Improving Architectural Knowledge Management in Public Sector Organizations – an Interview Study

Dan Tofan
University of Groningen
Groningen, Netherlands
d.c.tofan@rug.nl

Matthias Galster
University of Canterbury
Christchurch, New Zealand
mgalster@ieee.org

Paris Avgeriou
University of Groningen
Groningen, Netherlands
paris@cs.rug.nl

***Abstract* — Architecting software systems is a knowledge-intensive activity. It requires significant knowledge about architecting in general, but also about domains and technologies. Such knowledge should be managed systematically to make it available throughout the whole software development cycle (e.g. to facilitate maintenance). Architectural knowledge management (AKM) literature covers organizations in the private sector (e.g. software vendors). However, there is a lack of studies on AKM practices in public sector organizations (e.g. municipalities), even though AKM practices in the public sector are immature. Therefore, we propose applying lessons from AKM practices found in the private sector to address AKM challenges in the public sector. Thus, we conducted an interview study with four public and four private sector organizations. We identified challenges for AKM in the public sector. Then, we derived solutions from the private sector to the challenges in the public sector. The main challenges in the public sector are vaporization of architectural knowledge, insufficient knowledge sharing, and organizational cultures that do not encourage AKM. Solutions to these challenges include community building, improved tool support, quality control and management support. The results help improve AKM practices in the public sector.**

Keywords – software architecture; knowledge management; public sector; private sector

I. INTRODUCTION

Within software developing organizations, architectural knowledge is considered an important asset that needs to be managed systematically [1]. Software architects make important decisions. Making architectural decisions is a knowledge-intensive task. For example, deciding on the decomposition of a system requires experience, domain-specific knowledge, knowledge about technologies, and general software architecture knowledge. The software architecture is thus the result of early design decisions with regard to a software system. Typical examples of architectural decisions include choosing a development framework (e.g. J2EE, .NET), selecting architectural patterns (e.g. client-server, layers), or deciding on the middleware for a distributed software system (e.g. an enterprise service bus) [2].

Architectural knowledge management (AKM) increases the quality of software products by creating, capturing, and sharing knowledge among architects, developers and other stakeholders [1]. AKM can also improve the overall software development process [1], mainly by reducing architectural knowledge (AK) vaporization [3]. AK vaporization happens when knowledge about critical design decisions is lost. AK vaporization increases maintenance costs as stakeholders miss the rationale of previous decisions later on in a project (e.g. during maintenance) [3]. Therefore, the field of software architecture knowledge management has seen increased attention in recent years [1, 4].

Most work on AKM has been conducted in the context of private sector organizations (e.g. commercial software vendors or companies that develop products that rely heavily on software). Unfortunately, AKM in public organizations has neither been studied, nor understood well enough to propose solutions to its AKM challenges.

Architects in private sector organizations are software or enterprise architects. Organizations in the private sector are not owned or operated by a government. Typical private sector organizations are corporations, regardless of their size. In contrast to private sector organizations, public sector organizations are owned and operated by some government. Typical public sector organizations are municipalities or government agencies. Architects in public sector organizations are usually enterprise architects. Public sector architects are involved in e-government projects, which offer services to citizens, private sector organizations, and other public sector organizations.

From our previous work on service-oriented architectures in e-government [5], we learnt that AKM in the public sector needs improvement. For example, immature AKM leads to constraints on designing specialized reference architectures for municipalities [5]. Additionally, similar to the private sector, e-government projects in public sector organizations are under pressure to reduce costs. As shown for the public sector, AKM helps reduce costs. However, we could not find literature on AKM in the public sector. Therefore, the goal of this study is to understand AKM in the public sector and to provide solutions for improving AKM in the public sector. Towards this goal, we formulate the following research question**: What are potential solutions to the challenges for AKM in public sector organizations?**

To answer this research question, we conducted an interview study in public and private sector organizations, with the purpose of improving AKM practices in the public sector. The first step towards improving AKM in the public sector is to understand AKM challenges in the public sector. Then, we use AKM solutions from the private sector to address AKM challenges in the public sector. Proposing solutions for improving knowledge management practices in the public sector by using practices from the private sector has already been applied successfully [6, 7].

The main contribution of this paper is a set of AKM challenges in the public sector, mapped to challenges and solutions found in the private sector. Researchers can use the

results to propose further improvements to AKM practices in public sector organizations. Practitioners can apply the solutions to AKM challenges, to improve current AKM practices in public sector organizations.

