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A Proposed Conceptual Basis for Mode 2 Business and Management Research and Development Projects Based on Design Science Research Principles

Nicole Gerber, nicole.gerber@zhaw.ch
Prof. Dr. Matthew Tucker, M.P.Tucker@ljmu.ac.uk
Prof. Dr. Susanne Hofer, susanne.hofer@zhaw.ch

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IFM – Institut für Facility Management
Departement Life Sciences und Facility Management
Zürcher Hochschule für Angewandte Wissenschaften
Campus Grüental
CH-8820 Wädenswil
Schweiz

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Abstract

Due to progressing digitalisation and automatisation, the disciplines of Information Systems and Business / Management will increasingly be merging. It is assumed, therefore, that in Business and Management Research (BMR), there will be a greater demand for artefacts such as conceptual models, particularly in collaborative, Mode 2 research and development projects. Such endeavours require adequate conceptual frameworks, catering for diverse, creative and iterative steps including complementary (multi-)method application in order to handle complexity, uncertainty, user engagement and differing assumptions in a fast-paced environment. They need to be able to do this while rigorously addressing questions in their field or organisation of professionals. Design Science Research (DSR) has been suggested as an suitable approach to fulfil these needs. While numerous examples of applying DSR principles have been reported with respect to Information Systems Research (ISR), the application in BMR has so far been rather modest. This article presents a conceptual basis of DSR principles to apply in Mode 2 BMR artefact development projects, accompanied by a framework for a systematic quality evaluation. By doing so, the article contributes to the advancement of the emerging convergence of BMR and ISR by presenting guidelines embracing iterative and systematic procedures for BMR and ISR researchers.

1 Introduction and Starting Position

When conducting action-oriented, solution-focused, prescription-driven, exploratory, transdisciplinary Mode 2 business and management research projects as discussed by Birkinshaw et al. (2014), Bryman and Bell (2015), Burgoyne and Turnbull James (2006), Easterby-Smith et al. (2012), Hatchuel (2005), Holmström et al. (2009), Starkey and Madan (2001), Pettigrew (2001), van Aken (2004) or van Aken (2005), it is often necessary to consider the need to apply diverse, creative, complementary methods and iterative steps. Doing so supports the handling of complexity, uncertainty, user engagement and differing epistemological and ontological assumptions as discussed by Alvesson (2014), Burgoyne and Turnbull James (2006), Easterby-Smith (2012) and Pettigrew (2001). This particularly applies for interactive, collaborative, consortial business research partnerships as described in Hatchuel (2001), Österle and Otto (2009), (2010), Pettigrew (2001), Saunders et al. (2016) and Vicari (2013). It becomes clear that business and management researchers require conceptual frameworks catering for both, the demand for output-oriented business needs and the demand for rigour in the academic side of the project. Several authors have suggested Design Science Research (DSR) as a suitable method in order to develop relevant and rigorously attained knowledge to support professionals answering questions in their field or organisation (Burgoyne & Turnbull James, 2006; Chatterjee, 2014; Ekwaro-Osire, 2013; Hatchuel, 2005; Holmström et al., 2009; Pandza & Thorpe, 2010; Saunders et al., 2016; Starkey et al., 2009; van Aken, 2005).

This working paper therefore presents the principles of Design Science Research (DSR) as a conceptual basis for developing artefacts and outlines the emerging convergence of Information Systems Research (ISR) and Business and Management Research (BMR), and explains the goal of the working paper before presenting the *Design Science Research Cycle for the Business and Management Research* Context complemented by the *Quality Criteria Framework for the Evaluation of Design Science Research Artefacts in Business and Management Research.*

2 Conceptual Basis of Design Science Research (DSR)

Different nomenclatures regarding DSR have emerged, depending on the goals and manner of operationalisation. So far, a specific and unanimous distinction between the terms has not yet been defined (Goldkuhl, 2012). In the context of this working paper, DSR is seen as a research paradigm with the goal to solve relevant problems in order to better the human condition, improve practice or to enable one to predict future events. This is to be achieved by rigorously developing and evaluating practical, useful and innovative artefacts contributing and communicating to the knowledge context and scientific development, thus reducing the gap not only between theory and practice, but also between academics and practitioners (Borek et al., 2012; Dresch et al., 2015; Hevner et al., 2004; Hevner & Chatterjee, 2010; March & Smith, 1995; March & Storey, 2008; Ostrowski et al., 2012; Simon, 1996; Purao, 2002; van Aken, 2012; van Aken, 2004; Wieringa, 2014).

The design (pattern) approach was suggested by Alexander (1973) and Alexander et al. (1977) in the context of architecture and industrial design. Simon (1996) is seen as one of the initiators of DSR, triggering the discussion of differences between behavioural science and sciences of the artificial within ISR. For DSR – the science of the artificial – artificial things or artefacts are the major outputs (Simon, 1996). In DSR, the main artefacts can be

- Constructs such as conceptual vocabularies of a domain, arising during conceptualisation of a problem and being refined throughout the design cycle
- Models such as sets of propositions or statements expressing relationships between constructs in order to represent real-world situations, focusing on utility to aid the understanding of both problem and solution, comprising specific models as well as reference process models, reference information models and other reference models
- Methods such as sets of steps / processes used to perform a task or solve a problem, ranging from formal (mathematical) algorithms to informal, textual descriptions such as best practices or guidelines
- Instantiations such as situational operationalisations/realisations of artefacts in a specific environment, thus showing how to implement constructs, models and methods and thereby assessing their feasibility, suitability and effectiveness
- (Dresch et al., 2015; Hevner et al., 2004; Kenneally, 2012; March & Smith, 1995; Vaishnavi & Kuechler, 2004; Vaishnavi & Kuechler, 2008; Winter & Schelp, 2006; Winter, 2008)

