Syst Pract Action Res (2018) 31:239–267
DOI 10.1007/s11213-017-9424-9

ORIGINAL PAPER

# Is Action Design Research Indeed Necessary? Analysis and Synergies Between Action Research and Design Science Research

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Published online: 15 August 2017


**Abstract** Action research is one of the research methods that seeks to develop scientific knowledge while simultaneously acting to solve real problems. Design science and design science research are approaches that address problem-solving oriented researches, converging in this aspect with the objectives of action research. A significant part of the literature discusses action research and design science research separately. However, there are some early discussions regarding the similarities and the differences between these research methods. The objective of this study is to deepen an analysis that distinguishes action research, design science and design science research as research methods considering their convergences and divergences. This leads to the discussion of the need for a third method: action design research. This study was conducted based on a configurative systematic literature review. The analysis and the synthesis of literature took into account themes and content analyses. Some results could be observed. First, there is a significant number of similarities among these research methods; second, there are complementary and positive synergies in their use; and third, the concepts of artifact and classes of problems seem to contribute both to the proposition and to

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the evaluation of the results obtained by action research. Finally, it was possible to establish a set of possibilities for the use of action research and design science research in a combined manner. The limitations of this study have a theoretical nature. There is a need for a comparative analysis of the use of action research and design science research and the use of action research under the paradigm of design science.

**Keywords** Research methods · Problem solving · Action Research · Design Science Research · Action Design Research

## Introduction

Scientific research can be understood as a formal, rational and systematic process that aims to provide answers to the study of a phenomenon using scientific procedures. A research can be understood as a systematic investigation that aims to develop theories, establish evidence and solve problems (Gough et al. 2012). To achieve such an objective, there is a path from identifying a problem to presenting reliable results (Dresch et al. 2015a). The research process is supported by the knowledge available and by the careful use of methods, techniques and scientific procedures recognized by the academic community (Cauchick Miguel 2011). As there are different variables guiding the choices of the researcher, this study emphasizes variables resulting from particular areas of knowledge and from the choice of methods whose epistemological basis is consistent with the objectives pursued by researchers.

Operations management, for example, is oriented towards the need to generate knowledge that contributes to solve organization problems (Coghlan and Shani 2005). Such a need to unite the practical and the theoretical contexts of the study of organizations contributes to the implementation of action research and design science research as research methods.

However, there is no unanimity in the use of such methods or their main distinctions and complementarities. However, there is a productive disagreement that favors a wide range of studies (Cole et al. 2005; Iivari and Venable 2009; Loebbecke and Powell 2009). This discussion and the expansion of the portfolio of research methods contribute to improve knowledge with the necessary rigor to scientific research (Lacerda et al. 2013). Therefore, it is important that research methods be studied and disseminated among researchers, especially methods that promote an interaction between researchers and the real problems of organizations. The possibility of a dynamic cooperation among research methods is the focus of studies proposing a joint use of action research and design science research (Cole et al. 2005). New studies are needed to address specific issues such as epistemological roots and possible reasons why both approaches have evolved independently (Cole et al. 2005). Although it is necessary to investigate the ontological and epistemological aspects of methods, this will not be the main objective of this study.

Considering such a context, this study presents the main concepts related to action research and design science research in the context of operations management. These two research methods may support studies whose objectives are to solve problems which require actions or interventions and which, at the same time, require the design and the development of an artifact that operationalizes such actions. It should be noted that some authors suggest a third research method called “action research design” (Sein et al. 2011). Thus, the aim of this study is to deepen the distinctive analysis between these two research methods and discuss the need for a third method: action research design.

This study is structured into four sections, besides this introduction. We present in the next section the main theoretical concepts we used as a basis for this study. Then, we describe the methodological procedures used to conduct the study. Subsequently, we present the main results of the research. Finally, we exhibit the conclusions and the limitations of this study, and suggestions for future research.

## Theoretical Basis

This section presents the key concepts related to action research and design science research. Then, we draw a comparison between these two methods to guide the arguments used in this study.

It should be mentioned that the distinction in the groundwork of these methods (Action Research and Design Science Research) is not always understood. In a first approach, it is worth noting that action research is concerned simultaneously with the implementation of changes in organizations and with relationships between researchers and the members of participant organizations (Coughlan and Coghlan 2002; Coghlan and Shani 2005; Thiollent 2009; Cauchick Miguel 2011). Design science research, in turn, may require effective actions to enable changes in a collaborative manner. However, its main objective is to design artifacts and prescribe solutions (March and Smith 1995; Hevner 2007). Another topic that deserves attention concerns the scientific paradigm underlying these methods, which characterizes studies that use them. It should be noted that studies on operations management may be based on traditional science (social and natural) or even on design science (Dresch et al. 2015a). Operations management studies are generally based on the paradigms of traditional science. In that sense, their main objectives are often to explore, describe, explain and, whenever possible, predict something (Van Aken 2004). As such, these studies are therefore oriented towards a description and an explanation of how a particular system or phenomenon works in the real world. Research based on design science, in turn, is concerned with the generation of knowledge by projecting and prescribing solutions to real problems (Dresch et al. 2015b).

### Action Research

Action research is a research approach designed to establish a close association between actions and solving of problems. In this perspective, it involves researchers and participants of a research situation in a cooperative and participatory way. They identify a problem, conduct data analyses, plan actions, implement actions and finally present an evaluation of a problem (Coughlan and Coghlan 2002; Thiollent 2009; Cauchick Miguel 2011).

For Thiollent (2009), action research is a participant research. It does not comprise only taking actions or studying a problem; it also produces knowledge, accumulates experience and contributes to the discussion of problems (Thiollent 2009). In action research, the researcher observes from within an objective situation of the real world both to improve it and to acquire knowledge (Checkland and Holwell 1998). Action research is also a research that aims to act and to generate knowledge starting by studying the theory to implementing actions (Coughlan and Coghlan 2002).

In short, action research must achieve two basic objectives: intervention in practice and production of knowledge (Thiollent 2009). The first objective refers to the contribution of the

research to solve a practical problem, and the second objective relates to the knowledge generated by the solution of a problem (Thiollent 2009).

With regard to the participant aspect of action research, aspects of the cooperation between the researcher and the participants of the organization under study are highlighted by the definition of Thiollent (2009, p. 16). According to this author, "action research is a form of social research with an empirical basis designed and carried out in close association with an action or solving a collective problem, and which involves representative researchers and participants of a situation or problem in a cooperative or participatory way." In the context of organizations, action research is appropriate when the research seeks to describe the operations and developments of actions over time for a particular group, community or management (Coghlan and Brannick 2001). In addition, action research seeks to understand how a member of a particular group performs an action, how and why such action may change or improve the functioning of a system and how the process of change or improvement allows the generation of learning (Coghlan and Brannick 2001).

Action research is characterized by some key aspects. Among such aspects, there are among others the collaboration between researchers and participants of the organization and the intervention in the situation investigated. Figure 1 shows the main aspects of action research according to (Järvinen 2007).

The application of action research essentially comprises four main phases: (i) preliminary, (ii) conduction cycle, (iii) meta-phase (Coughlan and Coghlan 2002) and (iv) final phase (Thiollent 2009). Figure 2 illustrates the main phases of action research.

At the preliminary phase, the researcher conducts a study which aims to understand the context and the purpose of the research (Coughlan and Coghlan 2002). At the second phase, a conduction cycle is performed in six steps; it is applicable to an organizational environment (Coughlan and Coghlan 2002). The steps that comprise the conduction cycle are briefly presented in Table 1.

