Action Design Research in Practice: Lessons and Concerns

Research paper

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Abstract

This paper reports on the results of a study of how scholars engage with and use the action design research (ADR) method. Since its publication, ADR has been acknowledged as an important variant of DSR, and has been adopted by a number of researchers. It has been adopted as the primary research method for doctoral dissertations as well as research projects in several disciplines. With the increasing use of ADR, the research community is also learning about how to apply ADR in different contexts. In this paper, we focus on how researchers are using the method. Drawing on primary data from researchers who have recently engaged in or finished an ADR project, we identify several recurring themes: managing expectations with actual outcomes of ADR-projects, coordinating work across different ADR-stages, and balancing the focus on problem instance versus class of problems. Our work contributes a greater understanding about how ADR projects are carried out in practice, how researchers can avoid some of the common pitfalls, and how the method can be applied more effectively.

Keywords: *action design research, design science research, design knowledge*

1 Introduction

Action Design Research (ADR) (Sein et al., 2011) represents a variant of Design Science Research (DSR) (March & Smith, 1995; Hevner et al., 2004; Vaishnavi & Kuechler, 2004) that privileges organizational influences on the design and evolution of the design artifact, emphasizing concurrent building, intervention and evaluation (the BIE cycles), as an alternative to the stage-gate model (e.g. Peffers et al., 2008). The ADR method, thus, claims that it allows both the research team as well as the organizational actors (e.g. stakeholders, end-users, practitioners) to shape the artifact over the research lifecycle. Since the original publication of ADR in MISQ by Sein et al (2011), the method has gained significant attention and captured the imagination of scholars within Information Systems (IS) (e.g. Ahlemann et al., 2013; Zuiderwijk et al., 2014). Several scholars have described research projects and acknowledged that their work has implicitly followed the ADR method; others have reported use of the ADR method to initiate or complete research projects, and yet others have reported converting their research approach to follow the core tenets of ADR during the research projects (Lempinen et al., 2012; Schact & Mädche, 2013; Maccani et al., 2014; Haj-Bolouri et al., 2016; Keijzer-Broers et al., 2016). As interest in the ADR method continues to grow, new research projects (e.g. McCurdy et al., 2016; Petersson & Lundberg, 2016; De Vries & Berger, 2016; Dreyer et al., 2017) are being initiated following the method.

Despite this growing interest, there are still uncertainties about how the ADR method is being used in practice. Much of the anecdotal discussion in the design science research community is centered around two potential conflicts: (a) how to balance the competing interests of the organizational stakeholders and the research team, and (b) how to balance the situated implementation of the design artifact against the need to produce generalized knowledge outcomes. These are unique to ADR, as a variant of design science research (DSR) because ADR emphasizes authentic collaboration with organizational research partners, whereas traditional DSR (see, e.g. Nunamaker et al., 1991; March & Smith, 1995; Purao 2002; Hevner et al., 2004; Peffers et al., 2008) emphasizes the possibility of crafting a technological solution to a class of problems. As the design science research community has evolved, it has refined the original ideas underlying DSR (Hevner et al. 2004), leading to proposals for methods (e.g. Peffers et al., 2008; Kuechler & Vaishnavi, 2012) and adoption of process models (e.g. Takeda et al., 1990; Gregg et al., 2001). The work by Sein et al (2011) directly addresses one of the key assumptions in DSR (the sequential, 'stage-gate' model) by suggesting that authentic collaboration with organizational partners requires more iterative effort (the 'building-intervention-evaluation' or BIE stage in ADR) to see how the design works in practice and evolves through interaction between researchers, practitioners and the artefact. By identifying the concern (stage-gate) and suggesting a solution (BIE), Sein et al. (2011) extended the family of DSR approaches. Their work, therefore, not only introduced and defined the ADR-method, but also suggested explicit high-level phases for conducting ADR research projects.

Seen in this manner, ADR is arguably a contribution that articulates a research method (drawing on the DSR paradigm) that is *indigenous* to the IS research community. It provides phases and principles that emphasize participation from stakeholders and creation of new knowledge outcomes (such as design principles). The publication of ADR, in effect, legitimized an important genre of research, first within the IS research community and then, in other communities, with scholars who saw engaged scholarship (Van de Ven, 2007) and authentic collaboration as critical pre-requisites to establish relevance of their research. Within the efforts to legitimize this kind of highly situated and practical problem inspired research also lay the seeds of some of the problems of applying the method. Operationalizing the ADR method has shed light on the concerns that appear to surface in manuscript review processes, informal research conversations, and discussions with editors, most notably the problem of generalizing knowledge from the specific problem and reporting the solution in response to this need. Without adequate solutions to these problems, both experienced and novice researchers would find it difficult to 'practice' ADR, and senior researchers would continue to find it difficult to appreciate and defend scientific outcomes that are

generated through the use of ADR. These continue to be problematic (in spite of suggestions about publication formats for design science research (e.g. Gregor and Hevner 2013), and represent key motivations for the work we report in this paper.