II. Related Work

This paper is related to three research areas: knowledge management (KM) in software engineering, AKM, and KM in the public sector. We discuss related work from each area.

Dingsøyr and Conradi [8] analyzed eight case studies of KM in software engineering. All cases reported benefits due to KM, such as time savings. However, results from a systematic literature review on KM in software engineering indicate that most existing work consists of informal lessons learnt from applying KM, instead of scientific studies [9]. In contrast, we conducted an interview study to answer our research question in a scientific manner.

Various AKM challenges and solutions have been investigated in private sector organizations. For example, the challenge of architectural knowledge vaporization can be addressed by documenting design decisions [3]. Furthermore, the challenge of sharing architectural knowledge can be addressed by considering communication, planning issues, and quality of captured knowledge [1, 4] when implementing AKM strategies. Finally, a delicate balance must exist between sharing architectural knowledge through documentation and social interactions [6] to ensure that knowledge is made explicit, without causing much burden on architects.

The idea of getting inspiration from the private sector for improvements in the public sector has been used before. Bate and Robert [6] describe how knowledge management concepts and practices from the private sector can improve health care organizations in the UK public sector. Another study compares public and private sector perceptions and the use of knowledge management [7]. In both types of organizations, improved quality and efficiency were the main benefits of knowledge management.

Overall, many reports exist on AKM in the private sector (e.g. [1, 4]), as well as on general knowledge management in the public sector (e.g. [6, 7]). However, we could not find any work on AKM in the public sector.

III. Research Method

To answer the research question in Section I, we conducted an interview study in public and private sector organizations, using semi-structured interviews. Such interviews belong to qualitative research, which aims at investigating and understanding phenomena within their real life context [10]. Challenges and solutions for AKM are linked tightly to their context. Also, we needed flexibility during the interviews, so that we could ask new questions, to further probe for AKM challenges and solutions.

Similar to [11], we decided to conduct extended, semi-structured interviews. Using surveys was less optimal, because of the lack of reports on AKM practices in public sector organizations, which inhibits the development of relevant questionnaires. Additionally, in a survey, participants might have different interpretations of the questions. Therefore, we decided to conduct semi-structured interviews, which enabled us to present our topics of interest, and discuss them directly with the participants. Furthermore, semi-structured interviews are useful as preliminary work for an in-depth case study [10]. However, semi-structured interviews require significant effort to prepare a discussion plan, recruit participants, and conduct the interview sessions. Overall, semi-structured interviews suited best our research goal, given the lack of previous work on AKM in the public sector.

A. Data Collection and Analysis Procedures

To conduct the interviews, we selected organizations from the private and public sectors which had enterprise or software architects. We contacted diverse organizations from our collaboration network. For the interviews, we used recommendations from [12] to ensure that the interviewer has the needed skills, and to facilitate good interaction between interviewer and interviewees. In each organization, we interviewed one or two persons, depending on their availability. In total, we interviewed eleven persons. We conducted face-to-face interviews that typically lasted one hour. The interviews took place between January 2010 and July 2012. We made audio records for the interviews, with the permission of the interviewed persons. We used a discussion plan with open-ended questions structured around three areas: *strategy* (e.g. "what are the objectives of the AKM strategy?"), *processes* (e.g. "what are the processes for sharing AK?"), and *tools* (e.g. "what tools are used for AKM?"). We derived these areas from AKM literature [1, 4].

To analyze the interviews, we transcribed the audio recordings. Next, two researchers performed content analysis, by assigning individually codes to sentences, phrases or paragraphs [10]. Each code corresponded to either a challenge or solution for managing AK. Different codes could be assigned to the same piece of content. Afterwards, researchers discussed their differences, and they agreed on a common interpretation. In case of disagreements, we consulted a third researcher. Data analysis also included a mapping of challenges to solutions by identifying which challenges were addressed by which solutions.

B. Organizations

The organizations that took part in this study are listed in TABLE I. Only the software architect in PS1 had about five years of practical experience. All the other participants had at least ten years of practical experience. The private sector organizations are international corporations. The public sector organizations are part of Dutch government. For confidentiality reasons, we provide limited details on the organizations, and we assign aliases to them.