The third phase is the meta-phase, which consists in monitoring all conduction cycles (the six previous steps). Its objective is to identify the learning generated during the conduction of

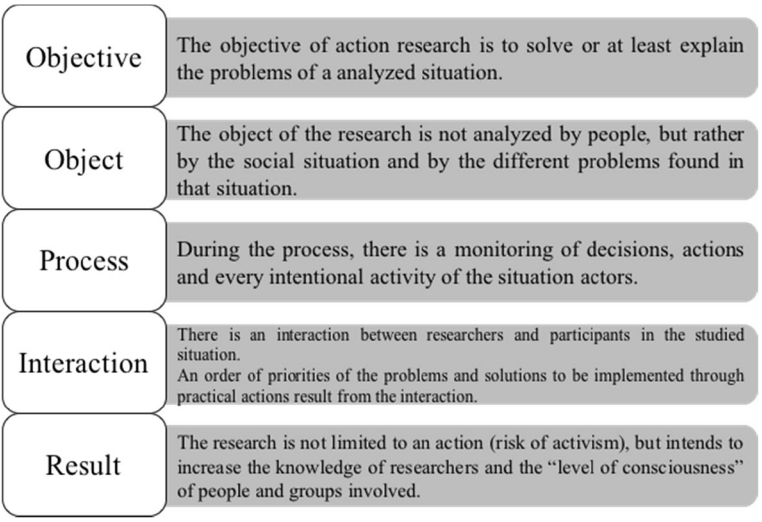


**Fig. 1** Aspects of action research. Source: Prepared by the authors based on Järvinen (2007)

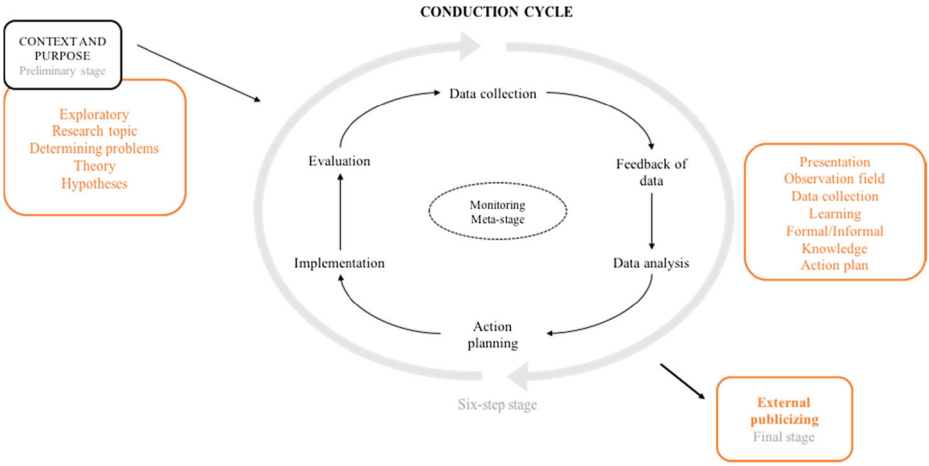


**Fig. 2** Phases of Action Research. Source: Adapted from Coughlan and Coghlan (2002) and Thiollent (2009)

the research as well as to improve the implementation of future cycles (Coughlan and Coghlan 2002). It is noteworthy that the six-step conduction cycle should be performed as often as necessary to obtain the desired solution to a studied problem (Coughlan and Coghlan 2002). Finally, Thiollent (2009) emphasizes the importance of communication and external publicizing of the research and its results for those interested in the study and for the academic community in general. The following section presents some basic concepts associated with design science research.

## Design Science Research

Design science research is a research method that seeks to generate knowledge on designing an artifact or even prescribing a solution (Dresch et al. 2015a). A research based on the design science paradigm helps to draw close researchers and members of organizations in order to generate useful knowledge to solve real problems (Bayazit 2004).

Design science research enables the conduction of research in several areas (Vaishnavi and Kuechler 2009), among them operations management (Holmström et al. 2006). Regarding operations management, design science research is appropriate since it may help to reduce the existing gap between theory and practice by engaging in issues of interest to both professionals and academics (Holmström et al. 2006). Design science research provides a systematic procedure that guide the conduction of studies aiming to design artifacts or even prescribe solutions (Dresch et al. 2015a).

Another concern of design science research is performing an evaluation to developed artifacts. Such evaluation is performed in order to verify the effective range of the objectives to which the artifact was intended (Çağdaş and Stubkjær 2011). Thus, the development of an artifact is not enough to characterize an investigation as design science research, but it is essential to certify that the device achieved the objectives originally proposed by the researcher (Dresch et al. 2015a).

Another feature of design science research is that, although it is an approach oriented towards problem-solving, its objective is not developing an optimal solution, but rather a satisfactory solution compared to existing ones (Dresch et al. 2015a). Another relevant aspect

**Table 1** Conduction cycle steps

| Steps | Description |
|---|---|
| Data collection | Data are collected in different ways depending on the context. Data appear as reports, financial statements, debates, meetings, interviews etc. In action research, the directly observable behavior is an important source of data for researchers. For example, dynamic observations of working groups, communication standards, leadership behavior, use of power, roles inside the group, rules, cultural elements, problem-solving, decision-making and relationships with other groups provide the basis for the research on underlying assumptions and their effects on the work and the life of these groups. Thus, the researcher works directly with observable phenomena of organizations. It is noteworthy that the data are collected not only from the participation and the observation of teams working in formal contexts, but also from informal contexts such as coffee breaks, lunch and other places/leisure situations. |
| Feedback of data | Data collected by the researcher are transmitted to those participating in the research in order to make such data valid and available for analysis. Sometimes, the researcher gathers data and writes reports; other times, the organization itself gathers data and the researcher acts as a facilitator or a participant in feedback meetings. |
| Data analysis | The critical aspect of data analysis in action research is the joint data review by the researcher and other people interested in the research. This collaborative approach is based on the assumption that clients know the organization and know what will work, and that ultimately they will implement and monitor actions. |
| Planning of actions | Once data analysis is concluded, new actions are planned. Some key questions arise, such as: What needs to change? In which parts of the organization? What changes are necessary? From whom is the support needed? What commitment must be stimulated? How does the resistance by the management works? Such questions are important and need to be answered as a part of plans for changes. |
| Implementation | The company's representatives who participated in the research process implement the planned actions. This involves performing planned changes in collaboration with the main components of the organization. |
| Evaluation | Evaluation is the key to learning. At this step, the results, expected or not, from the implementation of the action are thought through. |

Source: Prepared by the authors based on Coughlan and Coghlan (2002) and Thiollent (2009)

is that, although the problems addressed by design science research are specific, the solutions should be capable of generalization to a certain class of problems (Van Aken 2004; Sein et al. 2011; Lacerda et al. 2013). In view of these central concepts, researchers using design science research as a research method should consider some essential elements in order to obtain an adequate contribution. Such elements are briefly shown in Fig. 3.

The first element refers to the formalization of a relevant problem (March and Storey 2008). The second element is the evidencing by the researcher that there are no appropriate solutions to solve the problem, thus justifying the importance of the planned research (Dresch et al. 2015a). The third and fourth elements are related to the development and the evaluation of a new artifact that will be used to solve the problem (March and Storey 2008). This evaluation must be performed considering the utility and the viability of the artifact in order to demonstrate its practical and academic validity (Hevner et al. 2004).

Furthermore, design science research needs to address the following aspects: (a) the research should add value to the existing theoretical knowledge (contributing to the improvement of general knowledge) and improve practical situations of organizations; and (b) it is recommend that the researcher, upon concluding its activities, test the implications of the study's results in a real situation (March and Storey 2008).