It is becoming clear that DSR is a multi-method or even method pluralistic approach (Dresch et al., 2015; Gregor & Jones, 2007; Hevner & Chatterjee, 2010; Huysmans & Verelst, 2012; Kuechler et al., 2008; Niehaves, n.d.; Österle & Otto, 2010; Österle et al., 2010; Picot, 2010) bridging disciplines (Frank, 2006; Niehaves, n.d.; Schermann et al., 2009) and paradigms (Vaishnavi & Kuechler, 2004; Vaishnavi & Kuechler, 2008). Dealing with the different paradigms of the various methods mentioned has evoked intense discussions and disputations between proponents of the behavioural and the design-oriented approach (Dresch et al., 2015; Hevner & March, 2003; Hevner et al., 2004; Hevner & Chatterjee, 2010; March & Smith, 1995; Niehaves, n.d.; van Aken, 2012; Winter, 2008), similar to the dispute between the basic/quantitative and applied/qualitative science proponents (Grbich, 2007; Lamnek, 1995). In the meantime, it has increasingly been acknowledged that the different strategies have advantages and disadvantages, depending on the context. Implementing the approaches in the best combination throughout the whole research process complementarily using the benefits of the different strategies should help to overcome their disadvantages for the best possible research outputs (Hevner & March, 2003; March & Smith, 1995; Frank, 2006; van Aken, 2004). In empirical research, mixed methods combining qualitative and quantitative methods have been defined as research approaches in order to potentially reach better findings by overcoming weaknesses of each method and using their advantages (Creswell, 2014; Kuckartz, 2014; Morse & Niehaus, 2009; Tashakkori & Teddlie, 2003). However, there is no standardised approach to how the exact mix of the methods can or should be employed; different possibilities are described in literature. In terms of implementation, a distinction is made between simultaneously mixed, sequentially mixed or emergent design (Creswell et al., 2003; Creswell, 2014; Flick, 2016; Grbich, 2007; Morse & Niehaus, 2009; Tashakkori & Teddlie, 2003). On the level of integration, Creswell et al. (2003), Creswell (2014), Flick (2016), Grbich (2007) and Morse & Niehaus (Morse & Niehaus, 2009) differentiate by defining the point of interaction, namely at the point of data generation, data analysis, data interpretation, presentation of the data or at several intervals. In terms of prioritisation, the differentiation between equivalence of the qualitative and quantitative approach or the supremacy of a core component with a supplementary component (qualitative / quantitative or quantitative / qualitative) is made (Creswell et al., 2003; Creswell, 2014; Grbich, 2007; Morse & Niehaus, 2009; Tashakkori & Teddlie, 2003). In DSR, Huysmans & Verelst (2012) extended the term Mixed Methods by mixing design and empirical approaches.

In DSR, a plethora of methods have been proposed (Baskerville et al., 2009; Becker et al., 2012; Bilandzic & Venable, 2011; Checkland, 1999; Chen, 1976; Delfmann, 2006; Dresch et al., 2015; Fettke, 2009; Frank, 2014; Galliers, 1992; Gemino & Wand, 2003; Gibson & Arnott, 2007; Gregor & Hevner, 2013; Hars, 1994; Haux et al., 1998; Hevner et al., 2004; Hevner & Chatterjee, 2010; Huysmans & Verelst, 2012; Järvinen, 2005; Lehner, 2001; Nunamaker et al., 1991; Österle et al., 2010; Pervan & Klass, 1992; Pidd, 2009; Prilla, 2010; Ralyté et al., 2003; Rosemann, 1996; Roworth-Stokes, 2006; Schütte, 1998; Sein et al., 2011; Siau & Rossi, 1998; Teegavarapu & Summers, 2008; Thomas, 2006; vom Brocke, 2003; Wieringa, 2014; Wieringa & Morah, 2012; Wilde & Hess, 2006; Winter & Schelp, 2006):

- Empirical building and evaluation techniques: action research, case studies, content/document analysis, ethnography, experiments, focus groups, game role playing / operational gaming, grounded theory, observations, surveys / interviews
- Non-empirical building techniques: method engineering, creativity techniques, forecasting, modelling, prototyping, analysis
- Non-empirical (evaluation) techniques: descriptive evaluation, feature comparison; metrics approach, contingency identification, ontological evaluation, approaches based on cognitive psychology, statistics, testing

Dealing with such a multi-method and multi-disciplinary understanding, not surprisingly, DSR has been described as predestined within pragmatism (Dresch et al., 2015; Gregor & Hevner, 2013; Goldkuhl, 2012; Hevner, 2007; Purao, 2002; Vaishnavi & Kuechler, 2008; van Aken, 2012) with open philosophical perspectives (Ivari & Venable, 2005; Manson, 2006; Tsang, 2017; Vaishnavi & Kuechler, 2004) which can even change throughout the same research project (Vaishnavi & Kuechler, 2004).

Research projects following the DSR principles in the BMR context have been presented in literature (Barzelay & Thompson, no date; Smith et al., 2013). However, more examples are reported in the context of DSR and ISR e.g. Anderson et al. (2012), Carcary (2011), Ekwaro-Osire (2013) or Gacenga et al. (2012).