TABLE I. Summary of participating organizations

ID	Sector	Domain	# Employees	Interview with
Gov1	Public	Municipality	~1.000	Enterprise architect KM consultant
Gov2	Public	Municipality	~100	Enterprise architect
Gov3	Public	Agency	~1.300	Software architect Software architect
Gov4	Public	Ministry	~30.000	Enterprise architect
PS1	Private	Software provider	~600	KM director Software architect
PS2	Private	IT consultancy	~40.000	Enterprise architect
PS3	Private	Engineering	>100.000	Enterprise architect
PS4	Private	IT consultancy	>100.000	Software architect

C. Validity Threats

We discuss validity threats using the recommendations from [13], in line with a report that uses the same methodology conducted by [11]. *Construct validity* refers to the relation between the observations and the theory behind the research. We interviewed many practitioners to avoid mono-operation bias [13]. We avoided evaluation apprehension [13] by using the recommendations from [12] to create a comfortable and nonjudgmental atmosphere for the interviews, and ensuring their confidentiality. *Conclusion validity* refers to the accuracy of the study conclusions. To increase conclusion validity, we involved more researchers in the data analysis, who reached a high agreement when interpreting the data. *External validity* refers to how well the results can be generalized beyond the study. To increase external validity and to reduce validity threats, we conducted interviews at a variety of organizations in the public and private sectors. Besides architects, we also interviewed knowledge management consultants, who could offer insights on how architectural knowledge is managed. *Internal validity* threats are not applicable to this study, because we do not try to establish any causal relationships.

IV. CHALLENGES

We identified three common challenges for the public and the private sector, as well as a challenge only for the private sector. Additionally, we link these challenges to results from knowledge management literature. We summarize these challenges in TABLE II. Afterwards, we present details on all challenges, their consequences, and concrete examples from the public and private sectors.

TABLE II. CHALLENGES IN PUBLIC AND PRIVATE SECTOR ORGANIZATIONS.

Challenge	Public sector	Private sector
AK vaporization	Gov1, Gov2, Gov3, Gov4	PS1, PS2, PS3, PS4
Low AK sharing	Gov1, Gov2	PS1, PS2, PS3, PS4
Organizational culture	Gov1, Gov2, Gov3	PS1, PS2, PS4
Low integration	-	PS1

A. Challenges in the public sector

1) AK Vaporization: This challenge refers to the loss of architectural knowledge in an organization [3]. We learnt that AK vaporization contributes to increased vendor lock-in because the less in-house AK remains in public sector organizations, the more they depend on software vendors for technology decisions (e.g. extending existing software depends on one vendor). Also, AK vaporization makes it more difficult to modify the architecture without involving vendors. For example, migrating existing systems to a service-oriented architecture depends on the willingness of the vendors. Having more in-house AK enables organizations to make better decisions about software solutions that meet their core needs, and to decrease vendor lock-in. Overall, AK vaporization reduces flexibility for public sector organizations and increases maintenance costs.

AK vaporization is a challenge across all public sector organizations that we studied. In Gov3, little architectural knowledge was captured on a regular basis. Architects had no formalized way to capture their knowledge. A wiki was used in the past, but only for a brief period, so the content became quickly outdated. Consequences of AK vaporization were that similar problems were solved in different ways. Thus, new people who joined a team needed to re-discover solutions, instead of reusing a proven solution. Instead of reusing captured knowledge, much informal communication of knowledge needed to take place. Architects often needed to explain the same solution to more developers, instead of documenting a solution and sharing the documentation.

Similar to the other organizations, little architectural knowledge was captured in Gov4. The architects working for Gov4 were employed through external companies, and were not asked to document their knowledge, although they were willing to do it. Moreover, little architectural knowledge existed inside Gov4 to facilitate knowledge sharing through direct interactions. Therefore, when the external architects stopped working for Gov4, their knowledge vaporized from Gov4, because there was no mechanism for preserving it.

2) Low AK Sharing: This challenge refers to insufficient sharing of architectural knowledge, inside and across organizations [1]. We learnt that low AK sharing existed across Gov1 and Gov2. An architect from Gov1 compared his current position with his previous job in the private sector, where co-workers were much more open to knowledge sharing, resulting in higher efficiency, by helping each other.

At Gov3, architects worked in small, isolated groups, without sharing much knowledge across groups. Also, architects could allocate parts of their time to increase their knowledge, but not for sharing it with others. In Gov4, the same tendency for isolation between groups existed, with little knowledge sharing between them. Moreover, in Gov4 most architects were from external companies, and very few knowledgeable people existed in Gov4, so architects could not share their knowledge with them. Overall, low AK sharing caused inefficiencies.