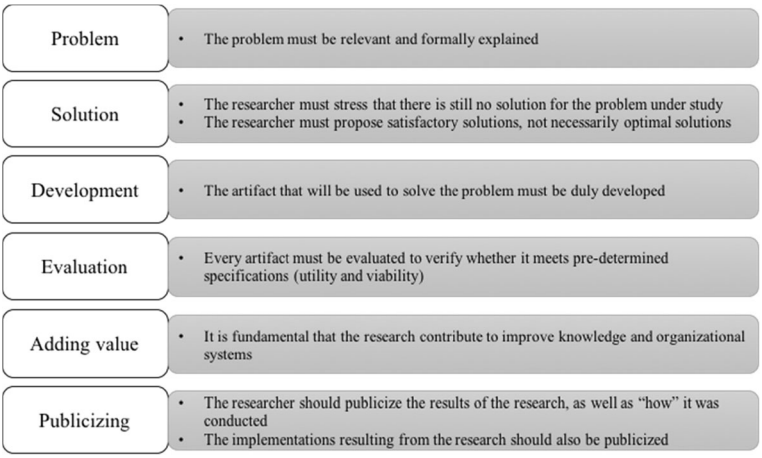


**Fig. 3** Essential elements for an adequate conduction of design science research. Source: prepared by the authors based on March and Storey (2008)

After presenting the main characteristics of design science research, below are the main steps recommended for a proper study conduction using this method. Figure 4 summarizes these steps.

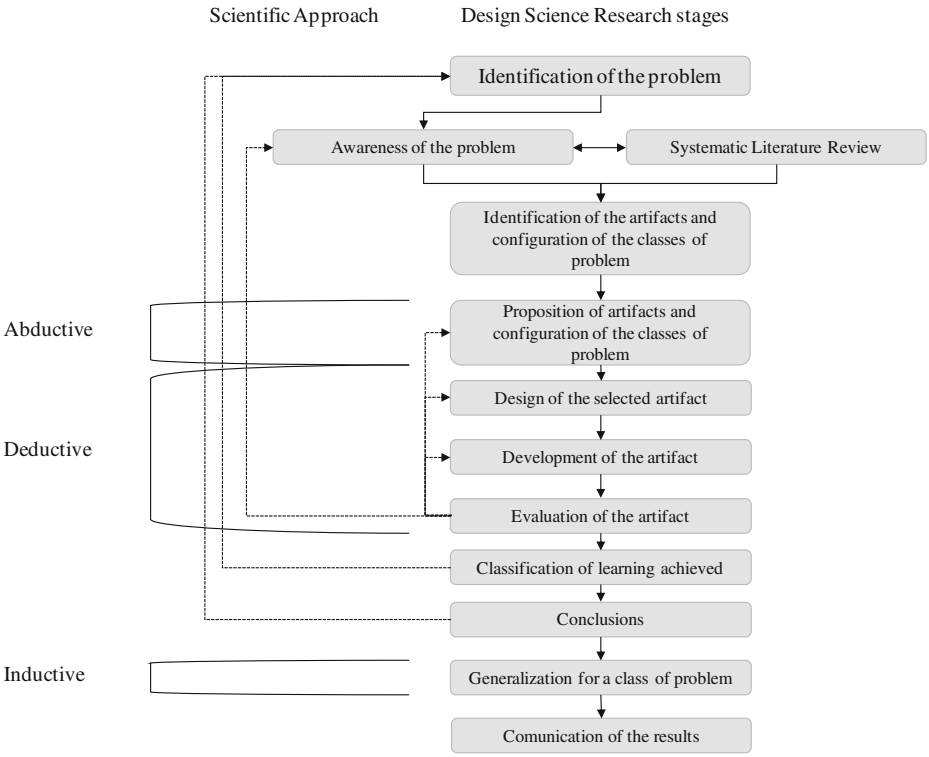


**Fig. 4** Main steps to conduct a design science research. Source: Dresch et al., 2015a, p. 125)

The purpose of Fig. 5 is to present the main steps to be taken to conduct a design science research. Overall, design science research begins with a clear identification of the problem, which, above all, must be relevant. It should be noted that the researcher needs to understand the problem in depth in order to identify all its facets and possible interrelations with the context in which it appears (Dresch et al. 2015a).

Once the problem is understood, the researcher must identify artifacts previously developed to address such problems, as well as possible classes of problems (Dresch et al. 2015a). Then, it is possible to make possible suggestions for future artifacts. Therefore, one or more alternatives of artifacts to solve a problem should be made explicit (Manson 2006).

This step results in a set of possible artifacts. One of them is selected to advance to the next steps, which focus on the development of such artifact. The suggestion step is essentially creative and therefore somewhat subjective (Vaishnavi and Kuechler 2009).

During the development of the artifact itself, the researcher constructs the internal environment of the artifact (Simon 1996). To design the artifact, different approaches may be used, for example algorithms, graphic models, models etc. (Lacerda et al. 2013). The product of the development step will be the artifact itself at a functional state (Manson 2006).

In design science research, the development of an artifact is not enough to conclude the research. The evaluation of the artifact is essential. Such evaluation aims to analyze how the artifact behaves in the context for which it was designed, verifying its ability to meet the intended objectives (Dresch et al. 2015a). In addition, the evaluation should pay attention to the pragmatic validity of the artifact, that is, whether the developed artifact meets the utility demands for its application in the external environment for which it was designed (Hevner et al. 2004).

In the final stages of the method, the researcher must formalize the whole research process, including its results and learning acquired from it. At this point, the steps of the research should

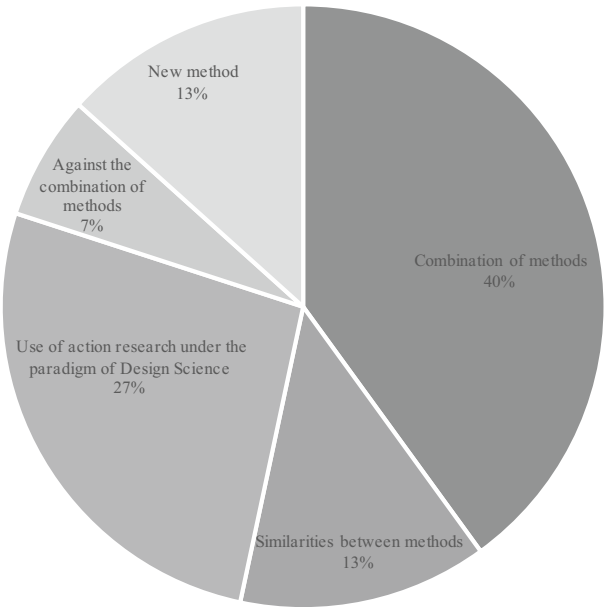


**Fig. 5** Categories for classifying articles. Source: Prepared by the authors

be synthesized detailing the conduction process and justifying the choices made. Whenever possible, the study should generalize the solutions obtained by using the artifact for a determined class of problems (Dresch et al. 2015a).

Finally, it is necessary publicize the research. Communication is fundamental because it presents the research results to the academic and organizational communities (Peffers et al. 2007). Such publicizing is essential to improve the knowledge of the studied areas.

In the following section, we present an analysis that distinguishes design science research from action research. This distinctive analysis helps to identify the main differences between action research and design science research as well as a possible need for a third research method, that is, action design research.

### Distinctive Analysis Distinguishing Action Research From Design Science Research

Once we identified the characteristics of action research and design science research, it is possible to find similarities and differences between them. Table 2 summarizes the characteristics of the this comparatively.

The main differences between action research and design science research are their objectives, evaluation of results, role of the researcher and need for empirical basis. On the one hand, studies that develop artifacts, use such artifacts in an organizational context (cooperatively or not) and evaluate artifacts have an appropriate methodological support by using design science research. On the other hand, studies that seek to cooperatively understand a phenomenon in depth and studies that require an intervention in practice have an adequate subsidy for conducting the research by using action research.

Moreover, comparing action research with design science research, it can be observed as an essential difference that design science research does not require a collaborator or a specific group interested in the research (Iivari and Venable 2009). In addition, design science research does not require a joint collaboration between researchers and participants in the environment in which the research is conducted.

