.*, 2015).



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Collaboration tools such as wikis can also be applied to streamline internal operations within government agencies, especially among disparate teams and across agencies enabling individuals to engage in open discussions leading to a potential build-up of knowledgebase (Sivarajah, Weerakkody and Irani, 2016). Moreover, Web 2.0 tools such as social networking sites, Wikis and deliberation platforms can be powerful tools for governments to revive civic engagement and harness the wisdom of crowds (Sivarajah, Weerakkody and Irani, 2016). In particular, it enables government organisations to efficiently and effectively collect dispersed collective intelligence from citizens with less effort in comparison to traditional crowdsourcing methods such as public forums and workshops (Sivarajah, Weerakkody and Irani, 2016). Web 2.0 tools such as microblogging and social networking sites can also help disseminate information over the internet faster compared to traditional methods (Sivarajah, Weerakkody and Irani, 2016).

Artificial Intelligence (AI)

Emerging systems empowered by Artificial Intelligence (AI) can support the fundamental dimensions of KM as outlined below (Jarrahi *et al.*, 2022):

- Knowledge creation:
 - Fostering predictive analytics via self-learning analytical capacities
 - Recognising previously unknown patterns
 - Sifting through organisational data and discovering relationships
 - Developing new declarative knowledge
- Knowledge storing and retrieving:
 - Harvesting, classifying, organising, storing, and retrieving explicit knowledge
 - Analysing and filtering multiple channels of content and communication
 - Facilitating knowledge reuse by teams and individuals
- Knowledge sharing:
 - Connecting people working on the same issues by fostering weak ties and know-who
 - Facilitating collaborative intelligence and shared organisational memory
 - Generating a comprehensive perspective on knowledge sources and bottlenecks
 - Creating more coordinated, connected systems across organisational silos
- Knowledge application
 - Enhancing situated knowledge application by searching and preparing knowledge sources
 - Offering more natural and intuitive system interfaces (e.g. voice-based assistants)
 - Promoting equitable access to knowledge without fear of reprisal or social cost



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Keeping in mind that knowledge production and management are inherently human-centred, the most effective roles assigned to AI in KM will mostly augment humans rather than replace them, thereby achieving collaborative intelligence, in which AI and humans enhance each other's complementary strengths (Jarrahi *et al.*, 2022). Furthermore, introducing AI for KM is not limited to technology but also adds value through necessary developments in new infrastructures, trained people, and redesigned processes (Jarrahi *et al.*, 2022).

The Swiss canton Aargau realised that much of the demanded knowledge in cantonal and municipal administrations is often documented and publicly available, but difficult to find. To make this information better accessible, identify holders of knowledge, and promote the exchange and archiving of specialist knowledge, a knowledge database – "*Wissensplattform für Gemeinden*" (WPG) – was developed. This platform is supported by AI to recognise questions, find suitable answers, or forward questions that can't be found directly in the database to a specialist. The network and knowledge database learn and grow with every interaction: the more questions and answers entered, the greater the informational value. As such, the platform serves as an expert network in municipal affairs, monitored and verified by experts from cantonal information centres, and eventually maturing so that it can be used like a search engine (Kanton Aargau, 2022).

The Panamanian cloud platform "Epidempredict" aims to support health authorities by facilitating decision making based on real and meaningful data, and by informing the adoption and implementation of strategic actions in the field of health and public welfare. It allows efficient data ingestion, administration, analysis, visualisation and export in a distributed, collaborative and secure form (Muñoz *et al.*, 2021). To that end, it combines tools and resources that are supported by disruptive technologies such as AI and Machine Learning (ML) integrating models (neuro-hybrid), predictive algorithms and dashboards (Muñoz *et al.*, 2021). This solution is oriented to volatile, uncertain, complex and ambiguous (VUCA) environments and proved helpful to generate insights during the covid-19 pandemic.





Blockchain

Another development with potential for KM is blockchain, which has been used as a lever for enforcing accountability and responsiveness in different contemporary information and knowledge management environments (Joseph, 2019). The core principle of blockchain is the use of technology to achieve anonymous vetting of integrity for different types of information (Joseph, 2019).





Outcomes

Evidence supports that KM capability enhances public organisations' effectiveness (Pee and Kankanhalli, 2016). Notably, KM instruments have been shown to consistently solve a range of organisational problems, as well as to support learner creativity and the motivation model⁴ for educational purposes (Frolova, Alwaely and Nikishina, 2021). Moreover, determinants of KM initiatives such as organisational learning, knowledge sharing, innovation, social identification, and technology infrastructure have been shown to enhance individual and organisational performance (Lartey et al., 2021).

KM is essential for public administrations as it plays a vital role in interagency information and knowledge sharing, which is key for optimal collaborative decision making (CDM) (Odhiambo, Ochara and Kadyamatimba, 2021). CDM is of great importance for public organisations as it helps address complex problems, which often require the involvement of numerous, diverse agencies (Odhiambo, Ochara and Kadyamatimba, 2021). Thus, it can be a major facilitator of effective response in emergencies (Odhiambo, Ochara and Kadyamatimba, 2021). Furthermore, organisational learning and knowledge sharing could address an increasing knowledge inequality in the public sector (Lartey *et al.*, 2021).

However, one should be aware that introducing a knowledge repository and knowledge-sharing systems may lead to employees experiencing de-skilling and work degradation, and be met with resistance, as was observed in Belgian public agencies (Taskin and Van Bunnen, 2015). De-skilling can occur as a result of job fragmentation and standardisation under KM processes, and threatens professional learning, responsibility, and integrity (Falkenström and Svallfors, 2022). Employees' resistance based on their perceptions of de-skilling and reflecting the knowledge-sharing negotiation process could eventually lead to organisational knowledge impoverishment (Taskin and Van Bunnen, 2015).

⁴ A motivation model provides an understanding of which tools may be used to shape and maintain the psycho-emotional profile of people, their "mood", and way of thinking so that they could perform effectively and be successful (Frolova, Alwaely and Nikishina, 2021)





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