3) Lack of Supportive Organizational Culture: Culture contains norms about who controls what knowledge, and who can share or hoard it [14]. For example, a cultural norm is accepting knowledge hoarding as a source of job security or power [14]. An architect from Gov1 stated: *"Nearby municipalities are very small compared to us, maybe they fear we are going to take over things from them. That's the kind of feeling, which is very old."* Such fears encouraged knowledge hoarding and reduced knowledge sharing.

An architect at Gov3 considered that organizational culture played a role in a previous failed attempt to use a wiki for knowledge sharing between architects and developers. However, there were no accepted norms in Gov3 to capture and share knowledge, so the wiki content became gradually outdated, and was abandoned. Overall, we noticed that the lack of a supportive organizational culture increases knowledge vaporization and leads to reduced knowledge sharing, within and across organizations.

B. Challenges in the private sector

The challenges in the private sector match the ones from the public sector and include one extra challenge, namely low integration of AKM with organizational goals.

1) AK Vaporization: We found this challenge in all the private sector organizations. Architects mentioned several factors that contribute to this challenge. First, due to lack of time, less knowledge can be documented (PS1, PS2, and PS3). Second, documentation becomes irrelevant a few years after writing it, so the return for spending much time documenting is unclear (PS1, PS2, and PS4). The architect at PS2 summarized his view on documenting AK: "*We typically document when either the client asks for it or we discover that we need it. I'm not really interested in this documentation, unless I discover that the speed by which I can address a problem depends on the documentation.*" Third, the differences in educational background between software architects and maintainers increased the documentations costs. The architect at PS2 described this as follows: "*I have a designer, who has knowledge, puts it into a document, and pass it to someone who does maintenance, and who reads that information, generates knowledge from it, and these two do not match. Why not? Well, this one has architectural schooling for eight years and this one is good at programming routers. The points of view are so different, that these simply do not match, even if the documentation is the same.*" Forth, existing research results on capturing architectural design decisions are not fully adopted in industry (PS1, PS2, and PS3). Overall, similar to public organizations, AK vaporization lead to increased maintenance costs.

2) Low AK Sharing: This challenge exists in all the private sector organizations. From the interviews at PS1, we learnt that a factor contributing to this challenge was sharing knowledge by e-mails, because senders determined receivers of its content. This created an obstacle for other persons that might be interested in the knowledge captured by e-mail. For example, let us assume the rationale for an architectural decision is in an e-mail thread among a few architects. If a developer working on the code is interested in the rationale for that decision, then he would need to find out that the e-mail thread exists, and then ask one of the architects to forward it to him. Reducing overhead from these steps may facilitate AK sharing.

3) Lack of Supportive Organizational Culture: We identified this challenge in the interviews at PS1, PS2, and PS4. Several factors contributed to this challenge. First, architects and developers needed to be convinced to deliver not only source code, but also their knowledge. For example, at PS2, architects were not interested in transferring knowledge, because they do not consider it an interesting activity. Second, trust was an important factor in organizational culture, as put by the interview at PS1: "*It's not about software. It's not about wiki content, it's about people getting trust and solving problems*."

4) Low Integration with Organizational Goals: This challenge refers to the integration of knowledge management efforts with the goals of the organization [15]. From the interviews at PS1, we learnt that if such integration is low, then AKM efforts carry the risk of adding too little value to the organization. Specifically, the challenge is to provide value from AKM efforts throughout the lifecycle of projects for customers, i.e., from sales, to architecting, development, and during maintenance. AKM efforts need to show benefits, such as time savings for architects and other stakeholders.

Although the integration challenge did not emerge from the interviews in the public sector organizations, we considers this challenge is also relevant to public sector organizations, because such integration is a critical element of knowledge management, regardless of the type of organization [15]. Due to their different nature, the organizational goals in the public sector differ from the goals in the private sector. However, in both types of organizations, AKM efforts must serve organizational goals.

V. SOLUTIONS

We describe six solutions to the challenges in Section IV, elicited from the interviews in the private sector organizations: *community building*, *tool support*, *training*, *resources allocation*, *quality control*, and *management support*. Next, we present details about each solution.

1) Community Building: This solution was described in all private sector organizations. PS1 built its community, based on three elements: people, tools, and processes. People include architects, developers, testers, partners, and customers, who joined the community voluntarily and gradually. The main tool is a commercial wiki. Processes are managed through PS1's own business process management tool. For example, architects follow predefined processes for capturing knowledge regularly in the company wiki. If an architect leaves, the impact is reduced, because the other people in the organization can still use the architect's previous regular contributions to the wiki.