Iivari and Venable (2009) pointed out that action research and design science research are compatible with each other, but, for some reasons, their combination may be difficult. For example: (i) design research science enables learning through “flaws and errors” due to the nature of the development of something new or of an innovative artifact, different from action research, whose interest is the generation of knowledge to solve a practical problem; (ii) in design science research, tests using the artifacts can be performed even without the participation of the people interested in the research. This partly reduces risks and partly ensures that the researcher makes technology decisions in a rigorous and robust way.

Finally, it can be noted that, for the use of design science research for some situations, an interaction may be required. However, it is not as essential as for action research, that is, the researcher may work collaboratively or not when using design science research. However, such cooperation is required for studies using action research.

## Methodological Procedures

To achieve the objective of this research, we performed a comprehensive and systematic literature review according to the procedures proposed by (Morandi and Camargo 2015). The systematic literature review was performed on studies found in the databases *EBSCOhost*,

**Table 2** Features distinguishing action research from design science research

| Characteristics | Action research (AR) | Design Science Research (DSR) |
|---|---|---|
| Epistemological paradigm | Traditional sciences (natural and social) | *Design Science* |
| Objectives that can be achieved | Solves or explains the problems of a system generating knowledge for practice and theory | Develops artifacts that offer satisfactory solutions to practical problems. Contributes in developing theories (mid-range theories) |
| | Explores, Describes, Explains and Predicts | Designs and Prescribes |
| Main activities planned for a proper conduction of the research | Based on traditional science, the AR is conducted through exploration of the theme, data collection, action planning, implementation, evaluation and publicizing of data | Problem identification, awareness of the problem, systematic literature review, identification of artifacts and existing classes of problems, artifact design, development of the artifact, evaluation of the artifact, making the learning explicit, generalization of the artifact to a given class of problems, conclusion and reporting of results |
| Main research results | Constructs, Hypotheses, Descriptions, Explanations, Actions | Artifacts (Constructs, Models, Methods, Instantiations, Design Propositions) |
| Generated knowledge | About how things are or how they behave | About how things should be |
| Role of the researcher | Multiple depending on the type of action research | Designer and/or evaluator of the artifact |
| Collaboration between researcher-participant | Required | Not required |
| Empirical basis | Required | Not required |
| Implementation | Required | Not required |
| Evaluation of the results obtained by the research | Confrontation with theory | Applications, simulations, experiments using the artifact |
| Nature of data (collection/analysis) | May be qualitative and/or quantitative | May be qualitative and/or quantitative |
| Specificity of the research results | Specific situations | Generalizable to a certain class of problems |

Source: (Dresch et al. 2015b)

*ScienceDirect* and *Google Scholar*. The selected publications contained the search terms "*action research*" associated with ""*design science*", "*design science research*", ""*prescriptive research"* and the specific words *""action research design*" and ""*action design research"*. The search was limited to studies published in scientific journals over the last ten years. A preliminary search found 43 studies with a high result rate for the association of the terms "*action research and design science*". Appendix 1 summarizes the main results of the systematic literature review.

Upon an inspectional reading (Adler and Van Doren 1972) of the studies found, we identified 15 relevant studies that met the literature review criteria. For their selection, the studies must have presented at least one of the following criteria: (i) comparison between action research and design science research; and (ii) proposition of a new method based on action research and design science research.

The inspectional reading process helps to verify the relevance of the texts to the research. After selecting the relevant texts, we analyzed them in depth and classified them into four categories: (i) articles claiming that action research and design science research can be combined; (ii) articles using action research under the paradigm of design science; (iii) articles proposing a new research method based on action research and design science research; (iv) articles that only present the similarities between action research and design science research; and (v) articles arguing against the combination of action research and design science research. Fig. 5 shows the distribution of the articles into each category.

In addition, by analyzing the articles, we found that the most articles are theoretical and only six articles analyzed or applied action research and design science research empirically. Finally, we could also identify that most articles identified during the systematic literature review addressed information systems and management. There were few articles applying these methods to education.

In the next section, we present the main results obtained by analyzing the selected articles. This analysis presents the point of view of several authors on the similarities and the differences of the three methods, the possible combination of methods and the proposition of a new one. The complete list of papers originated from the literature review, can be visualized in the Appendix 1.

## Results

First, we reviewed the characteristics of action research and design science research defined and mentioned above. Studies analyzed the similarities and differences between action research and design science research, and some researchers pointed out that they are similar (Cole et al. 2005; Loebbecke et al. 2007; Science 2007; Iivari and Venable 2009; Papas et al. 2012; Alles et al. 2013). Others consider that action research and design science research can be combined and, by this association, a new method is created including procedures from both (Rose and Saifullah 2012; Sein et al. 2011). This new method is called "action design research" (Sein et al. 2011).

By taking the objective of action research, the researcher works to solve practical problems and improve the knowledge in a particular area (Coughlan and Coghlan 2002; Järvinen 2007; Thiollent 2009). As for design science research, the objective is to design artifacts that propose satisfactory solutions to practical problems. Thus, it focuses on production systems that do not

yet exist either by changing existing practices or by creating new practices (Takeda et al. 1990; Romme 2004; Manson 2006; Peffers et al. 2007; Vaishnavi and Kuechler 2009).

In this sense, the objectives of both research methods converge to a same objective: problem-solving and improving knowledge. However, the guidelines of each method follow specific flows. The researcher using action research addresses research contexts and purposes, collects data, provides feedback, analyzes data, plans actions, implements, evaluates and finally presents the results. The researcher using design science research, in turn, identifies a problem with a practical relevance, designs and evaluates an artifact, occasionally implements and examines the scope of application and the possibility of generalization of the artifact to a class of problems, identifies and analyzes practical and theoretical contributions of the artifact and finally presents the results.

To deepen the discussion, we present below a synthesis of the converging aspects of action research and design science research. Such aspects have been identified by reading the papers found during the systematic literature review stage.

For comparison purposes, we considered the converging aspects identified by (Cole et al. 2005; Järvinen 2007). The choice for these two studies is because they are early researchers of the similarities between action research and design science research. The first study evidencing the existence of similarities between the action research and design science research was Romme (2004), who considered both as complementary tools. Romme (2004) did not focus on the methods' aspects aiming to draw comparisons. Table 3 shows the similarities between the action research and design science research.

Most studies shown in Table 4 argued that action research and design science research are analogous research approaches because both are based on planning and taking action in order to study the reality by using a practical problem-solving point of view. Thus, the motivation for both is to solve specific problems within the organizational context. Action research can be considered as an alternative to or a complementary strategy for design science research.

Ninety percent (90%) of the studies which addressed the similarities between action research and design science research, mention the generation of knowledge about the project analyzed (Alles et al. 2013; Cole et al. 2005; Holmström et al. 2009; Iivari and Venable 2009; Järvinen 2007; Loebbecke et al. 2007; Papas et al. 2012; Ractham et al. 2012; Romme 2004; Weeding and Dawson 2012). The generation of new knowledge through theoretical contributions and, simultaneously, the generation of practical improvements are connection points between the action research and design science research (Alles et al. 2013; Cole et al. 2005). New knowledge arises from the conduction of the research in which knowledge is generated, used, tested and modified so that it contributes to practical solving-problems (Järvinen 2007). The generation of knowledge about the project using action research is considered a success when there is an improvement in a real situation. In design science research, there is success when an artifact contributed satisfactorily to improve the reality or to solve a particular problem (Papas et al. 2012).

Sixty percent (60%) of the studies analyzed considered activities focused on intervention and evaluation, collaboration between researchers and participants, cyclicality and focus on improving reality as similarities between action research and design science research. In addition, both research approaches aim to improve reality, since their purpose is to improve an unwanted problem-situation (Romme 2004; Cole et al. 2005; Holmström et al. 2006; Järvinen 2007).