In response, this paper is aimed at providing a retrospective analysis of how ADR has been used in practice. Six years after its publication, ADR has been cited by more than 900 papers, theses and manuscripts according to Google scholar. As a body of practice about the use of ADR evolves, it is critical to uncover and label key concerns and problems to spur further research about understanding the use of ADR as a method in practice. The findings of this paper can thus serve as a precursor to potential refinements to, and elaborations of, different elements of ADR. Furthermore, the findings may also address present uncertainties about whether ADR is indeed necessary or not (Collatto et al., 2017), along with prior critiques concerning the empirical grounding/testing of ADR (Cronholm & Göbel, 2016). Thus, we believe that the truth to our objective of this paper is 'out there' among the individuals that have used ADR in practice. The main objective of this paper will therefore be to explicate *how researchers use ADR in their current research practice and, to share their insights*. Subsequently, we also seek to surface recurring challenges in the ADR projects, which can be addressed for future research.

To address the objective of this paper, we proceed as follows: the next section describes the ADR method and elaborate its current status, after that, we describe the research approach followed, next, the findings are outlined. The paper concludes with remarks about future work.

2 The Action Design Research (ADR) Method

The object of this research is the Action Design Research (ADR) method, originally defined as '*a research method for generating prescriptive design knowledge through building and evaluating ensemble IT artifacts in an organizational setting'* (Sein et al., 2011, p. 4). As a method, ADR focuses on building, intervening, and evaluating artifacts, in essence, reflecting the dual purpose of theoretical ambitions of researchers and involvement of stakeholders, practitioners, and users, and ongoing use in context. ADR is positioned by Sein et al. (2011), and considered by the DSR community, as a subtype of Design Science Research (DSR) (Gregor & Hevner, 2013; Iivari, 2015), because it requires a contribution that propose solutions for specific real world problems and addresses a class of problems through either instantiated IT-artifacts (e.g. Rogerson & Scott, 2013; Miah & Gammack, 2014; Keijzer-Broers & de Reuver, 2016) or distilled design knowledge (e.g. Lempinen et al., 2012; Mustafa & Sjöström., 2013; Haj-Bolouri et al., 2016).

Unlike earlier DSR methods (e.g. Takeda et al., 1990; Nunamaker et al., 1991; Peffers et al., 2008), ADR does not exclusively focus on the idea of constructing an IT meta-artifact as a general solution concept (Van Aken, 2004), method, construct or instantiation (March & Smith, 1995). Instead, ADR stresses the construction of a situated IT artifact that solves a specific organizational problem. Although it incorporates the key tenets of DSR (e.g. bridging practical relevance with scientific rigor through design of IT artifacts) (Hevner et al., 2004; Hevner, 2007), it extends this by allowing for the emergence of situated artifacts in an organizational setting (Dennis, 2001) and seeking applicability in the ensemble (Orlikowski & Iacono, 2001; Purao et al. 2013). Sein et al. (2011) describe this as 'guided emergence,' a term that captures the underlying tension between the two sets of stakeholders who must engage in the 'reciprocal shaping' of the IT artifact. This remains arguably an important tenet of IS research that seeks to understand the interweaved shaping of the artifact and organization as they are adjusting to each other, or in other words the shaping of digital life through socio-material. The ADR method also recommends conducting research activities in an iterative manner to involve researchers from various fields along with representative stakeholders, practitioners and end-users. Thus, similar to the AR, ADR provides guiding stages and principles that aim to link theory with practice, and activities of reflection and learning with doing (Susman, 1983; Davison et al., 2004) through iterative cycles of inquiry and action and design-oriented activities. Figure 1 outlines the ADR method: stages and principles.

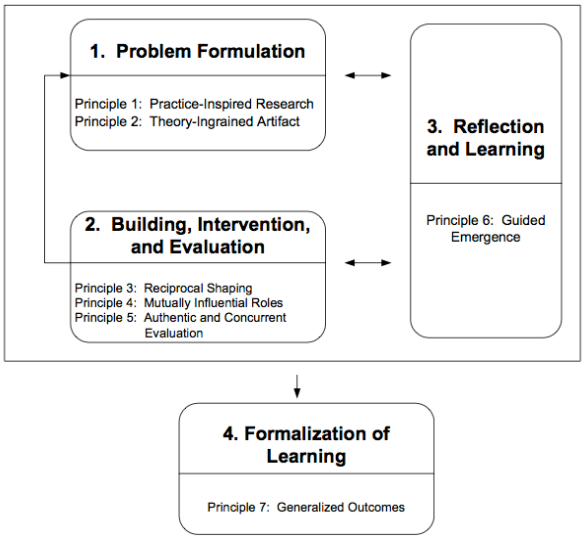

Figure 1. Action Design Research: Stages and Principles (Sein et al., 2011, p. 5).