PS2 supports the creation of various communities of practice, in which architects can share knowledge with people in other positions or fellow architects. Moreover, collocating architects with other project groups improves AK sharing across projects. Architects who work in other groups *"get the feeling on what that really means and how that works."* Overall, getting perspectives from other groups helps architects deliver better documentation as architects became aware of the documentation needs of other groups.

Architects in PS3 share their knowledge through communities of practice, on architectural or other technical topics (such as Java or .Net), or business related topics. For these communities, the company organizes regular events to help networking, and promote knowledge sharing. Recognized experts are invited to share their insights at such events. The architect at PS3 stressed the idea that although tools help, they are less important than networks of people.

2) Tool Support: This solution receives much attention in all private sector organizations. At PS1, tool support shifted from a sender-dominant paradigm (e-mail) to a receiver-dominant paradigm (subscription). This means that notification about content and the actual content are separated. For example, instead of architects emailing content, they put architectural content in the wiki, and then send an e-mail notification with the wiki link. If a person considers that the content is interesting for her work, then the person can subscribe to the topic, and receive future notifications about it, without the constraint of receiving content through email.

Moreover, at PS1 knowledge capturing is based on a wiki, to avoid using different tools (e.g. forums, wikis, or document management systems). Having content in multiple locations creates obstacles for end users in accessing and sharing it. Therefore, all content must be delivered in the wiki. For example, if architects produce artifacts with other tools (e.g. PowerPoint slides), then the artifacts need to be attached to a wiki page.

At PS2 and PS3, various tools (e.g. SharePoint, wikis, internal blogs, and a third party collaborative software system) are used for capturing and sharing architectural knowledge. Additionally, social networking tools (e.g. Skype, Twitter, and Yammer) are widely used in PS2, PS3, and PS4, enabling knowledge exchanges across offices around the world.

3) Training: PS2 develops training materials for maintenance persons, to facilitate the transfer of architectural knowledge. In PS3, to increase peoples' AK, architectural training take place as part-time assignments, which may take from six to nine months. Although demanding, such trainings are necessary to ensure similar levels of AK throughout PS3. In addition, PS4 has central training facilities in which architects from various offices can meet in person during trainings, which leads to stronger connections through the social networking tools.

At PS3, in addition to trainings, there are company-wide events with software architecture experts. Architects can attend such events to expand their knowledge, or share their knowledge with each other.

4) Resources allocation: This solution refers to planning and allocating resources for AKM activities. At PS1 and PS3, 10% of architects' time is allocated for KM activities. At PS2, transferring architectural knowledge to maintenance people is considered a project by itself. As part of the project, architects need to consider what knowledge is needed for maintenance, and plan for its transfer. Architects may join temporarily the maintenance team to facilitate the transfer.

5) Quality Control: This solution refers to measures for increasing the quality of captured knowledge. At PS1, various metrics are collected for the wiki pages, such as number of visitors, profile of visitors, time spent on a page, or next visited pages. Such metrics indicate issues with content. If the content in the wiki is useful and up to date, then visitors perceive value in accessing the wiki.

At PS3, peer-review is used to evaluate the quality of captured AK. For example, a group of architects involved in a healthcare project sent some design documents to another group of experienced architects for review. The experienced architects provided constructive feedback to increase documentation quality. On the other hand, the reviewers (experienced architects) improved their knowledge on the healthcare domain.

At PS4, a solution to increase quality is to separate domain-specific knowledge from department-specific knowledge in the wiki system used for capturing knowledge. The rationale was that domains and departments evolve at different speeds. For example, a department might disappear during a re-organization, but knowledge from that department about the architecture of a specific system might be needed across other departments. If no separation exists, then the captured knowledge about that specific system becomes difficult to update, because it is mixed with irrelevant knowledge about the disappeared department.

6) Management Support: Support from top management was essential for the knowledge management efforts at PS1, because AKM is a long term effort. A person from PS1 summarized this in a metaphor: "*Grass doesn't grow by pulling it."* PS1 needed two to three years to implement its new knowledge management practices. To sustain momentum for long-term knowledge management efforts, knowledge workers (including architects) needed to experience benefits from the new practices. This was mainly achieved by saving time through AK reuse.

Top management influences organizational culture by encouraging initiatives, and having tolerance for mistakes. This was described as a success factor at PS1: "*You'll only get fired if you didn't take initiative, not because you made a mistake. Otherwise I wouldn't be doing this. I wouldn't even be close to this kind of ideas [for knowledge management]*."