According to the analysis, action research can be used for activities focused on intervention, construction and evaluation (Järvinen 2007; Papas et al. 2012). In this perspective, action

**Table 3** Similarities between action research and design science research

| Aspects analyzed | Romme (2004) | Cole et al. (2005) | Järvinen (2007) | Loebbecke et al. (2007) | Holmström et al. (2009) | Iivari and Venable (2009) | Papas et al. (2012) | Ractham et al. (2012) | Weeding and Dawson (2012) | Alles et al. (2013) |
|---|---|---|---|---|---|---|---|---|---|---|
| Utility | | X | X | | | | | X | | X |
| Generation of knowledge on the action | | X | X | | | | | | X | |
| Generation of knowledge on the Project | X | X | X | X | X | X | X | X | X | X |
| Activities focused on intervention | | X | X | X | X | | X | | X | X |
| Activities focused on design | X | | X | X | X | | X | | | X |
| Activities focused on evaluation | X | X | X | | | X | X | X | X | |
| Participants (researcher/participant) | X | X | X | X | | | X | | X | X |
| Focus on improving reality | X | X | X | | X | X | X | X | | |
| Cyclicity | X | X | X | X | | | X | X | X | |
| Attention to relevance | X | X | | | X | | | | | |
| Attention to scientific rigor | X | X | | | X | | X | | | |
| Research as a process | | X | X | X | | | | | | |
| Attention to publicizing the researh | | X | | | | | | X | | X |
| Need for a theoretical basis | | X | X | X | X | | | | | X |
| Learning through reflecting | | X | | | | | X | | X | |

Source: prepared by the authors

**Table 4** Possibilities of combining action research (AR) and design science research (DSR)

| Characteristics | Alternative A<br>Use of AR under the DS paradigm | Alternative B<br>Use of AR and DSR as mixed-methods | Alternative C<br>Combination of AR and DSR |
|---|---|---|---|
| Scientific paradigm | Design Science | Design Science | Design Science |
| Research method | Action research | Mixed methods: Action research + design science research | Action design research |
| Research structure | Incorporation of the concepts of classes of problems, satisfactory solutions, internal/external artifact environment to action research | Sequential use of the methods | Establish a new method that integrates elements from action research and design science research |
| Artifact development | Not necessary | Occurs during the stage of design science research with construct-type artifacts, models or methods in general | Especially suitable for the development of instantiation-type artifacts |
| Assumptions | No need for the development of an artifact; the intervention will generate knowledge on how to design the artifact | Possibility of designing an artifact without the collaboration of participants; naturalistic evaluation of the artifact is required | There is collaboration between the researcher and the participants since the artifact's conception up to its evaluation; iteration during development and artifact evaluation are dynamic (data collection and analysis) and recurrent |
| Need for collaboration (researchers and participants) | Total | Partial | Total |
| Purpose of the research | Generate knowledge on how to design artifacts based on intervention | Generate knowledge about the utility of the device in the real context | Generate knowledge about the implementation of the artifact in the real context |

Source: Prepared by the authors

research can be used for evaluating or assisting in the implementation of a research artifact previously developed by design science research. Such application of action research can be made either for the artifact design or during its evaluation (Cole et al. 2005; Peffers et al. 2007).

Cole et al. (2005), Järvinen (2007), Papas et al. (2012) and Loebbecke et al. (2007) agreed on a proactive intervention of action research in the design of the artifact recognizing at the same time that the intervention of the researcher is not a requisite of design science research. Iivari and Venable (2009) highlighted the compatibility between action research and design science research and deemed the synergy between them as positive, although the authors warned of the risks of testing an artifact in a real situation. This is because, in design science research, tests of artifacts could be conducted in laboratory. However, some authors (Cole et al. 2005; Järvinen 2007) argued that the test of the artifact in certain situations should use an intervention approach, not only laboratory tests or simulations.

According to the analysis above, it is possible to observe the risks inherent to the process of evaluating artifacts developed during the research using design science research. Such risks depend on the nature of the technology and on the situation. However, it is suggested that high-risk evaluations be artificially made before being evaluated by action research (Iivari and Venable 2009). A careful evaluation is bound to an ethical conduction of the research. The research must identify and make explicit the risks of developing and experimenting something new, and take proper steps to mitigate such risks (Iivari and Venable 2009).

Another similarity between action research and design science research concerns the collaboration between researchers and participants. This is a significant challenge because action research and design science research seek to actively intervene in practice rather than just passively observing and analyzing reality (Alles et al. 2013). The collaboration can be useful for both artifact designs and artifact evaluation (Papas et al. 2012; Alles et al. 2013).

Another similar element between action research and design science research is cyclicality. Loebbecke et al. (2007) studied comparatively the methods using iterative steps and a cyclical analysis, including (i) an initial understanding of the situation (diagnosis in action research, and identification of needs in design science research), (ii) intervention of the researcher in the organization under study, and (iii) reflection on and evaluation of the results before restarting the cycle.

Empirical studies demonstrate the association of activities of action research and design science research. Ractham et al. (2012) based their study on a cyclical evaluation and a constructivist learning to develop a learning tool using Facebook. In a collaborative research, Weeding and Dawson 2012) presented an iterative use of action research for planning, acting, evaluating and reflecting aiming to develop a portable solution (artifact) to monitor the health of patients in hospitals.

Following the same line of analysis regarding the differences and similarities between action research and design science research, Papas et al. (2012) discussed the topic from four points of view: (i) the role of the artifact, (ii) the structuring process, particularly in relation to research cycle and development of methods, (iii) the evaluation focus of the intervention and the research, and (iv) the emphasis on learning and knowledge. By analyzing each of these aspects, the authors proposed three approaches combining methods for interventional research (Papas et al. 2012): (i) researchers use action research as a dominant approach and then other methods to examine and explain research problems; (ii) researchers opt for a multi-methodological approach: multiple approaches or methods are incorporated into research efforts; and (iii) meta-approaches: the meta-approach contains elements of both action research

and design science research, or even other methods. Sein et al. (2011), in turn, created a more comprehensive approach of design science research, appropriately called "action design research", based on the action and the organizational aspects of action research.

According to Sein et al. (2011) and Rose and Saifullah (2012), the similarities between action research and design science research is significant. Thus, Sein et al. (2011) proposes the action design research use at the evaluation stage in researches conducted at the organizational context and directed to problem-solving. So, the action design research reflects the assumption that artifacts are sets shaped by the organizational context during their development and use (Sein et al. 2011). Thus, this method approaches the research process by performing inseparable and inherently intertwined activities in order to design an artifact, intervening in the organization and evaluating it at the same time (Sein et al. 2011).

The reason for the creation of a new research method is the need to explicitly recognize the created artifacts, as well as their purpose, construction logic and their continuous improvement in the context in which they are used (Sein et al. 2011). The challenges of this proposal are solving a problem in an organizational environment with the collaboration of researchers and participants, jointly evaluating the formulation of a problem, designing an artifact and evaluating the solution that addresses a class of problems identified by the context (Cole et al. 2005).

The multi-methodological approach, as proposed by Papas et al. (2012), seems the most relevant because it is applicable to all research areas, allowing the combination of methods during the conduction of the research whenever necessary. In this sense, Peffers et al. (2007) consider action research as an alternative to complement design science research during the design and the evaluation of artifacts whenever necessary, including intervention in a real context.

Ractham et al. (2012) also used the action research's steps to perform evaluations and guide the creation of a learning environment. The authors followed six steps: (i) Problem: identification and motivation, (ii) Project: solution objectives, (iii) Design and development, (iv) Demonstration, (v) Evaluation, and (vi) Communication (Ractham et al. 2012). As a result of the joint application of methods, the authors could apply some of the steps of action research (strategies and interventions) and obtain a constant feedback from research participants to subsequently improve the artifact throughout the development process.

Iivari and Venable (2009) supported the multi-methodological approach, arguing that maintaining different methods is interesting because researchers can make decisions about the application or not of a new or different methodology during their research. Thus, upon suggesting the combination of methods in a different manner, Iivari and Venable (2009) proposed that the design of the artifact should first use design science research and that the artifact should be evaluated using action research. Such evaluation can be made by implementing the artifact in an organization with the support of action research, for example (Iivari and Venable 2009).