The stages and principles of ADR shown in Figure 1, advocate action driven research that is motivated by real world problems within a real organizational context, which are addressed by the ADR-team (researchers, stakeholders, practitioners, end-users). The ADR-team is responsible for shaping a solution through building, intervention, and evaluation of artifact prototypes, which are implemented and tested in the organizational setting through the support of an underlying participatory philosophy implemented throughout the ADR-stages.

2.1 ADR: Current Status

The original paper that described the ADR-method (Sein et al., 2011), and the precursor that examined the interplay between design science and action research (Cole et al. 2005), have been cited 900+ and 200+ times respectively (Google Scholar, November 2017). The citing papers have appeared in journals and at conferences for research associated with IS (e.g. *MISQ, EJIS, DESRIST, ICIS*), and business and organizational management (*BIS, SCM, TMIS*). The characteristics of the papers vary with respect to how ADR has been adopted, in what context, the scope of research (e.g. full research, initial studies), their nature of contribution (e.g. conceptual contribution, methodological contribution). Some of the papers however, explicitly describe results from actual ADR-projects (e.g. Mustafa & Sjöström, 2013; Maccani et al., 2014; Haj-Bolouri et al., 2016), including method refinements and methodological contributions (e.g. Bilandzic & Venable, 2011; Mullarkey & Hevner, 2015; Haj-Bolouri et al., 2016), design science frameworks and theorizing that refer to ADR (e.g. Venable et al., 2012; Kuechler & Vaishnavi, 2012; Gregor & Hevner, 2013; Gill & Hevner, 2011), elaboration of epistemological and ontological groundings for action and design-driven IS-research that cite ADR (e.g. Alter, 2002; Goldkuhl, 2004; Wieringa & Morali, 2012; Iivari, 2015), and evaluation initiatives for ADR (Cronholm et al., 2016).

The citations indicate that researchers use ADR in several disciplines beyond IS. Examples include medical systems (e.g. Castro et al., 2013), and project management (e.g. Ahlemann et al., 2013). The cited works indicate that scholars using ADR work in academic groups and departments that deal with policy making, business intelligence, artificial intelligence, and others. Such indications suggest that ADR is a versatile method in terms of utility and flexibility for use across disciplinary fields. Maccani et al (2013) and Zuiderwijk et al (2014) indicate the suitability of ADR in various research settings. They provide examples of how ADR can be used in practice and potential problems with using ADR in various research settings (e.g. problems with generalizing ADR-outcomes, problems with involving stakeholders and end-users in ADR-stages, and more). In response, extensions of ADR such as *PADRE* (Haj-Bolouri et

al., 2016) elaborate the ADR-method by fostering and extending the participatory culture of ADR through iterative loops of planning, implementation, evaluation, and reflection of learning outcomes, together with stakeholders, practitioners and end-users.

Among the citations of ADR, a critique of ADR (see, e.g. Cronholm et al 2016) concerns the empirical grounding of ADR. Cronholm et al (2016, p. 1) claim that: *"[…] ADR lacks proper evaluation based on primary data. We claim that the existing empirical evidence justifying ADR is either fragmented or based on reconstructions of prior studies conducted for other purposes"*. However, Cronholm et al's (2016) critique is directed toward the original work by Sein et al (2011) without considering other investigations of ADR in practice. A similar critique can be found in a study by Cronholm & Göbel (2015, p.1), where they claim that DSR-methodologies in general (e.g. Hevner et al., 2004; Peffers et al., 2008): "*[…] lack solid empirical grounding since they are based on reconstructions of studies conducted for other purposes*". In this case as well, Cronholm & Göbel (2015) do not examine how the methodologies have been used in practice by other researchers. To address this gap, it is important to gather and analyze primary data about the experiences of authors/researchers who have actually used the ADR-method in practice. The research approach, described next, outlines how we responded to this concern.

3 Research Approach

To examine the use of ADR in practice, we collected and analyzed primary data via semi-structured interviews (this form of interviewing is explained in detail by Bryman, 2015) of ADR researchers, informed by the critical incident technique (CIT) (Flanagan, 1954; Bradley, 1992), which suggests procedures for gathering data about human experiences (e.g. Zach, 2004; Serenko, 2006; Stach & Serenko, 2010). The data consisted of both, anecdotes and stories about the use of ADR in practice as well as personal experiences and impressions about the use of ADR in the projects these researchers had participated in / were participating in. This included descriptions of the use of ADR in their research efforts, to address problems that emerge / emerged during their research. This also included descriptions of the use of ADR in their research that (inadvertently) lead to problems during their research. Such stories about the use of ADR method in the wild, including anecdotes and impressions, can provide indications of how ADR is *actually* used in practice, and directly respond to the concerns expressed by Cronholm et al. (2016) in the form of empirical grounding about the use of the ADR method.

Towards this goal, interviewees were recruited by identifying researchers who have published research papers or have completed graduate theses that explicitly declare the use of ADR as their core research method. In spite of the large number of citations of ADR, there are few efforts that have reported conscious use of the ADR method. These researchers have published empirical articles or theses that employ ADR. Our first attempt at recruiting the interviewees was, therefore, to locate papers that have used ADR, and by contacting the authors of theses papers. This, followed by some snowballing lead to a set of 9 researchers/research teams who have used or were using ADR in their research projects.