At PS4, management supported knowledge management efforts by providing positive reinforcements to the top wiki contributors who shared their knowledge. The positive reinforcements were in the form of emails from the top management thanking contributors, and internal news articles praising their efforts. By receiving recognition for their efforts, the organizational culture became more supportive for knowledge management activities. In turn, people became comfortable to share their knowledge and help colleagues.

VI. DISCUSSION

A similar study in the UK public sector (i.e. national healthcare) [6] describes knowledge management as a core activity for organizational improvements. Unfortunately, knowledge management in UK public sector is much more immature, compared to private sector organizations [6]. Therefore, the public sector can benefit from the lessons and experiences in the private sector [6].

In our study, we noticed a similar situation for the Dutch public sector. Although architectural knowledge management provides significant benefits, AKM in the public sector is much less mature than AKM in the private sector. For example, interviewees from the public sector mentioned previous failed attempts to use wikis for capturing and sharing knowledge. Therefore, we think that the experiences derived from the private sector will help improve AKM practices in the Dutch public sector and elsewhere. Similar to [6, 7], we consider that solutions from the private sector help improve the situation in the public sector. Also, the improved quality and efficiency that the private sector derives from its AKM efforts can motivate public sector organizations to pay more attention to AKM.

We summarize the solutions from the private sector (detailed in Section V) and map them to the challenges in the public sector (detailed in Section IV.IV.A) in TABLE III. Each solution exists in two or more private sector organizations, and addresses one or more challenges. For example, community building addresses the AK vaporization and sharing challenges. Also, tool support addresses AK vaporization, sharing and organizational culture challenges.

TABLE III. SUMMARY OF SOLUTIONS AND CHALLENGES.

Organizations	Solution	Challenges
PS1,PS2,PS3,PS4	Community building	vaporization, sharing
PS1,PS2,PS3,PS4	Tool support	vaporization, sharing, culture
PS2,PS3,PS4	Training	vaporization, sharing, integration
PS1,PS2,PS3	Resources allocation	vaporization, integration
PS1,PS3,PS4	Quality control	vaporization, sharing, integration
PS1,PS4	Management support	culture, integration, sharing

Dependencies among challenges have received little attention in AKM literature on the private sector. We noticed dependencies between AK sharing and AK vaporization: sharing reduces the risk of vaporization. On the other hand, addressing vaporization by creating architecture documentation makes it possible to share AK. Also, to address the lack of AK sharing and vaporization we can use a common set of solutions: trainings, processes, tools and building communities. Another dependency is that organizational culture influences the willingness of architects to share and capture their knowledge. For example, architects might not share their knowledge because there is no positive reinforcement in their organization for sharing. On the other hand, management support influences organizational culture, by providing the positive reinforcement and long-term focus. Both are needed to foster an organizational culture, which encourages knowledge-related activities.

This study also contributes to existing literature on AKM in the private sector. For example, various solutions have been proposed to address AK vaporization and sharing [1, 3]. However, little work exists on the role of organizational culture and the integration of AKM efforts with organizational goals. Results from KM literature [14, 15] and from this study encourage more research on these challenges that focuses on architectural knowledge.

Researchers can use these results to develop a taxonomy of AKM challenges and their solutions, for the public and private sectors. Such taxonomy would make explicit the relationships among challenges, among solutions, and between challenges and solutions. Additionally, practitioners can use the results of this study to improve AKM practices in the public sector. For example, the challenges indicate potential pitfalls when implementing AKM strategies in public sector organizations, so practitioners can define actionable AKM activities from the solutions, such as improving tool support, and securing management support.

VII. CONCLUSION AND FUTURE WORK

In this paper, we present the results of an interview study consisting of eleven interviews conducted over two years. We conducted the interviews in four public and four private sector organizations. The paper contributes to the existing body of work on AKM (e.g. [1, 2, 4]) with lessons learnt from implementing AKM in the private sector and proposes these as solutions to the challenges in the public sector. Also, our study confirms that AK vaporization and sharing as major challenges. Furthermore, we identified less studied challenges in the AKM literature: the role of organizational culture, and the integration of AKM with organizational goals. These challenges require further research to understand their role in AKM efforts in the public and private sectors. Finally, we think that dependencies among AKM challenges need further attention. Overall, researchers can use the results of this study to propose taxonomies of challenges and solutions for AKM in both public and private sectors. Practitioners can use this study to improve AKM practices in the public sector.

As future work, we will conduct workshops in the Dutch public sector with architects and their managers to improve AKM practices. Also, using insights from this study, we are developing tool support (https://github.com/danrg/RGT-tool/wiki) to help architects capture their knowledge.

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