Accordingly, Cole et al. (2005) pointed out that design science research and action research, could be jointly used because of their degree of similarity and their overlap, especially because both operate pro-actively. The authors proposed adding the reflection and learning phases to design science research, the artifact design phase to action research and, finally, the integration of these two to research steps in general.

The practical aspect of the methods, as proposed by Cole et al. (2005), provides a definition of the problem during the first phase. The second phase, intervention, similar to the "Design" phase of design science research, is a combination of the action research's action planning and action itself. At this phase, it is possible to identify the need for both processes, artifact design

and intervention (planning and implementation of an action), in the organizational context (Cole et al. 2005). The third phase, evaluation, is a relevant criterion for both approaches. The last phase, reflection and learning, generates knowledge, theoretically and practically contributing to the field of study. Cole et al. (2005) proposed integrating the research methods and presented a summary of action research and central concepts of design science research. The central idea was to design or plan an artifact linked to a real context. The proposal has four phases: (i) problem identification, (ii) intervention, (iii) evaluation, and (iv) reflection and learning.

Another finding of this study is that the application of action research and design science research is strongly oriented towards information systems, followed by management, education and health. Such areas often require the design of artifacts, and often researchers in these areas face the need for a collaborative review, such as evaluation of the artifacts by users. We present a discussion on the combined use of action research and design science research in the following section.

## Analysis and Discussion of Results

After the systematic literature review and the analysis of the articles, it was possible to establish a set of alternatives that could guide researchers in developing studies using action research and design science research jointly. Table 4 shows possible combinations of these two.

As can be seen in Table 4, the alternative A corresponds to the use of action research taking into account the paradigm of design science. This means conducting the research action according to traditional procedures (Coughlan and Coghlan 2002), for example generate knowledge on how to design an artifact based on a real context and on the collaboration with environmental agents. Such knowledge is generated and refined through problem-solving efforts. In order to conduct this type of research, it is necessary to make some adjustments to the conduction of action research. Therefore, it is necessary to establish what class of problems the contributions may be generalized to, what are the characteristics of the artifact that will be applied (internal and external environment) and what are the satisfactory solutions expected from the artifact. An example of the application of action research taking into account the paradigm of design science is the study conducted by Papas et al. (2012). However, the authors do not name the method as above.

Alternative B is the use of action research and design science research as mixed-methods. Mixed-methods can be understood as the use of different research methods concurrently or sequentially (Borrego et al. 2009; Creswell and Clark 2013). In a context of method combination, in particular, it is suggested that the use of both methods be sequential. This combination is recommended when a previous development an artifact is necessary (design science research) to intervene in a real context (action research). Such artifact may be a construct, a model or a method. In this sense, it is initially necessary to conduct a design science research in order to develop and evaluate the artifact, and then conduct an action research to intervene in the real environment. The combination of action research and design science research was used by (Hüner et al. 2009; Ractham et al. 2012) to initially develop and evaluate an artifact artificially and subsequently perform a naturalistic evaluation (Pries-Heje and Baskerville 2008) of such artifact by implementing it in a real context. For such implementation, action research was used.

Finally, the third way of combining the action research and design science research (Alternative C) is especially indicated when the artifact to be developed and evaluated is an instantiation-type artifact. Instantiation can be understood as the implementation of an artifact in a real environment (Venable 2006). It is considered the most complex artifact in terms of development and evaluation (March and Smith 1995). A satisfactory solution achieved by instantiation depends on the interaction of its users or beneficiaries with the responsible agents. This makes this process complex. For the development of instantiation, it is necessary to design the artifact together with the research participants, anticipating potential problems of design derived from the lack of specific knowledge on the practical context by the researcher. Regarding the evaluation of this type of artifact and its improvement, the interaction between researchers, research participants and other instantiation environment agents is fundamental. This artifact evaluation and improvement becomes more robust by using the concept of cyclicality and collection and analysis of data as proposed by action research. Data collection and analysis occur repeatedly and can be adjusted or revised to allow taking into account new data and new analyses throughout the conduction of the research.

In this sense, considering the complexity of the instantiation artifact, the use of a new research method integrating the steps and the concepts of action research and design science research seems appropriate to this artifact's development and evaluation. This is precisely the purpose of action research according to (Bilandzic and Venable 2011; Sein et al. 2011). In the next section, we present the conclusions of this study, highlighting the major contributions, limitations and opportunities for future works.

## Conclusion

This study aimed to deepen a distinctive analysis between action research and design science research and to discuss the need for a third method (action design research).

Based on a systematic literature review and the analysis of articles, we identified the similarities between action research and design science research. The analysis limited to studies that addressed both action research and design science research. The articles analyzed are theoretical and practical.

From the analyzes, it was possible to identify the differences and similarities between the design science research and action research. The main differences between action research and design science research are their objectives, evaluation of results, role of the researcher and need for empirical basis.

Also, the analysis highlights the main similarities between action research and design science research. Generation of knowledge emerged in 90% of the searches in databases. In 60% of the studies analyzed, the following aspects stood out: activities focused on intervention and evaluation, collaboration between researchers and participants, cyclicality and focus on improving reality. Upon noting these similarities between the action research and design science research, this study seeks to improve the academic and professional dialogue on the need for a new research method or a joint use of action research and design science research.

It is possible to point out some findings which result from the analysis of the use of action research in conjunction with design science research. First, researchers who use action research considering the paradigm of design science do not make explicit which theory (traditional or design theory) they are contributing to. This implies a conceptual misalignment in using the methods. This is related to a lack of understanding by researchers about the distinction between

design science and design science research. On the one hand, design science is the paradigm that supports design research. Design science research, on the other hand, is a method which implements research considering the paradigm of design science.

A second issue observed is that researchers, by using combined research methods, do not distinguish assumptions when using both methods in a combined manner. In particular, they do not make explicit how they use the collaboration and intervention steps which are considered necessary to conduct this type of research.

The third issue observed is that the proposals for a new method (action research design) presented to date are little specific regarding the conduction of research, stressing only macro steps. In addition, studies on action design research are incomplete, lacking a reflection on the circumstances of use or on which research objectives this approach is necessary for and justifiable.

Based on such findings, it was possible to establish a set of alternatives that could guide researchers in conducting research. The alternatives were organized in three possibilities: (i) incorporation of new elements into action research - the concepts of classes of problems, satisfactory solutions, internal/external artifact environment and the time the research is developed under the paradigm of design science; (ii) the use of methods in a combined and sequential manner; and (iii) establishment of a new method integrating the elements of action research and design science research, i.e., action design research. However, it's necessary to develop researches and publications to propose clear and detailed procedure to conduct the action design research. Information on which are the steps required to operationalize action design research are needed. Only a description of the macro steps, such as the studies conducted to date presented, is not sufficient.

Thus, future studies can focus on proposing a more detailed method to operationalize action research design. Moreover, it is essential that such proposition be widely applied in practice in order to verify the method's suitability and evaluate its implementation.

The limitations of this study are of a theoretical nature. There is a need for further empirical studies that verify the functionality of each of the alternatives proposed for the conduction of research combining action research and design science research. Another limitation of this study is its analysis, which focused specifically on the research methods themselves (action research and design science research). That is, we have not performed a deeper analysis of these methods taking into account their ontological and epistemological roots.