3.1 Data Collection

The employment of CIT can also allow construction of typical scenarios that may help trigger memories and past experiences. We used this to overcome recall concerns by providing the participants the ability to explore key concerns with specific scenarios that they would relate to within their ADR project. This was accomplished by encouraging the respondents to recall specific moments that concerned their use of ADR. The interviews were always conducted by a sub-set of the research team for this paper, which allowed new voices to emerge during analysis. The procedure for conducting the interviews included the following steps:

First, the researcher introduced the purpose and scope of this research. Then, the participants were asked to introduce themselves and to talk briefly about their background as well as the ADR-project they engaed in, such as the length of the project, the context of work, and their industry partners. Next, the participants

were provided with brief scenarios that outlined activities such as working with stakeholders to formulate problem, prototyping, documentation, formalizing learning outcomes, and others. These were meant as prompts that the participants could use to identify, recall and share specific incidents coupled with relevant experiences of using ADR. As the participants described these incidents, the interviewer probed for additional details and specifics to capture the anecdotes and stories. Finally, the participants were asked to respond to a set of questions that encouraged assessment of how well ADR supported their research project. These included questions such as: during what stages of the ADR-project did the participants (e.g. stakeholders) engage or fail to engage in the project; what elements of ADR would you like to enhance further; how can other researchers engage better in the reflection and learning stage. The interview concluded with an invitation to share any concerns about using the ADR-method based on their experience so far.

The interview sessions, thus, allowed the participants to separate: (1) sharing of their experiences of using ADR in practice; (2) their suggestions for elaborating or improving the ADR-method. Each interview was audio recorded and transcribed. The researcher(s) also took notes during the interviews, which were captured in a document that was securely shared with the respondents, allowing them to adjust and refine the notes, as well as provide additional commentary. The recorded material was transcribed and co-edited to ensure member-checking (Flanagan, 1954), which added reliability to our data collection, but also, partially to the data analysis process. Table 1 shows a summary of the interviewee profiles and interviews.

Name (Anonymized)	Gender	Age	Project	Research Domain	Session Length (Minutes)
Aaru	Male	39	Dissertation	IS and Health Care	58
Sofia	Female	42	Dissertation	ICT for Smart Cities	38
Nasib	Male	34	Dissertation	Competence Management	32
Rafael	Male	37	Dissertation	Innovation Ecosystems	52
Lina	Female	27	Research Paper	IS and Finance Sector	62
Rudolph	Male	46	Dissertation	IS and Global Development	74
Amelia	Female	40	Dissertation	Oil and Gas Industry	55
Edmund	Male	29	Dissertation	IS and eCommerce	65
Andrej	Male	41	Dissertation	ICT for Smart Cities	60

Table 1. Profile of Interviewees and Interviews.

A majority of the interviewees (8 out of 9) were Ph.D. candidates, who were part of an ADR-team for each project, which included senior researchers (faculty members). However, we did not consciously select one kind of a respondent (e.g. junior, senior) over another. Rather, this was a random consequence of identifying respondents that have used ADR and that were willing to provide their experiences through interview sessions.

3.2 Data Analysis

To analyze the data gathered, we coded the transcribed interviews through content analysis. This allowed identification of themes and categories to reveal how the researchers used ADR in their respective research projects. Our analysis included a first round analysis of transcribed interviews, and content coding by looking for words / phrases that described features or experiences about the use of ADR. These codes were examined and grouped under tentative themes in the data by identifying associations between the respondents' answers, and the provided scenarios. Finally, these tentative themes were discussed within the research team to elaborate a consistent view with themes about such as working with ADR in practice, expectations of working with ADR, and others. Our analysis continued by elaborating the tentative themes identified in the first round. To accomplish this, the research team revised the initial themes, by coding additional interviews and by identifying new associations among existing themes. This resulted into new categories that were grouped under an extended list of new themes. The analysis

continued until the research team reached saturation, i.e., no further themes could be identified from the transcribed interviews.

During these rounds of analysis, the research team allowed the ADR stages (e.g. problem formulation, reflection and learning) to inform the themes that we report in the next section.

4 Findings: Use of ADR in Practice

Several key themes emerged from our analysis. We report these at two different levels: (a) a descriptive level that exhibits categories and themes based on an analysis of the data from the interview transcripts, and (b) an interpretation of the responses including the drawing of inferences beyond analyses of interview transcripts. The first level addresses problems and experiences that researchers directly face while working with ADR stages, including the framing and communicating of research results with the ADR-framework, and others. The second level deals with concerns such as balancing solutions for organizational problems with distilling and communicating design knowledge that require a reflective analysis of the data gathered in light of comments and concerns expressed within the design science community. Findings from both levels are described with quotes from practice and tables that show recurring themes from the analyses.