3 The Convergence of Information Systems Research (ISR) & Business and Management Research (BMR)

ISR is predominantly concerned with information systems of organisations and individuals in business and society, and deals with the interrelations of people, information and communication technology and organisations within the socio-technical system; the outputs are mainly applied business information systems, software, organisational solutions, models, methods and tools, but also theories in context, the integration of academic knowledge and business reality as well as business administration or management science and information and communication technology and computer science (Frank, 2009; Krcmar, 2010; Österle et al., 2010; WKWI, 1994).

The goal of BMR is the systematic process of collecting, recording, analysing and interpreting data providing findings which can be used to resolve business issues and managerial, organisational and planning problems, which in turn reduces uncertainty and facilitates decision-making activities and contributes to the knowledge base shifting from intuitive decision-making to a systematic procedure (Bryman & Bell, 2015; Checkland, 1999; Easterby-Smith et al., 2012; Pidd, 2009; Saunders et al., 2016; Sreejesh et al., 2014; van Aken, 2005; Vicari, 2013; Wilson, 2014; Zikmund et al., 2013).

BMR and ISR being broad, multi-disciplinary subjects and therefore specifically challenged and affected by such developments have to find new approaches to tackle the increasingly complex (business) problems even more because due to the development of digitalisation and automation and the implication of increasing interconnectivity and complexity, those disciplines are getting closer to each other, increasingly even amalgamating. This seems to concur with Starkey et al. (2009, p.554) who stated that "When systems meet, collide or even merge, new things are likely to happen, new forms of practice, new kinds of communication, new codes" and Probst (1991), who suggests more combinations of exact and inexact, quantitative, qualitative and heuristic methods to solve problems and/or reduce complexity. A possibility to reduce complexity and to foster a common understanding is to visualise. Developing artefacts as described in chapter 2 presents a way to do this in the context of ISR and BMR. Transferring the IS understanding of artefacts to a BMR context, it can be noted that models, methods and instantiations can be applied similarly while constructs in a BMR sense correspond to the provision of language/terminology within both the research context and instantiations.

4 Goal of this Working Paper

The goal of this working paper is to present a utile conceptual basis for action-oriented, solution-focused, prescription-driven, exploratory, transdisciplinary Mode 2 business and management research and development projects conducted in interactive, collaborative, consortial business research partnerships. The purpose of this is to support the need to apply diverse, creative, complementary (multi-)methods and iterative steps in order to handle complexity, uncertainty, user engagement and differing epistemological and ontological assumptions and to enable rigorous and relevant artefacts as project outputs. Further, the working paper intends to contribute to the call for more Mode 2 discussions by van Aken (2005) and the idea of consortial research proposed by Österle and Otto (2009) and (2010).

5 Design Science Research Cycle for the Business and Management Research Context

In the development of the DSR discipline, various cycles and frameworks illustrating the iterative connections between the different research phases and steps, methods and outputs - mainly for the context of Information Systems Research - have been presented (Baskerville et al., 2009; Dresch et al., 2015; Fettke & Loos, 2012; Gregor & Jones, 2007; Hevner et al., 2004; Hevner & Chatterjee, 2010; Kuechler et al., 2008; Manson, 2006; March & Smith, 1995; Meyer & Kenneally, 2012; Nunamaker et al., 1991; Ostrowski, 2012; Purao, 2002; Peffers et al., 2007; Takeda et al., 1990; Vaishnavi & Kuechler, 2008; Wieringa, 2014). The contents of the cycles mentioned above and the method propositions were consolidated in terms of content and structure, and put in a BMR context by excluding particular ISR methodologies (e. g. testing) and instead explicitly focusing on BMR methods and wording. The result – the *Design Science Research Cycle for Business and Management Research and Development Projects* – is presented in Figure 1; the principles of the model content will be explained subsequently.

A general note to start with explaining the model: the sizes of the shapes bear no relation to the duration, intensity or importance of the phases, methods or outputs.

The model consists of the following *six columns:*

- *Phases*
- *Knowledge Flow*
- *Process Steps*
- *Proposed Methods/Techniques*
- *Expected Outputs*
- *Logical Formalism.*

These will be explained in this chapter.

The column *Phases* is divided in the following five segments:

- *Theorising* including the process steps
  - *Identification of problem*
  - *Literature review / search for existing theories of solutions* and
  - *Awareness / understanding of the problem*
- *Building* with
  - *Identification and proposition of artefacts to solve (a) specific problem(s)*
  - *Design and (re) development of artefact(s)*
- *Evaluation* with the step *Evaluation of artefact(s)*
- *Reflecting* including the process steps
  - *Clarification of learning achieved*
  - *Conclusion and*
  - *Generalisation for a class of problems*
- *Disseminating* with the step *Communication of results*

The arrows in the column *Knowledge Flow* indicate the iterative characteristic of the approach: iterations are possible and even welcomed in any step.

The columns *Process Steps, Proposed Methods/Techniques* and *Expected Outputs* will be described together step by step:

- In the process step *Identification of problem,* the proposed methods/techniques are: exploring, experience, discussions with stakeholders and creativity methods. The expected outputs are the documentation of an idea or problem, the formalised research question, the demonstration of the importance of problem and relevance of research, and the identification of stakeholders.
- The process step *Literature review / search for existing theories or solutions* includes literature review and documentation such as proposed methods/techniques and the following expected outputs: understanding of the state-of-the-art, research and knowledge gap identified and explained, documentary and bibliography.