## Appendix 1

**Table 5** Results of Searches in Databases

| Search term | Associated term | Results | Relevant studies |
|---|---|---|---|
| design science | action research | 23 | 9 |
| design science research | action research | 18 | 4 |
| prescriptive research | action research | - | - |
| constructive research | action research | - | - |
| action research design | | 1 | 1 |
| *action design research* | | 1 | 1 |
| Total | | 43 | 15 |

## Appendix 2

**Table 6** Papers from the systematic literature review

| Reference | Title | Abstract | Field | Nature | Classification |
|---|---|---|---|---|---|
| Romme (2004) Commentary Action Research, Emancipation and Design Thinking. Journal of Community & Applied Social Psychology 499:495–499. | Commentary Action Research, Emancipation and Design Thinking | This article evaluates the notion and practice of action research, as defined by contributors to the recent special issue 'Action Research and Emancipation' in this journal. The author argues that, although action research implicitly has a design orientation, it largely draws on the humanities and sciences as its main role models. As a result, action researchers nowadays do not see themselves as design professionals. Idealized design methods serve to illustrate how design research can help realize the emancipatory intentions of action researchers. | information systems | theoretical | Combination of methods |
| Cole et al. (2005) Being Proactive : Where Action Research meets Design Research. Running Head: Proactive Research Approaches 1–21. | Being proactive: where action research meets design research | IS research has been criticized for having little influence on practice. One approach to achieving more relevance is to conduct research using appropriate research methods that balance the interests of both researchers and practitioners. This paper examines the similarities between two methods that address this mandate by adopting a proactive stance to investigating information systems in organizations. These two approaches, action research and design research, both directly intervene in "real world" domains and effect changes in these domains. We investigate these similarities by examining exemplars of each type of research according to the criteria of the other. Our analysis reveals interesting parallels and similarities between the two suggesting that the two approaches have much to learn from each other. Based on our analysis, we propose ways to facilitate cross-fertilization between the two approaches that we believe will be useful for both and for IS research in general | information systems | theoretical | Combination of methods |
| Järvinen (2007) Action Research is Similar to Design Science. Quality & Quantity 41:37–54. | Action Research is Similar to Design Science. | In management information systems (MIS) action research is long considered as promising but low-level research approach. It has an utmost relevance because action researchers are working with practitioners to solve the important practical | information systems | theoretical | Similarities between methods |

**Table 6** (continued)

| Reference | Title | Abstract | Field | Nature | Classification |
|---|---|---|---|---|---|
| | | problem. Design science outlined some years ago is just winning a wider audience. Action research was tradi- tionally classified into qualitative research methods. But it seems to be the "wrong" home of action research. We shall show that after comparison of the seven aspects: concrete results of the study, knowledge produced, activities, the intent and the nature of a study, the division of labor in a study and generation, use and test of knowledge, the concordance between the characteris- tics of action research on the one hand and of design science on the other hand is very good. Hence, action research and design science should next be considered as similar research approaches, and this is a turning point in the history of both action research and design science. | | | |
| Loebbecke et al. (2007) Diversity in Collaborative Information Systems (IS) Research Methods?: Academic Breadth or Re-Inventing the Wheel Americas Conference on Information Systems (AMCIS), 1–9. | Diversity in collaborative information systems (IS) research methods: Academic breadth or 're-inventing the wheel'? | Three examples of collaborative research methods, Action Research (AR), Design Science (DS), and Participatory Design (PD), have been applied successfully in Information Systems (IS) research. This paper investigates whether research projects which are prominently published under one method also meet the characteristics of the respective 'other two' methods and could thus also be published under those methods. For instance, we examine whether a project conducted and published as DS work could also be classified and appear as AR or PD. The paper first outlines characteristics of the three methods along their (1) research contribution, (2) roots, and (3) methodological guidelines. It then applies text analysis to fifteen selected publications, five for each method, AR, DS, or PD. The paper finds that research projects applying different methods demonstrate remarkable similarities concerning research contributions, roots, and methodological guidelines, but use different terminologies, also maintaining method- specific publication outlets and communities. | information systems | theoretical | similarities between methods |
| Holmström et al. (2009) Bridging Practice and | Bridging practice and theory: a desing science approach | Despite ambitious efforts in various fields of research overmultiple decades, the goal of making academic research | | theoretical | |

**Table 6** (continued)

| Reference | Title | Abstract | Field | Nature | Classification |
|---|---|---|---|---|---|
| Theory: A Design Science Approach. Decision Sciences [serial online] 40:65–88. | | relevant to the practitioner remains elusive: theoretical and academic research interests do not seem to coincide with the interests of managerial practice. This challenge is more fundamental than knowledge transfer, it is one of di- verging knowledge interests andmeans of knowledge production. In this article,we look at this fundamental challenge through the lens of design science, which is an approach aimed primarily at discovery and problem solving as opposed to accumulation of theo- retical knowledge.We explore in particular theways inwhich problem-solving research and theory-oriented aca- demic research can complement one another. In operations man- agement (OM) research, recognizing and building on this complementarity is especially crucial, because problem--solving–oriented research produces the very artifacts (e.g., technologies) that empirical OM research subsequently eval- uates in an attempt to build explanatory theory. It is indeed the practitioner—not the academic scientist—who en- gages in basic research in OM. This idiosyncrasy prompts the question: how can we enhance the cross-fertilization between academic research and research practice tomake novel theoretical in- sights and practical relevance complementary? This article proposes a design science approach to bridge practice to theory rather than theory to practice. | operations manage- ment | | Use of action research under the paradigm of Design Science |
| Iivari and Venable (2009) Action Research and Design Science Research - Seem- ingly similar but decisively dissimilar. In: 17th Europe- an Conference in Informa- tion Systems. ECIS, Verona, 1–13 | Action research and design science research - semmingly similar but deci- sively dissimilar | Prior research has identified the similarity of Action Research (AR) and Design Science Research (DSR). This paper anal- yses AR and DSR from several perspectives, including para- digmatic assumptions of ontology, epistemology, methodology, and ethics, their research interests, and activi- ties. We identify that often AR does not share the paradig- matic assumptions and the research interests of DSR, that some activities in DSR are always mutually exclusive from AR, and that there may be no, little, or significant (but not total) overlaps between AR and DSR. Thus we judge that AR | information systems | theoretical | Against the combination of methods |

**Table 6** (continued)

| Reference | Title | Abstract | Field | Nature | Classification |
|---|---|---|---|---|---|
| | | and DSR are decisively dissimilar. We further identify several key problems with combining AR and DSR based on the ethical requirement of researchers to identify and manage risks to research stakeholders. Management of such risks is done by careful disclosure, identifying research limitations or by choosing alternative methods than AR for accomplishing DSR | | | |
| Papas et al. (2012) The action research vs design science debate: reflections from an intervention in eGovernment. European Journal of Information Systems 21:147–159. | The action research vs design science debate: Reflections from an intervention in e Government. | As Design Science (DS) establishes itself as an acceptable approach to Information Systems research, many have commented on the similarity, or otherwise, between DS and Action Research (AR). Most of the writing on this topic has been conceptual, and not grounded in practice. In this paper, we present a piece of completed research that was perceived and executed as AR, but also reflected upon as DS. The research produced a new method for diagramming electronic workflows and creating the associated digital signatures, within the domain of eGovernment. Our conclusion is that AR that produces an artefact can be quite easily, and perhaps superficially, presented as DS. Epistemologically, there is little to separate the two methodologies. However, there are some subtle differences in practice, especially with regard to the role of the artefact, the structuring of the process, the focus of evaluation of the intervention and research, and the emphasis on learning and knowledge. We provide guidance to re-searchers contemplating either approach, and also consider the role of pluralist attempts to combine the approaches. | information systems | empirical | Use of action research under the paradigm of Design Science |
| Ractham et al. (2012) The Use of Facebook in an Introductory MIS Course: Social Constructivist Learning Environment*. Decision Sciences Journal of Innovative Education | The Use of Facebook in an Introductory MIS Course: Social Constructivist Learning Environment. | Themajor objective of this article is to evaluate via a Design Science Research Method- ology (DSRM) the implementa-tion of a Social Constructivist learning framework for an introductory Management Information System (MIS) course. Facebook was used as a learning artifact to build and foster a learning environment, and a series of features and activities using this artifact were conducted to utilize the social | education | empirical | Combination of methods |