We note that while some respondents (Sofia, Rafael, and Rudolph) mentioned that they loosely followed the ADR stages - although reported that the inspiration for their research could be described as ADR - other respondents (Aaru, Nasib, and Amelia) followed ADR implicitly during the early stages of their research due to project initiation before 2011. The rest of the respondents (Andrej, Edmund, and Lina) adopted and followed ADR explicitly. All respondents described their categorical choice to frame and communicate their research results as outcomes of ADR projects.

All Respondents	Sofia Rafael Rudolph	Aaru Nasib Amelia	Andrej Edmund Lina
Framed their work as ADR	**Loosely followed ADR**	**Implicitly followed ADR**	**Explicitly followed ADR**

Figure 2. Extent and Nature of Adherence to ADR.

The distribution of respondents in Figure 2 clearly shows that the ADR-method is not a strict, hard-coded specification or rules or a protocol. Instead, it proposes a broad set of phases within a high level process model and principles associated with each phase that need to be made operational (e.g. specific data-collection methods, specific systems design approaches and others).

As an illustration of this philosophy that appears to underlie the ADR method, Figure 2 shows that all respondents framed their research through the ADR process model (with related stages and principles). There were, however, significant differences in how the respondents followed ADR stages and principles: loosely, implicitly, or explicitly. For instance, respondents who loosely followed ADR did not emphasize the reflection and learning stage in their research although they added their own stages to the ADR-process model. Respondents that implicitly followed ADR, did intuitively incorporate the ADR-stages without an initial effort to frame their research as ADR due lack of knowledge about ADR or because their research project was initiated before the publication of ADR in 2011. Finally, researchers who explicitly followed ADR, did deliberately incorporate the stages and principles of ADR from the beginning to the end of their research project. Separate from these differences, the respondents described several issues related to the use of ADR in practice. Their comments and responses indicate that there are recurring issues, which may be addressed to make the application of the method easier in practice. During their descriptions, they described the obstacles in working with ADR throughout an ADR cycle, by framing their experiences within the ADR-stages. In the following, we use the ADR stages to cluster

these findings, pointing to specific concerns within each ADR stage. Table 2 shows essential themes extracted from the interview transcripts, following the data analysis rounds described earlier.

Stage	Theme	Description
Problem Formulation	Stakeholder Access and Involvement	Access and involvement of stakeholders was not an essential issue; Researchers used mainly workshops to involve stakeholders and identify essential priorities
	Problem Awareness	Initial problem awareness on the behalf of the stakeholders was addressed as a possible difficulty
	Essential Priorities	Research questions helped guiding the researchers for problem formulation and vice versa
	Use of Kernel Theories	Researchers used kernel theories to motivate potential solutions
Building, Intervention, and Evaluation	High Degree of Stakeholder Engagement	Early and Iterative interaction with stakeholders Researchers used agile approaches to support the BIE-stage
	Motivating Crucial Decisions	Establishing an early context for distilling design knowledge and motivating further crucial decisions for design and functionality
	Early, Incremental Evaluation	Early testing of artifact design and functionality; Early evaluation of artifact design and functionality; Incremental deliveries of artifact features
Reflection and Learning	Researcher Isolation in Reporting	Researchers spent isolated time for reflection, learning, and writing
	Ongoing Reflection and Learning	One researcher removed the stage of reflection and learning due to ongoing activities of reflection and learning
	Ad hoc and Post hoc Documentation	One researcher used a handbook for backtracking and pin-pointing lessons learned; Efficient documentation was hard to manage continuously and systematically
	Knowledge Sharing	Researchers used strategies such as workshops for dedicated knowledge sharing with stakeholders; One used software as a listen and learn tool

Table 2. Themes that Describe Use of ADR in Practice.

The 11 themes that describe the use of ADR in practice indicate that the current state of the ADR-method gives rise to considerations for further elaboration of the method. For instance, the first four themes (within the stage of Problem Formulation) imply that it is not difficult to involve stakeholders in problem formulation activities. Instead, the difficulty lies in arriving at a mutually agreed problem awareness and definition. One approach to address this concern was careful mutual elaboration of the key research issues (as indicated in the theme of Essential Priorities). An alternative was to start by specifying research questions and only then arrive at a firm problem formulation, rather than the other way around. These themes showed that different research teams considered both practice-driven as well as theoretical entry-points to enhance problem awareness. These themes (within the Problem Formulation stage) may, then, be characterized as centered around identifying the problem to drive the ADR project.