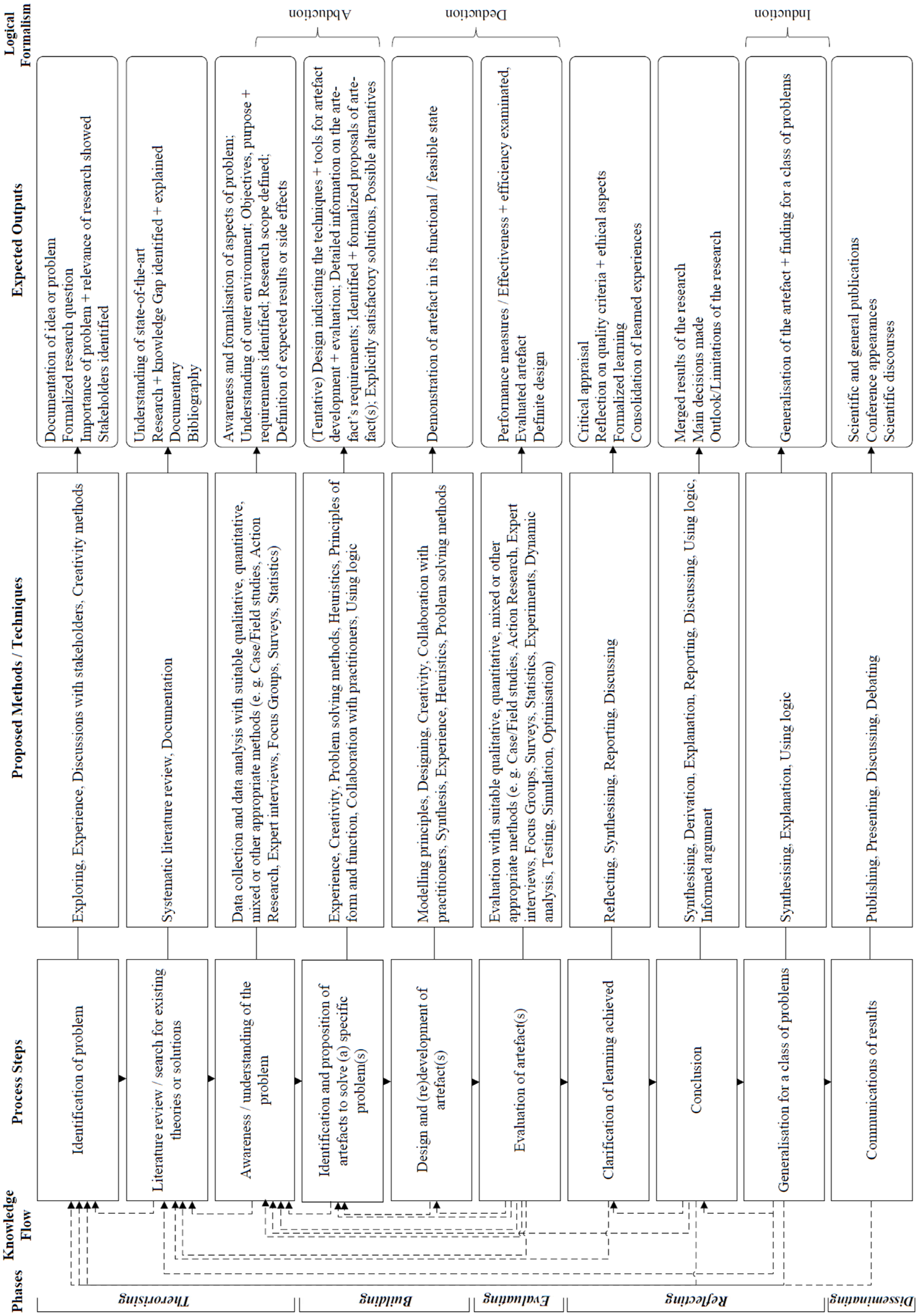

Figure 1: Design Science Research Cycle for Business and Management Research and Development Projects

- During the process step *Awareness / understanding of the problem*, data collection and data analysis with the appropriate qualitative, quantitative, mixed or other suitable methods (e.g. case/field studies, action research, expert interviews, focus groups, surveys, statistics) are the suggested methods/techniques. The expected outputs are the awareness and formalisation of aspects of the problem, the understanding of the environment, the identification of objectives, purpose and requirements, the definition of the research scope and the expected results or side effects.
- Within the process step *Identification and proposition of artefacts to solve (a) specific problem(s)*, experience, creativity, problem solving methods, heuristics, principles of form and function, collaboration with practitioners and using logic are the proposed methods/techniques. The expected outputs are the design indicating the techniques and tools for artefact development and evaluation, the detailed information on the artefact's requirements, the identified and formalised proposals of artefact(s), explicitly satisfactory solutions, the tentative design and the description of possible alternatives.
- During the process step *Design and (re)development of artefact(s)*, modelling principles, designing, creativity, collaboration with practitioners, synthesis, experience, heuristics and problem solving methods lead to a demonstrable artefact in its functional state.
- The process step *Evaluation of artefact(s)* has the goal to apply suitable qualitative, quantitative, mixed or other appropriate methods/techniques (e.g. case/field studies, action research, expert interviews, focus groups, surveys, statistics, experiments, dynamic analysis, testing, simulation, optimisation) in order to obtain performance measures, proven effectiveness and efficiency, thereby producing an evaluated artefact and a definite design as expected outputs.
- In the process step *Clarification of learning achieved*, with the proposed methods/techniques of reflecting, synthesising, reporting and discussing, a critical appraisal, a reflection on quality criteria and ethical aspects, formalised learning and a consolidation of learned experiences are the expected outputs.
- During the process step *Conclusion*, synthesising, derivation, explanation, reporting, discussing, using logic and informed argument are the proposed methods/techniques to enable the presentation of the merged results of the research, the main decisions made and the outlook/limitations of the research are the expected outputs.
- The process step *Generalisation for a class of problems* looks to generate, with the methods/techniques of method synthesising, explanation and use of logic, the generalisation of the artefact and finding for a class of problems as expected outputs.
- In the process step *Communications of results*, publishing, presenting, discussing and debating are the proposed methods/techniques with the purpose of featuring in scientific and general publications, taking part in conferences and scientific discourses.