**Table 6** (continued)

| Reference | Title | Abstract | Field | Nature | Classification |
|---|---|---|---|---|---|
| 10:165–188. doi: 10.1111/j.1540-4609.2011.-00337.x | | interactions amongst the system's users to foster constructivist learning. Various pedagogic strategies were used to integrate activities occurring both inside and outside of the classroom setting to achieve social learning. All features utilized were evaluated based upon activities and interactions amongst all users. The research findings show great potential for the implemented features, as well as the activities conducted to take advantage of these features, and suggest possible innovative features for use in similar future studies based on feedback from this study's sample group. | | | |
| Weeding and Dawson (2012) Laptops on trolleys: lessons from a mobile-wireless hospital ward. Journal of medical systems 36:3933–43. doi: 10.1007/s10916-012-9865--8 | Laptops on trolleys: Lessons from a mobile-wireless hospital ward. | Most hospital-based staff can be considered to be mobile but many hospital information systems (HIS) are based on fixed desk top computers. Wireless networks allow HIS to be brought to the point of care using mobile devices such as laptops on trolleys thus providing data which can aid in clinical decision-making. The research objective of this project focusses on the collaborative de- sign of a laptop solution for providing data at the point of care. The research approach was based on a combination of action research and design science. Action research tech- niques including participant observation and informal one- to-one discussions were used to obtain information that was used to evolve the trolley design as a design artefact while addressing usability limitations. This paper presents three versions of the trolley design and how they evolved based on the feedback provided to the researchers from clinical use. Also these results show that using iterative action research techniques (planning, action, evaluation and reflection) in collaborative research can provide pro- ductive outcomes addressing a specific design objective within an acute care setting. | management and health | empirical | Use of action research under the paradigm of Design Science |
| Alles et al. (2013) Collaborative design research: Lessons from | Collaborative design research: lessons from continuous auditing | In this paper we discuss Collaborative Design Research – a hybrid methodology for undertaking design science research in collaboration with industry partners – that has been applied | management | theoretical | Combination of methods |

**Table 6** (continued)

| Reference | Title | Abstract | Field | Nature | Classification |
|---|---|---|---|---|---|
| continuous auditing. International Journal of Accounting Information Systems 14:104–112. doi: 10.1016-/j.accinf.2011.06.004 | | to the area of Continuous Auditing and which also has wider applicability to AIS research. Collaborative Design Research has a role at the time in the evolution of a field when early adopting practitioners have made the decision to implement an innovation, but there is as yet no established product or set of best practices that makes it obvious what they should do. We discuss eight key issues facing researchers attempting to do collaborative design research: 1) choice of implementation partner (IP), 2) choice of projects, 3) managing expectations, 4) building on the expertise of the IP, 5) introducing innovation to the IP, 6) project evaluation and reassessment, 7) cost and resourcemanagement, and 8) publishing results. | | | |
| Sein et al. (2011) Action Design Research. MIS Quarterly 35:37–56. | Action Design Research | Design research (DR) positions information technology artifacts at the core of the Information Systems discipline. However, dominant DR thinking takes a technological view of the IT artifact, paying scant attention to its shaping by the organizational context. Consequently, existing DR methods focus on building the artifact and relegate evaluation to a subsequent and separate phase. They value technological rigor at the cost of organizational relevance, and fail to recognize that the artifact emerges from interaction with the organizational context even when its initial design is guided by the researchers' intent. We propose action design research (ADR) as a new DR method to address this problem. ADR reflects the premise that IT artifacts are ensembles shaped by the organizational context during development and use. The method conceptualizes the research process as containing the inseparable and inherently interwoven activities of building the IT artifact, intervening in the organization, and evaluating it concurrently. The essay describes the stages of ADR and associated principles that encapsulate its underlying beliefs and values. We illustrate ADR through a case of competence management at Volvo IT. | information systems | empirical | New method |

**Table 6** (continued)

| Reference | Title | Abstract | Field | Nature | Classification |
|---|---|---|---|---|---|
| Rose and Saifullah (2012) Bridging Worlds: Information Systems Development Through Cross-Cultural Comparison. Systemic Practice and Action Research 25:511–536. doi: 10.1007/s11213-012-9239--7 | Bridging Worlds: Information Systems Development Through Cross-Cultural Comparison | This paper reports a case study where soft systems methodology (SSM) was used to help automate a largely manual administrative (examination) information system in a Pakistani university. Various design suggestions for information system improvements, both administrative and IT-supported were made (and implemented) through comparison with another university in Denmark which is well supported by computer systems. An action design research approach with an interpretative epistemology/ontology was adopted. Though the single comparison experience is difficult to generalise, we conclude that SSM (with some adaptations) can enable a socio-technical comparison and design effort and offer a prototype process. The comparison stimulates forward-looking design, but great care must be taken to accommodate cultural differences, and further research is necessary to integrate more sophisticated cultural analysis tools into the design process. The research extends SSM in information system development—from a single situational analysis to a comparative process and can be adapted as a pattern for practitioners with similar auto- mation needs. | information systems | empirical | New method |
| Fendt J, Kaminska-Labbé, R (2011) Relevance and creativity through design-driven action research: Introducing pragmatic adequacy. European Management Journal 29:217–233. | Relevance and creativity through desing-driven action research: introducing pramatic adequacy | This study presents a meta-synthesis (1904–2010) of seminal voices on the? relevance gap?, the abyss between management science and management practice, and on remedies proposed. We then discuss dominant paradigms about truth and meaning and demonstrate how they can lead to irrelevance. We discuss relevance and its implica- tions. We revisit basic notions of pragmatism and suggest how they might influence the meaning of management science. We seek answers in action research and, more specifi- cally, in design-driven action research methods. We introduce the notion of pragmatic adequacy to explain how design-driven action research approaches can reduce the rele- vance gap, facilitate change and enhance creativity. | management | theoretical | Use of action research under the paradigm of Design Science |

**Table 6** (continued)

| Reference | Title | Abstract | Field | Nature | Classification |
|---|---|---|---|---|---|
| Hüner et al. (2009) Towards a maturity model for corporate data quality management. Proceedings of the 2009 ACM symposium on Applied Computing - SAC '09231. | Towards a maturity model for corporate data quality management. | High-quality corporate data is a prerequisite for world-wide business process harmonization, global spend analysis, integrated service management, and compliance with regulatory and legal requirements. Corporate Data Quality Management (CDQM) describes the quality oriented organization and control of a company's key data assets such as material, customer, and vendor data. With regard to the aforementioned business drivers, companies demand an instrument to assess the progress and performance of their CDQM initiative. This paper proposes a reference model for CDQM maturity assessment. The model is intended to be used for supporting the build process of CDQM. A case study shows how the model has been successfully implemented in a real-world scenario. | management | empirical | Combination of methods |
| Bilandzic and Venable (2011) Towards Participatory Action Design Research: Adapting Action Research and Design Science Research Methods for Urban Informatics. The Journal of Community Informatics 7:1–17. | Towards Participatory Action Design Research: Adapting Action Research and Design Science Research Methods for Urban Informatics. | This paper proposes a new research method, Participatory Action Design Research (PADR), for studies in the Urban Informatics domain. PADR supports Urban Informatics research in developing new technological means (e.g. using mobile and ubiquitous computing) to resolve contemporary issues or support everyday life in urban environments. The paper discusses the nature, aims and inherent methodological needs of Urban Informatics research, and proposes PADR as a method to address these needs. Situated in a socio-technical context, Urban Informatics requires a close dialogue between social and design-oriented fields of research as well as their methods. PADR combines Action Research and Design Science Research, both of which are used in Information Systems, another field with a strong socio-technical emphasis, and further adapts them to the cross-disciplinary needs and research context of Urban Informatics. | information systems | theoretical | Combination of methods |

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