Other themes (e.g. Early Incremental Evaluation) that were associated with the stage of Building, Intervention, and Evaluation (BIE), pointed towards early agile prototyping, testing, evaluation of the IT-artifact, together with continuous involvement of stakeholders. Early work on distilling design knowledge and key requirements (described as the theme of Motivating Crucial Decisions) was concerned as a prerequisite for motivating and taking crucial decisions for artifact design and functionality. This, together with the mindset of involving stakeholders early on in the ADR-cycle, were considered as key issues for successful BIE cycles. Of the last four themes shown in Table 2, one theme (Ongoing Reflection and Learning) showed that the activities of reflection and learning can be continuous and

transparent, and may result in removing a separate stage from the ADR-process model. The theme Ad Hoc and Post Hoc Documentation indicated that researchers wrote down their reflections and learning, isolated from the rest of the ADR-team (the theme of Reflection and Learning), while one researcher used a handbook for backtracking and pin-pointing reflected lessons learned. Other themes and issues will be exhibited subsequently.

4.1 Stage 1: Formulating a Problem and Research Questions

The idea of formulating a problem remains a central issue (Bryman, 2015), which involves collaboration with stakeholders in the context of ADR-driven research projects. The respondents did not describe this as a key issue; instead, their concerns focused on working with stakeholders to address *potentially* divergent priorities. Multiple respondents described this concern (underlining ours):

> *"It was tricky to make people to talk about things that we wanted them to start talking about in terms of a problem formulation. We had to co-design workshops with lots of participants and present possible solutions to given problems."* (*Lina*)

> *"It took months to learn what the problem was. It mostly took time to refine the problem. Then again, you already start to develop a solution parallel to defining the problem. The good thing with ADR is that you can work agile and collect data, provide solutions, revise, and start over."* (*Edmund*)

4.2 Stage 2: Managing the BIE (Building, Intervention, and Evaluation) Cycles

Working with stakeholders to incrementally generate, demonstrate and evaluate the hardware-software artifact (Sein et al. 2011) as an essential part of ADR's participatory philosophy. The respondents indicated that the most intense interactions occurred as the research team engaged in *building* the artifact and less so as during intervention and evaluation elements of the BIE cycles. The respondents applied principles from iterative and user centered approaches such as agile development (Highsmith & Cockburn, 2001; Vijayasarathy & Turk, 2008) and incremental design (Larman, 2004), which allowed them to engage with managers, system developers, and end-users. All respondents described it as rewarding to deliver and demonstrate results (e.g. design features, functionality) because it kept the stakeholders engaged and motivated. Multiple respondents described this issue as follows:

> *"It is true that the stakeholders were most interested in the second ADR stage… they were only interested in building the prototype and get tangible results…"* (*Edmund*)

> *"The stakeholders were less interested in the produced knowledge from the project and more interested in the actual artifact instead."* (*Nasib*)

4.3 Stage 3: Ongoing Reflection and Learning

The goal of establishing a space for stakeholders and researchers to reflect and learn throughout the ADR-project seemed to be difficult to achieve. Several respondents shared experiences and commented on obstacles related to the idea of establishing an ongoing process of reflection and learning (third ADR-stage) with the stakeholders of their projects. The respondents also commented about the difficulties of documenting lessons learned iteratively and sufficiently. They described the use of various techniques such as workshops, recurring meetings with stakeholders, and internal meetings with the researchers, to capture reflections and document lessons learned. Here are some:

> *"Workshop sessions were conducted for reflection and learning. However, there were a great lack of documenting the outcomes continuously in the project."* (*Nasib*)

> *"Besides me, others in the project were not interested in the ADR method. Rather, they were interested in the outcomes of the everyday efforts. It was therefore [difficult] to find an arena for reflection and learning. However, we had the opportunity to involve the researchers and the chief manager for reflection and learning… he was able to reflect on a higher level in terms of learning… he would reflect deeper than the users would…"* (*Amelia*)

4.4 Stage 4: Absence of Stakeholder Engagement in Formalizing Learning

Formalizing the learning outcomes from an ADR-project (fourth stage of ADR) was not identified as a problem by the researchers because they did not regard this task as a concern for the stakeholders. The respondents unanimously confirmed the absence of stakeholders in the process of formalizing learning outcomes and described this task as purely processed by the researchers only through writing and communicating learning outcomes through research papers. The most difficult issues in this stage were described as knowledge sharing and choosing the right theoretical framing, coupled with other aspects such as incorporating kernel theories, and sharing knowledge with the stakeholders and others both formally (e.g. workshop sessions) and informally (e.g. continuous dialogues in dispersed part of the working place). Multiple respondents described this concern through the following words:

> *"I did not have any problem with the knowledge sharing part in the ADR-project. But overall, it was more valuable for the researchers to share knowledge than for the business people. The business people are more pragmatic about their work and not interested in generating and sharing knowledge."* (*Edmund*)

> *"We brought in theories from literature about organizational change. We used the theories to feed into ideation sessions. For instance, we created an artifact in creating a shared vision to communicate to the stakeholders. This was accomplished by following the ADR-principle of embedding an abstract idea into the artifact."* (*Lina*)

5. Discussion

We identified three essential topics that the practicing researchers raised when working with the ADR-method: (1) how to balance the competing interests of the organizational stakeholders with the interests of a research community; (2) how to balance the situated implementation of the designed IT-artifact for the practitioner needs against the research need of produce generalizable knowledge; and (3) how to balance the findings between specific and generalizable research outcomes. We interpret these as potential concerns related to working with ADR in practice, and discuss each.