The last column, *Logical Formalism*, indicates the abductive, deductive and inductive phases within the process steps based on Bryman and Bell (2015), Dresch et al. (2015), Richter (1995), Saunders et al. (2016) and Wilson (2014).

- The steps awareness, understanding of the problem and identification and proposition of artefacts to solve (a) specific problem(s) have *abductive* character: it is the start of the exploration of a phenomenon, the building of new theory and/or the modification of existing theory. It answers the question "What could be?".
- The steps design and (re)development of artefact(s) and evaluation of artefact(s) are taken using a *deductive* approach: the artefact as a proposition or hypothesis is falsified or verified with respect to existing theories. It answers the question "What should be?".
- Finally, the generalisation for a class of problems has an *inductive* character, by moving from the known specific premises to general conclusions. It answers the question "What is?".

6 Quality Criteria for Design Science Research (DSR) Artefacts in Business and Management Research (BMR)

Quality criteria allow the evaluation of the research process and its outcome. They thereby help to assess the degree of credibility and contribution of research (Mayer, 2009; Lamnek, 1995; Wilson, 2014; Saunders et al., 2016). In order to fulfil the need for evaluating the extended mixed or multiple methods mentioned in the previous chapter, suitable quality criteria are required in a more holistic manner than in the past. In order to ensure quality in a multi-methodology context as described above, it is important that the approaches are properly conducted, considering the appropriate quality criteria on each level or in each step and also according to their suitability to answer the research question (Creswell, 2014; Flick, 2016; Grbich, 2007; Morse & Niehaus, 2009). Therefore, the quality criteria need to be discussed more broadly.

With respect to the quality criteria in DSR – chosen as the basis for the cycle presented – the focus so far has mainly been on the aspects of rigour and relevance (Hevner, 2007; Manson, 2006; Venable, 2007; Winter, 2007; Winter, 2008). Hevner et al. (2004) add the aspects of utility, quality, efficacy and viability of the artefacts, the importance and contribution of business problems, the need for audience-specific presentation and the utilisation of available means in the problem environment. Martensson & Martensson (2007) present a further development of assessing quality criteria in DSR by distinguishing between:

- Credibility: consistency, transparency and rigour (internal validity, reliability, contextuality)
- Contribution: originality, generalisability and relevance (interest, application, currency)
- Communicability: accessibility and consumability.