5.1 Balancing Expectations from Industry Partners and Research Community

We identified four sub-themes related to balancing expectations from the industry partners and the research community. These themes emerged as a part of our second round analysis and interpretation of several key concerns of the respondents' comments. The respondents acknowledged that ADR provided an opportunity to address and work with a real-world problem that is relevant for an industry partner, and a chance to produce relevant research outcomes. They described the dualism between addressing and solving real-world problems and distilling design knowledge as a continuous loop of iterations that need to be managed continuously. Following are excerpts from the respondents' comments that describe this issue further and provide ways of tackling the balance:

> *"The design iterations generated both outcomes for new design and functionality, but also input for formalization of learning for research…"* (*Sofia*)

> *"The stakeholders could see that the system worked because we delivered small increments of the IT-artifact so that the stakeholders could interact and evaluate early on…"* (*Aaru*)

Comments from the respondents indicate that the balancing issue is manifested and expressed in various ways (see Table 3). The implications contain solutions and ways of keeping everyone onboard.

Theme	Description and Implications
Impedance Mismatch and Speed Differences	• The pace of business for the organizational partners versus the need for slow deliberation important for research writing was cited by respondents as a recurring problem • Research activities were perceived as slowing things down • Ongoing, incremental delivery of functionality via the IT-artifact was considered a way to overcome the problem
Establishing Stakeholders' Trust	• Early trust between researchers and stakeholders was perceived as beneficial for establishing equilibrium among ideas, thought, priorities, and expectations • Inviting stakeholders to workshops and informal occasions (e.g. lunch, dinner) to bridge ideas

	for research and business • Stakeholders did not have any explicit interest in writing research papers. However, they felt a need for knowing the value of research outcomes for their organization
Keeping the Research Team Engaged	• The multi-disciplinary composition of the research team meant different individuals within the research team were busy at different times in the project • Keeping the industry partners engaged and motivated remained an ongoing concern • Researchers conducted activities (e.g. workshops) focusing on different areas of interest to keep the industry partners interested and motivated
Separate yet Equal	• Involving stakeholders in discussion of research outcomes was not considered fruitful for the stakeholders or researchers • The researchers needed to make an effort to generate outcomes such as prototype versions • The researchers took the opportunity to extract design knowledge through incremental steps of prototype building, and presented them as preliminary findings at conferences

Table 3. Themes about Balancing Expectations.

5.2 Balancing the tension between Problem Instance and Class of Problems

We found clear themes related to the issue of addressing the tension between of problem instance and class of problems. The respondents commented and shared insights about how practical problems were formulated as most relevant for stakeholders, whereas research problems were identified and formulated by the researchers. This lack of reciprocity across practitioners and researchers was described by multiple respondents as follows:

> *"It was hard to allocate class of problems for research together with stakeholders… this was done by us researchers instead…"* (*Rafael*)

> *"Stakeholders were desperate for advice in terms solving a specific problem… They appreciated a lot that we had done the research locally within the research team… But due to time issue, it was very hard to hit the academy-industry 'sweet spot'."* (*Lina*)

An analysis of this data explicated four themes of issues with balancing the specific and general knowledge needs across the respondents' comments, these are shown in Table 4.

Theme	Description and Implications
Problem Identification and Evolution	• Problem identification remained a problem with multi-disciplinary teams involved • New and interesting research problems continue to emerge as the team engages in the research life-cycle • It is demanding to keep everyone up to date
Research Responsibility	• Hard to involve stakeholders in the process of casting problem instances into a class • Easy to focus on solving the problem and ignore the class of problems • Identifying the class of problems requires active decisions • There are no standardized ways of casting instances of problems into classes of problems • It is not decided (when in time) to cast a specific problem into a class of problem
Reciprocal Shaping of Problem Awareness	• Time is a limitation for everyone, including researchers and stakeholders • It is hard to balance a rigorous approach to identify problems with stakeholders • A space for mutual interaction helps mediating and shaping mutual conditions for problem awareness
Focus on IT Artifact Easier	• It is easier to describe and elaborate features of the IT-artifact • It is easier to elicit and document solution requirements for the IT-artifact • It is important to cast these in terms of a class of problems

Table 4. Themes about Balancing Problem Instance-Class.

5.3 Balancing the Distribution of Specific-Generalized Outcomes

The issue of balancing the distribution of specific-generalized outcomes concerned the idea of generating research outcomes that bridge local contexts (e.g. specific industry partner) with other similar contexts.