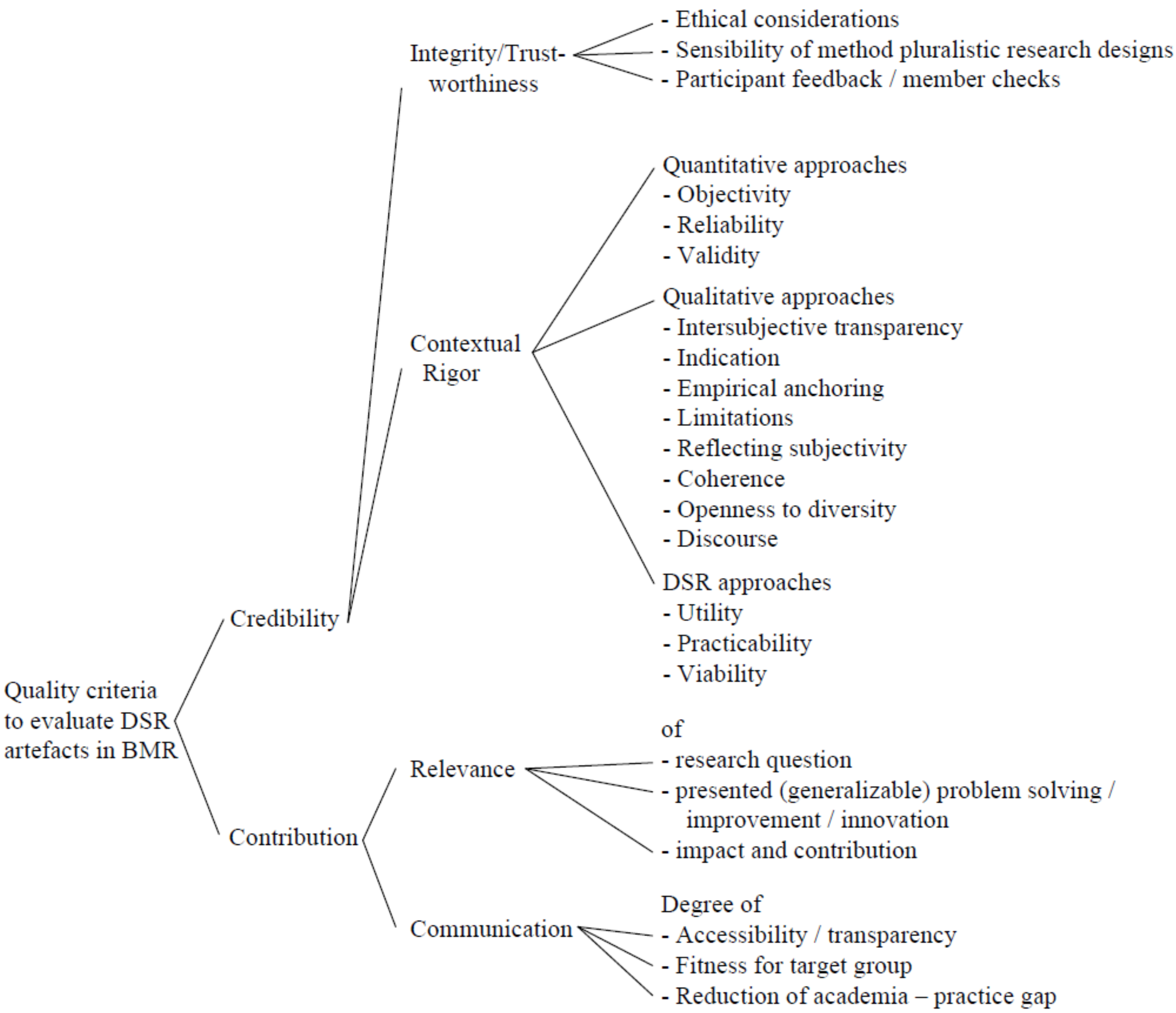

Figure 2: Quality criteria framework for the evaluation of Design Science Research artefacts in Business and Management Research

However: So far, no clear distinction between rigour within the different contexts seems to have been established, nor a consideration of different needs in a method pluralistic interdisciplinary environment. Transferring the DSR principles to the BMR context entails the need to have a correspondingly encompassing approach. This is why a quality criteria framework for the evaluation of artefacts in BMR is suggested, illustrated in Figure 2, as a complementation to the cycle model. The criteria are allocated to

- *Credibility* and *Contribution* in a first level
- *Integrity/Trustworthiness, Contextual Rigour, Relevance* and *Communication* in a second level and are further subdivided for
- the *Quantitative, Qualitative and DSR approaches* on a third level.

The different quality criteria within the framework are explained below.

6.1 Credibility

The quality criterion of Credibility basically determines whether the piece of research can be trusted (Martensson & Martensson, 2007; McLeod, 2011). In order to reach credibility, integrity and/or trustworthiness, rigour is required as well (Guba & Lincoln, 1989; Martensson & Martensson, 2007; McLeod, 2011; Saunders et al., 2016).

6.1.1 Integrity/Trustworthiness

The credibility of a piece of research depends on the trustworthiness of the researcher, which itself includes personal qualities, integrity, courage, honesty and prolonged engagement of the researcher, the fairness and ethics of the processes and actions as well as (ontological, educative, catalytic, tactical) authenticity and the implementation of credibility checks (McLeod, 2011; Guba & Lincoln, 1989; Saunders et al., 2016).

Ethical considerations

Ethics can be defined as "the principles, norms and standards of conduct governing an individual or group" (Wilson, 2014, p.110) and thus the legitimisation of the research, applying to every piece of research and all research stages conducted. According to Boyatzis (1998), Brinkmann and Kvale (2015), Flick (2007), Flick (2016), Mason (2002), McLeod (2011), Saunders et al. (2016) and Wilson (2014), ethical aspects and codices include

- description of the necessity of the research, the research goal, motivation and methodology, the access to and the management of data, not awakening unattainable expectations
- estimation and honesty of possible harm by research activities and prevention measures
- reflection on source stringency and style of conducting interviews and asking questions
- ensuring of accuracy
- following data protection regulations and legal requirements (confidentiality, anonymity, data protection, informed consent)
- transparency on relationship with interested parties with respect to results and potential commercial interest or conflicts of interest, own experience, values, (professional) background and intentions
- showing respect, professional conduct towards all stakeholders
- consideration of other researchers, wider community and own safety
- checking the need for approval of dissemination
- sensibility of (circumstances and adequacy of) dependencies and role/relationships and positive or negative impacts for participants involved
- full (de)briefing of participants about research context and their rights

Sensibility of method pluralistic research designs

As already mentioned, the aspect of the sensibility of the method pluralistic context as a quality criterion has been neglected. The combination and interlinking of multiple methods, disciplines and perspectives have several implications. In terms of the philosophical grounding, open positions and a multi-perspective concept of truth (Frank, 2006) have to be taken in order to embrace possibly rather new research design combinations. Researchers and assessors operating in this context have to have a certain openness for multiple world states (Vaishnavi & Kuechler, 2008) and diversity. According to Flick (2007), they have to bear the controversies between rigour and creativity, consistency and flexibility, transparency and indication. They have to have the courage to try new approaches and thus be ready to be in discourse and reflection with different stakeholders, leading to a need of a higher tolerance for ambiguity (Vaishnavi & Kuechler, 2008; Hevner & March, 2003). A constant balancing act between breadth and depth of methods seems unavoidable, as is the allowance of more iterations in order to find the necessary parts of the method mix.

Participant feedbacks / Member checks

In order to provide credibility checks, member feedback or member checks are suggested (Braun & Clarke, 2013; Flick, 2007; Guba & Lincoln, 1989; McLeod, 2011; Saunders et al., 2016; Yardly, 2015).

6.1.2 Contextual Rigour

Rigour means the effective use of knowledge, theories and research methods throughout the whole research process (Anderson et al., 2012; Dresch et al., 2015; Martensson & Martensson, 2007; Yardly, 2015). Rigour in the quantitative or behavioural approach has been discussed and defined for a long period of time (see following chapter). For the qualitative and DSR approaches, the ways and means to assess rigour are still discussed, which applies even more to multi-method research (Winter, 2008). This is why the context – the relation of the purpose of the research and the existing knowledge in the field – has to be considered, applied, discussed and reflected upon (McLeod, 2011; Martensson & Martensson, 2007; Yardly, 2015).

Quantitative approaches

In quantitative research approaches, the quality criteria have typically been objectivity, reliability and validity, which have been widely documented. The following chapters summarise the conventionally applied aspects to be considered.

- **Objectivity** is the degree to which a research result is independent of the researcher or other external factors; specific criteria can be the objectivity of application, objectivity of analysis and the objectivity of interpretation (Mayring, 2010; Lamnek, 1995; Ramb & Wübbenhorst, n.d.; Rammstedt, 2010; Steinke, 1999; Mayer, 2009)
- **Reliability** indicates to what extent results remain consistent when replicating the same procedures and can include the retest/external reliability, the parallel test reliability, the internal reliability, the split-half

reliability or the inter-coder reliability (Maier & Wübbenhorst, n.d.; Mayer, 2009; Pervan & Klass, 1992; Saunders et al., 2016; Sreejesh et al., 2014; Steinke, 1999; Lamnek, 1995; Mayring, 2010; Wilson, 2014)

- **Validity** is the appropriateness of the measuring method used to measure the intended construct and can include the content validity, the criterion validity, the predictive validity, the construct validity, the internal validity, the external validity, the ecological validity, the sampling/population validity or the face validity (Braun & Clarke, 2013; Lamnek, 1995; Mayer, 2009; Mayring, 2010; Saunders et al., 2016; Sreejesh et al., 2014; Steinke, 1999; van Aken, 2012; Wilson, 2014; Wübbenhorst, n. d.)

Qualitative approaches

Steinke (1999) and Lamnek (1995) have researched the transferability from quantitative quality criteria to the qualitative paradigm and have documented various challenges and inapplicabilities, while emphasizing the importance of applying rigorous quality criteria also for qualitative research in order to ensure credibility. They therefore present alternative quality criteria specifically for qualitative research approaches: intersubjective transparency, indication, empirical anchoring, limitations, reflecting subjectivity, coherence, openness for diversity and discourse. Those criteria will be summarised in the following sub-sections.

- **Intersubjective transparency** means, according to Steinke (1999), the explicitness of transparency through documentation. This includes underlying understandings and personal anticipations, the personal involvement of the researcher, the survey and analysis methodologies and contexts, the transcription rules, the data, the information sources, decisions and challenges, the criteria, the reflections and knowledge gained, interpretations in the group, application of codified procedures and rhetorical structure (McLeod, 2011; Steinke, 1999; Saunders et al., 2016; Yardly, 2015).
- **Indication**, according to Steinke (1999), comprises the indication of the qualitative approach within the research question, indication of the method selection, indication of the transcription rules, indication of the sampling strategy, indication of methodical decisions and indication of evaluation criteria. This includes the justification of the appropriateness of the method choice and development, evaluation criteria and grounding in examples, the efficacy and efficiency of the sample(s) and the overall research pragmatism (Boyatzis, 1998; Flick, 2007; McLeod, 2011; Steinke, 1999).
- **Empirical anchoring** includes, according to Steinke (1999), forming theories with codified procedures and theory evaluation with documented empirical principles.
- **Limitations**, according to Steinke (1999), means the descriptions of limitations within the whole context under the relevant conditions with the help, for example, of thinking ahead techniques, contrasting of cases or the search and analysis of differing or extreme cases.
- **Reflecting subjectivity:** McLeod (2011), Steinke (1999) and Yardly (Yardly, 2015) emphasise the importance of reflection throughout the whole research process, including at least the reflection of the research process, personal and professional prerequisites and dependencies, the oscillation between approximation and distance of the research context, the relationship between the researcher and the respondents, and the researcher's motivation.

- **Coherence** (internal and external) requires comprehensibility, dealing with and integrating contradictions in a sensible manner, balancing methodology and design, and the clarity and power of argumentations (Lamnek, 1995; Martensson & Martensson, 2007; McLeod, 2011; Steinke, 1999; Winter, 2008; Yardly, 2015).
- **Openness to diversity** can include handling the different upcoming scientific and personal challenges as well as coping with contradictions and dissonances throughout the research process like rigour vs. creativity or consistency vs. flexibility (Flick, 2007; Frank, 2006).
- **Discourse**, according to McLeod (2011), includes appropriate discussions and exchange with readers, the scientific community or other stakeholders involved, and competing explanations and interpretations not only of the results, but also throughout the process.

DSR Approaches

The third thread contributing to contextual rigour when combining DSR and empirical methods is the quality of the main DSR outputs, the artefacts. As described earlier, for DSR artefacts, one of the main criteria is utility, which has to be evaluated and judged by practitioners and experts. For models, different modelling principles have been proposed.