Similar ideas have been expressed in the Action Research and Design Research literature (Baburoglu & Ravn, 1992; Baskerville & Wood-Harper, 1998; Davison et al., 2004; Baskerville et al., 2009), about issues concerning the generalizibility of research outcomes and how to use specific research outcomes to intervene similar contexts through iterative cylces of design and research activities. Some of the respondents commented about these issues and shared their concerns through the following words:

> *"The issue of generating outcomes that are suitable for other contexts is highly relevant for our project, because we are essentially building smart cities for more than only one country…"* (*Andrej*)

> *"It is hard to know if our generalized outcomes are appropriate or not for other situations and projects… maybe this is a question of trial-and-error and evaluation… but it is in beforehand hard to assure…"* (*Amelia*)

The data for this concern was discerned and extracted into three themes shown in Table 5.

Theme	Description and Implications
The IT-Artifact as a Package of Knowledge	• Packing and unpacking produced knowledge into and from the IT-artifact, can be a medium for cross-boundary knowledge distribution • Produced knowledge needs to be elucidated easily in order to inspire other organizations to find interest in local research outcomes
Crossing Boundaries through Boundary Objects	• Defining the IT-artifact as a boundary object may create inter-organizational interest • Boundary objects link stakeholders, practitioners, end-users, and researchers together • It is difficult to define and realize an IT-artifact as a boundary object in practice
Multidisciplinary Interest	• Research outcomes are generated through multi-disciplinary co-operation • Research outcomes are appropriated for publication across various fields • Compatibility of research outcomes is flexible for use in various disciplines

Table 5. Themes about Balancing the Distribution of Specific-Generalized Outcomes.

The findings emphasize the nature of ADR as a high level framework, and the need for more concrete ways for working with the method. In the following we provide indicators for some good practices and define areas of further development of the method. The discussion so far can be summarized in four key lessons as follows:

First, the initial research problem is easy to define, but it becomes progressively harder to keep the users and their organizations involved in the later phases of the project. The research team can try to overcome this concern by resisting the attempt to distill the research question. The research team can encourage participation from the practitioner stakeholders by explicating the benefits of long-term collaboration and generalizable research outcomes. Several respondents also noted that early signs of progress such as early prototypes and concrete demonstrations can help in this regard. Second, several respondents commented that the practitioners were eager to see the artifacts, but not necessarily to adopt them into use. An awareness of this problem can prompt the research team to better plan the engagement and communication. Third, the researchers found that they were isolated in reflection and learning and even more in formalizing the results. These issues may be better managed through good research communication and deployment planning. A practice that several respondents reported was to arrange workshops to share outcomes with the stakeholders. It was noted that often there was no follow-up after these workshops, suggesting the possible use of techniques such as research diaries for documenting and communicating the results. Finally, the researchers found a need for more directions toward how to re-use their research outcomes in similar settings such as theirs. The issue of transferring knowledge from one setting to another setting and applying the knowledge through for instance design principles, is arguably (Chandra Kruse & Seidel, 2017) an issue for not only ADR-researchers, but for DSR-scholars in general. But because of the interdisciplinary nature of ADR, in terms of active co-researchers from various disciplines involved in a ADR-project, the sharing of outcomes reaches to several different outlets of research (journals, proceedings), meaning that knowledge is shared across communities of researchers.

6. Concluding Remarks

This study has identified issues arising from use of the ADR method in practice. Due to reason that the method is described in broad terms in the original paper by Sein et al (2011), applications of the method in projects have revealed recurring issues that researchers and practitioners face in practice. This was explicated through the interviews with respondents that have used ADR in practice and subsequently chosen to share their experiences. They also shared best practices about how they managed the difficulties of working with stakeholders in their research project(s) through ADR. While there were many occasions where the respondents felt that ADR was suitable for mutual problem formulation and prototype building/testing/evaluation with stakeholders, they also reported that there were times when the stakeholders felt disengagement. All of the respondents confirmed that the stakeholders were heavily engaged during the BIE stage, where the practical outcomes were seen as directly relevant for most stakeholders. As one of the respondents affirmed, stakeholders are trained to maintain a primary interest for business and not for research. This is understandable given the different priorities of researchers and stakeholders. But at the same time, the use of ADR seems to generate outcomes that bridge research interests with solutions for real world problems. We can speculate that with a right framing and communication the practitioners can see the value of more general knowledge creation, but this calls for careful communication between the researchers and practitioners.

Our findings reveal the suitability of ADR as a method for multi-disciplinary engagement to solve real-world problems. Several respondents were involved in projects where researchers and practitioners from several disciplines worked together to solve complex practical problems. They all agreed to work applying the ADR-method, which can be seen as a proof that the method works in multi-disciplinary real world projects. As research projects with practitioners have a tendency to be oriented towards action and design, regardless of the discipline, we will see a lot more of this kind of engagement in the future. Furthermore, as most of the grand challenges of research are naturally multi-disciplinary, the ADR-method should provide tools for researchers to apply their knowledge to solve real world problems and generate new scientific knowledge that is highly applicable. It may be argued that this study has a limited number of participants. However, the rich and dense interviews have provided a window into the several issues faced by researchers using ADR. We will thus continue the reported research through additional rounds of analysis and further interviews with other stakeholders of the involved ADR teams. This will be a task for further research.

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