Degree of utility, practicability and viability

The main question about the completeness and effectiveness of an artefact is, whether it

- can be utilised
- satisfies the needs of the users
- solves the problem defined

(Anderson et al., 2012; Benbasat & Zmud, 1999; Hevner & March, 2003; Martensson & Martensson, 2007). Ostrowski (2012, p.67) suggests the following dimensions and items for assessing the degree of artefact quality by practitioners and experts, applying empirical evaluation methods and their quality criteria mentioned above:

- Interpretability (interpretable, appropriate language / symbols, readable)
- Ease of understanding (easy to understand, to comprehend and to identify the key point)
- Consistency (consistent meaning, structure and format)
- Conciseness (and compactness)

For models, the modelling principles presented and discussed by Anderson et al. (2012), Becker et al. (2000), Becker et al. (2012), Benbasat and Zmud (1999), DIN (2000), Frank (2000), Frank (2007), Martensson and Martensson (2007), Rautenstrauch and Schulze (2003), Rosemann (1996), Schütte (1998) and Shanks et al. (2003) can be applied for evaluation:

- Relevance (of goal and contribution, of modelled elements, relationship to real world, applicability and acceptance in practice)

- Economic efficiency (the cost-benefit-ratio is positive)
- Correctness (semantic correctness judged by the consensus of experts and syntactic correctness evaluated in terms of the compliance to the defined notation)
- Systematic design (compatible and consistent perspectives within model architecture and metamodel)
- Clarity (clear structure, intuitive understanding, readability and consumability, syntactical and semantic simplicity)
- Comparability (semantic comparison is possible, if parallel models exist and have to be compared)
- Construction adequacy (clear definition of problem, goal of model usage, naming conventions, content and scope)
- Language adequacy (suitability of language and degree of formalisation of language, correctness of syntax use)

6.2 Contribution

Next to credibility, contribution is an important indicator for quality of research, being influenced by relevance and communication (Manson, 2006; Martensson & Martensson, 2007; Winter, 2007).

6.2.1 Relevance

Relevance on different levels has to be ensured – just as much as rigour:

- **Relevance of the research question** (degree of current interest, adequacy) (Anderson et al., 2012; Benbasat & Zmud, 1999; Dresch et al., 2015; Flick, 2007; Martensson & Martensson, 2007; Sreejesh et al., 2014; Steinke, 1999)
- **Relevance of the presented (generalisable) problem solving / improvement / innovation / theory** (Anderson et al., 2012; Benbasat & Zmud, 1999; Dresch et al., 2015; Martensson & Martensson, 2007; Sreejesh et al., 2014; Steinke, 1999)
- **Degree of impact and contribution** (Martensson & Martensson, 2007; McLeod, 2011; Sreejesh et al., 2014; Yardly, 2015)

6.2.2 Communication

In order for the research to be contributory, communication aspects have to be considered (Anderson et al., 2012; Martensson & Martensson, 2007).

- **Degree of accessibility / transparency:** A quality criterion for communicable research is its accessibility (clear, understandable, concise and structured writing style) and transparency (cf. contextual rigour) (Benbasat & Zmud, 1999; Flick, 2007; Martensson & Martensson, 2007; McLeod, 2011; Yardly, 2015).

- **Degree of fitness for target group:** The fitness for different target groups, not only in the technology- and management-focused academic and practical context, but also in writing and in oral presentation (Anderson et al., 2012; Flick, 2007; Martensson & Martensson, 2007).
- **Degree of reduction of academia - practice gap:** As one of the DSR paradigms is narrowing the gap between theory and practice (cf. Chapter 3), this criterion also has to be considered when evaluating the quality of communication.

6.3 Summary / Implications of Quality Criteria for DSR Artefacts in Business and Management Research

It is becoming clear that assessing DSR artefacts in the Business and Management Research context includes many different levels and aspects, and different contradictions have to be balanced depending on the overall context. It seems important to keep in mind the underlying assumptions and the research question and goal in order to choose the appropriate set of quality criteria (Guba & Lincoln, 1989).

7 Conclusion and Discussion

The goal of the working paper was to introduce a systematic conceptual basis supporting Mode 2 researchers in their quest for relevant and rigorous, applied, consortial research and development projects. With the *Design Science Research Cycle for Business and Management Research and Development Projects* complemented with the *Quality criteria framework for the evaluation of Design Science Research artefacts in Business and Management Research*, such a basis is presented, taking into account non-linear development procedures and the need for adequate quality evaluation criteria.

By using the existing Design Science Research (DSR) approaches of Information Systems Research (ISR) to develop artefacts and putting them into a Business and Management Research (BMR) context, the *Design Science Research Cycle for Business and Management Research and Development Projects* is based on known and already applied principles, however focusing on the context of BMR. The differences of the cycle model presented compared to existing models are mainly the even wider scope of embracing methodological pluralism not only for evaluation, but also particularly for the theorising phase and the specifications of methods and outputs within BMR replacing or complementing the explicit technical information system outputs of the previous ISR cycles. The main advantage of this procedure compared to previous BMR approaches is that the cycle model presented not only allows, but encourages diverse, creative, complementary and iterative steps with (multi-)methods while still enabling a systematic procedure in an increasingly fast-paced environment requiring iterative, agile procedures. The *Quality criteria framework for the evaluation of Design Science Research artefacts in Business and Management Research* presented delivers a corresponding holistic basis for applying quality criteria for the evaluation of artefacts in a multi-method environment.

The working paper has thus presented a model of action for applied BMR called for by Starkey et al. (2009) and has also made a contribution to the development of DSR-based Mode 2 approaches propagated by Burgoyne and Turnbull James (2006) supporting their «Choices for Mode 2 researchers» within the «Best Practice principles for Mode 2 research» (p.313). In this way, the working paper contributes to the advancement of the emerging convergence of BMR and ISR, helping to reduce complexity, to offer a basis for a common understanding and to produce relevant and rigorous artefacts in future Mode 2 research and development projects.

8 Limitations and Future Research

However, the artefacts presented have their limitations, as so far, they have not been validated. In order to do so, they have to be applied in different contexts in Mode 2 research and development projects so that they are evaluated in a multi-perspective and multi-methodological manner and thus potentially be refined in iterative approaches in the future. It will also have to be clarified whether the artefacts presented are suitable for all BMR areas or if differentiations for different fields, differing project kinds or research designs are required.

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